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ABSTRACT

Reported is a study of possible differences in student characteristics between high, expected, and low achievers in an individualized learning biology program. Nine variables, ranging from biographical data through attitudinal data were studied. Effects on achievement and explanation of some of the differences were determined by examination of student responses to questionnaires that were developed to evaluate both the course and the teacher. The study included 406 students enrolled in 24 biology classes taught by 7 teachers. All students were required to complete 34 learning contracts. Psychometric inventories were used to obtain data concerning student characteristics. An author-constructed inventory was also used. Statistical analyses included group formation, testing of assumptions, discriminant analysis, cross validation and analysis of variance. The findings indicated that differences did exist between the three levels of achievers in the biology program as related to all the variables investigated. By combining a number of factors, a summary description characterizing each group was presented. Generalizations made indicated that educational goals should not be the same for all students, and individualization provides an environment that enables students to become responsible for their own learning. (Author/EB)

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AN INVESTIGATION OF STUDENT CHARACTERISTICS AS RELATED TO ACHIEVEMENT IN AN INDIVIDUALIZED HIGH SCHOOL BIOLOGY PROGRAM

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Introduction

Background

One of the techniques that is increasingly being used in the teaching of science is that of individualized instruction. Educators are cognizant of individual differences in students and realize the need for providing for these differences in the teaching and learning of science. It is recognized that students should be allowed to develop their own unique learning styles. On the other hand, the more conventional methods of teaching may not only tend to inhibit educational growth, but may also hinder personal development. Thus, there arises the need to individualize instruction.

The traditional approach of teaching science in America —that of teacher lecture, class discussion, and laboratory exercises—has assumed that all students with the proper effort are capable of achieving the same goals. Some educators feel that science programs employing traditional approaches have failed to meet individual needs in that the low achiever learns practically nothing while the superior

student learns little that he does not already know.[1]

Science educators are aware of the increasing importance of and the need for individualized instruction, as demonstrated by the Callaway Gardens Conference (1971). The conferees, a group of specialists in science education, realized that there is a need for revision within the existing high school science programs. Those present at the Conference felt that units of science materials should be presented in such a way that students would be able to progress at a rate that is commensurate with their individual interests and abilities. It was concluded that deficiencies now present in the schools warrant an alternative to the present mode of instruction and that:

> There is an urgent need to design a total system for high school science instruction that will enable interested schools to conveniently install an alternative form of science teaching, radically different both in content and pedagogical style from that found today in most schools.[2]

The National Science Teachers Association (NSTA) also recognized the need for individualization of instruction when it adopted the following recommendation on July 18, 1970:

> As a consequence of greater concern for individualized instruction, the trend is

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[1]P. L. Dressel, M. A. Burmester, J. M. Mason, and C. H. Nelson. 1960. "How the Individual Learns Science." Rethinking Science Education, Fifty-ninth Yearbook of the National Society of the Study of Education. Chicago, University of Chicago Press. p. 60.

[2]E. Burkman. 1972. "New Directions for the High School Science Program." Science Teacher. 39. 2: 42-44.

> strongly toward more and more independent study by students. While there will be a place for group instruction for a long time to come, perhaps always, it is becoming increasingly clear that many students find great challenge and actually work better through independent study than through group instruction, and that, consequently every school should make some provisions for it.[3]

Statement of the Problem

In the individualized learning situation, the following different assumptions are made concerning the characteristics of students:

1. All students do not learn at the same rate, utilizing the same learning styles.
2. All students do not need the same kind or amount of instruction.
3. Some students do not interact with their teacher in a traditional class.
4. All students will not necessarily achieve the same goals.
5. Some students will learn more effectively by being exposed to individualized instruction.
6. Some students will be able to handle the freedom in an individualized learning situation and will achieve certain goals, while others will not.
7. It should not be taken for granted that individualization for slower students will necessarily solve their problems.

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[3]National Science Teachers Association. 1970. "Conditions for Good Science Teaching in Secondary Schools. Recommendations of the Commission on Professional Standards and Practices of the National Science Teachers Association." Supplement to the November issue of the American Biology Teacher. p. 5.

The immediate problem that arises, then, is—What are the characteristics that differentiate the students who "do well" in individualized science courses from those who "do not do well"? In this study an individualized high school biology program has been selected for the investigation of this problem.

The investigation of this problem makes possible the identification of the primary question of this study which can be stated as a single null hypothesis:

> There are no differences in student characteristics between "high" achievers, "expected" achievers, and "low" achievers in an individualized learning biology program with regard to the following variables: (1) biographical data, (2) personality, (3) motivation, (4) science attitude, (5) understandings about science, (6) the ability to think critically, (7) scholastic aptitude, (8) student's feelings and attitudes toward the course and teacher, and (9) the success of students in their other courses.

Purpose of the Study

Individualization of instruction provides an educational environment that allows students to progress at a rate commensurate with their interests and abilities. However, research has shown that unless students are well organized and self-directed, they are unable to cope with this freedom. The primary purpose of this research study was to investigate the various characteristics of successful and less successful students and to determine what effect these characteristics have on achievement in an individualized learning situation.

In addition, this study made an attempt to explain some of these differences in achievement by examining student responses to questionnaires that evaluated the course and the teacher.

Significance

This study provides data regarding the characteristics of "high" and "low" achievers in an individualized high school biology program. To capitalize on the educational advantages offered by the individualized method of learning, it is necessary to know the characteristics of these types of students and how they react to the individualized learning environment.

In addition, this study has considerable significance regarding the use of individualization of science instruction. There is immediate application of these research findings. Once the characteristics of "high" and "low" achievers have been identified, recommendations can then be made for modifying the educational environment, particularly for the "low" achievers. Thus a program can be developed that will meet the individual needs of all students. Educators must continue to study the learning environment, and if necessary, manipulate variables to improve the educational setting so that discrepancies between predicted achievement and observed achievement can be minimized.

Uniqueness of the Study

Research done to date demonstrates that individualized learning is often superior when contrasted and compared with traditional classes. But, until now, little or no research has been done exclusively within an individualized program dealing with the relationships existing between student characteristics and cognitive achievement. These results have both theoretical and practical implications. Of theoretical importance is an enhanced understanding of the educational process. Of practical importance is the manipulation of the educational environment to improve the educational enterprise.

At the present time, individualized learning is considered to be an innovative approach in secondary education. The research findings would be useful to schools considering the implementation of such a program. These findings would provide information that would be useful for improving an existing individualized learning program by recommending the placement of "low" achievers in a modified program. Unless individualized learning programs are evaluated by quantitative methods, it becomes far more difficult for educators to make decisions regarding modifications in the existing programs.

Sources of Data for the Study

In this study, an investigation has been made of students who were participating in an individualized biology program at Glenbrook North High School, Northbrook, Illinois during the

1973-1974 academic year. At Glenbrook North High School, flexible, workable, multimedia, individualized high school science courses have been developed for earth science, biology, and chemistry. These individualized learning science programs at Glenbrook North were implemented on a partial basis in the fall of 1970-1971 and on a full-time basis during the 1971-1972 school year.

The study includes 406 students enrolled in 24 biology classes taught by seven teachers. All the students who elect a biology class at a particular time are assigned to one of the seven teachers at random by the school computer. All the students are required to complete on an individual basis 34 "learning units" or "contracts." This format is the same for all students regardless of class section or teacher. These students are required to complete their designated number of learning "contracts" in order to receive credit for one year of biology.

Limitations of the Study

The population of the study was limited to the students taking two semesters of biology at Glenbrook North High School during the academic year of 1973-1974. Glenbrook North has a student population of approximately 2,500 representing an upper middle class background.

A number of psychometric inventories were utilized to obtain data concerning student characteristics. Those used

were: (1) the Nelson Biology Test, Forms E and F, (2) Watson-Glaser Critical Thinking Appraisal, Form ZM, (3) a Scientific Attitude Inventory, (4) School Motivation Analysis Test, Form A, (5) High School Personality Questionnaire, Form A, and (6) the Test on Understanding Science, Form W. In addition, the following data were used: (1) biographical data obtained from an author-constructed inventory, (2) scores on ENDEAVOR VIII, a questionnaire that evaluates the course and the teacher, (3) responses to an author-constructed questionnaire that evaluates the individualized learning course, and (4) grades that the students received in their other courses.

Prospectus

The purpose of this introductory chapter has been to point out the need and to state the problem for research concerning student characteristics as related to cognitive achievement in an individualized learning program. In the next chapter, a review of related research studies will be presented. Chapter III includes a presentation of the research design. Attention will be given to describing: (1) the individualized learning program, (2) the methods of collecting data, and (3) the statistical procedures employed.

The results of the data analyses and their interpretations are presented in Chapter IV. Included is a discussion of some of the factors which might have influenced the results. Chapter V contains an overall summarization of the

study, conclusions, implications, recommendations, and suggestions for possible future research.

Chapter II

Review of the Literature

The review of the literature pertinent to this investigation is presented in five sections. In the introduction, a definition of individualization is given and its application to this study. In the second section, general articles dealing with individualization of science are reviewed. The third section reviews related research studies on individualization in high school biology programs. This section is divided into two parts. The first summarizes descriptive and subjective studies, while the second part summarizes those that employed statistical research procedures. The fourth section reviews the literature on personality and motivational characteristics as related to individualization. The conclusion summarizes the main points presented in the chapter.

Introduction

Before any meaningful discussions of individualization are described and elaborated upon, individualization must

first be defined. Weisgerber[1] noted a plethora of definitions and meanings of individualization when he reviewed the literature on individualization and found that the Educational Resource Information Center (ERIC) "had '59 descriptors' of individualized learning."

Weisgerber[2] offered this broad definition of individualized learning: "In the general sense, individualization of education implies a tailoring of the educational process which takes into account the unique qualities and needs of each individual." Other more cogent definitions follow. Glaser[3] has defined individualization as "the adaption of instructional procedures to the requirements of the individual learner."

An even more specific definition is provided by Baker and Goldberg[4] when they stated:

> An individualized learning system is a highly flexible system of multiple materials and procedures, in which the student is given substantial responsibility for planning and carrying out his own organized program of studies, with the assistance of his teacher, and in which his progress is determined solely in terms of those plans.

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[1]R. A. Weisgerber. 1972. "Trends, Issues and Activities in Individualized Learning." Educational Resources Information Center (ERIC). p. 6.

[2]Ibid.

[3]R. Glaser. 1968. "The New Pedagogy." In F. G. Knirk and J. W. Childs (Eds.). Instructional Technology. New York, Holt, Rinehart and Winston, Inc. p. 227.

[4]G. Baker and I. Goldberg. 1970. "The Individualized Learning System." Educational Leadership. 27: p. 775.

Wilhelms[5] stated that individualization must "come to grips with the fundamental differences among students—differences in interests and purposes, their personal needs and their whole mode of thinking and learning...."

For the purposes of this investigation, individualization as a generic term can best be defined as an educational process adapting to the unique needs, interests, and abilities of each student.

Some of the methods by which individualization of instruction are accomplished include self-paced study, self-directed study, and independent learning. Dearing[6] reported that programs range from

> those involving open, highly permissive relationships between student and instructor in which the student defines and develops his own plans to those characterized by a highly structured and guided relationship.

The problem of adapting education to individual differences has been studied by Cronbach,[7] who has identified three major past, present, and future educational patterns. These patterns are described according to the extent that (1)

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[5]F. T. Wilhelms. 1962. "The Curriculum and Individual Differences." Individualizing Instruction, The Sixty-first Yearbook of the National Society for the Study of Education. Chicago, University of Chicago Press. p. 65.

[6]B. Dearing. 1965. "The Student on His Own: Independent Study." In S. Baskin (Ed.). Higher Education: Some New Developments. New York, McGraw-Hill. pp. 49-77.

[7]L. Cronbach. 1967. "How Can Instruction Be Adapted to Individual Differences?" In R. M. Gagne (Ed.). Learning and Individual Differences. Columbus, Ohio, Charles E. Merrill Books, Inc. pp. 23-39.

educational goals and (2) instructional methods have been modified to meet individual differences of the students. Cronbach described these three educational patterns as follows:

1. Adaption Within a Pre-determined Program. This pattern occurs when both educational goals and instructional methods are relatively fixed. Individual differences are taken into account by eliminating students as the less able are dropped along the way. The rationale is that each student "should go as far in school as his abilities warrant."

2. Adaption by Matching Goals to the Individual. This pattern is characterized by optional educational goals with the instructional methods fixed within an option. In this system, the prospective role of the student is determined and he is provided with an appropriate curriculum. Subject matter is adapted and students are grossly matched in terms of academic ability.

3. Adaption by Erasing Individual Differences. This pattern occurs when the educational goals are fixed within a course, but the instructional methods are varied. Different students are taught by different methods as educational goals are not necessarily the same for all students. Adaption can occur by diagnosing specific needs and then tailoring a course of instruction specifically meeting the student's needs.

Glaser,[8,9] in reviewing and commenting on Cronbach's "Patterns of Adaption to Individual Differences," stated that with all the current experimentation taking place in the

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[8]R. Glaser. 1970. "The Education of Individuals." In V. M. Howes (Ed.). Individualizing Instruction in Science and Mathematics. New York, The Macmillan Company. pp. 128-135.

[9]R. Glaser. 1968. op. cit. pp. 227-235.

schools today, it is most likely that many schools will develop and adopt patterns falling between Cronbach's last two categories. This has indeed been the case, since many commercial educational companies and school systems have already developed and printed their own operational learning packages.

Edling[10] offered one of the best summarizations of these new approaches to individualized learning when he classified the various operational methodologies into one of four main categories. Goar[11] also identified the same four main categories of individualizing instruction. These categories, according to both Edling and Goar, are as follows:

1. Individually Diagnosed and Prescribed. In this method the school diagnoses and prescribes (1) what each student will be taught, (2) the learning materials, and (3) the objectives.

2. Self-Directed. According to this method the student chooses the materials and methods, but the school determines the objectives to be met.

3. Personalized. In this setting the student determines the learning objectives while the school determines the learning materials and methodology to be employed.

4. Independent Study. In this method the student chooses (1) his own goals, (2) the learning materials, and (3) the methods for learning.

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[10] J. V. Edling. 1970. "Individualized Instruction: A Manual for Administrators." Corvallis, Oregon, D. C. E. Publications. In R. A. Weisberger, 1972. "Trends, Issues and Activities in Individualized Learning." (ERIC Document). p. 6.

[11] F. D. Goar. 1972. "Toward Humanization and Individualization of Science." The Science Teacher. 39. 6: p. 23.

Rarely can a school's individualized program be neatly labeled into one of these four categories. Each school and each program in some way alters its program so that it best meets the needs of its students according to the best facilities that the school has to offer. Several options may be present within one school as one department may have a self-paced, self-directed program whereas another may teach via independent study.

The individualized biology program at Glenbrook North High School best resembles Edling's second category. The teachers at Glenbrook have predetermined the course objectives, but the students are provided with options concerning instructional materials and methodology. The students are free to choose those materials and learning methods which best fit their needs and interests.

It must be pointed out that in this investigation a distinction is being made between independent study and the other forms of individualization. Baker and Goldberg[12] reported that individualized learning is more structured than independent study and that these "two terms are not synonymous." According to Dunn and Dunn[13] a totally individualized program is independent study. Dunn and Dunn differentiate between the two as follows:

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[12]Baker and Goldberg. op. cit. p. 776.

[13]R. Dunn and K. Dunn. 1972. Practical Approaches to Individualizing Instruction: Contracts and Other Effective Teaching Strategies. West Nyack, New York, Parker Publishing Company, Inc. pp. 67-68.

> When children work on the same topics (curriculum, spheres of interests, unit, contract), they are working an on individualized program, if variations occur in objectives, resources and activities and in reporting sections. If, however, children are learning about vastly different self-designed areas (curriculums, spheres of interests, units or contracts), they are working on independent or fully individualized programs.

Individualized learning as dealt with in this investigation encompasses a whole new educational philosophy and methodology as opposed to conventional methods of teaching. According to Weisgerber,[14] a truly individualized program is one in which the learner believes that the educational goals are tailored to his individual needs. Weisgerber goes on to say that education will have been individualized to the full extent when each individual student believes that he:

1. Is responsible for his own progress and that it is largely dependent upon his own effort.
2. Can influence the selection of subject matter according to his performance and preferences.
3. Can decide whether he wants to work independently or interact with others.
4. Has the choice to select instructional resources suiting his learning style.
5. Views school personnel primarily as human resources rather than as supervisors or competitors.
6. Exhibits an active, purposeful approach to learning tasks when unsupervised and thinks of school as only one of the settings in which learning can occur.

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[14] Weisgerber. op. cit. p. 8.

7. Has control, within admissible school standards, over where and when he studies.

8. Feels that the intended outcomes of instruction are relevant and attainable.

9. Understands how to proceed toward the accomplishment of his goals.

10. Is aware that he is evaluated against his own potential rather than that of others.

Last to be considered are some of the techniques for individualizing instruction. According to Dunn and Dunn[15] the five basic ways of individualizing are:

1. The contract method. In this method of individualization, the student is responsible for achieving predetermined performance objectives as agreed upon between the student and the instructor.

2. Instructional packages or educational materials. Examples are the commercial products as Elementary School Science (ESS) and Science As a Process Approach (SAPA).

3. Programmed sequences. Examples are Science Research Associates (SRA) and Project Plan.

4. Work-study programs and/or internships.

5. Community contribution programs. These are self-developed programs that meet their specific needs and interests.

In this section, an attempt was made to point out that in the individualized learning situation, the goals, the rates of learning, and the methodology in achieving these

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[15] R. S. Dunn and K. Dunn. 1972. "Practical Questions Teachers Ask About Individualizing Instruction—and Some of the Answers." Audiovisual Instruction. 17. 1: p. 48.

goals are not necessarily the same for all students. According to Triezenberg and McLeod,[16] this mode of instruction is an attempt on the part of professional educators "to accommodate instruction to the unique abilities, goals, and learning rates of each student.... Individuals, not groups, learn." In the next section, a look will be taken at how science educators have provided for individualization.

General Articles on Individualization of Science

The conventional approach to mass education in America has been described by Dressel et al. as one that has assumed "all students with the proper effort can achieve the same goals."[17] Consequently, science programs have failed to meet the individual needs of students. As a result, science educators have turned their attention to individualized instruction.

McBurney[18] reported that individualized instruction in science is "quickly being established as a routine teaching procedure in many classrooms." According to Lee,[19] many

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[16]H. J. Triezenberg and J. R. McLeod. 1972. "Individuals Learn." In H. Triezenberg (Ed.). Individualized Science: Like It Is. Washington, D. C., The National Science Teachers Association. p. 6.

[17]Dressel. op. cit. p. 65.

[18]W. F. McBurney. 1969. "Individualized Instruction: A Case for Independent Study Investigation in Science." School Science and Mathematics. 69. 9: p. 827.

[19]A. E. Lee. 1971. "Teaching Biology in the 1970's." American Biology Teacher. 33. 2: pp. 79-85.

science teachers now recognize that students do not need the same kind or amount of instruction. Consequently, the ultimate aim is to provide for each individual a more relevant learning experience in school, and science teachers will need to devote more attention to individual needs and to make greater utilization of self-learning materials.

Kuhn[20] stated that "individualized instruction in science is widely supported" and that it is a promising trend for "effective science education" in the 1970's. This mode of instruction is needed to meet the current demands of today's education. According to Jenkins and Russell,[21] "individualized instruction has the potential to meet these new demands," as this style of instruction makes it possible for each student to obtain a meaningful education that meets his personal needs.

Klopfer[22] concurs with these statements because he maintains that individualization is one "way to increase the relevance of the student's learning experience in school." Klopfer also believes that individualization of science will enable students to meet today's educational challenges, and the aim of many science educators at this time should be to

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[20]D. J. Kuhn. 1972. "Science Education in a Changing Society." Science Education. 56. 3: pp. 395-396.

[21]J. R. Jenkins and J. D. Russell. 1971. "Involving Students in Individualized Instruction." American Biology Teacher. 33. 8: pp. 489-492.

[22]L. E. Klopfer. 1971. "Individualizing Science: Relevance for the 1970's." Science Education. 55. 4: pp. 441-448.

provide a "complete individualized science learning system to serve the student from the time he begins elementary school up to his entry into high school."

Carnie[23] speculated that by 1980, society will need a flexible problem-solving type of individual. Therefore, curricular changes in science programs should provide for a variety of ways in which one learns the science processes. Educators must keep in mind that an individual is a learner all his life and the best preparation that a school can offer is a curriculum that will help him become a responsible, self-confident person.

Lunetta and Dyrli,[24] in describing individualized high school programs, stated that "unfortunately, the science curriculum committees of the past decade have not, in general, made significant attempts to encourage individualized instruction." However, the authors go on to say that fortunately this philosophy has changed considerably, that more programs are now coming into existence, and that some of the results are now beginning to appear in the literature.

Lunetta and Dyrli also go on to report that a number of secondary schools, in attempting to develop individualized science programs, have experimented with and adopted such new

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[23]G. M. Carnie. 1970. "Doing Your Own Thing Via Self-Determined Units." The Science Teacher. 37. 2: pp. 35-37.

[24]V. N. Lunetta and O. E. Dyrli. 1971. "Individualized Instruction in the Science Curriculum." School Science and Mathematics. 71. 2: p. 124.

techniques as modular scheduling and contract learning and have established instructional materials centers. Although many of these individualized programs have not been thoroughly evaluated statistically, the overall value of these programs to the school system and to the students is difficult to dispute. One of the main advantages to the school system is that materials do not have to be available in large quantities as students become spread out in their work and do different experiments at different times. In addition, the teacher, who has developed a well-organized individualized program, with the help of teacher aides and/or lab assistants should be able to process a larger number of students.[25]

DeRose[26] evaluated the individualized and self-paced seventh grade science program in the Marple Newtown Schools, Newtown Square, Pennsylvania. These students were given considerable freedom and responsibility as they were encouraged to plan their own working schedules. In such a program, DeRose stated that the students have to practice and learn "self-discipline, scholarly behavior, and social responsibility."

DeRose reported that at the end of the year 562 out of 588 students succeeded in passing the minimum requirements. Of the 26 who did not complete the minimum requirements, 22 of them gave reasons like (1) no motivation, (2) did not like

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[25] Ibid. p. 127.

[26] J. V. DeRose. 1972. "Evaluation of Learning in Individualized and Self-Paced Science Courses." The Science Teacher. 39. 5: pp. 32-36.

to work, (3) not interested, etc. The results indicated that for the majority of students, the individualized program offered an educational challenge and the students took advantage of this freedom to learn independently.[27]

Carnie[28] described similar results in another seventh grade science program. For each nine-week grading period, the student selected a major topic of interest in the textbook and then with the teacher's guidance, each student chose the way he was going to learn and the method of evaluation. No student received failing grades because they "were actively involved in developing their own program." It was also noted that the quality of work improved immensely and that "students were excited about science as they had never been before."

The Nova Plan for individualization, as described by Bethune,[29] attempts to build student confidence by developing a learning style in the student that enables him to properly analyze scientific situations in arriving at valid conclusions. Individualization can be accomplished two ways for the student. He may (1) progress through various science units at a rate commensurate with his ability or (2) pursue a specific topic through a guided variety of experiences.

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[27] Ibid.

[28] Carnie. op. cit.

[29] P. Bethune. 1966. "The Nova Plan for Individualized Learning." The Science Teacher. 33. 8: pp. 52-57.

Joyce and Kearney[30] have developed an individualized science program in the life and physical sciences. Students, by selecting various activities, move through the science units by satisfying behavioral objectives. The authors feel that the outcomes are extremely beneficial and they are convinced that their "programs motivate students to succeed."

There are a number of potentially positive outcomes due to individualization of science. If individualization is successful, then the expectations, according to Triezenberg and McLeod,[31] are:

1. Students should become more interested in learning as they become more involved in decision making.

2. Discipline problems should decrease as pacing and the nature of the material is adjusted to the student's needs and interests.

3. Greater learning takes place as students progress at a rate commensurate with their individual interests and abilities.

4. The work becomes more challenging and rewarding to both teacher and students.

According to Keuscher,[32] science and other curricular areas should be individualized at least to some extent. He

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[30] R. Joyce and P. Kearney, 1972. "Individualized Science Program: A Guide for Developing Your Own." The Science Teacher. 39. 7: pp. 45-46.

[31] H. J. Triezenberg and R. J. McLeod. 1972. "Individualizing Your Own Classroom." In H. Triezenberg (Ed.). Individualized Science: Like It Is. Washington, D. C., The National Science Teachers Association. p. 89.

[32] R. E. Keuscher. 1967. "Why Individualize Instruction?" In V. M. Howes. (Ed.). 1970. Individualizing Instruction in Science and Mathematics. New York, The Macmillan Company. pp. 6-19.

gives five "compelling reasons" why instruction "must" be individualized and states that individualized instruction:

1. Is more democratic.
2. Teaches critical thinking.
3. Teaches self-direction.
4. Nurtures creativity.
5. Develops one's self-concept.

One should not be misled in assuming that individualization is going to solve all the problems of education. One drawback is that some students have been unable to cope with the added freedom. At least one student has spoken out on the issue of choice and responsibility in high school. Polly Chico Gross, a student at the University of Chicago Laboratory School, made this comment:

> While I agree that choice is not enough, I cannot resist adding, 'choice can be too much.' Needless freedom can overwhelm the student with decisions which will either play no importance in his life, or steer him toward a course of action which may be based on mere momentary infatuation, and which he may regret later. Therefore, I would ask all educators to ponder the role they feel their high school should play, before they overindividualize the high school years—a pattern which unnecessarily forces the student to play at adulthood.[33]

It is apparent that a growing number of science educators favor individualization. Also, while there are some disadvantages, they seem to be outweighed by the advantages. In

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[33]P. C. Gross. 1970. "Choice Can Be Too Much." School Review. 78. 2: pp. 240-241.

the next section, research studies on individualization in biology programs will be reviewed and the advantages as well as the drawbacks will be discussed.

Related Research Studies on Individualization in Biology

In the last decade, only a few major articles have appeared in the literature dealing with individualization of science instruction; and it has only been within the last five years that empirical research on individualization of instruction in biology has been conducted and reported in the literature. Review of the literature has shown that evaluations of individualized learning situations, when concerned with high school biology programs, have been either: (1) descriptive and subjective in nature, or (2) statistical comparisons. The literature in each of these two categories will now be reviewed.

Descriptive and Subjective Studies

An individualized high school biology program, described by Eastman,[34] had not yet been formally evaluated at the time of publication. However, subjective evaluations after three years of individualization indicated that: (1) the students did not suffer academically, and some actually seemed to improve, (2) some students did much better in the individual-

[34] S. W. Eastman. 1970. "Biology in an Individualized School." American Biology Teacher. 32. 9: pp. 533-536.

ized system than they would have done in the traditional system, (3) individualization provided a closer contact with the students, and (4) the students seemed to prefer the individualized system.

Diesner[35] described the results of a self-paced, week-long, three-part investigation in a seventh grade biology class. The class did not progress in a lock step manner, but each student individually progressed to the next investigation when he successfully finished the previous one. It was found that for the faster students less time was lost because they did not have to sit and wait for the rest of the class. The slower students were able to complete their activities in a later class period. Diesner commented that "this continuous progress sequence eliminated a good deal of teacher and student frustration." The faster students found time to explore related topics, something they would not have done if the class had all moved together, and the slower students were able to complete and understand one or two activities instead of only being able to complete half of all of the required activities.

Engel and Torgenson[36] felt that after two and one-half years of individualized study, the following factors were fairly evident:

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[35]R. H. Diesner. 1969. "Continuous-Progress Approach in Biology." The Science Teacher. 36. 3: pp. 53-55.

[36]D. Engel and K. J. Torgenson. 1970. "Individualized Science With Behavioral Objectives." The Science Teacher. 37. 8: pp. 22-23.

1. The program motivated some students to attain goals that had seemed beyond their capabilities.

2. Students liked the individualized program. 90 percent of the students indicated on a questionnaire that they preferred this method over all others.

3. Teacher student rapport became very close.

4. The boredom of a regimented class was eliminated.

Similar results were found by Smiley et al.[37] in a self-paced audiotutorial high school biology course. In this self-contained, self-instructed multimedia approach, the students were provided a study carrell containing a cassette tape-player, a set of headphones, a slide-viewer, and reference textbooks. A study guide was provided for each unit and performance and instructional objectives were written for each lesson. The students were provided several options relating to cognitive achievement and they were allowed to establish their own pace. Smiley et al. felt that this system has such advantages as:

1. The teacher did not waste valuable time by repeating the same lecture four or five times.

2. The teacher was able to work more closely with the students.

3. Provision of greater freedom in the area of study methods.

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[37] C. Smiley, K. Bush and D. McGaw. 1972. "An AT Program in High School Biology." American Biology Teacher. 34. 2: pp. 84-89.

4. The students moved at their own pace and took quizzes when ready.

5. Low-ability students can earn an A or a B.

6. The students preferred to structure their own time and liked the freedom to select the experiments.

The two major limitations of this program were:

1. Some students who have always had structure found it difficult to change to a more open and independent setting.

2. A few students were unable to cope with self-pacing as they lacked the self-discipline necessary in meeting certain deadlines.[38]

Statistical Comparisons

One of the first statistical comparative studies was done by Richard[39] and Richard and Sund[40] in which they investigated the relative achievement level of students in an individualized and traditional BSCS High school biology course. Two classes of students were matched on the basis of "Differential Aptitude test scores, science achievement, and IQ scores." One class received the traditional teacher-directed approach while the students in the other class could work with the materials the way they chose to and at

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[38] Ibid.

[39] P. W. Richard. 1969. "Experimental Individualized BSCS Biology." The Science Teacher. 36. 2: pp. 53-70.

[40] P. Richard and R. B. Sund. 1969. "Individualized Instruction in Biology." American Biology Teacher. 31. 4: pp. 252-256.

their own rate. At the end of the year final achievement test scores for the individualized class were slightly higher than those for the control. A test for significance between the two means revealed no significant differences at the .01 level. It was also found via student questionnaires that most of the students enjoyed the individualized approach and preferred it to the traditional method.

In addition, Richard [41] reported that the students generally fell into one of two basic groups:

1. The self-directed students enjoyed working at their own pace as they were not held back by other students. They appreciated the freedom of choice and enjoyed the variety.

2. Some students had difficulty in organizing their work. They had to be told what to do. They tended to waste time and felt rushed when they did do their work.

In a study reported by Shavelson and Munger,[42] 96 students (72 biology and 24 geology students) were used to test the relative effectiveness of an individualized approach and a traditional self-contained approach in teaching high school science. The 72 biology students were assigned to three groups. The first (N=24) and second (N=24) groups received a lecture and lab approach in a self-contained teacher-directed classroom. The third group (N=24) of biology students received individualized, self-paced instruction and lab. A

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[41] P. W. Richard. op. cit.

[42] R. J. Shavelson and M. R. Munger. 1970. "Individualized Instruction: A System Approach." Journal of Educational Research. 63. 6: pp. 263-268.

no-treatment control group consisted of 24 geology students.

Analyses of posttest data revealed that the individualized group (No. 3) performed significantly better ($p<.01$) with regard to cognitive achievement and learning time than did the first two groups of biology students. It was also found that the teacher-directed groups performed significantly better ($p<.01$) than the control group on both cognitive achievement and the unit of time it took to learn the material. These results were interpreted by the authors to indicate that the individualized instruction was a more superior and effective system than the teacher-directed approach. In addition, students in the individualized groups felt they had received a "better education" than they would have in the teacher-directed approach.[43]

Glass and Yager[44] tested the hypothesis that there is no difference in student understanding of the scientific enterprise when taught by two different methods—one individualized and the other traditional. In the individualized class there were no class discussions and the students worked and solved problems on their own. The traditional class was taught in a conventional manner with discussions involving the whole class. The results indicated significant differences in understanding of the scientific enterprise favoring students

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[43] Ibid.

[44] L. W. Glass and R. E. Yager. 1970. "Individualized Instruction as a Spur to Understanding the Scientific Enterprise." American Biology Teacher. 32. 6: pp. 359-360.

who participated in the individualized self-paced class.

Humphreys[45] conducted a study comparing two groups of biology students (N=29, N=28) on self-image of achievement and academic achievement. The self-paced, student-structured experience (SSE) group was required to master biological concepts via learning experiences that they themselves had to structure. In the second group, the self-paced, teacher-structured experience (TSE) group, the teacher provided the learning experiences that lead to mastery of the same biological concepts. Both groups were pretested and matched so as to be statistically homogeneous.

The results indicated that the TSE group generally achieved more academically and mastered the biological concepts in a shorter period of time. There were no differences concerning the self-image of academic achievement. No significant differences were reported between the two groups on all three categories.[46]

An investigation comparing four instructional strategies was conducted by Hug.[47, 48] The question asked in this investigation was which of the four following teacher strategies

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[45] D. W. Humphreys. 1972. "An Analysis of the Relationship of Individualized Instruction, Self-Image of Achievement, and Academic Achievement in High School Biology," Dissertation Abstracts. 33. 4: p. 1539-A.

[46] Ibid.

[47] W. E. Hug. 1969. "An Experiment Comparing Cognitive and Affective Dimensions of Independent Study, Small-Group Discussion, and Large-Group Instruction in High School Biology." Dissertation Abstracts. 30. 1: p. 618-A.

[48] W. E. Hug. 1971. "Comparisons of Cognitive and Affective Gains Between Independent Study, Small-Group Discussion, and Large-Group Presentation in High School Biology." Science Education. 55. 2: pp. 241-247.

would be the most effective for teaching a single unit of study in high school biology: (1) independent study, (2) small-group discussion, (3) large-group instruction, or (4) a combination of all three strategies. The design employed 436 students divided into each of the four methods. At the end of the experiment, which lasted seven days, cognitive and affective growth for all four groups were compared.

There were no significant differences in cognitive achievement between any of the four groups. However, the students in the independent study group manifested a more positive attitude toward the unit of instruction when compared to the other three groups.[49]

Perhaps the most comprehensive study to date was done by Fulton.[50] The purpose of his investigation was to determine whether students who had experienced:

> two different approaches to biology displayed differences in achievement in biology, degree of understanding science, ability to think critically, attitude toward science, and attitude toward the ability of the teacher to make the material understandable.

Two classes of 20 students were selected for the study. Both classes used the BSCS Blue Version, but they were taught by two different methods. The first class of 20 students was taught by group instruction. The rate of progress was

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[49] W. E. Hug. 1970. "Independent Study Evokes Good Student Attitudes." Science Education. 54. 2: pp. 115-118.

[50] H. F. Fulton. 1971. "Individualized vs. Group Teaching of BSCS Biology." American Biology Teacher. 33. 5: p. 277.

determined by the instructor and it was applied to all students. The following year, the second class of 20 students was taught, this time by an individualized approach. These students progressed at their own individual rates through verbal "contacts" with the teacher.[51, 52]

To determine what effect these approaches had on the students, seven testing instruments were given at the beginning and end of each year. Adjusted posttest means were then compared through analysis of covariance. Statistical analyses revealed that students in the individualized class had statistically significant greater gains in: (1) achievement in BSCS biology, (2) understanding of science, (3) ability to think critically, and (4) attitude toward science. Significant F-ratios had been obtained for the individualized class on the following inventories:

1. BSCS Comprehensive Final Exam
2. Test on Understanding Science
3. Facts About Science
4. Watson and Glaser Critical Thinking Appraisal
5. Prouse Subject Preference Survey[53]

On the Nelson Biology Test and the Silance Attitude Scale, the individualized group again attained higher adjusted

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[51] Ibid. pp. 277-280.

[52] H. F. Fulton. 1970. "An Analysis of Student Outcomes Utilizing Two Approaches to Teaching BSCS Biology." Unpublished Doctoral Dissertation, University of Iowa.

[53] Ibid.

posttest means, but there were no significant differences between the two groups. Fulton also found that the individualized group rated the teacher's ability to make the material understandable higher than the class taught by the group approach. The results were statistically significant and again they favored the individualized group. The evidence in this study favored the individualized class in each of the areas studied.[54, 55]

The findings of these research studies revealed that in some cases individualization was considered to be relatively more effective than conventional teacher-directed approaches. It is the opinion of this writer that these studies are not to be considered conclusive evidence for the efficacy of individualization due to poor conceptualization of the problem, poor design, and weak statistical treatments. Comparative studies should be conducted simultaneously over a reasonable length of time involving a representative sample of students involved in an ongoing biology program. Regardless of the sophistication of these studies, a summarization of the results revealed that the students exposed to individualization of instruction performed at least as well or significantly better than conventionally taught students in terms of cognitive and/or affective performance.

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[54] Ibid.

[55] H. F. Fulton. 1971. "A Comparative Study of Student Attitudes Toward Science and the Ability of the Teacher to Make Material Understandable in Individualized and Group Approaches to BSCS Biology." School Science and Mathematics. 71. 3: pp. 198-202.

Personality and Motivational Characteristics As Related to Individualization

Individualization of instruction is seen by most educators as an attempt to adopt and tailor a learning program to the individual needs and interests of students. Any individualized program must therefore be ready to adjust to a wide range of individual differences, some of which may be directly related to cognitive and/or affective achievement. One of the major problems in offering an individualized program is the lack of empirical knowledge concerning various individual characteristics as personality and motivation and how these factors are related to academic success in the individualized setting. This section is a review of the literature of student characteristics as related to achievement in the individualized approach.

The relationship of personality factors measured by the Guilford-Zimmerman Temperament Survey (GZTS) to academic success in an independent study instructional biology program was conducted by Szabo and Feldhusen.[56] The results revealed that both the restraint and ascendance scales of the GZTS were significantly correlated to academic success. It was also found that the restraint scale was significantly correlated to the traditional teacher-directed biology course.

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[56]M. Szabo and J. F. Feldhusen. 1971. "Success in an Independent Study Science Course at the College Level as Related to Intellective, Personality, and Biographical Variables." Journal of Research in Science Teaching. 8. 3: pp. 225-229.

Several studies investigated the relationship between certain personality characteristics of students and the student's preference for a particular instructional approach. Wispe[57] reported that the more independent students preferred a more permissive approach, while a more teacher-directed approach was favored by students who were insecure. Haigh and Schmidt[58] found similar results in that students who elected the non-directive approach were generally more flexible and better able to cope with inconsistencies and ambiguities than students who elected a teacher-directed class. Koenig and McKeachie[59] found that women students who were high in need for achievement preferred the small groups and the independent approach over the lecture method.

More recent research has investigated the relationships and interactions between personality characteristics and instructional methods—both of which affect cognitive achievement. McKeachie[60] in 1961 found that students low in anxiety

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[57]L. G. Wispe. 1951. "Evaluating Section Teaching Methods in the Introductory Course." Journal of Educational Research. 45. 3: pp. 161-186.

[58]G. V. Haigh and W. Schmidt. 1956. "The Learning of Subject Matter in Teacher-Centered and Group-Centered Classes." Journal of Educational Psychology. 47. pp. 295-301.

[59]K. Koenig and W. J. McKeachie. 1959. "Personality and Independent Study." Journal of Educational Psychology. 50. pp. 132-134.

[60]W. J. McKeachie. 1961. "Motivation, Teaching Methods, and College Learning." In M. R. Jones (Ed.). Nebraska Symposium on Motivation, Lincoln, Nebraska, University of Nebraska. Quoted by C. E. Pascal. 1971. "Individual Differences and Preferences for Instructional Methods." ERIC Document. p. 2.

and high in achievement motivation received relatively higher grades than students high in anxiety and low in achievement motivation when participating in a class in which the instructor gave limited information and feedback regarding the correctness of behavior. In another study by McKeachie et al.[1] in 1966, the investigators found that male students high in affiliation received relatively better grades than male students low in affiliation when in class characterized by a warm and friendly atmosphere.

The relationship of sociability to academic achievement was investigated by Beach.[62] In this study, students were randomly assigned to the following experimental groups characterized by varying degrees of student and teacher interaction: (1) lecture section, (2) class discussion, (3) autonomous small groups, and (4) independent study. Analyses of posttest data revealed a significant relationship between sociability and achievement. It was found that "the less sociable student achieved more than the more sociable student" in both the lecture section and the class discussion section. The situation was reversed for the autonomous small groups as the more sociable students achieved more than the less social

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[61] W. J. McKeachie, L. Yi-Guang, J. Milholland, and R. Isaacson. 1966. "Student Affiliation Motives, Teacher Warmth, and Academic Achievement." Journal of Personality and Social Psychology. 4. 4: pp. 457-461.

[62] L. R. Beach. 1960. "Sociability and Academic Achievement in Various Types of Learning Situations." Journal of Educational Psychology. 51. 4: pp. 208-212.

student. No differences were found between the more or less sociable students in achievement for the independent study group.

Pascal,[63] in a study on 185 students in a psychology course at the University of Michigan, evaluated the relative effectiveness of the three following teaching approaches when offered to students on an optional basis: (1) lecture, (2) lecture with discussion, and (3) independent study. After the students choose one of the teaching methods, Pascal attempted to identify the relationships between student characteristics and their choice of an option.

The results revealed the following differences between the three groups of students:

1. Those who chose the independent study option had a significantly greater need for autonomy, flexibility, a higher tolerance for ambiguity, and a greater preference for abstract and scientific thinking than students who chose the lecture option.

2. Those in the independent study group and in the lecture-discussion group both scored significantly higher in tolerance for ambiguity and autonomy than the lecture only group.

3. Those who chose the independent study as an option were more likely to have had previous experience with this method of learning.

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[63] C. E. Pascal. 1971. "Individual Differences and Preferences for Instructional Methods." Montreal, McGill University. ERIC Document. pp. 1-22.

4. Those in the independent study group had better study habits—that is they were more independent and self-directed than students choosing the other two options.[64]

Additional findings indicated that:

1. 47% of students choosing independent study did so because it gave them the opportunity to achieve personal and academic goals.

2. 18% of the students choosing the lecture option said that the main reason for doing so was because it provided them with necessary structure.

3. 92% of the students who chose the lecture-discussion method stated that this approach gave them the opportunity to interact with other students and with the instructor.

4. A larger number of students in independent study stated that they "liked to write papers" than students who chose the other two options.[65]

A considerable amount of research concerning personality and motivational characteristics of students has been done by Cattell and others. One study in this area conducted by Cattell, Sealy, and Sweney[66] investigated "the direct relations between personality and motivation traits and level of achievement measured in a given year..." Personality characteristics were measured by the High School Personality

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[64] Ibid.

[65] Ibid.

[66] R. B. Cattell, A. P. Sealy and A. B. Sweney. 1966. "What Can Personality and Motivation Source Trait Measurements Add to the Prediction of School Achievement." The British Journal of Educational Psychology. 36. 3: pp. 280-295.

Questionnaire (HSPQ), a psychometric inventory consisting of fourteen personality traits. The School Motivation Analysis Test (SMAT) was used to inventory interest and motivational traits, each of which is composed of two factors: (1) the integrated or conscious and organized component, and (2) the unintegrated or less conscious and more hedonic component. In this study, the HSPQ and SMAT were administered to 563 students and correlations were determined between personality and motivational traits and level of achievement.

Analyses of the data concerning the personality factors revealed five significant correlations of the personality traits with achievement when corrected for attenuation. A negative correlation was found for dominance and positive correlations were found for: (1) warmth-sociability, (2) super ego strength, (3) fastidious individualism, and (4) self-sentiment strength. It was also found that the self-sufficiency trait was positive at a younger age and negative at an older age.[67]

Analyses of the data on the motivational and interest traits revealed nine significant correlations with achievement when corrected for attenuation. Results on the integrated (conscious) component revealed negative correlations for (1) sensuality, (2) gregariousness, (3) protectiveness, and (4) pugnacity. Positive correlations were revealed for: (1) assertion and (2) self-sentiment. Results of the

[67] Ibid.

unintegrated (less conscious) component revealed negative correlations for (1) assertion, (2) protectiveness, and (3) pugnacity. Cattell, Sealy, and Sweney, in interpreting these results, feel that these instruments have potential use in predicting educational achievement and that personality and motivational measures should be added to current ability testing batteries.[68]

Similar results were found in a study conducted by Pierson, Barton and Hey[69] in which they investigated the relationship of motivational factors to school achievement in delinquent boys. The School Motivation Analysis Test (SMAT) was administered to 44 male students, and at the end of the treatment period Pearson product-moment correlation coefficients were computed between motivational traits on the SMAT and school achievement scores. The results revealed a number of high correlations suggesting that the academic achiever in this particular program invests little energy in aggressive assertion and a considerable amount of energy in enhancing his self-sentiment and narcissism.[70]

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[68] Ibid.

[69] G. R. Pierson, V. Barton and G. Hey. 1964. "SMAT Motivation Factors as Predictors of Academic Achievement of Delinquent Boys." Journal of Psychology. 57. pp. 243-249.

[70] G. R. Pierson. 1964. "A Refinement in the Use of School Motivation Analysis Test (SMAT) as a Predictor of School Achievement of Delinquent Boys." Educational and Psychological Measurement. 24. 4: pp. 929-935.

Conclusion

Individualization of instruction is the provision of an educational environment that allows students to progress and achieve at a rate commensurate with individual interests and abilities. Four basic operational approaches—(1) individually diagnosed and prescribed, (2) self-directed, (3) personalized, and (4) independent study—offer unique and different instructional techniques and educational opportunities to the student.

Science educators have recognized the need for individualization of instruction and many feel that it offers a relevant education to today's students. Review of the literature has shown that a limited number of research studies exist on individualization of biology programs. The review of research studies found that: (1) subjective evaluations revealed a number of positive outcomes along with a few limitations and (2) the qualitative comparative studies revealed that in each case the students exposed to individualization did at least as well or significantly better than conventionally taught students in terms of cognitive and/or affective performance.

Research on personality and motivational characteristics of students in an individualized program is also limited. However, a few studies have shown that certain personality traits were significantly correlated to a particular instructional approach. The indication is that personality and

motivational traits may likely effect cognitive and affective performance in an individualized learning program.

Chapter III

Design of the Investigation

The purpose of this chapter is to describe the research design and procedures of the investigation. Included are: (1) a description of the individualized biology program at Glenbrook North High School, (2) the research design of the problem, (3) a statement of the problem and the research hypothesis, (4) descriptions of the sample, instruments, data collection, and (5) an explanation of the statistical procedures employed.

The Individualized Biology Program at Glenbrook North High School

A flexib , multimedia, individualized biology program has been developed at Glenbrook North High School, Northbrook, Illinois. This individualized learning (IL) program was implemented on a partial basis in the fall of 1970-1971 and on a full-time basis the following year.

Students enrolled in the IL biology program receive a year of credit upon completing "contracts" for 34 learning units of material. Upon completion of minimum requirements

for a learning contract, the student has the option of: (1) investigating in great detail an area of interest related to that contract, (2) tutoring other students involved in the same contract, or (3) advancing to the next contract. The students start at the beginning of the year with their first learning packet and then progress at their own rate until they complete the course requirements. The work rate and the responsibility for completion of the contracts to satisfy course requirements is left entirely to the student.

When progressing through the learning contracts, the following resources and materials are available to each student: (1) the Science Instructional Materials Center (IMC), which has audio-equipped learning carrels providing various learning implementers such as biological materials, charts, scientific equipment and reading materials, (2) a Testing Center run by a paraprofessional to which the students report for the administration of examinations, either during scheduled or unscheduled time, (3) optional teacher presentations on the "contracts" which are made available to the students when needed throughout the course of the year, (4) a tape-and-help room providing tapes of the presentations and offering personal assistance from one of the team teachers, and (5) a lab room equipped with scientific and teaching facilities run by another of the team teachers.

By actively participating in the learning contracts, students learn to accept the responsibility for their progression

through the course. Students can theoretically learn on their own, completely independent of the teacher, by utilizing the IMC and by taking advantage of other learning resources such as the tapes. Or, a student can maximize the use of the teacher by attending all the teacher presentations and by capitalizing on the teacher's personal attention offered in the tape-and-help room.

The Individualized Learning Program at Glenbrook North High School attempts to promote and facilitate the optimum development of students with regard to their individual potential, thus insuring a continuous and cumulative learning situation with pupils working at different levels within a subject area. Instruction is individualized and personalized in terms of methods, achievement and pacing. The individual student determines those strategies and curricular devices that: (1) are tailored to his individual strengths, (2) are personally beneficial, and (3) will satisfy contract requirements. The program has been designed and developed to meet the unique needs, interests, abilities and aspirations of each student as they progress through the required course objectives at a rate commensurate with their interests and abilities.

Research Design

Research studies concerned with individualization of science instruction are inadequate in number, and many of those are questionable in design. Welch,[1] in reviewing research

[1] W. W. Welch. 1972. "Review of Research 1968-69 in Secondary Level Science." Journal of Research in Science Teaching. 9. 1: pp. 109-111.

studies on secondary science programs, commented on 30 studies devoted to comparing various instructional approaches. He reported as follows: 17 found no significant differences; 6 found mixed results; 6 favored the experimental procedure; and 1 favored the control. The results revealed that only a few studies demonstrated a superiority of one method over another since the majority called it a draw. Generalizations were difficult to make due to the multiplicity of factors involved along with any previous convictions an investigator might have had prior to the study. Welch seriously questioned the value of these comparative research studies for they were poorly conceptualized and designed.

In an article on improvement of research in science education, Tyler[2] stated that "many of our current research efforts are irrelevant, inadequately conceptualized, and methodologically naive." In order for improvement to take place, Tyler[3] reported that certain criteria should be met and that "research in science education has promise when it is relevant, is adequately conceptualized, and has sound methodology."

According to Melnick[4], the ambiguity of research results goes beyond poor conceptualization and design for it "may be

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[2]R. W. Tyler. 1967. "Resources, Models, and Theory in the Improvement of Research in Science Teaching." Journal of Research in Science Teaching. 5. p. 43.

[3]R. W. Tyler. 1967. "Analysis of Strengths and Weaknesses in Current Research in Science Education." Journal of Research in Science Teaching. 5. p. 52.

[4]M. Melnick. 1969. "Independent Study—A Review of the Research Literature." Hempstead, New York, Hofstra University, Center for the Study of Higher Education. ERIC Document. p. 13.

due in part to the fact that the wrong research question was asked." Instead of simply asking if one instructional approach is superior to another, a more sophisticated question needs to be asked.

Cronbach[5] stated that "I have no faith in any generalizations upholding one teaching technique against another...." Instead, research should concentrate on the relative effectiveness of a particular approach rather than attempting to establish the superiority of one method over another. Ramsey and Howe[6] concur with this statement for they said:

> Much more useful information is likely to be gained by investigating different instructional procedures for teaching a given course or instructional module than by attempting to compare one course with another.

Instead of a comparative investigation, research questions should concentrate on what effect does an instructional approach have on what kinds of students, what is their cognitive and affective performance, with what kinds of media, for which school subjects, and with how much interaction with the teachers? Watson and Cooley[7] stated that if research can

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[5]L. J. Cronbach. 1966. "The Logic of Experiments on Discovery." In L. Shulman and E. Keislar. (Eds.). Learning by Discovery: A Critical Appraisal. Chicago, Rand McNally. pp. 76-92.

[6]G. A. Ramsey and R. W. Howe. 1969. "An Analysis of Research on Instructional Procedures in Secondary School Science. Part 1—Outcomes of Instruction." The Science Teacher. 36. 3: p. 68.

[7]F. G. Watson and W. W. Cooley. 1960. "Needed Research in Science Education." Rethinking Science Education, Fifty-ninth Yearbook of the National Society for the Study of Education. Chicago. University of Chicago Press. p. 306.

differentiate between students "who are able to learn at different rates and at different levels of abstraction, then a way of grouping students for expediting instruction is suggested." If it is possible to identify different types of students and something about their learning characteristics, then a program can be adapted and modified according to their individual needs.

If it can be assumed that individualization provides a more relevant and meaningful education, then the research questions should focus on how this approach can be adapted to suit the needs and interests of students. By understanding the characteristics of the students, an instructional approach can be strengthened to suit the superior student and modified so that it also provides a meaningful and worthwhile education to the slower student. Only by asking a more sophisticated question will the research results be of value to science educators.

The Problem

The purpose of this study was to investigate the characteristics of "high," "expected," and "low" achievers in an individualized biology program at Glenbrook North High School. To date, comprehensive studies investigating student characteristics as predictors of achievement in individualized high school science programs have been lacking. The problem that arises is—What are the characteristics that differentiate

the students who "do well" in an individualized biology program from those who "do not do well"?

Statement of the Research Hypothesis

Review of the literature has shown that the need for individualization is clear. However, the ways and means to provide for individualization in the most efficient and effective manner remains unclear.

The definition of this problem makes possible the identification of the primary question of this proposal, which can be stated as a single null hypothesis:

> There are no differences in student characteristics between "high" achievers, "expected" achievers, and "low" achievers in an individualized learning biology program with regard to the following variables: (1) biographical data, (2) personality, (3) motivation, (4) attitude toward science, (5) understandings about science, (6) the ability to think critically, (7) scholastic aptitude, (8) student feelings and attitudes toward the course and the teacher, and (9) the success of the students in their other courses.

The Sample

This study utilized responses of students who were enrolled in the individualized learning biology program at Glenbrook North High School, Northbrook, Illinois, for the academic year 1973-1974. Glenbrook North High School has a total student population of approximately 2,500 representing an upper middle class background. The village of Northbrook

is located 25 miles north of downtown Chicago. Northbrook is a residential suburb supporting light industry and modern corporations. The populus of the community is relatively young in age, with a large percentage employed in white collar occupations.

Glenbrook North High School has developed on its own an individualized curriculum. This program not only promotes but attempts to facilitate the optimum development of students with regard to their individual potential, thus insuring a continuous and cumulative learning environment with pupils working at different levels within subject areas. Instruction is individualized and personalized in terms of methods, achievement and pacing.

The individualized biology program at Glenbrook North High School was chosen for this investigation because of the following reasons:

1. The individualized learning program has national implications increasing the need for critical data.

2. There is an urgent need for data regarding student characteristics as related to achievement in the individualized program.

3. Statistical data are needed in support of subjective and intuitive feelings of the teachers involved in the individualized program.

4. The study had the endorsement and cooperation of the administration.

5. The study also had the cooperation and full support of the Science Instructional Supervisor and all members of the biology staff.

The study involved all of the students who were enrolled in two semesters of individualized biology. This included 24 biology classes, 7 teachers and 406 students. All students who elected biology were assigned to one of the seven teachers at random by the school computer.

The Instruments

In this investigation a total of 75 measures were collected for each individual in five major categories: (1) psychometric inventories, (2) aptitude measures, (3) biographical information, (4) student questionnaires, and (5) data concerning the students' success in their other courses.

Psychometric Inventories

Nelson Biology Test, Forms E and F. A 65-item inventory developed to measure the understanding and ability necessary to apply knowledge and to interpret problem situations in biology. The test is designed to measure the knowledge of biological concepts and principles, the understandings of these concepts and principles, and the ability to interpret data and to draw conclusions. This test in the past has been the best single instrument used in conducting research within high school biology programs.[8] The reported reliability of this instrument ranges from .89 to .92.[9]

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[8] J. D. Novak. 1972. In O. K. Buros. (Ed.). Seventh Mental Measurements Yearbook. Highland Park, New Jersey. The Gryphon Press. p. 820.

[9] C. H. Nelson. 1965. Manual for the Nelson Biology Test. Harcourt Brace Jovanovich, Inc. p. 13.

Watson-Glaser Critical Thinking Appraisal (WGCTA), Form ZM. A 100-item instrument designed to measure the ability to think critically. This instrument consists of five subtests, each designed to inventory a different but related aspect of critical thinking: (1) inference, (2) recognition of assumptions, (3) deduction, (4) interpretation, and (5) evaluation of arguments. The reported split-half reliability coefficient for Form ZM is .79 for tenth grade students.[10] The total score for this instrument was utilized in this investigation.

In reviewing the WGCTA, Crites[11] stated that this inventory is an adequate research instrument at the secondary school level and that "the test appears to measure not only general intelligence but also certain logical reasoning abilities." Past research conducted by George[12] has shown significant differences in the ability of students to think critically in a high school biology program.

Test on Understanding Science (TOUS), Form W. A 60-item multiple choice inventory designed to measure understanding of science in the following areas: (1) the scientific enterprise, (2) the nature of scientists, and (3) the methods and aims of science. TOUS is a research instrument providing a useful

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[10] G. Watson and E. M. Glaser. 1964. Manual for the Watson-Glaser Critical Thinking Appraisal. Harcourt Brace Jovanovich, Inc. p. 13.

[11] J. O. Crites. 1972. In O. K. Buros. op. cit. p. 784.

[12] K. D. George. 1968. "The Effects of Critical-Thinking Ability Upon Course Grades in Biology." Science Education. 52. 5: pp. 421-426.

means of measuring this aspect of scientific knowledge within the realm of science education. Kuder-Richardson Formula 20 reliability is .76 for the total score.[13]

Scientific Attitude Inventory. A 60-item inventory providing a valid and reliable measure of scientific attitudes to be used at the secondary level. The attitudes assessed are intellectual and emotional and they are based upon the concerns of science educators found in the Fifty-ninth Yearbook of the National Society for the Study of Education. This instrument was utilized to inventory student's knowledge and feelings in four categories: (1) positive intellectual, (2) negative intellectual, (3) positive emotional, and (4) negative emotional. Students respond by agreeing or disagreeing to six types of position statements. The test-retest reliability for this inventory is .934.[14]

High School Personality Questionnaire (HSPQ), Form A. A 140-item instrument that according to Cattell and Cattell[15] "yields a general assessment of personality development." This standardized test purports to measure personality traits that are considered by some psychologists in coming close to

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[13] V. H. Noll. 1972. In O. K. Buros. op cit. p. 805.

[14] R. W. Moore and F. X. Sutman. 1970. "The Development, Field Test and Validation of an Inventory of Scientific Attitudes." Journal of Research in Science Teaching. 7. pp. 85-94.

[15] R. B. Cattell and M. D. L. Cattell. 1968. Manual for the High School Personality Questionnaire. Champaign, Illinois, Institute for Personality and Ability Testing. p. 3.

representing one's total personality and the "psychologist by working with these scores can obtain predictions of school achievement...."

This instrument is appropriate for students ages 12 through 18 and it can be administered in a single class period. Scoring of the HSPQ yields 14 measures. The descriptions of the subscales and their reliability and validity coefficients for Form A are given in Table 1.[16]

School Motivation Analysis Test (SMAT), Form A, Research Edition. A 190-item interest-motivational inventory purported to be related to achievement. This inventory is designed to measure ten independently derived motivational traits consisting of six ergs (drives, instincts, needs) and four sentiments (acquired attitude patterns, secondary drives). The dynamic traits measured are:

The Ergs (Drives)

1. Assertiveness (Self-assertion)
2. Mating (Sex drive)
3. Fear, Escape (Security-seeking)
4. Narcism
5. Pugnacity-Sadism
6. Protectiveness (Parental pity)

The Sentiments

7. Self-Sentiment
8. Superego
9. School
10. Home

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[16] Ibid. pp. 4-5.

TABLE 1

SUBSCALE RELIABILITIES AND VALIDITIES

FOR THE HSPQ

HSPQ factor	Description		Reliability[1]	Validity[2]
	Low Score	High Score		
A	Reserved	Warmhearted	.85	.67
B	Less Intelligent	More Intelligent	.78	.69
C	Affected by Feelings	Emotionally Stable	.77	.71
D	Undemonstrative	Excitable	.80	.63
E	Obedient	Assertive	.74	.65
F	Sober	Enthusiastic	.76	.68
G	Disregards Rules	Conscientious	.72	.68
H	Shy	Adventurous	.81	.72
I	Tough-Minded	Tender-Minded	.88	.70
J	Zestful	Circumspect Individualism	.81	.58
O	Self-Assured	Apprehensive	.83	.77
Q_2	Sociable Group-Dependent	Self-Sufficient	.82	.61
Q_3	Uncontrolled	Controlled	.78	.57
Q_4	Relaxed	Tense	.84	.74

[1]Reliability coefficients of Form A based on test-retest after one day on three groups of 90 to 110 high school juniors.

[2]Construct validity coefficients of Form A based on 200 high school students.

Each of these ten factors are inventoried in four categories. Two of the scores are combined to form the unintegrated (U) component measuring unconscious contributions. The remaining two scores form the integrated (I) component measuring conscious, deliberate interest. Thus the scoring of the SMAT yields ten U component measures and ten I component measures for each trait. The U and I scores may then be added to yield a single total score. Total scores for Form A were utilized in this study.

The SMAT test was administered in this investigation to obtain a greater understanding why a student performs the way he does in school. According to Sweney, Cattell, and Krug,[17] the authors of this inventory, the SMAT test should be used "to complement ability and personality measures." In addition, Sweney et al. pointed out that past research has indicated that the information inventoried by this instrument is not redundant for students of similar ability and personality often acquire different interests.

The SMAT inventory is a relatively new instrument for it is still in the research stage. Validity and reliability coefficients are not reported; however, the authors do state that this instrument has substantial predictive power.[18]

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[17] A. B. Sweney, P. B. Cattell, and S. E. Krug. 1970. Preliminary Manual for the School Motivation Analysis Test. Champaign, Illinois, Institute for Personality and Ability Testing. pp. 1-16.

[18] Ibid.

Aptitude Measures

Administration of the Classification and Placement Examination (CAPE) to all incoming students is part of the testing program of the Glenbrook High School District. Utilization was made of (1) percentile scores of eight of the CAPE subtests measuring general mental ability and scholastic achievement and (2) an aptitude score representing I.Q. Measurements collected were:

1. Verbal
2. Quantitative
3. Total aptitude score (verbal and quantitative)
4. Reading
5. Math
6. English
7. Total achievement (reading, math and English)
8. Total score (total achievement and total aptitude)
9. Aptitude (I.Q.) measurement

Biographical Data

An author-constructed Student Information Sheet (Appendix A) was used to gather biographical data concerning the students enrolled in the individualized learning biology program. This information sheet inventoried the following ten factors:

1. Sex
2. Age
3. Number of older siblings
4. Number of younger siblings
5. Completion of earth science
6. Father's educational level
7. Mother's educational level
8. Number of bookshelves in the home
9. Potential major in college
10. Expected level of education

Student Questionnaires

ENDEAVOR VIII. An 18-item Likert-type questionnaire designed to evaluate the course and the instructor (Appendix B). This inventory was utilized in assessing students' attitudes toward the individualized learning program and the teachers. Students responded to the 18 questions in six major areas:

1. Teacher's presentation
2. Course workload
3. Student accomplishment
4. Organization of the course
5. Fairness of grading
6. Teacher accessibility

Course Evaluation Form. An author-constructed course evaluation questionnaire was administered in assessing students' feelings and attitudes toward the individualized learning (IL) biology course (Appendix C). This instrument was designed to inventory students' feelings toward: (1) individualization and self-pacing, (2) methodology, (3) motivation, and (4) personal attitudes toward the course. Information from this inventory would be of assistance in analyzing differences found in the study. By analyzing students' feelings and attitudes at the end of the year one could possibly hypothesize in accounting or explaining some of the reasons for the students' academic status at the end of the year. Items inventoried were:

1. Self-knowledge of biology
2. Enjoyment of the course
3. Difficulty of the course
4. Value of the teacher's presentations
5. Value of the tapes

6. Value of the labs
7. Value of the readings
8. Self-directedness
9. Course preference
10. Work pace
11. Motivation
12. Contract involvement
13. Grade expectation
14. Attitude
15. Independence

Student Status at the End of the Year

Data were gathered concerning the success of the students in the total academic program at Glenbrook North High School. Data gathered included:

1. Number of semesters of IL taken during the year
2. Number of semesters of IL completed during the year
3. Grade point average of the IL courses
4. Number of semesters of traditional courses taken
5. Grade point average for the traditional courses
6. Grade point average for all courses during the year

These data were gathered to evaluate overall student success, or lack of success, in relationship to the total school setting. The purpose was to analyze relationships between student achievement and the (1) number of individualized learning (IL) courses taken and completed, (2) grade point averages for the IL courses, (3) number of traditional courses taken and grade point average, and (4) the overall grade point average of the students.

Data Collection

The data for this investigation were collected during the 1973-1974 academic school year. Data were collected during

the first few months of the school year and again at the conclusion of the school year in June. First to be collected were critical data, followed by collection of information that tended to be more stable, such as motivational and personality factors. It was felt that if the inventories were dispersed student responses would be more reliable than if they took all the tests at once and became test weary. Additional critical data, responses to questionnaires, and biographical information were collected at the end of the school year.

Inventories were administered and data were collected according to the following timetable. The Nelson Biology Test (Form E) and the Scientific Attitude Inventory were administered in early September. Data were collected from the Watson-Glaser Critical Thinking Appraisal and the Test on Understanding Science in October and early November. The School Motivation Analysis Test and the High School Personality Questionnaire were administered in late November and early December. At the end of the school year, the Nelson Biology Test (Form F) was administered, biographical data, and student responses to questionnaires were collected. At the close of school, course grades, number and kinds of courses, and scores from the Classification and Placement Examination were gathered.

The students involved in the study were not told that they were participating in a research investigation, but they were told that "their responses were needed for evaluating and improving the individualized learning program at Glenbrook North High School."

Statistical Analyses

The data of the investigation were subjected to a number of different analyses in answering the questions of this study. A random sample of 100 students was selected from the total population of 406 students for the purposes of determining achievement levels for the remaining individuals. Once the students had been classified into their respective achievement levels, three random groups were formed. Multiple discriminant analyses were then performed to see if differences could be found between achievement levels in the three random groups. A cross validation was then conducted to determine the effectiveness of the discriminant function equations. Finally, student responses to questionnaires were analyzed for the purpose of understanding and explaining differences found between achievement levels in each of the three groups. A more detailed description of the statistical procedures and techniques performed is given in the separate subheadings in this section.

Group Formation

Utilizing all students (N=406), a sample representing 25% of the population (N=100) was selected at random (using a table of random numbers). By employing multiple regression analysis, data obtained from these 100 individuals was utilized in deriving a prediction equation in which achievement was used as the criterion measure. For each of the remaining 306 individuals, a "predicted" achievement score plus or minus the standard error of estimate was calculated.

According to Thorndike,[19] "overachievement" and "underachievement" can only be defined in relationship to predicted achievement for that individual. In predicting achievement, two main factors should be taken into consideration: (1) aptitude measures and (2) prior achievement or knowledge. The means of determining "predicted" achievement can be accomplished by employing multiple regression analysis.

Utilization of this prediction equation determines the average or typical achievement level for individuals at any given aptitude level. The predicted value is an unbiased estimate of achievement. Failure to recognize this regression effect results in the establishment of a meaningless criterion. Over and underachievement is then defined by Thorndike[20] as a "discrepancy of actual achievement from the predicted value, predicted upon the basis of the regression equation between aptitude and achievement."

The methodology employed in deriving predicted achievement was based on the simultaneous solution of the following equation for the 100 individuals:[21]

$$y = a + b_1x_1 + b_2x_2$$

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[19] R. L. Thorndike. 1963. The Concepts of Over and Underachievement. New York, Teachers College, Columbia University. pp. 1-79.

[20] Ibid. p. 13.

[21] M. Ezekiel and K. A. Fox. 1966. Methods of Correlation and Regression Analysis. New York, John Wiley and Sons, Inc. pp. 170-177.

where: y = Nelson Biology Posttest (dependent variable)

a = constant

b_1, b_2 = regression coefficients to be derived

x_1 = aptitude score (independent variable)

x_2 = Nelson Biology Pretest (independent variable)

The solution to this multiple linear regression equation was performed by utilizing the BMD29 Multiple Regression Library Program.[22] Once the regression coefficients had been generated, predicted achievement scores were calculated by solving the following equation:

$$\hat{y} = a + b_1x_1 + b_2x_2$$

where: $\hat{y}$ = predicted achievement score

a = constant

b_1 = regression coefficient for x_1

x_1 = aptitude score

b_2 = regression coefficient for x_2

x_2 = Nelson Biology Pretest Score

Predicted achievement scores were then calculated, but as in any type of prediction, they are subject to error. Consequently, the standard error of estimate (S.E.) was calculated for $\hat{y}$ (called y hat).

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[22] BMD29, Multiple Regression and Correlation Analysis. Library Number NUCC043, Vogelback Computing Center, Northwestern University. 1971.

Due to the fact that both independent variables contributed significantly in predicting achievement scores ($\hat{y}$) any overlap between these two independent variables had to be subtracted out of the equation when calculating the standard error of estimate. The standard error of estimate for $\hat{y}$ involving two independent variables was based on the following equation found in Draper and Smith:[23,24]

$$\text{S.E. of } \hat{y} = \left[V(b_o) + X_1^2 V(b_1) + X_2^2 V(b_2) + 2X_1 \text{cov}(b_o b_1) + 2X_2 \text{cov}(b_o b_2) + 2X_1 X_2 \text{cov}(b_1 b_2)\right]^{\frac{1}{2}}$$

where: b_o, b_1 and b_2 = the variance-covariance matrix of the regression coefficients

X_1 and X_2 = the independent measures

After the standard error of estimate for $\hat{y}$ was calculated for each individual, the confidence limits of the standard error of $\hat{y}$ were calculated at the .001 level.

The range of the predicted achievement score for each individual was derived by calculating the following for each individual: (1) the predicted achievement score ($\hat{y}$) and (2) the standard error of estimate for that predicted score at the .001 confidence limits. Therefore, predicted achievement can be depicted as:

$\hat{y}$ = ±(S.E. of estimate)(.001 confidence limits)

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[23]N. R. Draper and H. Smith. 1966. Applied Regression Analysis. New York, John Wiley and Sons, Inc. p. 121.

[24]OMNITAB, A Computer Program for Statistical and Numerical Analysis. Library Number NUCC228, Vogelback Computing Center, Northwestern University. 1972.

Once the range of predicted scores ($\hat{y} \pm$ S.E.) was calculated for each individual, those individuals who showed discrepancies between "predicted" achievement ($\hat{y}$) and "actual" achievement (y) were designated "high" or "low" achievers. Those who did not show discrepancies were designated "expected" achievers.

According to Thorndike,[25] the next step is to study student characteristics and to investigate what kinds of relationships exist above and beyond what is incorporated in the multiple regression equation. Any discrepancies that are defined are then unrelated to achievement or to aptitude, but to some other variables.

In this investigation, 80 "high" achievers, 132 "expected" achievers and 94 "low" achievers were identified. Following the identification of the three classes of achievement levels, sampling without replacement was conducted so that a random sample of each achievement level appeared in each of three groups (Group I, Group II and Group III). More specifically, a random sample of one third (1/3) of the "high" achievers, one third (1/3) of the "expected" achievers, and one third (1/3) of the "low" achievers was assigned to Group I (N=102). A second random sample of one third of the "high," one third of the "expected," and one third of the "low" achievers was assigned to Group II (N=102). Group III consisted of the remainder of the students. This arrangement

[25] R. L. Thorndike. 1963. op. cit. p. 63.

was utilized so that three replications of results would be available for comparative purposes.

To make sure that Group I, Group II and Group III were selected at random, an analysis of variance was performed between the three groups to insure that they were selected at random and that there were no differences in the make-up of the achievement levels in each of the three groups. An analysis of variance was performed between the "high" achievers of all three groups, the "expected" achievers of all three groups, and the "low" achievers of all three groups (Appendix D). Only five of the reported 216 F-ratios indicated a difference between achievement levels for the three groups. The results indicated that the three classes of achievement levels comprising Group I, Group II and Group III were selected at random.

Testing of the Assumptions

The data for Group I, Group II and Group III were tested for the assumption of normality (Appendix E).[26] Results revealed that with the exception of dichotomized variables and author-constructed questionnaires, few variables showed a departure from normality. It was felt that the results were indicative of a normal distribution and that no transformations were performed.

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[26]John Morris, Institute for Social Science Research of Michigan State University. N-Par, Nonparametric Statistical Package-Program, Library Number NUCC264, Vogelback Computing Center, Northwestern University.

Homoge eity of variance for Group I, Group II and Group III was also tested (Appendix F).[27] In testing for this assumption, the variance due to experimental error within each of the three groups was tested. The results indicated a homogeneous distribution with the exception of ten dichotomized variables. Weiner[28] stated that moderate departures from this assumption do not seriously affect the sampling distribution and that researchers "need be concerned about only relatively large departures from the hypothesis of equal population variances." It was felt that the data of this study were homogeneously distributed and that the results were not indicative of widespread departures.

In this investigation, univariate analyses and multivariate analyses were conducted. The assumptions of normality and homogeneity of variance necessary for univariate analyses were met. Similar assumptions are made concerning multivariate analyses; that of multivariate normal distribution of the population sampled and equality of group dispersions (analogous to homogeneity of variance in anova designs) which is a test of no differences between the variance-covariance matrices of the respective groups.

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[27] N. Nie, D. Bent, and C. Hull, SPSS: Northwestern University Statistical Package for the Social Sciences—Library SPSS. Vogelback Computing Center, Northwestern University.

[28] B. J. Weiner. 1971. Statistical Principles in Experimental Designs. New York, McGraw-Hill Book Company. p. 206.

Cooley and Lohnes[29] stated that in multivariate analyses, Wilks' lambda test for the null hypothesis of equality of population centroids (H_2) is based upon the assumptions of: (1) multivariate normal populations and (2) equality of group dispersion (H_1). Concerning the first assumption, Cooley and Lohnes[30] stated research workers have to worry very little about multivariate normal distribution and that "we do not know of any useful test for multivariate normality."

Concerning the second assumption, Cooley and Lohnes[31] reported:

> Many research workers prefer to ignore the issue of the homogeneity of group dispersions (H_1) on the grounds that the test for H_2 is probably fairly robust under departures from its assumptions. Also, these multivariate tests are quite powerful, so research on large samples is quite likely to lead to rejection of H_1....

McFadden,[32] in reviewing the literature and previous related research studies, concluded:

> There appeared to be a substantial degree of uncertainty regarding tests of these assumptions, particularly as to how to proceed in carrying out the assumed required tests; and if it were discovered that the assumptions did not hold, what this precisely meant.

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[29] W. W. Cooley and P. R. Lohnes. 1971. Multivariate Data Analysis. New York, John Wiley and Sons, Inc. p. 228.

[30] Ibid. p. 38.

[31] Ibid. p. 228.

[32] J. D. McFadden. 1965. "The Relationship of Values, Attitudes and Personality Characteristics of Student Teachers to Ratings by Their Supervisors." Unpublished Doctoral Dissertation, Northwestern University. p. 53.

In view of the sparse amount of information and uncertainty dealing with such a tedious procedure, it was decided to dispense with testing for the assumptions for multivariate procedures.

Selection of Variables

Academic success or failure is usually due to a complex combination of human traits. In an attempt to assess these traits, different kinds of inventories were utilized in this study. The problem that exists is—how to best combine the measurements of the various inventories to produce the most effective battery of test variables maximizing group differences between achievement levels in Groups I, II and III.

The problem of combining variables into an effective battery is discussed by Thorndike.[33] There is some ambiguity on the part of educators concerning the "concept of most effective selection" of combining variables into a battery. The contribution of the effectiveness of any single instrument, according to Thorndike,[34] "is a function both of its correlations with the criterion and of its correlations with other tests."

In developing a battery of instruments, it is of crucial importance to avoid overlap or redundancy of information.

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[33] R. L. Thorndike. 1949. Personnel Selection—Test and Measurement Techniques. New York, John Wiley and Sons, Inc. pp. 185-226.

[34] Ibid. p. 192

Thorndike[35] stated the most effective form of a test battery is when:

> Two or three predictor measures, chosen because they are each good predictors when taken singly and because they are as independent of one another as possible, each yielding new and different information, will usually do about as much for us as the most elaborate and extensive battery.

The result of this information is that: (1) selection of several variables is better than that of a single variable and that (2) the gain of information from additional variables is extremely reduced due to intercorrelations of the measures.

In this investigation a separate battery of variables was selected first from the psychometric inventories and aptitude measures and secondly from the biographical data in an attempt to discriminate between achievement levels in Group I, Group II and Group III.

The first battery of variables was reduced from a combination of 27 measures from the various psychometric inventories and 8 measures from the Classification and Placement Examination. The following steps were taken in reducing these 35 variables to a battery of only 5 variables:

1. The CAPE scores were examined for "overlap" (independence of measures). Intercorrelations (r) between the "partial subtest" scores and the "total" scores were examined and, since the r between the partial scores were lower than those for

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[35] R. L. Thorndike. 1964. "Educational Decisions and Human Assessment." Teachers College Record. 66. 2: p. 107.

the total scores, the partial scores were retained and the three total scores were deleted.

2. For the remaining 32 variables, the univariate F-ratios between the "high," "expected," and "low" achievers for Groups I, II and III were examined. It was found that 13 of these variables had a significant univariate F-ratio in at least one of the three groups. These 13 variables were retained and the rest were deleted.

3. The intercorrelations between these 13 variables were examined and the following 5 variables were selected: WGCTA, HSPQ factors G, H and Q_2, and the SMAT trait measuring sentiments toward school.

The battery of variables selected from the biographical data was conducted in a similar manner. Five variables were chosen out of the ten based on the significance of the F-ratios and intercorrelations between the variables. The variables selected were sex, age, number of older siblings, number of younger siblings, and expected level of education.

A summary of the univariate F-ratios between "high," "expected," and "low" achievers for both the psychometric and biographical variables is found in Tables 2 and 3 at the end of this chapter.

Discriminant Analysis

The problem of maximizing differences between three or more groups on multiple measurements lends itself to a multivariate statistical technique known alternately as discriminant function analysis, multiple discriminant analysis, or

the analysis of the discriminant function. This technique is commonly known simply as discriminant function or discriminant analysis.

Discriminant analysis was first described by R. A. Fischer in 1936 as a tool for classifying an individual into one of two groups on the basis of multiple measurements. This technique was later extended to apply to problems involving more than two groups. Rao (1948), Tukey (1949), and Bryan (1950) independently generalized discriminant analysis for the multiple-group case.[36,37]

The use of discriminant analysis has not been widespread, due to complicated computations involving matrix algebra which is a tremendous generator of laborious mathematics. But with the recent advance of the electronic computer and the eventual realization that discriminant analysis could serve as a statistical procedure for separating several groups from one another, the use of discriminant analysis has become more common.

This technique provides for a minimum number of measures in maximizing group differences. According to Cooley:[38]

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[36] W. W. Cooley. 1959. "Identifying Potential Scientists: A Multivariate Approach." School Science and Mathematics. 59. 5: p. 385.

[37] M. M. Tatsuoka. 1969. "Multivariate Analysis." Review of Educational Research. 39. 5: p. 741.

[38] W. W. Cooley. 1959. op. cit. p. 385.

> The task is to assign individuals to one of two or more groups on the basis of two or more independent measurements of each individual. The general procedure is to measure the same predictor variables on a large sample of which group membership is known and then derive discriminant functions which weight these measures so that their weighted sum minimizes the overlap between groups. New individuals can then be classified by determining the group which they most nearly resemble.

Discriminant analysis is of practical importance in educational research, particularly in educational counseling. The analyses of the multiple test scores yield a predicted score that aids in placement decision making concerning the probability of the future success or failure of an individual.[39] A new subject is then assigned to the group which he "is most like" in accordance to his scores on the predictor variables. One can now assign new subjects into a program where their chances of success have been greatly improved.[40]

Watson and Cooley[41] pointed out that multivariate techniques have not been widely used in science education and that a greater application should be made of more sophisticated techniques such as the multiple discriminant function. The

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[39] M. K. Chen. 1967. "Analysis of the Discriminant Function in Educational and Psychological Research," Journal of Experimental Education. 35. 3: pp. 52-58.

[40] D. V. Tiedeman. 1951. "The Utility of the Discriminant Function in Psychological and Guidance Investigations." A Paper Read at a Symposium on the Multiple Discriminant Function. Harvard Educational Review. 21. 2: pp. 71-80.

[41] F. G. Watson and W. W. Cooley. 1960. op. cit. p. 307.

value of discriminant analysis to educational research was summarized by Anderson:[42]

> Use of a technique such as this makes more sense in assigning students to classes than the usual methods employed in setting up so-called 'ability groups.' With this technique we have discriminated between known groups and this enables us, therefore, to assign an individual to a given group with a minimum of error.

The approach of discriminant analysis is to optimize the separation of groups as differences between groups are maximized and differences within groups are minimized. Essentially, discriminant analysis "uses group membership as the criterion and makes all comparisons between groups and none within groups."[43]

The basic mathematics of multiple discriminant analysis is described by Cooley and Lohnes:[44]

> The maximum value λ and the associated vector of weights v are shown by the differential calculus to be the largest eigenvalue and its eigenvector of the equation
>
> $$(W^{-1}A-\lambda I)v = 0$$

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[42] K. E. Anderson. 1962. "Application of the Discriminant Function to Problems in Science Education." Science Education. 46. 6: p. 285.

[43] P. J. Rulon. 1951. "Distinctions Between Discriminant and Regression Analyses and a Geometric Interpretation of the Discriminant Function." A Paper Read at a Symposium on the Multiple Discriminant Function. Harvard Educational Review. 21. 2: p. 88.

[44] W. W. Cooley and P. R. Lohnes. 1971. op. cit. pp. 225, 246.

where: I = identity matrix

W = within-groups matrix of squares and cross-products of deviations of subjects from their group centroids, pooled over all groups

A = among-groups matrix of weighted squares and cross-products of deviations of group centroids from the grand centroid

λ = eigenvalue or latent roots

Wilks' lambda criterion (Λ) is used for testing the discriminating power of the test battery. Bartlett's chi-square approximation of Λ is then used to test for the significance of the discriminant functions.[45,46]

The computational technique utilized in this investigation was a version of the SPSS Discriminant Analysis routine developed at Northwestern University.[47] This subprogram generates linear functions which best separate three or more groups. The generation of the discriminant functions is done in two steps. First, the variables are selected in a stepwise manner employing the distance statistic known as Rao's V. Secondly, a canonical analysis is performed on the discriminant functions to reduce them to a minimum number of independent functions.[48]

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[45] Ibid. p. 103.

[46] C. R. Rao. 1952. Advanced Statistical Methods in Biometric Research. New York, John Wiley and Sons, Inc. pp. 258-272.

[47] N. Nie, D. Bent, and C. Hull. op. cit. SPSS Statistical Package. SPSSEXP—Discriminant Analysis.

[48] Ibid.

The criterion for the first variable selected is the one with the highest univariate F-ratio and Rao's V is calculated for that variable. The remaining variables are then "searched" and the variable that adds the greatest amount to Rao's V (not necessarily the greatest change in V) when tested for significance by Wilks' lambda is selected for the next variable. This can be loosely interpreted as searching for the variable which adds the greatest "increase" in distance between the respective groups. This procedure is continued for the remaining variables.

It should be noted that after the first variable of the battery is selected, the remaining variables are not selected on the basis of the greatest F-ratio nor due to the greatest change in Rao's V, but due to the "greatest accumulated increase" in Rao's V. These variables, due to interaction effects, are added to the discriminant function because they give maximum separation of the respective groups. In addition, a variable may be added that does not have a significant change in Rao's V, but it still adds to the significance of the linear discriminant function that separates the various groups.

The final computations of the variables employed in discriminant analysis are: (1) the classification function coefficients and (2) the reduced space orthogonal discriminant function coefficients which can be used for predictive purposes. Wilks' lambda, the significance of the discriminant function equation, is tested by chi-square. Last of all,

the group centroids are computed and plotted in the discriminant space.

In this investigation, a total of six independent discriminant analyses were performed, one on the psychometric inventories and one of the biographical data for each of the three groups. Analyses were made of differences in characteristics among "high," "expected," and "low" achievers independently for Groups I, II and III. In other words, the weightings of the predictor variables between "high," "expected," and "low" achievers were compared for Group I, for Group II and lastly for Group III.

In addition, comparisons of achievement levels were made across groups only on those variables that had a significant change in Rao's V when obtained from the discriminant function analyses performed between the achievement levels in Group I, Group II and Group III. More specifically, this procedure compared results of the "high" achievers in Group I with the "high" achievers in Group II and Group III. This was repeated for the "expected" and "low" achievers across Groups I, II and III.

Cross Validation

Once the discriminant analysis has been performed and if a significant Wilks' lambda is obtained when tested by chi-square or tested by the F-ratio at the $p<.05$ or $p<.01$ level, it can be assumed that (1) the variables which separate the groups would happen by chance only five times out of one

hundred or would happen by chance only once out of a hundred and that (2) these variables can be used for predictive purposes. However, researchers should be aware of several cautions in interpreting these results. First, according to Huck,[49] it should be noted that the "percentage of incorrect classifications will not be equal to the level of significance associated with the results of the F-tests."

Another caution is stated by Travers:[50]

> It has often been considered that the discriminant function procedure represents a desirable model for educational classification. When this is suggested, it is often forgotten that the mere fact that it is possible to discriminate between two groups does not mean that the basis for discrimination is necessarily one that can be used for future classification.

Travers[51] pointed out that a common problem of multiple prediction is the "phenomenon of shrinkage." The results of any type of predictive study are subject to error and one can expect shrinkage of the differences when applied to another sample. Consequently, all predictive studies should have built into them a means of testing the predictive ability of the criterion battery, by a procedure identified by Lord and Novick[52] as "cross validation."

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[49] S. W. Huck. 1973. "A Note on the Correct Interpretation of Significant F in Discriminant Function Analysis." Science Education. 57. 4: pp. 413-415.

[50] R. M. W. Travers. 1969. An Introduction to Educational Research. New York, The Macmillan Company. p. 262.

[51] Ibid. pp. 257-264.

[52] F. M. Lord and M. R. Novick. 1968. Statistical Theories of Mental Test Scores. Reading, Massachusetts, Addison-Wesley Publishing Company. pp. 284-285.

The procedure of cross validation is explained by Travers[53] as follows:

> The usual way to do this is to divide the population to be studied into two groups. On the first group all measures are applied in order to identify those most likely to be effective in making the desired prediction. The most promising measures are then applied to the second group to find out how far they can be relied on to make the same prediction in a new population.

A cross validation in this study was performed by using the discriminant function prediction equation from one group to predict the achievement classification for each member of the other two groups (Groups I, II and III were still employed). The procedure was as follows: the predicted group achievement classification (i.e. whether "high," "expected," or "low" achievers) for Group I was determined by Groups II and III; for Group II it was determined by Groups I and III; and for Group III it was determined by Groups I and II.

From this procedure, two predicted scores were obtained for each individual. Comparisons of predicted scores were made with observed scores, and the percent of those "correct predictions" and the percent of "wrong predictions" were recorded. The purpose of this was to show the effectiveness of the prediction equation for one group to predict the achievement classification for the other two groups.

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[53] R. M. W. Travers. 1969. op. cit. p. 264.

Post Hoc Analyses

Once group differences were found and the groups centroids were plotted in the discriminant space, several questionnaires were analyzed to account for or explain some of these differences. The purpose of these questionnaires was to inventory the students' feelings and attitudes toward the individualized learning biology course and the teaching methodology. Explaining group differences between achievement levels is more meaningful when analyzed in conjunction with student responses regarding their feelings and attitudes toward the individualized learning biology program.

Last of all, a relationship was sought between achievement levels and the success of the students at the end of the year with regard to their individualized work in biology and school work in other classes which were either individualized or traditional. Data were analyzed in terms of predicted achievement levels in biology and success in school work in other courses.

Summarization of Statistical Procedures

A summarization of the statistical techniques and procedures employed is as follows:

Step 1. Calculate the multiple regression equation using as predictors the Nelson Biology pretest (Form E) and aptitude scores. These scores are used in conjunction with the Nelson Biology posttest (Form F) scores.

Step 2. Calculate the predicted achievement scores ($\hat{y}$) utilizing the data obtained from step 1 for the remaining individuals.

Step 3. Calculate the standard error of estimate (S.E.) for the predicted scores using the .001 level of confidence.

Step 4. Identify y observed and $\hat{y}$ ± the S.E. for $\hat{y}$.

If y observed is: (Post-Nelson Biology Test Score)

(1) Higher than $\hat{y}$ ± S.E. = "high" achiever

(2) Same as $\hat{y}$ ± S.E. = "expected" achiever

(3) Lower than $\hat{y}$ ± S.E. = "low" achiever

Step 5. Formation of Group I, Group II and Group III with each group containing a random sample of 1/3 of the "high," "expected," and "low" achievers.

Step 6. Selection of a battery of 5 variables from (1) the psychometric inventories and aptitude measures and (2) the biographical data.

Step 7. Run the discriminant analyses utilizing the battery of variables between the three achievement levels identified in step 4 for Group I, Group II and Group III.

Step 8. Comparisons were made of among weights for Group I, Group II and Group III. An analysis was also made across groups on variables that have a significant change in Rao's and the weights of the "high," "expected," and "low" achievers were compared with each other for Groups I, II and III.

Step 9. Cross validation was performed using the alternate two groups for each group under consideration (Groups II and III for predicting scores for Group I, Groups I and III for predicting for Group II, and Groups I and II for predicting for Group III.)

Step 10. An analysis of variance was performed between the achievement levels for Groups I, II and III on: (1) responses to student questionnaires and (2) data concerning the courses and the grades of the students.

TABLE 2

SUMMARY OF UNIVARIATE F-RATIOS BETWEEN HIGH, EXPECTED AND LOW ACHIEVERS OF PSYCHOMETRIC VARIABLES FOR GROUPS I, II AND III

Variable	Group I N = 102	Group II N = 102	Group III N = 102
WGCTA	5.92**	7.74**	9.27**
TOUS	7.20**	2.79	3.63*
SMAT Factors			
Factor 1	<1	1.47	<1
Factor 2	<1	3.12*	1.58
Factor 3	2.03	2.79	2.83
Factor 4	<1	<1	<1
Factor 5	<1	<1	2.15
Factor 6	<1	<1	<1
Factor 7	<1	1.57	<1
Factor 8	2.04	1.73	1.12
Factor 9	<1	6.27**	<1
Factor 10	<1	<1	<1
SAI	6.89**	1.30	3.58*
HSPQ			
Factor A	1.07	2.23	2.26
Factor B	1.98	<1	1.43
Factor C	<1	1.77	1.63
Factor D	1.28	<1	1.35
Factor E	<1	2.44	2.73
Factor F	<1	1.32	1.11
Factor G	<1	4.57*	<1
Factor H	3.45*	<1	<1
Factor I	1.32	2.09	<1
Factor J	1.17	1.21	<1
Factor O	1.26	<1	2.52
Factor Q_2	<1	1.52	3.81*
Factor Q_3	<1	2.72	1.43
Factor Q_4	1.37	2.24	<1
CAPE			
Verbal	4.95**	1.98	1.71
Quantitative	3.98*	1.99	3.45*
Reading	9.72*	2.47	5.27**
Math	6.83**	2.24	3.61*
English	5.64**	<1	2.30

*p<.05
**p<.01

TABLE 3

SUMMARY OF UNIVARIATE F-RATIOS BETWEEN HIGH, EXPECTED AND LOW ACHIEVERS ON BIOGRAPHICAL VARIABLES FOR GROUPS I, II AND III

Variable	Group I N = 102	Group II N = 102	Group III N = 102
Sex	1.07	2.41	<1
Age	2.84	2.30	1.20
Number of older siblings	3.88*	1.09	1.37
Number of younger siblings	<1	1.85	<1
Earth Science	<1	<1	<1
Father's education	5.19**	1.45	<1
Mother's education	1.06	<1	1.41
Number of books	2.23	<1	<1
Major	<1	1.79	<1
Level of education aspired	4.04*	3.52*	2.41*

*p<.05
**p<.01

Chapter IV

Results of the Investigation

The purpose of this chapter is to report the results of the study, and is divided into four sections. The first section reports the results of the discriminant analyses performed on the psychometric variables between achievement levels in Groups I, II and III. This section also reports the comparisons of the lambda weights of the classification coefficients among and across achievement levels and the results of the cross validation for Groups I, II and III.

The second section reports the results of the discriminant analyses performed on the biographical variables between achievement levels in Groups I, II and III. This section also reports the results of the comparisons of the lambda weights of the classification coefficients among and across achievement levels and the results of the cross validation for Groups I, II and III.

The third section of this chapter reports the results of the analyses performed between "high," "expected," and "low" achievers with regard to students' feelings and attitudes toward the course and instructor. The last section reports

the results of the analyses performed between "high," "expected," and "low" achievers with regard to the success of the students in their other courses.

Psychometric Variables

The question considered in this section can be stated in the following form as a null hypothesis:

> There are no differences in student characteristics between "high" achievers, "expected" achievers, and "low" achievers in an individualized learning high school biology program with regard to the following psychometric variables: (1) the ability to think critically, (2) understandings about science, (3) attitude toward science, (4) personality factors, (5) motivational factors, and (6) scholastic aptitude.

The testing of this hypothesis was performed by discriminant analyses between achievement levels for Groups I, II and III on a five-variable battery. Discriminant analyses were performed independently between "high," "expected," and "low" achievers for all three groups. In each case the Watson-Glaser Critical Thinking Appraisal was the first variable entered and the remaining variables were selected in a step-wise manner so that the next variable selected added the greatest accumulated increase to the distance statistic, known as Rao's V. This was continued until all variables were exhausted.

A significant discriminant function ($\lambda=.8232$, $p<.05$) was found between "high," "expected," and "low" achievers for Group I and all five variables contributed significantly in

producing this separation (Tables 4 and 5). The Watson-Glaser Critical Thinking Appraisal (WGCTA) produced the initial and greatest amount of separation between the achievement levels. For this variable, both the Wilks' lambda (λ) and Rao's V were significant at the .01 level.

The second variable selected in the discrimination between achievement levels for Group I was Factor H (Shy, Adventurous) of the High School Personality Questionnaire (HSPQ). Factor 9 (Sentiments toward School) of the School Motivation Analysis Test (SMAT) was the third variable selected. The last two variables selected were Factor G (Disregards Rules, Conscientious) and Factor Q_2 (Sociably Group-Dependent, Self-Sufficient) of the HSPQ inventory.

A significant discriminant function (λ=.6788, $p<.01$) was also found between achievement levels for Group II (Table 7). In this group the WGCTA, Factor 9 of the SMAT, and Factor G of the HSPQ were selected as the first three variables. All three of these variables had a significant Wilks' lambda and change in Rao's V (Table 6). Factors Q_2 and H of the HSPQ were the last two variables selected.

A significant discriminant function (λ=.7498, $p<.01$) was found between achievement levels for Group III (Table 9). In this group the WGCTA and Factor Q_2 of the HSPQ were the first two variables selected and both had a significant Wilks' lambda and change in Rao's V (Table 8). Factors G and H of the HSPQ were the next two variables selected. Last was Factor 9 of the SMAT inventory.

TABLE 4

SUMMARY TABLE OF PSYCHOMETRIC VARIABLES DISCRIMINATING BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS IN GROUP I

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Watson-Glaser Critical Thinking Appraisal	.8932**	11.8400**
2	HSPQ—Factor H	.8480**	5.3945
3	SMAT—Factor 9	.8330**	1.8558
4	HSPQ—Factor G	.8271*	.7843
5	HSPQ—Factor Q_2	.8232*	.4962

TABLE 5

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR GROUP I — PSYCHOMETRIC VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-Square	D. F.
0	.1419	.8232	19.07*	10
1	.0679	.9310	6.07	4

*p<.05
**p<.01

TABLE 6

SUMMARY TABLE OF PSYCHOMETRIC VARIABLES
DISCRIMINATING BETWEEN HIGH, EXPECTED, AND
LOW ACHIEVERS IN GROUP II

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Watson-Glaser Critical Thinking Appraisal	.8648**	15.4810**
2	SMAT—Factor 9	.7570**	15.5250**
3	HSPQ—Factor G	.7040**	7.8542*
4	HSPQ—Factor Q_2	.6863**	3.2790
5	HSPQ—Factor H	.6788**	1.3967

TABLE 7

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR
GROUP II — PSYCHOMETRIC VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-Square	D. F.
0	.3417	.6788	37.97**	10
1	.0981	.9107	9.16	4

*p<.05
**p<.01

TABLE 8

SUMMARY TABLE OF PSYCHOMETRIC VARIABLES DISCRIMINATING BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS IN GROUP III

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Watson-Glaser Critical Thinking Appraisal	.8423**	18.5415**
2	HSPQ—Factor Q_2	.7842**	7.3350*
3	HSPQ—Factor G	.7671**	2.4212
4	HSPQ—Factor H	.7562**	1.7065
5	SMAT—Factor 9	.7498**	.9213

TABLE 9

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR GROUP III — PSYCHOMETRIC VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-Square	D. F.
0	.2118	.7498	28.22**	10
1	.1006	.9086	9.39	4

*p<.05
**p<.01

The orthogonal discriminant function coefficients (used for predicting unclassified individuals) for the selected variables discriminating between achievement levels for Groups I, II and III are presented respectively in Tables 10, 12 and 14. The group centroids of the "high," "expected," and "low" achievers in the reduced discriminant space for all three groups are found respectively in Tables 11, 13 and 15 and are plotted respectively in Figures 1, 2 and 3.

These results do produce a replication of the findings in this investigation for in all three groups: (1) the WGCTA was the first variable selected, (2) in each case the WGCTA produced a significant change in Rao's V, (3) all five variables as a battery produced a significant discriminant function ($p<.05$), and (4) separation was produced between achievement levels for all groups.

Since the results of the discriminant analyses of Groups I, II and III produced a replication of the results, the discussion of differences between achievement levels when determined by these five variables was based on data when all three groups were combined together. It was felt that the discussion of the results would be more meaningful when the data across achievement levels were pooled. In addition, the results would be statistically more powerful and would reveal a relatively more accurate indication of student differences. Table 16 reports the means and standard deviations for the "high" achievers (N=80), "expected" achievers (N=132), and "low" achievers (N=94) on these five variables.

TABLE 10

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP I — PSYCHOMETRIC VARIABLES

Variable	Lambda Weights 1	2
Watson-Glaser Critical Thinking Appraisal	-.0947	.0716
SMAT—Factor 9	.0205	.1709
HSPQ—Factor G	-.0617	-.0696
HSPQ—Factor H	-.1348	-.2366
HSPQ—Factor Q_2	-.0065	-.0899

TABLE 11

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP I — PSYCHOMETRIC VARIABLES

Achievement Levels	Centroids	
High Achievers	.0740	.4120
Expected Achievers	-.3873	-.1192
Low Achievers	.4852	-.1898

TABLE 12

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP II — PSYCHOMETRIC VARIABLES

Variable	Lambda Weights 1	2
Watson-Glaser Critical Thinking Appraisal	-.0784	-.0011
SMAT—Factor 9	.1975	-.0840
HSPQ—Factor G	-.0796	-.2935
HSPQ—Factor H	-.0547	.0485
HSPQ—Factor Q_2	-.1168	-.0345

TABLE 13

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP II — PSYCHOMETRIC VARIABLES

Achievement Levels	Centroids	
High Achievers	-.2127	-.5014
Expected Achievers	-.4731	.2474
Low Achievers	.8568	.0855

TABLE 14

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP III — PSYCHOMETRIC VARIABLES

Variable	Lambda Weights 1	2
Watson-Glaser Critical Thinking Appraisal	-.1133	-.0081
SMAT—Factor 9	-.0108	-.0924
HSPQ—Factor G	.0634	.1587
HSPQ—Factor H	.0786	.0202
HSPQ—Factor Q_2	.0265	.2930

TABLE 15

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP III — PSYCHOMETRIC VARIABLES

Achievement Levels	Centroids	
High Achievers	-.2667	-.5016
Expected Achievers	-.3293	.2778
Low Achievers	.6695	.0155

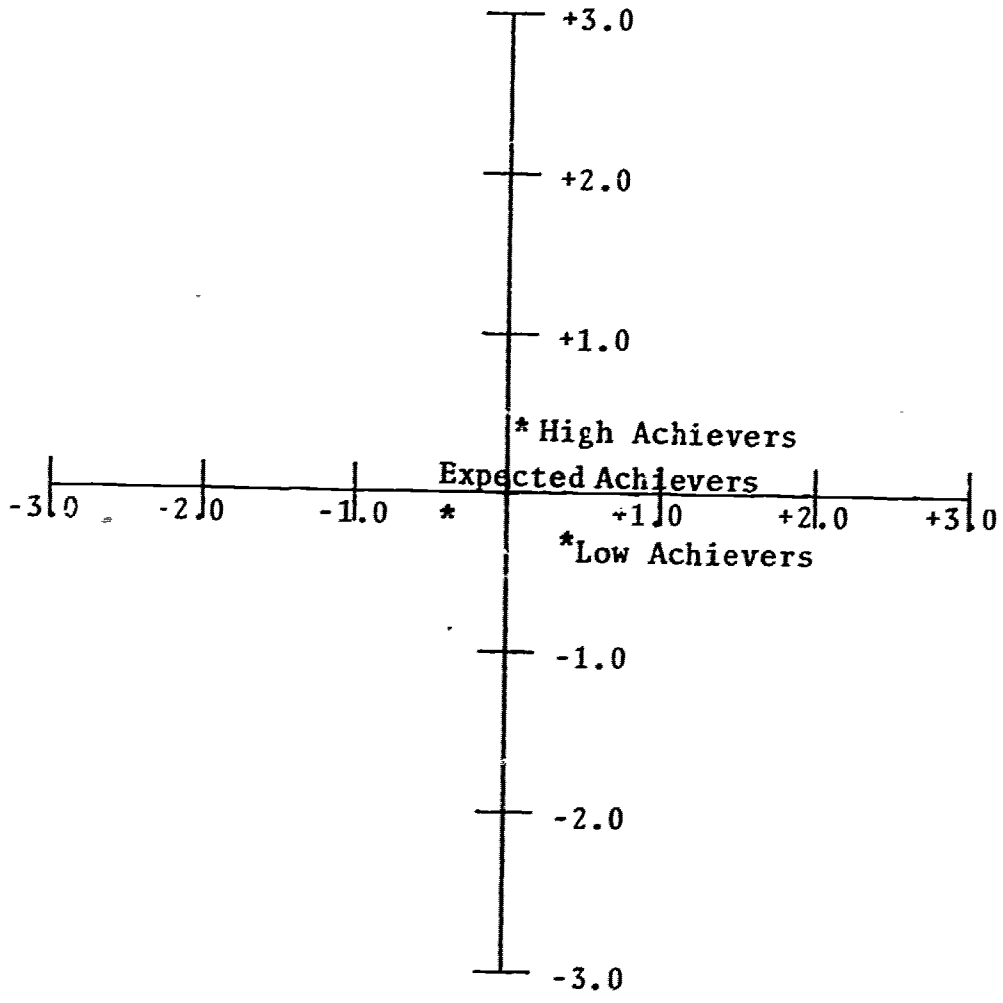

Figure 1

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP I — PSYCHOMETRIC VARIABLES

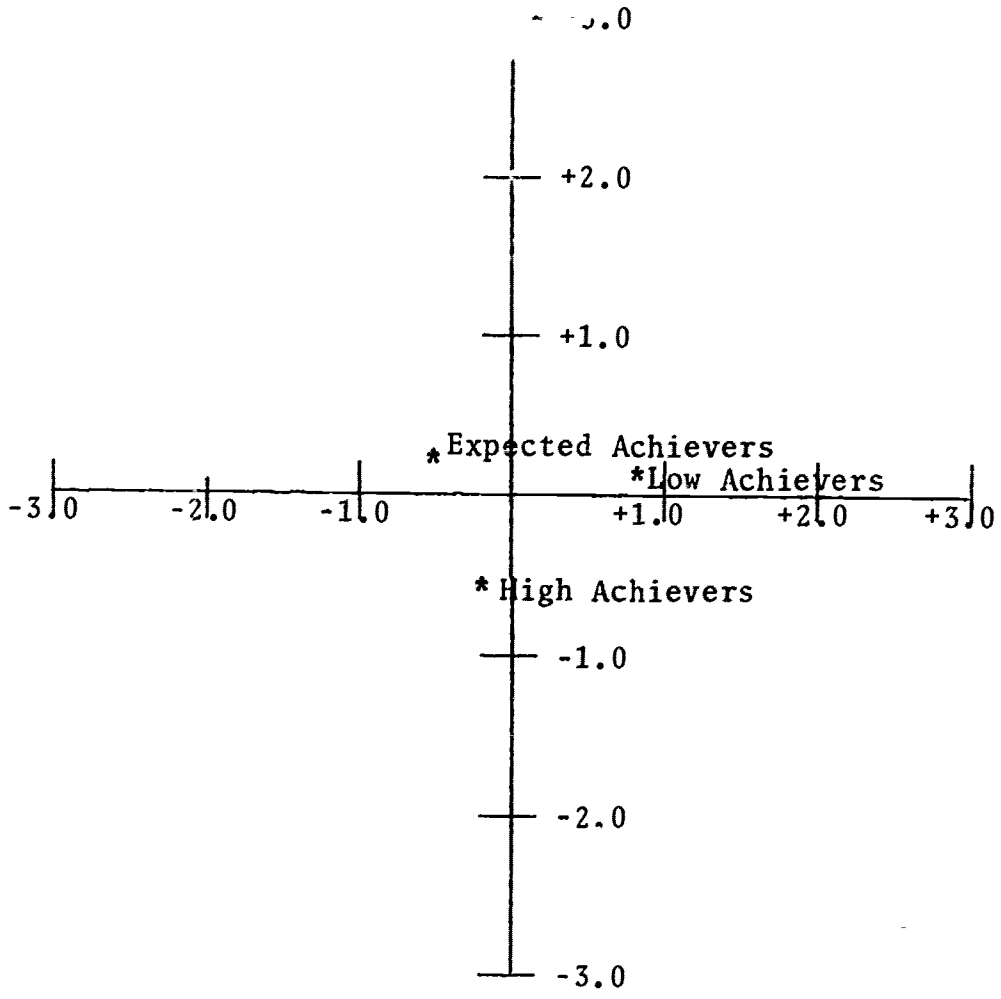

Figure 2

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP II — PSYCHOMETRIC VARIABLES

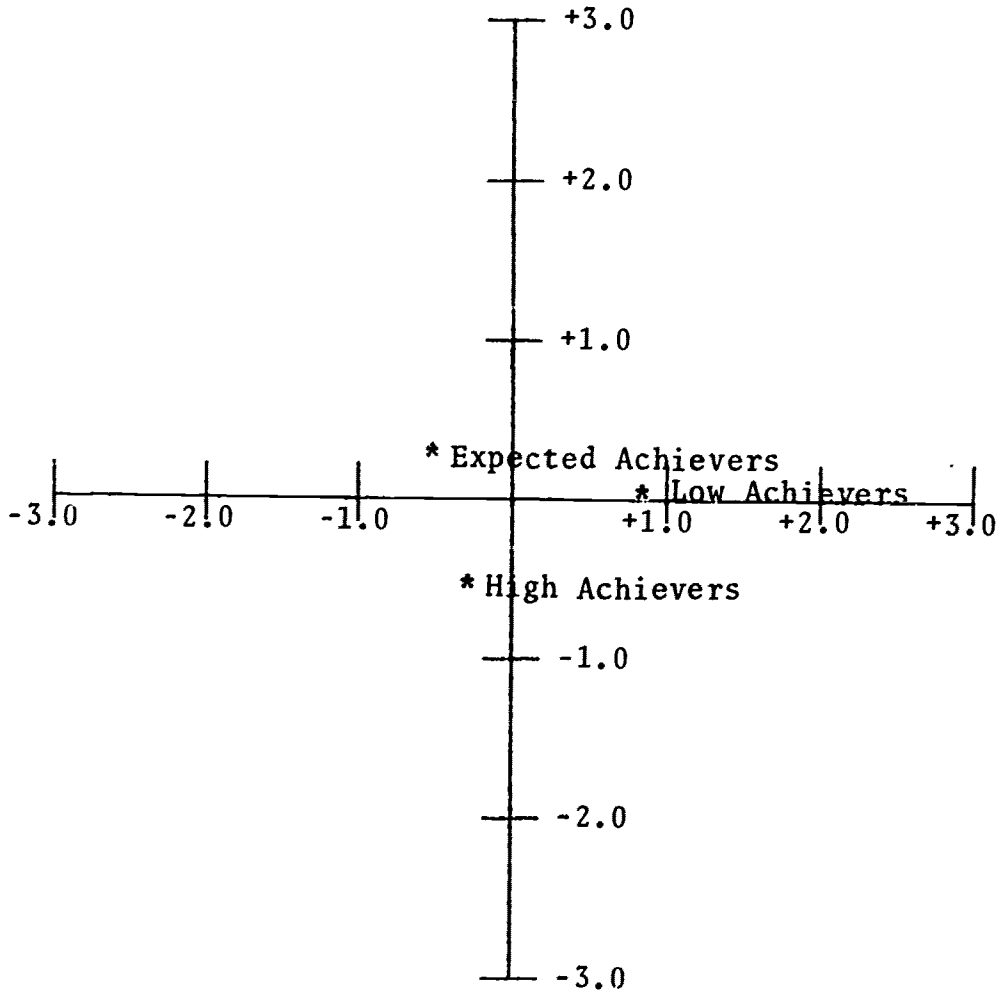

Figure 3

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP III — PSYCHOMETRIC VARIABLES

TABLE 16

MEANS AND STANDARD DEVIATIONS OF HIGH, EXPECTED, AND LOW ACHIEVERS ON THE PSYCHOMETRIC BATTERY OF VARIABLES

Variable	High Achievers N = 80		Expected Achievers N = 132		Low Achievers N = 94	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
WGCTA	59.54	7.19	60.58	9.60	53.04	7.99
SMAT 9	21.26	3.25	20.13	3.50	21.10	3.72
HSPQ G	10.91	3.19	10.73	3.25	10.29	3.23
HSPQ H	9.36	3.67	10.02	3.44	9.52	3.72
HSPQ Q_2	9.06	3.22	9.67	3.28	8.99	3.15

The results revealed that the "high" and "expected" achievers had a significantly higher score on the WGCTA than the "low" achievers. This can be interpreted to mean that the "high" and "expected" achievers have a greater ability to think and analyze situations critically. It was also found that the "high" achievers had the highest score on Factor 9 (Sentiments toward School) of the SMAT inventory. This represents a measure of the students' interests in school activities, particularly emphasizing scholastic and classroom interests. Group means on this variable were very close to one another, with "low" and "expected" achievers following in that order.

Differences on personality Factors G, H, and Q_2 of the HSPQ inventory again favored the "high" achievers, or both the "high" and "expected" achievers. Factor G ranges from a low score representing a disregard of rules (weaker superego strength) to a high score representing conscientious and persistent (stronger superego strength) feelings. On this Factor the "high" achievers had a more positive score representing a more conscientious attitude while the "low" achievers had the lowest score demonstrating more of a "I could care less" attitude.

The "high" achievers had the lowest mean score on Factor H (Shy, Adventurous) representing a tendency to be more timid while the "expected" and "low" achievers were more sociably bold. On personality Factor Q_2 (Sociably Group-Dependent, Self-Sufficient), the "expected" and "high" achievers had

higher mean scores indicating that they were more resourceful and preferred to make their own decisions, while the "low" achievers had the lowest mean score indicating that they were less resourceful and were more of a joiner and a sound follower. It must be pointed out that mean scores on some of these variables are very close to one another, but when taken as a battery, all the variables together produced a significant discrimination between the "high," "expected," and "low" achievers in Groups I, II and III with a minimum amount of overlap.

In determining the efficacy of the discrimination between achievement levels, an analysis of variance was made on the classification function coefficients (coefficients used in the placement of individuals into their respective achievement levels) both among and across achievement levels independently for Groups I, II and III on those variables that had both a significant Wilks' lambda and change in Rao's V (Tables 17, 18 and 19). Since only the WGCTA inventory met both criteria, an analysis of variance was performed among achievement levels on the lambda weights independently for Groups I, II and III (Tables 20, 21 and 22). The results in each case revealed a significant F-Ratio indicating that the lambda weights of the WGCTA produce a significant discrimination between "high," "expected," and "low" achievers.

An analysis of variance was then performed across achievement levels on the classification function coefficients for the WGCTA independently for the "high" achievers, "expected"

TABLE 17

CLASSIFICATION FUNCTION COEFFICIENTS FOR THE WATSON-GLASER CRITICAL THINKING APPRAISAL IN GROUP I

Achievement Level	Lambda Weights	(constant)
High Achievers	.9188	-27.1048
Expected Achievers	.9425	-28.5219
Low Achievers	.8435	-22.8412

TABLE 18

CLASSIFICATION FUNCTION COEFFICIENTS FOR THE WATSON-GLASER CRITICAL THINKING APPRAISAL IN GROUP II

Achievement Level	Lambda Weights	(constant)
High Achievers	.7711	-23.0890
Expected Achievers	.7743	-23.2802
Low Achievers	.6770	-17.7977

TABLE 19

CLASSIFICATION FUNCTION COEFFICIENTS FOR THE WATSON-GLASER CRITICAL THINKING APPRAISAL IN GROUP III

Achievement Level	Lambda Weights	(constant)
High Achievers	.7416	-22.1486
Expected Achievers	.7852	-23.1515
Low Achievers	.6507	-17.0496

TABLE 20

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP I

Source	df	SS	MS	F-Ratio
Between Groups	2	760.29	380.15	5.92**
Within Groups	99	6357.17	64.21	
Total	101	7117.46		

TABLE 21

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP II

Source	df	SS	MS	F-Ratio
Between Groups	2	1202.42	601.21	7.74**
Within Groups	99	7689.40	77.67	
Total	101	8891.82		

TABLE 22

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP III

Source	df	SS	MS	F-Ratio
Between Groups	2	1493.36	746.68	9.27**
Within Groups	99	7973.63	80.54	
Total	101	9466.99		

**p<.01

achievers, and "low" achievers for Groups I, II and III. Results revealed no significant differences across achievement levels for Groups I, II and III (Tables 23, 24 and 25). The overall results demonstrate that the lambda weights of the classification function coefficients of the WGCTA significantly discriminate among achievement levels but not across achievement levels for Groups I, II and III.

In determining the efficacy of the discriminant function equations for Groups I, II and III, a cross validation was performed using the discriminant function prediction equation (orthogonal discriminant function coefficients) from one group to predict the achievement classification level for each member of the other two groups under consideration (Tables 26, 27 and 28). The results revealed that a considerable amount of shrinkage did take place, because the percentage of correct predictions ranged from 41% correct when Group I was predicted by Group II to 50% correct when Group III was predicted by Group I. It was also found that the highest percentage of correct predictions were for the "expected" achievers for it ranged from 57% to 75% correct. The lowest number of correct predictions were for the "high" achievers as predictions ran from 15% to 23% correct. Correct predictions for "low" achievers ranged from 39% to 52% correct. These results indicate that significant discrimination can be obtained in separating "high," "expected," and "low" achievers but that some caution should be exercised when using these orthogonal discriminant function coefficients for predictive purposes.

TABLE 23

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA ACROSS HIGH ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	12.11	6.05	<1
Within Groups	77	4073.78	52.91	
Total	79	4085.89		

TABLE 24

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA ACROSS EXPECTED ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	19.29	9.64	<1
Within Groups	129	12072.95	93.59	
Total	131	12092.24		

TABLE 25

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE CLASSIFICATION FUNCTION COEFFICIENTS OF THE WGCTA ACROSS LOW ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	58.37	29.18	<1
Within Groups	91	5873.46	64.54	
Total	93	5931.83		

TABLE 26

CROSS VALIDATION FOR GROUP I WHEN PREDICTED BY GROUP II AND GROUP III — PSYCHOMETRIC VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group II	Percent of Correct Predictions	Number Predicted Incorrectly by Group II	Percent of Incorrect Predictions
High Achievers	27	5	19	22	81
Expected Achievers	44	25	57	19	43
Low Achievers	31	12	39	19	61
Total Number	102	42	41	60	59

Achievement Level	Number of Individuals	Number Predicted Correctly by Group III	Percent of Correct Predictions	Number Predicted Incorrectly by Group III	Percent of Incorrect Predictions
High Achievers	27	5	19	22	81
Expected Achievers	44	25	57	19	43
Low Achievers	31	13	42	18	58
Total Number	102	43	42	59	58

TABLE 27

CROSS VALIDATION FOR GROUP II WHEN PREDICTED BY GROUP I AND GROUP III — PSYCHOMETRIC VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group I	Percent of Correct Predictions	Number Predicted Incorrectly by Group I	Percent of Incorrect Predictions
High Achievers	27	5	19	22	81
Expected Achievers	44	27	61	17	39
Low Achievers	31	16	52	15	48
Total Number	102	48	47	54	53

Achievement Level	Number of Individuals	Number Predicted Correctly by Group III	Percent of Correct Predictions	Number Predicted Incorrectly by Group III	Percent of Incorrect Predictions
High Achievers	27	4	15	23	85
Expected Achievers	44	28	64	16	36
Low Achievers	31	16	52	15	48
Total Number	102	48	47	54	53

TABLE 28

CROSS VALIDATION FOR GROUP III WHEN PREDICTED BY GROUP I AND GROUP II — PSYCHOMETRIC VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group I	Percent of Correct Predictions	Number Predicted Incorrectly by Group I	Percent of Incorrect Predictions
High Achievers	26	5	19	21	81
Expected Achievers	44	33	75	11	25
Low Achievers	32	13	41	19	59
Total Number	102	51	50	51	50

Achievement Level	Number of Individuals	Number Predicted Correctly by Group II	Percent of Correct Predictions	Number Predicted Incorrectly by Group II	Percent of Incorrect Predictions
High Achievers	26	6	23	20	77
Expected Achievers	44	25	57	19	43
Low Achievers	32	13	41	19	59
Total Number	102	44	43	58	57

On the basis of these findings, it is possible to reject the null hypothesis and to conclude that significant differences do exist between "high," "expected," and "low" achievers in an individualized high school biology program with regard to psychometric variables. An analysis of variance performed between the achievement levels in Groups I, II and II (Table 2) revealed significant F-ratios between the achievement levels in at least one of the respective groups on the following variables: (1) Watson-Glaser Critical Thinking Appraisal, (2) Test on Understanding Science, (3) Scientific Attitude Inventory, (4) Motivational Factors 2 (Mating) and 9 (Sentiment toward School) inventoried by the School Motivation Analysis Test, (5) Personality Factors G (Disregards Rules, Conscientious), H (Shy, Adventurous), and Q_2 (Sociably Group-Dependent, Self-Sufficient) when inventoried by the High School Personality Questionnaire, and (6) Scholastic Aptitude in Verbal, Quantitative, Reading, Math and English when measured by the Classification and Placement Examination.

A battery of five variables, selected from the above 13 variables based on intercorrelations, revealed a significant discrimination between "high," "expected," and "low" achievers on the following variables: (1) the ability to think critically, (2) Sentiments toward School, (3) Shy vs. Adventurous, (4) Disregards Rules vs. Conscientious, and (5) Sociable Group-Dependent vs. Self-Sufficient. Significant differences were found on 13 variables with these five selected variables pro-

ducing the maximum amount of separation between achievement levels in Groups I, II and III with the least amount of overlap

Biographical Variables

This section considers the following null hypothesis:

> There are no differences in student characteristics between "high" achievers, "expected" achievers, and "low" achievers in an individualized learning high school biology program with regard to the following biographical variables: (1) sex, (2) age, (3) number of older siblings, (4) number of younger siblings, and (5) level of education aspired.

The testing of this hypothesis was performed by discriminant analyses between achievement levels for Groups I, II and III on a battery of five selected biographical variables. Discriminant analyses were performed independently between "high" "expected," and "low" achievers for all three groups. In each case the level of education aspired by each student was the first variable selected and the remaining variables were entered in a step-wise manner, so the next variable selected added the greatest accumulated increase to the distance statistic, known as Rao's V.

A significant discriminant function (λ=.7844, $p<.01$) was found between "high," "expected," and "low" achievers for Group I and all five variables contributed significantly in producing this separation (Tables 29 and 30). In this group the level of education produced the initial and greatest

TABLE 29

SUMMARY TABLE OF BIOGRAPHICAL VARIABLES DISCRIMINATING BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS IN GROUP I

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Level of Education	.9246*	8.0742*
2	Age	.8777*	5.4155
3	Number of Older Siblings	.8346**	5.6441
4	Sex	.8119**	2.9611
5	Number of Younger Siblings	.7844**	3.9906

TABLE 30

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR GROUP I — BIOGRAPHICAL VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-square	D.F.
0	.2088	.7844	23.80*	10
1	.0547	.9482	5.21	4

*p<.05
**p<.01

amount of separation between achievement levels. For this variable, both the Wilks' lambda (λ) and Rao's V were significant at the .05 level. The remaining four variables in the order in which they were selected were: (1) age, (2) number of older siblings, (3) sex, and (4) number of younger siblings. All of these variables had a significant Wilks' lambda but did not have a significant change in Rao's V.

A significant discriminant function (λ=.7993, $p<.05$) was also found between achievement levels for Group II (Table 32). In this group the level of education aspired and age were the first two variables selected, both of which had a significant Wilks' lambda and change in Rao's V. The remaining variables selected were sex, number of younger siblings, and number of older siblings (Table 31).

No significant differences were found between achievement levels for Group III (Table 34). The level of education was once again selected as the first variable, but neither this variable nor any of the others produced a significant Wilks' lambda (Table 33).

The orthogonal discriminant function coefficients (used for predicting unclassified individuals) for the biographical variables in Groups I, II and III are presented respectively in Tables 35, 37 and 39. The group centroids of the "high," "expected," and "low" achievers in the reduced discriminant space for all three groups are found respectively in Tables 36, 38 and 40 and are plotted respectively in Figures 4, 5 and 6.

TABLE 31

SUMMARY TABLE OF BIOGRAPHICAL VARIABLES DISCRIMINATING BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS IN GROUP II

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Level of Education	.9337*	7.0304*
2	Age	.8781*	6.5581*
3	Sex	.8412**	4.4392
4	Number of Younger Siblings	.8128*	3.8319
5	Number of Older Siblings	.7993*	1.8113

TABLE 32

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR GROUP II — BIOGRAPHICAL VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-square	D.F.
0	.1673	.7993	21.95*	10
1	.0718	.9330	6.79	4

*p<.05
**p<.01

TABLE 33

SUMMARY TABLE OF BIOGRAPHICAL VARIABLES DISCRIMINATING BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS IN GROUP III

Step	Variable Entered	Wilks' Lambda	Change in Rao's V
1	Level of Education	.9535	4.8268
2	Number of Older Siblings	.9280	2.7948
3	Age	.9120	1.8414
4	Number of Younger Siblings	.8990	1.5328
5	Sex	.8822	2.0571

TABLE 34

SUMMARY TABLE OF DISCRIMINANT FUNCTIONS FOR GROUP III — BIOGRAPHICAL VARIABLES

Number Removed	Eigenvalue	Wilks' Lambda	Chi-square	D.F.
0	.1176	.8822	12.28	10
1	.0142	.9860	1.38	4

TABLE 35

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP I — BIOGRAPHICAL VARIABLES

Variable	Lambda Weights 1	2
Level of Education	.5928	-.4775
Age	-.6495	-.9066
Sex	.6983	-1.1068
Number of Younger Siblings	-.3899	.2683
Number of Older Siblings	-.5348	-.1595

TABLE 36

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP I — BIOGRAPHICAL VARIABLES

Achievement Levels	Centroids	
High Achievers	.3614	-.3364
Expected Achievers	.2561	.2297
Low Achievers	-.6783	-.0330

TABLE 37

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP II — BIOGRAPHICAL VARIABLES

Variable	Lambda Weights 1	2
Level of Education	.8549	.0945
Age	.9680	.6905
Sex	-.6008	1.4125
Number of Younger Siblings	-.3476	.2233
Number of Older Siblings	-.1845	-.3774

TABLE 38

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP II — BIOGRAPHICAL VARIABLES

Achievement Levels	Centroids	
High Achievers	.4843	.3049
Expected Achievers	.0990	-.2961
Low Achievers	-.5622	.1547

TABLE 39

ORTHOGONAL DISCRIMINANT FUNCTION COEFFICIENTS FOR GROUP III — BIOGRAPHICAL VARIABLES

Variable	Lambda Weights 1	2
Level of Education	1.0215	-.2369
Age	-.6251	.3967
Sex	-.8794	.3665
Number of Younger Siblings	.4506	-.3781
Number of Older Siblings	-.0474	-1.0484

TABLE 40

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS IN THE REDUCED DISCRIMINANT SPACE FOR GROUP III — BIOGRAPHICAL VARIABLES

Achievement Levels	Centroids	
High Achievers	.0909	.1985
Expected Achievers	.2986	-.0862
Low Achievers	-.4843	-.0428

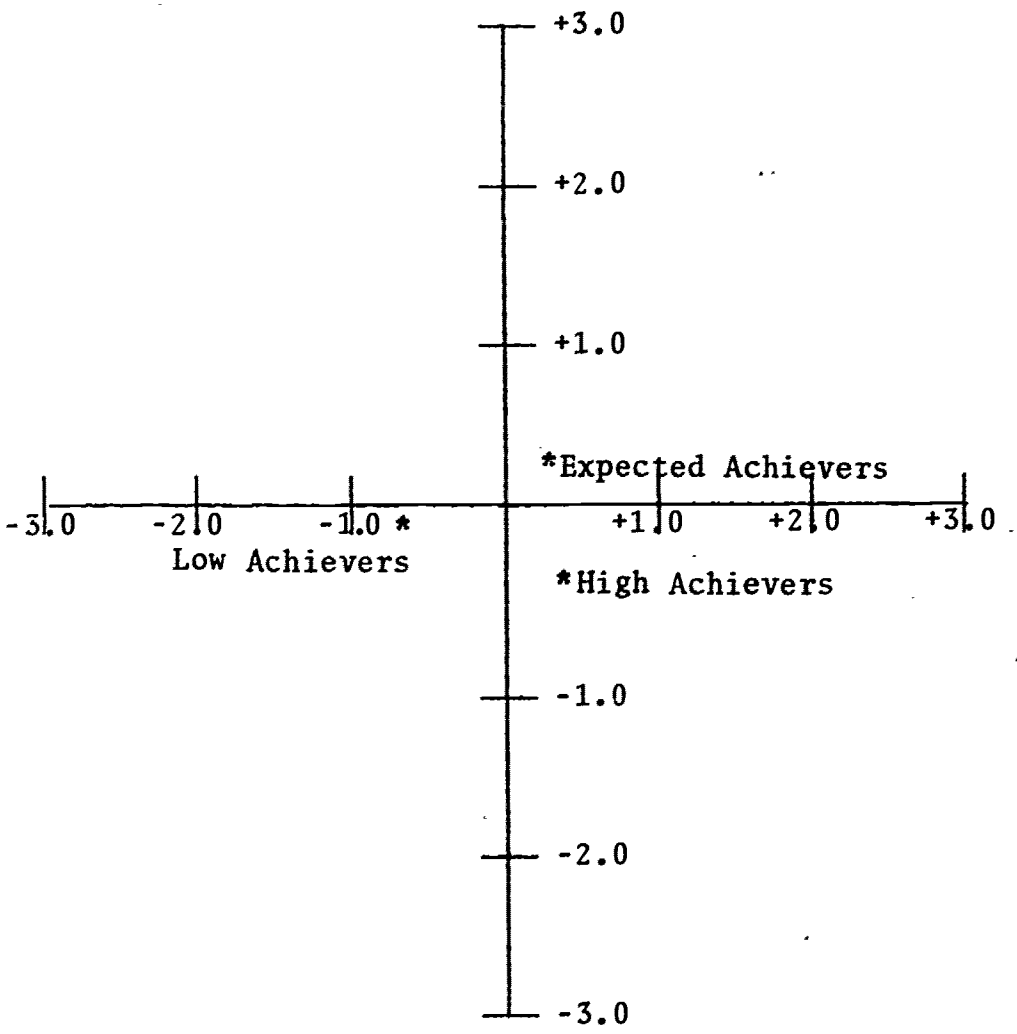

Figure 4

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP I — BIOGRAPHICAL VARIABLES

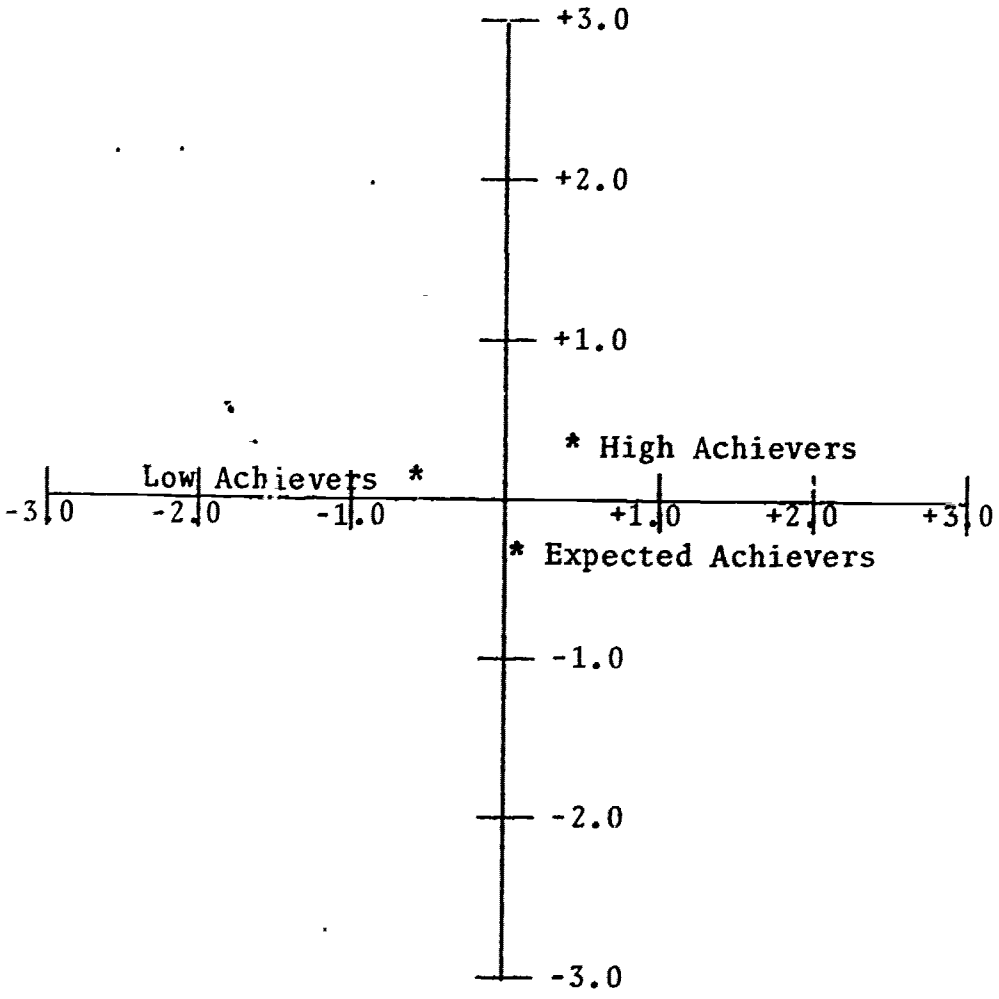

Figure 5

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP II — BIOGRAPHICAL VARIABLES

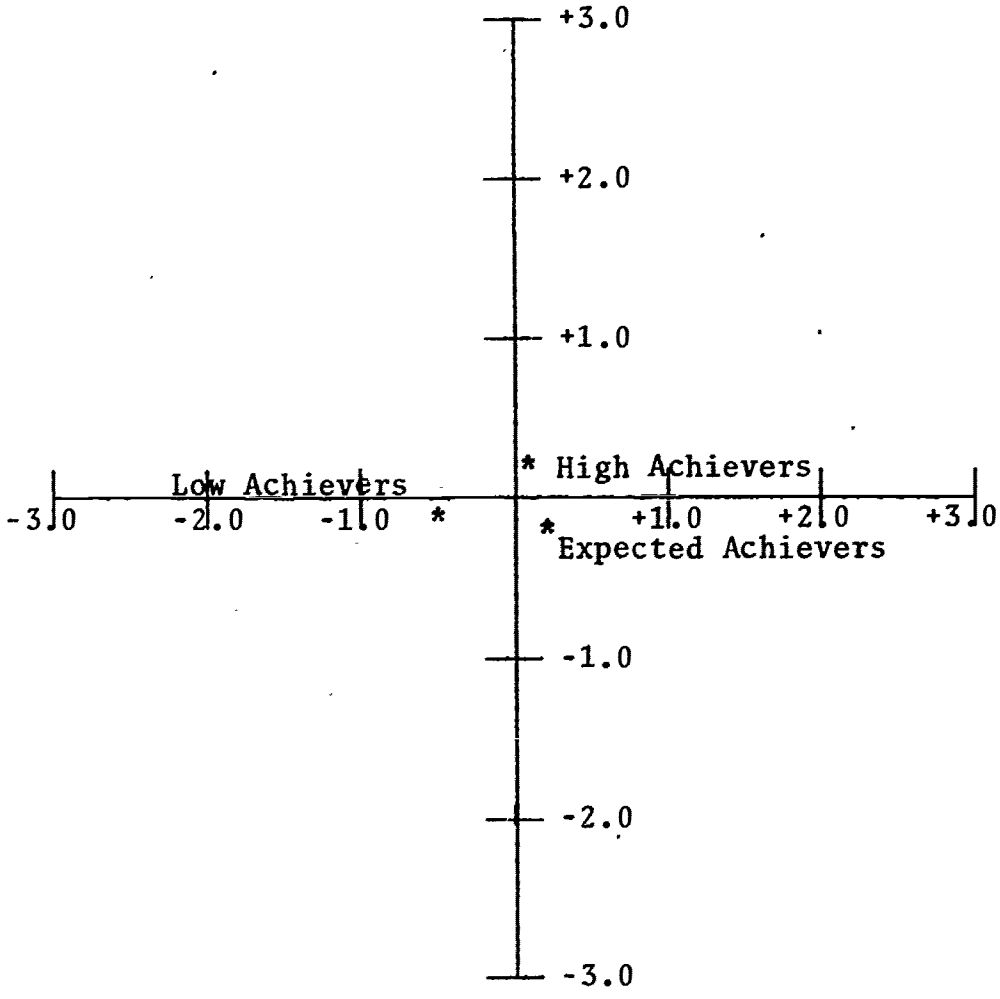

Figure 6

CENTROIDS OF HIGH, EXPECTED, AND LOW ACHIEVERS PLOTTED IN THE REDUCED DISCRIMINANT SPACE FOR GROUP III — BIOGRAPHICAL VARIABLES

The results of the discriminant analyses performed between achievement levels on the biographical variables for Groups I, II and III produced significant results in only two of the three groups. It was found that the results of the analyses performed between achievement levels on the biographical variables were not as powerful as those produced by the psychometric variables. Since two of the three analyses produced significant results, it was decided that the discussion of the results would again be analyzed when data were pooled across achievement levels for all three groups. It was felt that such results would reveal a more accurate picture of differences between achievement levels on the biographical variables.

Even though no significant differences were found between achievement levels in Group III, it was felt that real differences between achievement levels for all students could be more accurately analyzed when the results of the total number of students were examined. If the results of only the first two groups were examined, this would constitute a biased sample, whereas the true measure of differences between achievement levels is obtained when the results of all the students in each of the achievement levels are examined (Table 41).

The results revealed significant differences (univariate F-ratios) between achievement levels on three of the five selected variables. It was found that the "expected" achievers were younger than either the "high" or "low" achievers. The only reasonable explanation for this finding is that the

TABLE 41

MEANS, STANDARD DEVIATIONS, AND UNIVARIATE F-RATIOS OF HIGH, EXPECTED, AND LOW ACHIEVERS ON THE BIOGRAPHICAL VARIABLES

Variable	High Achievers N = 80 $\bar{X}$	S.D.	Expected Achievers N = 132 $\bar{X}$	S.D.	Low Achievers N = 94 $\bar{X}$	S.D.	N = 306 F-Ratio
Sex	1.53[1]	.50	1.41	.49	1.52	.50	1.96
Age	15.63	.68	15.41	.71	15.62	.66	3.57*
Number of Older Siblings	.94	1.01	1.09	1.15	1.44	1.31	4.32*
Number of Younger Siblings	1.13	1.28	1.33	1.25	1.40	1.30	<1
Level of Education	4.05[2]	.67	3.96	.81	3.57	.87	9.37**

[1]Sex (Male = 1, Female = 2)

[2]Based on a scale of 1 to 5

1 = Less than a high school diploma
2 = High school diploma
3 = At least some college
4 = A college degree
5 = Beyond college

*p<.05
**p<.01

accelerated freshmen who take sophomore biology (they skipped freshman earth science) tend to be "expected" achievers, thus slightly dropping the average age of the "expected" achievers.

Of more importance were the significant differences found between achievement levels on the number of older siblings and level of education aspired by the students. It was found that the "high" and "expected" achievers had fewer older siblings (.94 and 1.09 respectively) than did the "low" achievers who had 1.44 older siblings. It was also revealed that the "high" and "expected" achievers planned to obtain a college degree while the "low" achievers planned to obtain at least some college education.

In determining the efficacy of the discrimination between achievement levels, an analysis of variance was performed on the classification function coefficients (used in the placement of individuals into their respective achievement levels) both among and across achievement levels independently for Groups I, II and III. The variable selected was level of education for this was the only biographical variable that produced any significance in the discriminant function analyses (Tables 42, 43 and 44).

The results of the analysis of variance performed among achievement levels for Groups I, II and III produced a significant F-ratio among lambda weights for the first two groups (Tables 45 and 46). No significant differences were found among achievement levels for Group III (Table 47).

TABLE 42

CLASSIFICATION FUNCTION COEFFICIENTS FOR LEVEL OF EDUCATION ASPIRED — GROUP I

Achievement Level	Lambda Weights	(constant)
High Achievers	5.3293	-11.0533
Expected Achievers	5.0806	-10.0457
Low Achievers	4.5173	- 7.9417

TABLE 43

CLASSIFICATION FUNCTION COEFFICIENTS FOR LEVEL OF EDUCATION ASPIRED — GROUP II

Achievement Level	Lambda Weights	(constant)
High Achievers	6.6710	-13.7126
Expected Achievers	6.3801	-12.5426
Low Achievers	5.8102	-10.4022

TABLE 44

CLASSIFICATION FUNCTION COEFFICIENTS FOR LEVEL OF EDUCATION ASPIRED — GROUP III

Achievement Level	Lambda Weights	(constant)
High Achievers	7.1016	-13.7934
Expected Achievers	7.3125	-14.6250
Low Achievers	6.6270	-12.0114

TABLE 45

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP I

Source	df	SS	MS	F-Ratio
Between Groups	2	6.28	3.14	4.04*
Within Groups	99	77.06	.78	
Total	101	83.34		

TABLE 46

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP II

Source	df	SS	MS	F-Ratio
Between Groups	2	4.33	2.17	3.52*
Within Groups	99	61.01	.62	
Total	101	65.34		

TABLE 47

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS AMONG HIGH, EXPECTED, AND LOW ACHIEVERS FOR GROUP III

Source	df	SS	MS	F-Ratio
Between Groups	2	2.64	1.32	2.4i
Within Groups	99	54.15	.54	
Total	101	56.79		

*p<.05

An analysis of variance was then performed across achievement levels on the classification function coefficients for the level of education aspired independently for the "high" achievers, "expected" achievers, and "low" achievers for Groups I, II and III. Results revealed no significant differences across achievement levels for Groups I, II and III (Tables 48, 49 and 50). The overall results demonstrate that the lambda weights of the clas. fication function coefficients of the level of education do discriminate among achievement levels but not across achievement levels for Groups I, II and III.

In determining the efficacy of the discriminant function equations for Groups I, II and III, a cross validation was performed using the discriminant function prediction equation (orthogonal discriminant function coefficients) from one group to predict the achievement classification level for each member of the other two groups under consideration (Tables 51, 52 and 53).

The results revealed that a considerable amount of shrinkage took place for the percentage of correct predictions ranged from 40% correct when Group I was predicted by Group II to 48% correct when Group III was predicted by Group I. Once again the highest percentage of correct predictions were for the "expected" achievers for correct percentages ranged from 52% to 80% correct. The lowest number of correct predictions were for the "high" achievers as predictions ranged from 4% to 37% correct. Correct predictions for the "low" achievers ran from 26% to 48% correct.

TABLE 48

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS ACROSS HIGH ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	.19	.09	<1
Within Groups	91	70.79	.78	
Total	93	70.98		

TABLE 49

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS ACROSS EXPECTED ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	.11	.05	<1
Within Groups	129	86.70	.67	
Total	131	86.81		

TABLE 50

SUMMARY TABLE OF THE ANALYSIS OF VARIANCE ON THE ASPIRED LEVEL OF EDUCATION CLASSIFICATION FUNCTION COEFFICIENTS ACROSS LOW ACHIEVERS FOR GROUPS I, II AND III

Source	df	SS	MS	F-Ratio
Between Groups	2	1.07	.54	1.19
Within Groups	77	34.73	.45	
Total	79	35.80		

TABLE 51

CROSS VALIDATION FOR GROUP I WHEN PREDICTED BY GROUP II AND GROUP III — BIOGRAPHICAL VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group II	Percent of Correct Predictions	Number Predicted Incorrectly by Group II	Percent of Incorrect Predictions
High Achievers	27	10	37	17	63
Expected Achievers	44	23	52	21	48
Low Achievers	31	8	26	23	74
Total Number	102	41	40	61	60

Achievement Level	Number of Individuals	Number Predicted Correctly by Group III	Percent of Correct Predictions	Number Predicted Incorrectly by Group III	Percent of Incorrect Predictions
High Achievers	27	1	4	26	96
Expected Achievers	44	31	70	13	30
Low Achievers	31	15	48	16	52
Total Number	102	47	46	55	54

TABLE 52

CROSS VALIDATION FOR GROUP II WHEN PREDICTED BY GROUP I AND GROUP III — BIOGRAPHICAL VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group I	Percent of Correct Predictions	Number Predicted Incorrectly by Group I	Percent of Incorrect Predictions
High Achievers	27	7	26	20	74
Expected Achievers	44	28	64	16	36
Low Achievers	31	9	29	22	71
Total Number	102	44	43	58	57

Achievement Level	Number of Individuals	Number Predicted Correctly by Group III	Percent of Correct Predictions	Number Predicted Incorrectly by Group III	Percent of Incorrect Predictions
High Achievers	27	1	4	26	96
Expected Achievers	44	33	75	11	25
Low Achievers	31	14	45	17	55
Total Number	102	48	47	54	53

TABLE 53

CROSS VALIDATION FOR GROUP III WHEN PREDICTED BY GROUP I AND GROUP II — BIOGRAPHICAL VARIABLES

Achievement Level	Number of Individuals	Number Predicted Correctly by Group I	Percent of Correct Predictions	Number Predicted Incorrectly by Group I	Percent of Incorrect Predictions
High Achievers	26	3	12	23	88
Expected Achievers	44	35	80	9	20
Low Achievers	32	11	35	21	65
Total Number	102	49	48	53	52

Achievement Level	Number of Individuals	Number Predicted Correctly by Group II	Percent of Correct Predictions	Number Predicted Incorrectly by Group II	Percent of Incorrect Predictions
High Achievers	26	3	12	23	88
Expected Achievers	44	30	68	14	32
Low Achievers	32	10	31	22	69
Total Number	102	43	42	59	58

The results of the findings concerning the biographical variables indicate that discrimination can be obtained, but that caution should be exercised when employing these orthogonal discriminant function coefficients for predictive purposes, particularly for the "high" achievers.

On the basis of these findings, it is possible to reject the null hypothesis and to conclude that significant differences do exist between "high," "expected," and "low" achievers in an individualized high school biology program with regard to biographical variables. Differences between achievement levels regarding biographical variables can best be summarized by analyzing the results found in Table 41. The results reveal that differences do exist between achievement levels with regard to: (1) age, (2) number of older siblings, and (3) level of education aspired by the students.

Student's Attitudes toward Course and Instructor

Two major null hypotheses are considered in this section:

(1) There are no differences between "high," "expected," and "low" achievers in an individualized learning high school biology program with regard to the student's feelings and attitudes toward the course and instructor when inventoried by ENDEAVOR VIII.

(2) There are no differences between "high," "expected," and "low" achievers in an individualized learning high school biology program with regard to the student's feelings and attitudes toward the individualized biology program when inventoried by an author-constructed questionnaire.

An analysis of variance was performed between the total number of "high" (N=80), "expected" (N=132), and "low" (N=94) achievers on both the ENDEAVOR VIII inventory (Appendix B) and the author-constructed questionnaire (Appendix C). Differences were sought between achievement levels in an attempt to assess, verify, and/or explain differences revealed by the discriminant analyses performed between achievement levels.

The total number of students comprising each achievement level were utilized in both this section and the section following for several reasons. First, it was felt that since the results of the discriminant analyses performed between achievement levels did show consistency, total numbers of "high," "expected," and "low" achievers could be utilized without losing statistical information. Secondly, it was felt that this information would be more meaningful when the various achievement levels across groups were pooled. Lastly, the results would be statistically more powerful and would reveal a relatively more accurate indication of student differences.

ENDEAVOR VIII

An analysis of variance between "high," "expected," and "low" achievers revealed significant univariate F-ratios in four of the six categories inventoried by the ENDEAVOR VIII questionnaire (Table 54). The means and standard deviations of these six factors on the ENDEAVOR VIII are found in Table 55.

The results are as follows:

TABLE 54

SUMMARY TABLE OF THE UNIVARIATE F-RATIOS BETWEEN HIGH (N = 80), EXPECTED (N = 132), AND LOW (N = 94) ACHIEVERS ON ENDEAVOR VIII

ENDEAVOR Factors	F-Ratio
(1) Teacher's Presentation	3.94*
(2) Course Workload	4.69**
(3) Student Accomplishment	15.63**
(4) Course Organization	1.75
(5) Fairness of Grading	4.62*
(6) Teacher Accessibility	<1

*p<.05
**p<.01

TABLE 55

MEANS AND STANDARD DEVIATIONS FOR HIGH, EXPECTED, AND LOW ACHIEVERS ON ENDEAVOR VIII FACTORS

ENDEAVOR Factors	High Achievers N = 80 $\bar{X}$	S.D.	Expected Achievers N = 132 $\bar{X}$	S.D.	Low Achievers N = 94 $\bar{X}$	S.D.
Teacher's Presentation	14.64[1]	2.83	14.04	2.58	13.45	3.05
Course Workload	13.43	3.14	13.65	2.96	14.77	3.58
Student Accomplishment	14.38	2.41	14.14	2.44	12.48	2.66
Course Organization	14.30	2.48	13.58	2.67	13.79	2.96
Fairness of Grading	14.53	2.90	14.23	3.08	13.21	3.20
Teacher Accessibility	15.49	3.13	15.25	3.05	14.96	3.24

[1]Each Factor is composed of three questions with each question having a range of 1 (definitely no) to 7 (definitely yes). The three questions are then totaled together giving for each Factor a range from 3 to 21.

1. A significant difference ($p<.05$) was found regarding the teacher's presentations (Factor 1). The "high" achievers rated the presentations clear and helpful while the "low" achievers rated them less helpful. This can be interpreted as indicating that the "high" achievers made better use of group discussions and "mini-lectures," while the "low" achievers felt them to be less useful. The opinion of the "expected" achievers fell in-between those of the "high" and "low" achievers.
2. A significant difference ($p<.01$) was found regarding the students' conception of the workload of the course (Factor 2). The "high" and "expected" achievers felt that they had to work hard only sometimes, while the "low" achievers felt they had to work hard quite often.
3. A significant difference ($p<.01$) was found pertaining to the students' feelings regarding their own accomplishments in the course (Factor 3). The "high" and "expected" achievers had the highest assessment in judging their own growth in biology over the past year. The "low" achievers gave this factor a lower rating, indicating a feeling that they had less confidence in understanding and examining biological concepts.
4. A significant difference ($p<.05$) was found between achievement levels concerning fairness of grading

(Factor 5). The "high" achievers gave this factor a favorable score while the "low" achievers gave it the lowest rating. The opinion of the "expected" achievers was in-between.

5. No significant differences were found between achievement levels regarding organization of the course (Factor 4) and teacher accessibility (Factor 6).

Author-Constructed Questionnaire

An analysis of variance between the "high," "expected" and "low" achievers revealed significant univariate F-ratios in 11 of the 15 areas inventoried by the author-constructed questionnaire (Table 56). The means and standard deviations of these 15 questions are found in Table 57.

The results are as follows:

1. A significant difference ($p<.01$) was found between achievement levels regarding the students' feelings about how much they thought they had learned in the Individualized Learning (IL) biology program. The "high" and "expected" achievers both felt that they had learned "a lot" to "some" biology, while the "low" achievers felt that they had learned only "some" to "a little" biology.
2. A significant difference ($p<.01$) was found regarding the students' enjoyment in taking biology in the IL program. The results revealed that the "high" and

TABLE 56

SUMMARY TABLE OF THE UNIVARIATE F-RATIOS BETWEEN HIGH (N = 80), EXPECTED (N = 132), AND LOW (N = 94) ACHIEVERS ON THE AUTHOR-CONSTRUCTED QUESTIONNAIRE

Factor Description	F-Ratio
Self-knowledge of biology	13.37**
Enjoyment of the course	13.36**
Course difficulty	4.10*
Value of teacher's presentations	<1
Value of the tapes	<1
Value of the labs	3.74*
Value of the readings	<1
Self-directedness	9.18**
Course preference	9.42**
Work pace	<1
Motivation	13.43**
Contract involvement	8.59**
Grade expectation	20.05**
Attitude	16.72**
Independence	4.76**

*p<.05
**p<.01

TABLE 37

MEANS AND STANDARD DEVIATIONS FOR HIGH, EXPECTED, AND LOW ACHIEVERS ON THE AUTHOR-CONSTRUCTED QUESTIONNAIRE

Factors	High Achievers N = 80 $\bar{X}$	S.D.	Expected Achievers N = 132 $\bar{X}$	S.D.	Low Achievers N = 94 $\bar{X}$	S.D.
Knowledge of biology	1.70[1]	.80	1.84	1.01	2.44	1.26
Enjoyment of biology	2.11[2]	1.58	2.20	1.25	3.00	1.47
Course difficulty	2.67[3]	.70	2.74	.73	2.44	.85
Teacher's presentations	1.81[4]	.96	1.95	.96	2.00	.97
Tapes	2.44[4]	1.37	2.43	1.16	2.52	1.20
Labs	2.53[4]	1.13	2.96	1.15	2.93	1.30
Readings	2.55[5]	1.27	2.46	1.16	2.44	1.21
Self-directedness	2.18[6]	1.31	2.03	1.13	2.74	1.40
Course preference	2.26[5]	1.11	2.08	1.09	2.76	1.32
Work pace	2.21[5]	1.12	2.36	1.11	2.40	1.26
Motivation	2.33[7]	1.09	2.38	1.27	3.16	1.35
Contract involvement	2.60[8]	.74	2.61	.84	2.19	.79
Grade expectation	2.83[9]	.79	2.78	.84	2.16	.79
Attitude	2.14[5]	.79	2.30	.87	2.87	1.03
Independence	2.29[5]	1.18	2.58	1.41	2.91	1.40

[1]Likert scale of 1 (a lot) to 5 (very little)
[2]Likert scale of 1 (very much) to 5 (not at all)
[3]Likert scale of 1 (too hard) to 5 (too easy)
[4]Likert scale of 1 (very helpful) to 5 (not helpful at all)
[5]Likert scale of 1 (yes) to 5 (no)
[6]Likert scale of 1 (individualized learning) to 5 (traditional)
[7]Likert scale of 1 (no personal involvement) to 5 (personal involvement)
[8]A = 4, B = 3, C = 2, and incomplete = 1
[9]Likert scale of 1 (positive attitude) to 5 (negative attitude)

"expected" achievers enjoyed taking biology on the IL program, while the "low" achievers did not enjoy IL biology very much at all.

3. A significant difference ($p<.05$) was found regarding the difficulty of the course. The "low" achievers rated the course in being fairly hard, while the "high" and "expected" achievers rated it in being less difficult. This is in agreement with Factor 2 of the ENDEAVOR VIII questionnaire.
4. No significant differences were found between achievement levels regarding the teacher's presentations. In this inventory all the students regarded the teacher's presentations as being fairly helpful.
5. No significant differences were found between achievement levels regarding the lecture tapes. All students felt that the tapes were helpful in understanding the material.
6. A significant difference ($p<.05$) was found between achievement levels regarding the laboratory investigations. The "high" achievers felt that the labs were more helpful in understanding the material than the "expected" and "low" achievers.
7. No significant differences were found between achievement levels regarding the value of the textbooks and outside readings.

8. A significant difference ($p<.01$) was found between achievement levels concerning the students' own feelings regarding their capability in directing their own study habits. The "high" and "expected" achievers felt that they were capable of directing their own study habits, while the "low" achievers felt they were less able to direct their own study habits.

9. A significant difference ($p<.01$) was found regarding the student's preference of course structure. The "high" and "expected" achievers generally preferred an individualized biology course, while the "low" achievers preferred the course to be less individualized and with more structure.

10. No significant differences were found between achievement levels regarding self-pacing in the IL biology program. All students felt that they could work at their own pace most of the time.

11. A significant difference ($p<.01$) was found regarding self-motivation. The "high" and "expected" achievers indicated that they did feel motivated to learn, while the "low" achievers felt they were motivated only a little.

12. A significant difference ($p<.01$) was found concerning the students' feelings regarding their involvement with the IL biology learning contracts. The "high"

and "expected" achievers indicated that they were involved with most of the contracts, while the "low" achievers indicated that they had involved themselves with only a few of the learning contracts.

13. A significant difference ($p<.01$) was found regarding the st· ·nts' expectations concerning their course grades. The "high" and "expected" achievers indicated that they would receive a passing grade (2.83 and 2.78 respectively). The "low" achievers indicated that their grade would be lower, probably hovering around a grade of C or an incomplete (2.16). The writer felt that a significant F-ratio obtained on this question added meaning to the study because: (1) such results would be expected and (2) that it indicates honesty on the part of the students in answering this and other questions.

14. A significant difference ($p<.01$) was found regarding the students' attitude toward science. The "high" and "expected" achievers indicated that they liked science, while the "low" achievers were neutral in their attitude toward studying science. This is in agreement with the results of the Scientific Attitude Inventory ($p<.01$) which revealed that "high" and "expected" achievers had a more positive attitude toward science.

15. A significant difference ($p<.01$) was found between students regarding their feelings about learning science on their own. The "high" achievers indicated that they generally did like learning science independently, while the "low" achievers generally did not like learning science on their own. The "expected" achievers expressed an attitude in-between.

On the basis of these findings, it is possible to reject the null hypotheses and to conclude that significant differences do exist between "high," "expected," and "low" achievers with regard to students' feelings and attitudes toward the individualized learning biology program and the instructor. The results indicated that the "high" achievers, when contrasted to the "low" achievers in particular: (1) had a more positive self-image regarding the amount of biology they felt they had learned, (2) enjoyed working in an individualized learning program, (3) were more capable of directing their own study habits, (4) felt more motivated and were involved with the learning contracts, (5) had a more positive attitude toward science, (6) felt that the teacher's presentations and laboratory investigations were particularly helpful in understanding the material (7) liked working independently in science, and (8) felt that the course was not overly difficult and that the students did have to do some work in order to complete the course.

Student Success in Their Other High School Courses

The following null hypothesis was considered in this section:

> There are no differences between "high," "expected," and "low" achievers in an individualized learning high school biology program with regard to the success of the students in their other courses.

In this section relationships were sought between the students' achievement level in biology and the number, kind, and grade point averages of their other courses taken during the year. The testing of this hypothesis was performed by an analysis of variance between the total number of "high" (N = 80), "expected" (N = 132), and "low" (N = 94) achievers across Groups I, II and III. The results revealed significant differences on data regarding grade point averages (Table 58). The means and standard deviations for this data are found in Table 59.

The results were as follows:

1. There were no significant differences between achievement levels regarding the number of semesters of individualized learning (IL) taken during the year above and beyond the two semesters taken in biology.
2. There were no significant differences between achievement levels regarding the number of IL semesters that were completed during the year. However, a trend did appear as the "high" achievers completed a higher percentage of their IL semesters than the "expected" and "low" achievers. A compilation of the figures

TABLE 58

SUMMARY TABLE OF THE UNIVARIATE F-RATIOS BETWEEN HIGH, EXPECTED, AND LOW ACHIEVERS ON DATA CONCERNING THE SUCCESS OF STUDENTS IN THEIR OTHER COURSES

Factor	F-Ratio
Number of semesters of IL taken during the year	<1
Number of semesters of IL completed during the year	2.14
Grade point average of the completed IL courses	6.59**
Number of semesters of traditional courses taken during the year	<1
Grade point average of the traditional courses	5.07**
Grade point average for all courses taken during the year	10.46**

**p<.01

TABLE 59

MEANS AND STANDARD DEVIATIONS FOR HIGH, EXPECTED, AND LOW ACHIEVERS ON SUCCESS DATA OF STUDENTS IN THEIR OTHER COURSES

Factors	High Achievers N = 80 $\bar{X}$	S.D.	Expected Achievers N = 132 $\bar{X}$	S.D.	Low Achievers N = 94 $\bar{X}$	S.D.
Number of semesters of IL taken during the year	4.70	1.53	4.67	1.41	4.44	1.50
Number of semesters of IL completed	4.26	1.68	4.11	1.71	3.76	1.69
Grade point average of the IL courses	3.18[1]	.55	3.03	.72	2.80	.75
Number of traditional semesters	2.79	1.48	2.75	1.34	2.68	1.46
Grade point average of traditional courses	2.78[2]	1.01	2.62	1.09	2.25	1.24
Grade point average for all courses	3.05[3]	.56	2.91	.64	2.63	.65

[1]Grade point average for IL courses was computed as follows: A =4, B = 3, C = 2.

[2]Grade point average for traditional courses was computed as follows: A = 4, B = 3, C = 2, D = 1, F = 0.

[3]Overall grade point averages were computed by averaging the grade point averages for both the IL and traditional courses.

revealed that the "high" achievers completed 327 out of 362 IL semesters (90%); the "expected" achievers completed 534 out of 603 (89%); and the "low" achievers completed 346 out of 415 IL semesters (83%).

3. A significant difference ($p<.01$) was found between achievement levels and the grade point average of the completed IL semesters. The "high" and "expected" achievers, respectively, had a B average of 3.18 and 3.03. The "low" achievers had a C average of 2.80.
4. No significant differences were found between achievement levels and the number of traditional semesters taken during the year.
5. A significant difference ($p<.01$) was found between achievement levels and the students' grade point average in the traditional courses taken during the year. The "high," "expected," and "low" achievers respectively had grade point averages of 2.78, 2.62 and 2.25.
6. A significant difference ($p<.01$) was found between achievement levels and the grade point average for all courses taken during the year, including biology. The overall grade point averages of the "high," "expected," and "low" achievers, respectively, were 3.05, 2.91 and 2.63.

It should be pointed out that caution should be undertaken in comparing the grade point averages of the IL semesters with the grade point averages for the traditional courses for grade equivalents were derived in different ways. The IL grade point averages were based upon completed grades only on a scale of 2 to 4, while the traditional grade point averages were based upon all grades on a scale of 0 to 4. True comparisons of grades can only be made among achievement levels for each factor but not across achievement levels for different factors. However, it can be stated that "high" achievers have more success than "low" achievers in both traditional and individualized courses.

On the basis of these findings, it is possible to reject the null hypothesis and to conclude that significant differences do exist between "high," "expected," and "low" achievers with regard to the success of students in their other courses. The data revealed that the "high" achievers earned the highest grades in both the IL and traditional courses. The "low" achievers in each case had the lowest grade point averages.

The results can be interpreted to demonstrate that the "high" achievers did well in both educational settings, while the "low" achievers did not do so well in either educational environment. "High" achievers had success in their other courses regardless of the educational setting, while the "low" achievers had difficulty in both educational settings. It can also be pointed out that the "high" achievers have a tendency (differences were nonsignificant) to complete more IL courses (90%) than the "low" achievers (83%).

Chapter V

Summary and Conclusions

The purpose of this chapter is to summarize the results of this investigation, and it is divided into five sections. Section I is a summary of the methodology and results of the study. Section II presents the conclusions and a discussion. Section III gives the implications and recommendations with regard to individualization of science programs. Section IV discusses suggestions for further research, and Section V presents a concluding statement.

Summary

The purpose of this investigation was to determine if individualization of instruction had any effects on students' cognitive and affective performance in a high school biology program. An attempt was made to discriminate and identify students who "did well" in an individualized program from those who "did not do so well." In addition, this study sought to determine if any differences existed between achievement levels regarding the students' feelings and attitudes toward the individualized program.

This investigation was conducted at Glenbrook North High School, Northbrook, Illinois, during the 1973-1974 school year. The sample consisted of 406 students enrolled for two semesters of biology. All students, regardless of class section or teacher, received a year of credit for completing "contracts" for 34 learning units of material.

Differences between "high," "expected," and "low" achievers were sought in four main areas: (1) psychometric variables, (2) biographical variables, (3) students' attitude toward the course and instructor, and (4) the success of the students in their other courses.

Psychometric data were collected by administering the following inventories: (1) the Watson-Glaser Critical Thinking Appraisal, (2) Nelson Biology Test, (3) a Scientific Attitude Inventory, (4) School Motivation Analysis Test, (5) High School Personality Questionnaire, and (6) the Test on Understanding Science. Biographical data were collected via an author-constructed student information sheet. Students' attitudes toward the course and teacher were inventoried by: (1) ENDEAVOR VIII, a factor-analyzed course and teacher evaluation inventory and (2) an author-constructed questionnaire.

Preliminary statistical analyses made use of a random sample of 25% of the population (N = 100) and a multiple regression equation was developed. By employing multiple regression analysis, a prediction equation was developed in which achievement was used as the criterion measure. This was

then applied to the remaining 75% of the population (N = 306), and each individual was classified into one of three achievement levels; i.e. "high," "expected," or "low" achievers.

Once these students were classified into their respective levels, three random groups (Groups I, II and III) were formed. Multiple discriminant analyses were then performed to discriminate between achievement levels in Groups I, II and III with regard to the psychometric and biographical variables. A cross validation was then performed to determine the effectiveness of the discriminant function equation in predicting the achievement level for unclassified individuals. Finally, an analysis of variance was performed between achievement levels with regard to: (1) students' feelings and attitudes toward the course and instructor and (2) the success of the students in their other courses.

The results of the statistical analyses revealed the following significant differences between "high," "expected," and "low" achievers:

1. A significant discriminant function was found between achievement levels for Groups I, II and III on a battery of five psychometric variables. These variables were: (1) the Watson-Glaser Critical Thinking Appraisal, (2) Motivational factor: Sentiments toward School, and (3) Personality factors: Shy vs. Adventurous, Disregards Rules vs. Conscientious, and Sociably Group-Dependent vs. Self-Sufficient.

2. A significant discriminant function was found between achievement levels for Groups I and II on a battery of five biographical variables. These variables were: (1) level of education aspired, (2) age, (3) number of older siblings, (4) number of younger siblings, and (5) sex. In addition, an analysis of variance performed between the total number of "high," "expected," and "low" achievers revealed a significant univariate F-ratio with regard to: (1) age, (2) number of older siblings, and (3) level of education.
3. An analysis of variance performed between achievement levels with regard to students' feelings and attitudes toward the course and instructor found significant differences on the following factors: (1) teacher's presentations, (2) course workload and difficulty, (3) student accomplishments and self-knowledge of biology, (4) enjoyment of the course, (5) value of the labs, (6) self-directedness, (7) course preference, (8) motivation, (9) contract involvement, (10) grade expectation, (11) attitude, and (12) independence.
4. An analysis of variance performed between achievement levels with regard to the success of the students in their other courses revealed significant differences on the following three factors: (1) grade point average for completed individualized learning (IL)

courses, (2) grade point average for traditional courses, and (3) overall grade point average for all courses taken during the year.

Conclusions and Discussion

On the basis of the findings of this investigation, it is possible to conclude that differences do exist between "high," "expected," and "low" achievers in an individualized high school biology program with regard to the following variables: (1) biographical data, (2) personality, (3) motivation, (4) attitude toward science, (5) scholastic aptitude, (6) understandings about science, (7) the ability to think critically, (8) students' feelings and attitudes toward the course and instructor, and (9) the success of the students in their other courses. A number of these variables discriminated and/or differentiated between students who did well in the individualized program from those who did not do so well. By combining a number of these factors, a summary description can be given characterizing the "high," "expected," and "low" achievers.

The "high" achievers can be described as individuals who have a high ability to think critically, a high interest in school activities, a conscientious attitude toward science and school, are less sociable, and are more self-sufficient. In addition, it was found that the "high" achievers had the fewest number of older siblings and planned on at least a four-year

college degree. In analyzing the feelings of the "high" achievers toward the individualized program, it was found that they had a more positive self-image, enjoyed working independently in a self-paced course, felt motivated, and felt that they were capable of directing their own study habits. It was also found that the "high" achievers earned relatively higher grades in both individualized and traditional courses.

The "low" achievers can be characterized as individuals who have a lesser ability to think critically, a lower interest in school activities, a tendency to disregard rules, and are more sociably group-dependent. "Low" achievers also tended to have more older siblings and expected at least some college education. With regard to the feelings of the students toward the course and teacher, it was found that they had more of a negative self-image, did not enjoy working independently in a self-paced course, did not feel motivated or self-directed, and had a negative attitude toward science. "Low" achievers also did poorly in their other subjects, whether the subjects were traditional or individualized.

The "expected" achievers are harder to characterize since they have some of the characteristics of both the "high" and "low" achievers. These individuals have a high ability to think critically, a relatively conscientious attitude regarding school rules, a low interest in school activities, are adventurous, and are self-sufficient. The "expected" achievers had

fewer older siblings than the "low" achievers and more older siblings than the "high" achievers. In addition, "expected" achievers plan to complete four years of college. "Expected" achievers also have a positive self-image, felt motivated to learn, enjoyed the self-paced program, and felt highly self-directed. It was also found that the "expected" achievers possess an ambivalent attitude toward science and toward learning science independently. "Expected" achievers were also fairly successful in their other courses, whether the courses were individualized or traditional.

The findings of this investigation tend to support the results of previous research studies on individualization. Successful students are those who have a high interest and positive attitude toward science and school activities. Aptitude, attitude, personality, and motivation all contribute toward determining the achievement of a given student in an individualized program.

A crucial and important question to consider and discuss at this point is—Which of these characteristics seem to have the greatest effect and influence in determining the achievement status of a given individual? The present investigation seems to demonstrate that individuals who are interested and motivated will at least perform as expected in an individualized program.

In a program that is self-paced, the ultimate responsibility for the completion and passing of course requirements

is left entirely to the student. The ultimate factors which appear to determine success are not knowledge, but instead are attitude and motivation. If a student has a poor attitude toward science and is not motivated, regardless of his prior knowledge, he is likely to do poorly in an individualized setting. The same factors can be argued for the lack of success in a traditional course, but these two factors of interest and motivation seem to be of more importance in a self-paced individualized science program where the decisions and responsibilities are placed into the hands of the learner.

An individualized self-paced program has several advantages. First, it allows the students who have limited academic ability, but who are willing to try, to work at a pace and rate that nets them success. The students are no longer pitted against the brighter and faster students, thus they are no longer falling behind the class and missing out on vital information. These students are willing to work a little harder and longer to achieve a level of success which is acceptable to them.

The second type of students who benefit from an individualized program are the bright individuals who are also motivated and interested in science. These students are no longer held back by others and are able to accomplish objectives which could not ordinarily be done in a traditional setting. For these students objectives may be modified according to interests and abilities. The net result is that the students

are challenged, but of utmost importance is the fact that these students have learned something that is of personal interest and value to them.

The last type of students who benefit from a self-paced program are the average students, because they learn to accept responsibility for their own actions. These students do what is necessary, get it done on time, and earn a grade that is satisfactory to them.

The students who have difficulty with an individualized self-paced program are those who are simply not motivated or interested. This factor seems to be true regardless of the academic ability or potential that the students possess. If the students are not interested, motivated, or hate science, they do not accept the responsibility for meeting and completing course requirements. These students either end up with low grades or they have extreme difficulty in completing the course.

This study has shown that student characteristics are related to cognitive achievement in an individualized high school biology program. The reasons are multiple and complex. It is not known why these differences do exist, but it is obvious that differences in cognitive achievement do exist. Herein lies the major implications of this investigation, because this information can be put to use concerning the future placement of students in an individualized self-paced program.

Implications and Recommendations

It is recognized by educators that students do not learn, utilizing the same methods, at the same rate. It is therefore illogical to place students in classes in which they are forced to conform to the pace established by the instructor. A self-paced approach overcomes this problem because students no longer are forced to speed up or slow down in order to keep pace with the class. In the individualized self-paced class, students establish rates according to their ability, not the teachers. The results are that frustration and anxiety on the part of the students are often relieved, thus resulting in improved achievement and attitude toward the course.

Because students are of varying ability, individualization provides an educational setting in which the students can adapt according to their individual interests and abilities. The findings of this investigation demonstrate that a self-paced program has several advantages for students who are of varying ability. Each individual has the opportunity to work at a pace suitable to his needs without class and teacher pressure. For many students this is a welcome relief, because this pressure may have a negative learning effect. However, some students may thrive on or need competition in order to achieve their goals. The competition in this case can be supplied by the teacher according to individual needs.

This investigation has identified a number of psychometric and personality characteristics that might be useful for iden-

tifying and placing students in an individualized learning program. The results demonstrate that some students achieve as expected or better, while others do not perform as expected. In addition, this study indicates that it may be possible to predict the achievement levels of students based on a selected number of characteristics.

Based on the findings of this investigation, several recommendations can be made with regard to the placement of students in an individualized learning program. A totally unstructured educational setting for most students is undesirable. There is, however, an area between a highly structured curriculum and a totally unstructured one in which students can be placed according to their needs and abilities. It is critical and essential that guidelines are established, if individualization is to be successful.

The research in this investigation has shown that unscheduled free time and student choice in decision making is not desirable for all students. Some form of structure is needed for some students. This study demonstrated that "high" and "expected" achievers were able to meet cognitive objectives by participating in a self-paced high school biology program. More structure and guidance is needed for the "low" achievers so that they also are able to meet cognitive and affective objectives.

Based on the research findings of this investigation, a problem has been identified regarding cognitive achievement of

the "low" achievers. The following generalizations, assumptions, solutions, and recommendations are given only as a means of offering a solution to the problem and should be regarded only as tentative.

Assumptions:

1. Not all students are able to learn effectively and efficiently in an individualized and self-paced program.
2. Not all students are able to assume the responsibility that is necessary for success in an individualized program.

Solutions:

1. The creation and establishment of a more "conventional" type of course with more structure.
2. Student placement in an appropriate educational setting where chances of success are maximized.

Generalizations:

1. Educational instructional goals should not be the same for all students.
2. Individualization offers an educational opportunity which takes into account individual differences, and it provides an environment that enables students to become responsible for their own learning.

Rationale:

1. Students should be placed into an educational setting where their probable chances of success are maximized.

Recommendations:

1. The placement of students into a program based upon the findings of this investigation.

2. The administration of attitude and cognitive instruments as a means of assessing motivation, interest, and knowledge in biology.

3. Determination of student motivation either by testing and/or consultation with the student.

4. Administration of the necessary inventories in the spring so that the results can be utilized for placement of students in courses at the beginning of the school year.

5. Offer a choice to the student of taking the course as individualized learning (IL) or traditional.

6. Retain the IL format for all students who show the ability and interest in learning science independently and who are willing to assume the responsibility for their own learning.

7. Placement of poorly motivated and uninterested students into a modified type of course to provide more structure and guidance.

Ultimate Goal:

1. The placement of students into courses so that they will learn to become successful and responsible individuals.

From the results of this study, one should not conclude that students should be totally excluded from individualized courses, but some students with certain characteristics should be placed into a modified program until they learn to become responsible learners. Rather than exclude individuals who do not like working individually, these students should be given special consideration in order to help them learn how to accept responsibility and to be accountable for their own education and decision making. Increased knowledge about the personal characteristics of such students should enhance the

ability of educators to fulfill and provide educational opportunities for students that are of value, interest, and relevant for each and every individual.

Suggestions for Future Research

In completing this study, several areas of possible research have risen in the mind of the investigator. The following is a list of possible investigations which science educators might pursue:

1. Can the results of the study be replicated in another area of science?
2. Might a different battery of variables prove to be better predictors of achievement?
3. Would a battery of variables measuring only attitude, interest, and motivation be just as effective in discriminating between achievement levels?
4. Does a modified course with more structure result in increased responsibility and/or achievement on the part of the student?
5. Are the results comparable to other courses which are individualized learning (IL)?
6. Do students become more responsible as they progress through IL courses as opposed to traditional courses?
7. What effect does maturation have on student responsibility in IL courses?
8. Would a different battery of variables improve the percentage of correct predictions in the cross validation?

Concluding Statement

In summary, individualization is an educational technique providing a unique learning program for all students. The objective is to take into account individual differences such as background, maturity, motivation, attitude, scholastic aptitude, interest, personal needs, and learning styles that differ among all students. The aim is to diversify the educational program in an attempt to provide an optimum learning environment for each and every individual learner. Individualization nurtures responsibility and has the potential for developing students who can become self-resourceful and independent individuals.

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APPENDICES

APPENDIX A

STUDENT INFORMATION SHEET

Glenbrook North High School
Student Information Sheet

Fill in the blanks or circle the appropriate answers.

Name: _____

1. Sex: Male Female

2. Age: ___

3. How many older brothers and/or sisters do you have? _____

4. How many younger brothers and/or sisters do you have? _____

5. Have you taken Earth Science? Yes No

6. - 7. Parents educational level: (circle grade level achieved)

Father	Mother
1 Non high school graduate	1 Non high school graduate
2 High school graduate	2 High school graduate
3 Some college	3 Some college
4 College graduate	4 College graduate
5 Masters degree	5 Masters degree
6 Doctorate	6 Doctorate

8. How many shelves of books are there in your home?

1	2	3	4
less than 5	between 5 and 10	between 10 and 15	over 15

9. If you should go to college, what would you major in?
Science Math Social Studies English Other

10. What level of education do you expect to achieve?
1. Less than a high school diploma
2. High school diploma
3. Some college education
4. A college degree
5. Beyond college

APPENDIX B

ENDEAVOR VIII

ENDEAVOR VIII INSTRUCTIONAL RATING FORM

CIRCLE THE NUMBER WHICH MOST CLOSELY APPROXIMATES YOUR ASSESSMENT OF THIS COURSE.

1. The students had to work hard in this course.

1	2	3	4	5	6	7
never	seldom		sometimes	often		always

2. I can now understand relatively advanced presentations on this subject.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

3. The details of this course were carefully planned in advance.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

4. The grading procedure in this course was fair and impartial.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

5. The teacher discussed the course material in an insightful and penetrating fashion.

1	2	3	4	5	6	7
never	seldom		sometimes	often		always

6. The teacher listened to students' questions and was willing to help.

1	2	3	4	5	6	7
never	seldom		sometimes	often		always

7. The grades in this course were based on important aspects of the course material.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

8. The teacher was readily available outside of class for discussion of course material.

1	2	3	4	5	6	7
never	seldom		sometimes	often		always

9. The course was rationally organized in a logical fashion.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

10. This course had a heavy workload.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

11. This course has enabled me to identify and analyze central issues in this field

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

12. The teacher communicated his ideas in an unambiguous manner.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

13. This course required a lot of time.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

14. The teacher made good use of examples and illustrations.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

15. The grading in this course accurately reflected the student's performance.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

16. When a confused student asked an inappropriate question, the teacher tried to clarify the misunderstood material without embarrassing the student.

1	2	3	4	5	6	7
never	seldom		sometimes		often	always

17. The teacher arranged the class schedule in an orderly way and followed it closely.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

18. This course has developed my ability to examine the evidence in this field.

1	2	3	4	5	6	7
definitely no		no		yes		definitely yes

APPENDIX C

AUTHOR-CONSTRUCTED QUESTIONNAIRE

COURSE EVALUATION FORM

CIRCLE THE NUMBER WHICH MOST CLOSELY APPROXIMATES YOUR ASSESSMENT OF THE IL BIOLOGY PROGRAM.

1. How much do you think you have learned in the IL Biology Program?

1	2	3	4	5
a lot	some		a little	very little

2. Did you like taking biology on the IL Program?

1	2	3	4	5
very much	somewhat		a little	not at all

3. The IL Biology course was:

1	2	3	4	5
too hard	hard		easy	too easy

4. Did you find the teacher's presentation to be:

1	2	3	4	5
very helpful	somewhat helpful		a little helpful	not helpful at all

5. Did you find the tapes to be:

1	2	3	4	5
very helpful	somewhat helpful		a little helpful	not helpful at all

6. Did you find the labs to be:

1	2	3	4	5
very helpful	somewhat helpful		a little helpful	not helpful at all

7. Did you find the textbooks and other readings to be:

1	2	3	4	5
very helpful	somewhat helpful		a little helpful	not helpful at all

8. Did you feel that you were capable of directing your own study habits?

1	2	3	4	5
yes	somewhat		a little	no

9. If you were to take the biology course over again, what would you prefer?

1	2	3	4	5
100% IL	75% IL 25% traditional	50% IL 50% traditional	25% IL 75% traditional	100% traditional

10. Where you able to work at your own pace in the IL Biology Program?

1	2	3	4	5
yes	most of the time		a little of the time	No, not at all

11. Did you feel motivated to learn?

1	2	3	4	5
yes	somewhat		a little	no

12. Do you feel that you were personally involved in the IL Biology Program?

1. No. I was a passive learner
2. I became involved with just a few of the contracts
3. I was involved with most of the contracts
4. I felt personally involved with all of the contracts

13. What grade do you expect to achieve in this course?

A	B	C	Incomplete

14. What is your attitude toward studying science?

1	2	3	4	5
like it very much	like it	not like it		dislike it very much

15. Do you like learning science on your own?

1	2	3	4	5
yes	somewhat		a little	no

APPENDIX D

AN ANALYSIS OF VARIANCE ACROSS ACHIEVEMENT LEVELS FOR GROUPS I, II AND III

KEY FOR THE ANALYSES OF VARIANCE

Variable Number	Variable	Variable Number	Variable
1	Watson-Glaser Critical Thinking Appraisal		ENDEAVOR VIII Questionnaire
		38	Factor I
2	Test on Understanding Science	39	Factor II
		40	Factor III
		41	Factor IV
	School Motivation Analysis Test	42	Factor V
		43	Factor VI
3	Factor 1		
4	Factor 2		Author-constructed Questionnaire
5	Factor 3		
6	Factor 4	44	Question 1
7	Factor 5	45	Question 2
8	Factor 6	46	Question 3
9	Factor 7	47	Question 4
10	Factor 8	48	Question 5
11	Factor 9	49	Question 6
12	Factor 10	50	Question 7
		51	Question 8
13	Scientific Attitude Inventory	52	Question 9
		53	Question 10
		54	Question 11
	High School Personality Questionnaire	55	Question 12
		56	Question 13
14	Factor A	57	Question 14
15	Factor B	58	Question 15
16	Factor C		
17	Factor D		Classification and Placement Examination
18	Factor E		
19	Factor F	59	Verbal
20	Factor G	60	Quantitative
21	Factor H	61	Total aptitude
22	Factor I	62	Reading
23	Factor J	63	Math
24	Factor O	64	English
25	Factor Q_2	65	Total achievement
26	Factor Q_3	66	Total score
27	Factor Q_4		
			Student Status at End of Year
	Biographical Data		
28	Sex	67	No. semesters of IL
29	Age	68	Semesters IL completed
30	No. older siblings	69	IL grade point average
31	No. younger siblings	70	Traditional semesters
32	Earth Science	71	Traditional average
33	Father's education	72	Total grade average
34	Mother's education		
35	Number of books		
36	Major		
37	Level of education		

TABLE 60

SUMMARY TABLE OF THE ANALYSES OF VARIANCE ON ALL VARIABLES ACROSS GROUPS I, II AND III FOR THE HIGH ACHIEVERS, THE EXPECTED ACHIEVERS, AND THE LOW ACHIEVERS

Variable	F Ratio High Achievers (N=80)	F Ratio Expected Achievers (N=132)	F Ratio Low Achievers (N=94)
1	<1	<1	<1
2	1.20	1.05	<1
3	<1	<1	2.58
4	2.46	1.39	2.32
5	<1	1.10	<1
6	<1	1.95	<1
7	1.61	1.21	<1
8	<1	<1	<1
9	<1	2.13	<1
10	<1	4.29*	2.48
11	<1	2.27	2.14
12	1.02	<1	<1
13	<1	1.08	1.42
14	<1	2.91	<1
15	<1	2.43	<1
16	2.05	2.51	<1
17	<1	<1	<1
18	1.32	<1	<1
19	<1	<1	3.77*
20	2.93	2.51	2.93

ANALYSES OF VARIANCE
(continued)

Variable	F Ratio High Achievers (N=80)	F Ratio Expected Achievers (N=132)	F Ratio Low Achievers (N=94)
21	<1	1.39	1.02
22	<1	<1	<1
23	<1	<1	1.40
24	<1	<1	<1
25	<1	2.40	1.25
26	2.14	<1	<1
27	<1	<1	2.63
28	1.23	<1	<1
29	<1	<1	3.10*
30	<1	1.62	1.27
31	<1	<1	1.31
32	<1	<1	<1
33	2.13	3.98*	1.82
34	<1	<1	<1
35	<1	3.17*	<1
36	<1	<1	<1
37	1.19	<1	<1
38	<1	<1	<1
39	<1	<1	<1
40	2.26	2.41	<1
41	<1	<1	1.20
42	<1	<1	<1

ANALYSES OF VARIANCE
(continued)

Variable	F Ratio High Achievers (N=80)	F Ratio Expected Achievers (N=132)	F Ratio Low Achievers (N=94)
43	1.04	<1	<1
44	<1	<1	1.04
45	<1	<1	<1
46	<1	2.45	<1
47	<1	1.63	<1
48	1.06	<1	<1
49	<1	<1	<1
50	<1	1.98	<1
51	<1	<1	2.16
52	2.11	1.08	<1
53	1.36	<1	<1
54	1.09	<1	<1
55	<1	1.03	2.93
56	<1	<1	2.18
57	<1	1.33	<1
58	<1	1.90	<1
59	<1	1.30	<1
60	<1	<1	<1
61	1.30	<1	<1
62	<1	<1	1.69
63	<1	<1	<1
64	1.43	1.35	1.25

ANALYSES OF VARIANCE
(continued)

Variable	F Ratio High Achievers (N=80)	F Ratio Exp[illegible] Achievers :132)	F Ratio Low Achievers (N=94)
65	1.22	<1	1.38
66	<1	<1	<1
67	<1	1.40	1.99
68	<1	<1	2.80
69	<1	1.84	2.03
70	<1	1.48	1.68
71	<1	1.20	2.52
72	<1	<1	1.22

*p<.05

APPENDIX E

KOLMOGOROV-SMIRNOV D TESTS FOR DISTRIBUTION NORMALITY

KEY FOR KOLMOGOROV-SMIRNOV D TESTS

Variable Number	Variable
1	Watson-Glaser Critical Thinking Appraisal
2	Test on Understanding Science
	School Motivation Analysis Test
3	Factor 1
4	Factor 2
5	Factor 3
6	Factor 4
7	Factor 5
8	Factor 6
9	Factor 7
10	Factor 8
11	Factor 9
12	Factor 10
13	Scientific Attitude Inventory
	High School Personality Questionnaire
14	Factor A
15	Factor B
16	Factor C
17	Factor D
18	Factor E
19	Factor F
20	Factor G
21	Factor H
22	Factor I
23	Factor J
24	Factor O
25	Factor Q_2
26	Factor Q_3
27	Factor Q_4
	Biographical Data
28	Sex
29	Age
30	No. older siblings
31	No. younger siblings
32	Earth science
33	Father's education
34	Mother's education
35	Number of books
36	Major
37	Level of education
	ENDEAVOR VIII Questionnaire
38	Factor I
39	Factor II
40	Factor III
41	Factor IV
42	Factor V
43	Factor VI
	Author-Constructed Questionnaire
44	Question 1
45	Question 2
46	Question 3
47	Question 4
48	Question 5
49	Question 6
50	Question 7
51	Question 8
52	Question 9
53	Question 10
54	Question 11
55	Question 12
56	Question 13
57	Question 14
58	Question 15
	Classification and Placement Examination
59	Verbal
60	Quantitative
61	Total aptitude
62	Reading
63	Math
64	English
65	Total achievement
66	Total score
	Student Status at End of Year
67	No. semesters of IL
68	Semesters IL completed
69	IL grade point average
70	Traditional semesters
71	Traditional average
72	Total grade average

TABLE 61

KOLMOGOROV-SMIRNOV D TESTS FOR DISTRIBUTION NORMALITY

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
1	.0810	.0650	.0889	.0426	.0767	.0521			
2	.0568	.0429	.0735	.1062	.0692	.0694			
3	.0868	.0863	.0912	.0619	.1022	.1253			
4	.0650	.1181	.0511	.0668	.0486	.0886			
5	.0821	.0877	.0784	.0595	.0790	.0551			
6	.0723	.0771	.0946	.0829	.1366	.0619			
7	.0719	.0746	.0869	.0951	.0482	.0789			
8	.0556	.0744	.0632	.0797	.1001	.0728			
9	.0611	.1137	.0992	.0774	.1358	.0998			
10	.0761	.0903	.0772	.0582	.1053	.0743			
11	.0806	.0550	.0693	.0925	.0749	.0762			
12	.0828	.1090	.0893	.0364	.0518	.0602			
13	.0397	.0517	.0453	.0579	.0327	.0516			
14	.0685	.1083	.0616	.0887	.1006	.0890			

KOLMOGOROV-SMIRNOV D TESTS
(continued)

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
15	.0939	.1111	.1162	.1642**	.1792**	.2134**	X	X	X
16	.0741	.1293	.0932	.1023	.0629	.0971			
17	.0564	.0758	.0674	.0970	.1122	.1022			
18	.0667	.1030	.0912	.0803	.0915	.0745			
19	.0829	.0552	.0695	.0806	.1088	.1030			
20	.0992	.0867	.0696	.0609	.0769	.0766			
21	.0743	.0604	.1059	.0841	.0740	.0502			
22	.0900	.1166	.0828	.0820	.0973	.0837			
23	.1099	.0910	.1009	.0967	.0566	.0687			
24	.0826	.0830	.0795	.0844	.0916	.0578			
25	.1053	.0919	.0934	.0537	.0935	.0699			
26	.1013	.0726	.1011	.0687	.1412	.0716			
27	.1048	.0505	.0930	.1005	.0795	.0737			
28	.3314**	.3466**	.3718**	.3415**	.3263**	.3010**	X	X	X

KOLMOGOROV-SMIRNOV D TESTS
(continued)

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
29	.2505**	.3087**	.2421**	.2497**	.2483**	.2665**	X	X	X
30	.2159**	.2148**	.2446**	.1762**	.1242	.1679**	X	X	X
31	.2255**	.2612**	.1683**	.1320	.1520**	.1341	X	X	X
32	.3668**	.3970**	.3567**	.3061**	.2757**	.3162**	X	X	X
33	.1407	.2086**	.2225**	.2221**	.2326**	.2285**	X	X	X
34	.2033**	.2125**	.2193**	.2050**	.2199**	.2257**	X	X	X
35	.1876**	.2119**	.1945**	.3026**	.2362**	.2432**	X	X	X
36	.2643**	.2795**	.3057**	.4514**	.4656**	.4296**	X	X	X
37	.1939**	.2162**	.2699**	.2767**	.2642**	.3379**	X	X	X
38	.1070	.0892	.1154	.1595**	.0652	.1122			
39	.1231	.1395	.1401	.0849	.1118	.0675			
40	.1041	.1078	.0915	.1713**	.0772	.1420	X		
41	.0827	.1030	.0788	.1607**	.1306	.0915	X		
42	.0944	.0666	.0801	.1590**	.0592	.1334			

KOLMOGOROV-SMIRNOV D TESTS
(continued)

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
43	.0475	.0612	.0786	.1052	.1014	.1077			
44	.2698**	.2512**	.2813**	.1812**	.1792**	.1612**	X	X	X
45	.3189**	.2683**	.2975**	.1388**	.1500**	.1341	X	X	X
46	.1921**	.2287**	.2213**	.2589**	.2351**	.2873**	X	X	X
47	.2830**	.2558**	.2667**	.1720**	.1854**	.1647**	X	X	X
48	.2423**	.2982**	.2754**	.1337	.1331	.1364	X	X	X
49	.2398**	.2544**	.2337**	.1597**	.1543**	.1834**	X	X	X
50	.2574**	.2247**	.2842**	.1620**	.1649**	.1472	X	X	X
51	.2896**	.2303**	.2417**	.1587**	.1467	.1561**	X	X	X
52	.2704**	.2031**	.2337**	.1338	.1391	.1257	X	X	X
53	.3064**	.2480**	.2747**	.1446	.1329	.1371	X	X	X
54	.2707**	.2379**	.2601**	.1215	.1235	.1212	X	X	X
55	.1660**	.2258**	.2028**	.2556**	.2140**	.2895**	X	X	X
56	.2064**	.2297**	.2265**	.2226**	.1670**	.2310**	X	X	X

KOLMOGOROV-SMIRNOV D TESTS
(continued)

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
57	.2785**	.1801**	.2895**	.1921**	.2120**	.2105**	X	X	X
58	.2519**	.2467**	.2667**	.1694**	.1683**	.1159	X	X	X
59	.0650	.0627	.0597	.1109	.0551	.0643			
60	.0929	.0765	.0791	.0978	.0974	.0899			
61	.0694	.0807	.0745	.0820	.0683	.1023			
62	.0631	.0800	.0560	.1011	.0807	.0821			
63	.0866	.0539	.0590	.1189	.0581	.1137			
64	.0911	.0513	.0895	.0988	.1041	.0881			
65	.0597	.0526	.0522	.0964	.0713	.0802			
66	.0631	.0628	.0532	.0935	.0586	.1031			
67	.1598**	.2042**	.1734**	.1539**	.1586**	.1697**	X	X	X
68	.1342	.1797**	.1720**	.1442	.1372	.1614**		X	X
69	.0832	.0675	.0859	.2126**	.1354	.1262	X		
70	.2720**	.2768**	.1740**	.1665**	.1908**	.1938**	X	X	X

KOLMOGOROV-SMIRNOV D TESTS
(continued)

Variable	D (Left Skew)			D (Right Skew)			2-Sided Probability <.01		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
71	.0708	.1026	.1139	.2049**	.2023**	.1380	X	X	
72	.0416	.0514	.0448	.0848	.0990	.0775			

**p<.01

APPENDIX F

HOMOGENEITY OF VARIANCE

KEY FOR TESTS OF HOMOGENEITY OF VARIANCE

Variable Number	Variable
1	Watson-Glaser Critical Thinking Appraisal
2	Test on Understanding Science
	School Motivation Analysis Test
3	Factor 1
4	Factor 2
5	Factor 3
6	Factor 4
7	Factor 5
8	Factor 6
9	Factor 7
10	Factor 8
11	Factor 9
12	Factor 10
13	Scientific Attitude Inventory
	High School Personality Questionnaire
14	Factor A
15	Factor B
16	Factor C
17	Factor D
18	Factor E
19	Factor F
20	Factor G
21	Factor H
22	Factor I
23	Factor J
24	Factor O
25	Factor Q_2
26	Factor Q_3
27	Factor Q_4
	Biographical Data
28	Sex
29	Age
30	No. older siblings
31	No. younger siblings
32	Earth science
33	Father's education
34	Mother's education
35	Number of books
36	Major
37	Level of education
	ENDEAVOR VIII Questionnaire
38	Factor I
39	Factor II
40	Factor III
41	Factor IV
42	Factor V
43	Factor VI
	Author-Constructed Questionnaire
44	Question 1
45	Question 2
46	Question 3
47	Question 4
48	Question 5
49	Question 6
50	Question 7
51	Question 8
52	Question 9
53	Question 10
54	Question 11
55	Question 12
56	Question 13
57	Question 14
58	Question 15
	Classification and Placement Examination
59	Verbal
60	Quantitative
61	Total aptitude
62	Reading
63	Math
64	English
65	Total achievement
66	Total score
	Student Status at End of Year
67	No. semesters of IL
68	Semesters IL completed
69	IL grade point average
70	Traditional semesters
71	Traditional average
72	Total grade average

TABLE 62

SUMMARY TABLE OF THE TESTS OF HOMOGENEITY OF VARIANCE FOR ALL VARIABLES FOR GROUPS I, II AND III

Variable	Bartlett-Box F Group 1	Group 2	Group 3
1	<1	1.94	2.74
2	1.83	1.56	2.79
3	<1	<1	<1
4	<1	1.95	1.05
5	<1	1.01	<1
6	<1	<1	1.27
7	<1	1.01	2.00
8	<1	<1	<1
9	<1	<1	2.04
10	1.18	<1	<1
11	2.51	<1	1.17
12	<1	<1	<1
13	<1	1.19	<1
14	<1	<1	<1
15	<1	1.49	1.09
16	1.92	<1	<1
17	1.58	1.54	<1
18	1.63	<1	<1
19	<1	<1	<1
20	<1	<1	<1
21	<1	<1	<1

TESTS OF HOMOGENEITY
(continued)

Variable	Group 1	Group 2	Group 3
22	<1	<1	<1
23	<1	<1	<1
24	2.08	<1	<1
25	1.87	<1	<1
26	<1	<1	<1
27	<1	<1	<1
28	<1	<1	<1
29	<1	<1	<1
30	2.97	<1	2.49
31	<1	1.30	<1
32	<1	<1	<1
33	<1	<1	2.81
34	<1	<1	<1
35	1.15	<1	<1
36	<1	1.79	3.43*
37	1.42	<1	1.59
38	<1	2.80	<1
39	3.21*	<1	<1
40	6.79**	<1	1.61
41	3.74*	1.01	2.45
42	6.79**	3.94*	<1
43	<1	1.51	<1

TESTS OF HOMOGENEITY
(continued)

Variable	Group 1	Group 2	Group 3
44	4.99**	1.55	1.69
45	<1	2.97	<1
46	1.59	<1	1.44
47	<1	<1	<1
48	1.26	<1	<1
49	<1	<1	<1
50	<1	<1	<1
51	2.53	<1	<1
52	4.55*	1.35	<1
53	1.85	<1	<1
54	3.42*	2.08	<1
55	1.08	2.71	<1
56	<1	<1	<1
57	5.24**	<1	<1
58	<1	1.31	<1
59	1.30	2.00	1.58
60	1.09	<1	2.39
61	1.28	<1	2.40
62	1.94	<1	<1
63	1.32	<1	1.02
64	1.51	<1	<1
65	1.68	1.29	1.15
66	1.54	1.58	<1

TESTS OF HOMOGENEITY
(continued)

Variable	Group 1	Group 2	Group 3
67	1.14	<1	2.66
68	1.32	<1	1.57
69	4.45**	1.25	<1
70	1.28	<1	<1
71	1.86	<1	<1
72	1.55	<1	<1

*p<.05
**p<.01

APPENDIX G

INTERCORRELATIONS OF VARIABLES

KEY FOR SUMMARY OF INTERCORRELATIONS

Variable Number	Variable
1	Watson-Glaser Critical Thinking Appraisal
2	Test on Understanding Science
	School Motivation Analysis Test
3	Factor 1
4	Factor 2
5	Factor 3
6	Factor 4
7	Factor 5
8	Factor 6
9	Factor 7
10	Factor 8
11	Factor 9
12	Factor 10
13	Scientific Attitude Inventory
	High School Personality Questionnaire
14	Factor A
15	Factor B
16	Factor C
17	Factor D
18	Factor E
19	Factor F
20	Factor G
21	Factor H
22	Factor I
23	Factor J
24	Factor O
25	Factor Q_2
26	Factor Q_3
27	Factor Q_4
	Biographical Data
28	Sex
29	Age
30	No. older siblings
31	No. younger siblings
32	Earth science
33	Father's education
34	Mother's education
35	Number of books
36	Major
37	Level of education
	ENDEAVOR VIII Questionnaire
38	Factor I
39	Factor II
40	Factor III
41	Factor IV
42	Factor V
43	Factor VI
	Author-Constructed Questionnaire
44	Question 1
45	Question 2
46	Question 3
47	Question 4
48	Question 5
49	Question 6
50	Question 7
51	Question 8
52	Question 9
53	Question 10
54	Question 11
55	Question 12
56	Question 13
57	Question 14
58	Question 15
	Classification and Placement Examination
59	Verbal
60	Quantitative
61	Total aptitude
62	Reading
63	Math
64	English
65	Total achievement
66	Total score
	Student Status Data
67	No. semesters of IL
68	Semesters IL completed
69	IL grade point average
70	Traditional semesters
71	Traditional average
72	Total grade average
73	Nelson Biology Test (E)
74	Nelson Biology Test (F)
75	Aptitude Score

TABLE 63

SUMMARY OF INTERCORRELATIONS[1]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		57	26	-04	18	-02	-02	02	05	19	06	03	41	12	26	14	-16	-08	-09
		64	33	-20	26	15	-13	11	13	26	01	-04	33	-13	44	04	-15	-10	-21
1		39	-03	09	37	-08	-14	28	03	11	02	16	22	09	24	16	-21	-06	02
		52	19	-04	27	02	-10	13	07	18	02	04	32	04	32	10	-17	-08	-10
			40	-16	19	05	-12	00	15	34	25	07	47	00	31	08	-04	-07	-16
			23	-31	31	07	-20	15	10	26	21	00	40	-10	41	-04	-19	-21	-29
2			02	06	42	11	-15	18	-08	39	06	03	33	13	35	02	-10	-16	-11
			23	-14	30	07	-16	11	06	34	18	02	39	01	37	01	-11	-15	-20
				-25	18	-06	16	-03	11	20	08	-13	31	-06	15	23	-06	01	13
				-18	05	07	-02	-10	15	08	06	-28	13	-14	23	00	11	10	-06
3				02	-05	-03	16	08	10	17	00	-07	-05	10	-01	44	06	-15	02
				-15	07	-02	08	-02	12	16	05	-18	13	-05	15	09	03	-01	01
					-06	19	01	05	14	-31	-15	-08	-10	24	-02	-19	09	-20	00
					-24	-07	09	-17	-13	-32	-22	-06	-33	15	-21	-04	25	-03	30
4					-22	17	-02	10	-02	-17	-24	-11	-07	15	03	03	06	-25	22
					-15	11	02	01	00	-27	-21	-08	-16	19	-08	-09	13	-16	18
						-08	-07	02	-11	06	-09	-13	20	01	-10	-06	10	02	00
						-07	05	09	-10	13	-07	02	19	-24	33	-11	-11	07	-09
5						-15	-10	07	-12	21	00	02	23	-03	13	23	-13	-06	-06
						-09	-05	06	-11	13	-06	-04	21	-07	10	00	-03	01	-05

[1]Correlations shown are in order Group 1 (N=102), Group 2 (N=102), Group 3 (N=102), and total number (N=306). For significance, the critical level when N=102 would be .195 ($p<.05$) and .256 ($p<.01$). The critical level for significance when N=306 would be .113 ($p<.05$) and .147 ($p<.01$).

Note: Decimal points have been omitted.

SUMMARY OF INTERCORRELATIONS
(continued)

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
	22	22	05	-07	-11	02	17	-15	-01	-29	-26	11	21	26	21	25	-24	32	27
1	18	-02	06	08	-11	15	10	-22	03	-02	-01	-22	07	10	13	02	-16	27	10
	17	07	14	-05	-13	11	25	-17	-02	-13	-26	19	10	18	21	04	-03	12	14
	18	09	09	-01	-12	09	17	-18	00	-14	-18	02	12	18	18	10	-13	23	16
	30	10	19	07	-17	05	23	00	14	-09	-31	02	15	27	12	21	-21	29	24
2	20	-08	12	-13	-01	04	19	-18	14	-12	05	-10	07	08	17	03	-18	30	02
	20	-05	34	12	-06	08	23	-07	20	-24	-17	04	24	20	16	05	00	17	04
	24	00	22	03	-08	06	20	-10	15	-14	-16	-01	16	19	15	10	-15	25	09
	12	09	-04	09	08	08	-16	03	-07	-14	03	-04	-02	02	05	08	-27	18	-13
3	08	-18	-23	15	-02	10	00	06	-17	19	07	-10	-06	13	13	03	-12	15	-14
	04	00	04	-09	-01	-06	04	07	-01	13	-01	-01	15	14	06	-03	04	-02	15
	09	-03	-08	03	-04	05	06	04	-08	07	-02	-05	03	10	08	03	-11	11	-06
	-15	10	07	-03	18	-20	-26	07	11	-05	06	00	16	04	13	-13	12	08	02
4	-37	08	00	-09	15	-27	-13	17	02	03	-10	07	09	-11	-06	-01	23	-29	-19
	-12	-01	10	-17	04	-27	-13	12	11	08	-08	13	04	03	03	13	-06	-07	02
	-22	05	06	-09	12	-25	-18	12	09	02	-03	07	09	-01	04	00	09	-08	-05
	00	09	-04	09	08	08	-16	03	-07	-14	03	-06	-02	08	10	15	-18	00	-14
5	-02	-07	-11	18	-01	24	-08	-07	-07	09	10	-12	07	-08	-17	-13	-21	-02	-26
	16	09	16	09	-20	15	18	-21	05	00	-25	03	15	09	17	18	02	08	04
	04	04	01	11	-04	15	-02	-08	-03	-03	-03	-05	06	04	04	08	-12	02	-12

SUMMARY OF INTERCORRELATIONS
(continued)

	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
	05	13	-02	11	-05	-17	-02	-08	02	-01	-08	-19	01	-10	08	-13	11	25	-05	01
	-19	27	-13	-01	06	-17	-18	19	05	-27	-10	-13	-32	-19	-24	-23	24	42	-20	-17
1	-04	29	-04	17	10	-16	-23	05	00	20	04	10	-15	-25	-07	-18	-05	31	-26	-26
	-06	23	-06	09	04	-17	-15	05	02	-03	-04	-07	-16	-19	-08	-18	10	33	-17	-15
	16	23	01	16	-07	-20	-10	06	-08	01	-05	-03	-08	02	03	-21	12	37	-22	-12
	-18	34	-12	05	02	-22	-22	11	06	-18	-22	-33	-29	-16	-23	-25	29	49	-25	-29
2	10	17	-10	23	08	-25	-07	-09	-05	07	13	08	-26	-11	01	-09	01	22	-21	-07
	03	25	-07	15	00	-22	-12	02	-02	-03	-03	-11	-22	-07	-06	-18	15	36	-23	-16
	03	12	-09	04	-04	-08	02	-05	14	06	08	-09	04	10	-06	-08	-07	14	-17	-21
	-06	07	-11	-10	-19	-06	-01	08	04	-01	05	11	-11	-02	07	-02	15	31	-09	-02
3	-11	18	23	06	10	-09	-21	15	-01	-15	-03	-05	07	-13	-02	-17	02	03	-19	-21
	-04	12	00	-01	-07	-08	-06	04	07	-02	05	-01	-02	-01	00	-09	04	18	-15	-15
	-08	-06	13	-06	-09	00	01	-17	02	-10	14	16	-12	-08	01	-06	20	08	05	-03
	01	-30	04	-17	-07	26	21	-07	06	-10	19	18	25	01	23	31	-27	-33	32	33
4	-06	05	-14	-01	18	-04	04	-04	03	-12	-09	03	06	00	01	06	02	08	-07	-02
	-05	-11	02	-08	00	08	08	-09	03	-10	07	13	07	-03	07	10	-01	-06	10	09
	-25	-07	-25	-16	-15	-08	-05	19	15	-17	10	-16	-15	03	-12	-04	00	13	-09	-05
	-17	00	-25	-19	-11	00	02	-07	14	-15	-06	00	14	11	07	-06	-02	06	-04	-09
5	03	11	-15	08	-01	-12	-12	-08	18	18	07	01	-01	-03	05	01	-11	23	-11	-07
	-14	00	-22	-09	-09	-06	-05	03	16	-05	04	-06	-01	03	-01	-03	-04	13	-08	-07

SUMMARY OF INTERCORRELATIONS
(continued)

	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	51	60	63	55	66	57	67	67	13	18	33	09	30	50	48	56	59
	60	58	67	63	64	49	66	68	17	23	47	-11	30	51	61	67	61
1	41	49	53	45	49	37	52	54	23	17	39	-15	12	38	54	57	49
	50	55	60	54	59	47	61	63	18	19	38	-07	24	46	54	60	56
	51	36	50	50	38	49	51	52	15	18	27	14	38	47	61	65	47
	48	50	56	54	47	35	50	54	20	30	52	-12	40	58	64	61	51
2	54	37	49	61	40	41	54	53	07	07	37	00	26	35	64	57	53
	52	40	52	55	42	42	52	53	12	18	37	01	36	46	63	61	50
	35	18	31	31	15	28	28	21	08	12	07	-08	19	18	29	35	28
	26	19	25	30	21	20	25	26	08	15	23	-14	01	23	18	24	19
3	06	11	09	-01	03	14	08	07	07	07	-10	-17	-09	-09	04	05	05
	24	16	24	22	15	21	22	23	06	10	08	-11	06	13	19	23	19
	-01	01	01	05	-02	03	01	01	-04	-06	15	10	-09	-01	-08	-09	05
	-23	-12	-19	-23	-15	-17	-20	-21	01	-13	-20	-01	-17	-23	-31	-38	-13
4	05	22	17	05	21	24	20	19	02	02	04	-07	-14	00	04	13	16
	-06	03	00	-05	00	03	-01	-01	01	-06	00	00	-15	-10	-12	-12	03
	34	29	34	28	24	27	30	32	00	02	03	02	21	18	36	31	30
	22	30	30	25	23	09	22	25	17	08	07	-05	-05	01	31	38	21
5	41	28	37	42	28	24	35	40	01	-03	14	-04	16	21	45	42	39
	32	29	34	31	24	21	28	32	06	03	06	-02	10	12	37	36	30

SUMMARY OF INTERCORRELATIONS
(continued)

	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		-12	30	07	10	04	-01	-01	20	21	-25	07	-28	-15	-05	-21	46	-07
		-28	08	00	05	-02	08	-18	10	18	-25	10	-24	-06	04	-21	37	-14
6		-11	20	19	-02	06	08	01	12	13	-06	24	-35	-06	16	-17	47	-18
		-17	19	09	03	02	05	-05	15	16	-20	14	-29	-08	03	-20	43	-13
			-25	-01	-19	-20	-19	03	05	-02	16	12	26	12	-04	05	-32	06
			-22	00	02	-09	-13	-03	-16	-04	-05	03	10	07	-01	07	-44	27
7			-47	-01	-12	-10	-27	-24	-06	-11	-09	16	30	09	-34	05	-47	08
			-32	-01	-10	-13	-19	-09	-05	-06	02	10	22	10	-12	05	-41	13
				-08	18	00	20	-02	06	18	02	-20	-27	-19	-04	-09	40	-25
				-01	19	10	19	05	00	21	-11	-12	-27	-17	-02	-10	36	-19
8				-08	30	11	30	16	13	14	00	01	-49	-20	39	-06	49	-02
				-05	23	07	22	06	06	18	-04	-11	-34	-19	10	-08	42	-16
					-07	15	25	-02	25	14	-03	-05	-07	02	09	25	-08	-29
					05	29	-03	24	00	18	-06	-04	-06	-10	18	-04	-07	-02
9					11	02	-11	05	18	12	-02	02	-03	06	06	11	05	-18
					04	15	04	08	15	07	-04	-02	-05	-01	11	11	-03	-17
						11	13	13	-04	12	13	-01	-09	01	21	-13	15	02
						15	07	20	08	34	00	06	-16	-07	21	12	08	-12
10						27	21	13	10	14	-12	19	-21	-36	37	-13	30	05
						18	12	15	04	22	00	08	-16	-16	27	-03	18	-01
							28	14	00	23	08	-09	-04	-08	13	09	15	-06
							12	24	-07	-01	-05	02	-23	-13	27	-06	14	-13
11							16	08	15	12	06	04	-06	-31	35	12	10	-06
							19	16	02	12	03	-01	-11	-18	28	05	13	-08
								03	15	-03	16	-20	-02	-02	00	20	12	-30
								-11	12	-10	16	-09	-04	-09	00	08	10	-07
12								12	17	12	-06	07	-08	-21	27	00	18	06
								12	14	-02	10	-08	-05	-10	08	09	13	-12

SUMMARY OF INTERCORRELATIONS
(continued)

	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	28	-11	-12	21	56	06	-04	03	12	04	08	-02	21	-04	00	07	-18	-02
6	19	00	06	19	45	17	-02	02	05	00	05	01	04	01	04	-01	14	-06
	13	-14	-06	22	48	09	-13	22	15	04	08	-10	12	06	14	14	-01	15
	20	-10	-05	21	50	10	-05	09	10	03	07	-03	12	01	06	06	-03	01
	-05	03	-04	02	-29	-01	-03	05	01	08	-04	03	05	03	03	05	09	11
7	-02	09	-02	06	-30	01	-11	08	-08	-13	-23	-08	04	-07	-04	01	-05	07
	01	00	-28	13	-38	18	02	-15	-20	-07	-09	-25	-10	-15	-07	-02	-08	-03
	-02	04	-11	08	-32	05	-04	-01	-09	-04	-12	-11	00	-06	-02	02	-01	06
	13	02	00	-12	47	05	02	15	25	05	18	16	16	-03	10	-02	-17	08
8	00	-05	-02	-10	36	04	16	02	09	-07	00	-18	07	-18	21	00	-02	06
	13	03	20	-04	51	-16	-03	19	11	19	15	12	12	01	14	07	11	00
	09	00	06	-10	44	-02	05	12	16	06	10	04	11	-07	14	01	-04	05
	-20	-17	01	02	-01	-08	-17	09	-04	00	02	00	01	-08	-06	04	03	10
9	-11	-09	04	02	02	-28	02	00	-03	17	07	00	-11	18	03	14	14	-19
	-01	-11	-01	-05	-02	-14	-19	18	00	02	-04	-08	04	-03	07	-25	10	17
	-10	-12	01	-01	00	-16	-12	09	-02	06	02	-03	-02	02	01	-02	09	02
	-04	05	06	-01	14	-02	-04	00	06	17	01	03	-01	06	11	02	-03	00
10	-18	-04	-06	-04	12	-11	-02	-03	04	08	-04	-08	10	08	23	16	16	05
	11	11	11	01	30	-11	-11	01	13	15	-05	14	-04	14	01	12	-01	12
	-04	04	04	-03	18	-08	-07	-01	09	14	-03	04	02	09	11	09	05	06
	-09	03	16	-13	10	09	-13	15	08	19	21	09	-12	20	14	11	17	10
11	-13	04	06	00	12	03	06	28	06	24	-01	02	-03	18	13	18	23	10
	-01	-12	21	04	06	-14	-27	14	01	12	03	-08	-08	15	21	23	16	18
	-08	-01	15	-03	09	-01	-11	19	05	18	07	00	-07	17	16	17	19	12
	-25	-08	04	-17	17	12	07	-02	17	00	-07	03	00	-08	26	-08	17	25
12	-05	-02	05	-33	08	-04	02	19	-05	-19	-24	11	22	-10	15	-07	04	-09
	10	09	29	-07	24	00	-06	05	16	03	-04	06	13	06	05	23	04	-02
	-07	-01	12	-19	16	03	02	07	07	-06	-20	06	12	-05	16	02	08	05

SUMMARY OF INTERCORRELATIONS
(continued)

	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
	11	-14	10	00	-11	-14	-07	03	15	-10	13	-11	-03	05	10	24	16
	-04	04	-02	06	04	06	-18	-07	-09	-07	-04	04	-12	09	08	02	-03
6	04	-05	-08	01	-05	-02	-04	-21	-05	-15	00	-14	-08	10	04	01	04
	04	-04	01	-02	-04	-05	-09	-09	01	-10	02	-07	-07	07	07	10	06
	06	29	-02	-03	-11	01	04	-15	-07	09	-02	17	01	-01	-03	-05	-16
	-09	15	-12	03	05	-05	00	11	05	04	05	17	01	-05	-04	01	03
7	-10	01	13	17	-03	-04	-02	21	10	10	14	02	14	-17	-18	13	04
	-04	17	-01	05	-03	-03	00	05	03	08	06	12	05	-07	-07	03	-03
	09	-08	01	-09	-17	00	-19	01	-09	-02	-08	-01	-16	01	02	00	00
	16	15	04	-08	03	-07	06	-34	-09	07	10	-07	-13	01	-02	-14	-14
8	16	05	-20	-19	01	03	-02	-21	00	-10	-17	-19	-14	17	23	-12	-18
	13	03	-04	-11	-05	-01	-05	-17	-07	-01	-05	-09	-14	05	06	-08	-10
	09	02	06	12	00	08	-02	05	08	-03	02	-08	-02	14	09	10	10
	-11	-04	-12	-02	03	00	-05	-05	-02	01	-03	-16	-11	13	16	-13	-11
9	-09	02	15	00	11	-10	-10	01	11	04	-06	-02	-13	-06	05	-16	00
	-04	00	03	04	04	00	-06	01	05	00	-02	-09	-09	08	10	-06	00
	15	-23	-01	08	11	-03	02	-09	-10	-01	03	08	-16	01	03	-14	-05
	14	-03	03	02	-15	-04	-02	-22	-18	03	10	01	-08	23	20	-06	-09
10	13	-06	-10	-15	06	00	08	09	-01	-16	-06	-10	-09	09	21	-01	-07
	14	-11	-02	-04	-01	-01	03	-06	-11	-06	03	00	-11	12	15	-07	-08
	15	15	-13	-05	08	-24	08	12	-11	-02	07	-20	-14	18	20	-06	01
	16	18	-10	-02	-04	02	-09	-16	-05	-02	01	-16	-12	16	25	-17	-30
11	25	05	-07	-23	-06	-02	08	-18	-12	-20	-12	-29	-29	25	24	-05	-34
	18	13	-10	-10	-01	-08	02	-15	-09	-08	-01	-21	-18	20	23	-10	-21
	08	25	-21	-17	17	-29	-09	-17	-03	00	-10	-07	-20	24	00	-05	-06
	08	21	-07	-07	03	-04	05	04	08	00	03	-05	-09	-03	-12	06	02
12	18	-01	04	03	-05	08	11	03	-15	06	02	-12	-09	05	09	05	03
	11	17	-09	-07	06	-10	01	-04	-02	02	-01	-07	-13	09	-02	02	00

SUMMARY OF INTERCORRELATIONS
(continued)

	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	12	03	08	08	01	30	16	13	23	25	18	-09	03	13	02	03	13
6	-02	04	01	03	-02	06	02	02	21	22	16	-10	07	14	00	04	00
	11	-06	03	17	03	31	20	15	-16	-06	20	28	24	19	00	04	02
	07	00	04	08	00	22	11	10	10	15	17	03	09	14	00	03	05
	02	-05	00	01	05	-03	00	-01	-02	-07	-12	02	-02	-08	-05	-06	-03
7	00	-15	-10	01	-02	-08	-03	-06	-08	-07	-09	12	-04	-14	-06	00	-07
	-02	-01	-01	-11	04	-13	-06	-04	-01	-05	-12	-09	-10	-17	01	-06	-05
	-01	-08	-04	-03	02	-08	-04	-04	-03	-05	-10	01	-06	-12	-04	-05	-06
	16	06	10	04	-03	15	03	07	01	09	20	-01	-01	11	06	07	12
8	07	05	07	09	02	07	06	07	00	-02	-03	06	09	-01	04	02	12
	17	02	10	13	06	31	19	18	03	06	16	-02	20	26	17	20	15
	14	05	10	08	02	17	09	10	00	03	11	02	09	10	09	10	13
	09	08	09	22	18	22	22	17	01	15	12	-02	22	26	13	14	11
9	20	12	18	24	24	26	29	26	-05	03	21	10	19	21	22	19	20
	-01	00	-02	-07	06	03	03	02	-10	-08	02	14	09	00	-10	01	00
	10	07	09	13	16	17	18	15	-05	03	11	08	17	15	09	11	11
	17	16	18	17	11	16	17	18	-04	-03	-11	03	15	07	17	25	17
10	36	18	30	32	25	30	34	34	05	18	24	06	15	25	31	26	27
	41	05	24	25	19	28	28	31	09	13	24	-10	31	34	26	17	29
	32	13	25	26	19	25	27	28	02	08	11	01	22	23	26	23	25
	15	10	14	14	14	17	18	17	10	11	01	02	22	23	22	20	11
11	11	-02	05	04	-06	17	04	04	02	09	23	02	13	20	12	08	07
	06	-09	-03	15	05	04	09	05	03	19	16	-02	16	20	14	12	-02
	22	00	06	11	05	13	11	09	04	12	13	01	17	21	16	14	06
	07	-05	01	17	03	01	06	04	-02	06	-04	-05	05	11	13	10	-04
12	-11	09	-01	-07	-03	07	-01	-01	-02	-05	-14	13	18	-13	-04	-01	01
	14	01	10	13	04	17	14	13	17	16	22	-10	07	17	05	-02	10
	02	01	02	07	01	08	05	04	04	06	00	-01	10	03	03	02	01

SUMMARY OF INTERCORRELATIONS
(continued)

	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		14	26	07	-12	22	-13	15	19	03	13	-01	07	07	-19	-06	-31	-20	00	08	21
		-09	11	06	-10	-04	-10	19	07	-07	-18	-14	01	20	-15	-11	-04	05	-08	13	09
13		-01	16	09	-14	-01	17	30	06	20	28	08	10	31	-03	09	-25	-16	05	02	-15
		02	17	06	-12	05	-02	21	11	05	07	-02	06	19	-12	-02	-20	-10	-01	08	06
			27	02	-18	-28	05	13	31	33	-46	-06	-56	-06	-10	20	-19	02	-18	22	23
			01	25	-17	-03	35	09	43	14	-40	-12	-48	01	-14	15	-04	-11	16	20	05
14			-01	19	-10	-26	14	09	41	25	-30	-16	-32	-01	-17	28	-06	-19	19	04	16
			09	14	-15	-19	18	10	38	24	-39	-11	-46	-03	-13	21	-11	-08	06	15	15
				-03	-09	-12	-02	01	16	29	-11	04	00	14	-13	17	-04	-03	11	19	22
				-12	-09	-10	-11	01	02	11	00	-11	-07	-09	-19	23	-12	08	-19	05	04
15				-07	-12	-02	-08	06	-10	18	-04	05	05	07	-12	16	03	-09	14	-01	06
				-07	-10	-08	-09	04	03	19	-04	-01	00	05	-16	18	-04	-02	01	09	12
					-33	11	12	30	36	-19	-25	-48	-10	33	-34	-16	-09	00	13	10	13
					-36	28	06	15	44	-22	-16	-55	01	27	-50	-30	-10	00	-11	-11	-10
16					-32	13	11	20	53	-10	-13	-57	04	36	-43	-13	-21	-13	-01	18	12
					-33	18	08	23	44	-18	-18	-53	-01	32	-42	-21	-13	-04	01	05	04
						13	23	-32	-21	-11	34	31	14	-35	51	-15	17	00	-10	-26	-18
						-19	20	-18	-30	18	05	33	00	-32	52	11	13	-01	12	12	10
17						-20	-07	-05	-43	-06	-09	35	-06	-36	50	15	33	05	04	-14	-05
						-09	13	-18	-31	00	11	33	03	-34	51	03	21	01	02	-10	-06
							22	-18	29	-60	04	-26	20	-08	-08	-56	-10	-09	09	-09	-08
							16	-16	19	-62	30	-22	19	02	-30	-60	-06	05	-12	-18	-07
18							17	-20	20	-59	14	-27	14	06	-12	-57	02	07	-24	-16	-10
							18	-18	22	-60	16	-25	17	01	-17	-57	-04	01	-10	-14	-08
								-32	35	-27	-13	-16	-16	-42	07	-18	-13	11	-05	-02	03
								-22	32	-10	-27	01	-38	-17	06	-05	00	-24	-04	19	-08
19								-38	25	-18	-14	-17	-16	-16	-01	-22	09	-11	02	-04	-11
								-31	30	-18	-19	-10	-24	-25	05	-14	-02	-06	-03	04	-05

SUMMARY OF INTERCORRELATIONS
(continued)

	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	23	16	-32	30	13	-01	24	-09	-02	03	-12	-06	11	-06	23	01	-11	-09	-05	19	-21
	10	-07	-23	20	11	05	32	04	13	03	-25	-23	01	04	-06	-22	-08	-18	-19	-02	-20
13	-11	-05	04	02	19	-12	36	03	20	21	-28	-21	01	-08	-01	-06	-21	-16	-10	-14	-34
	07	01	-16	18	14	-03	30	-01	10	09	-21	-17	04	-04	06	-09	-13	-14	-12	01	-25
	17	10	-18	20	-07	02	-07	00	-03	03	-07	-04	01	12	-10	06	-01	-19	01	-06	-03
	06	14	13	-02	03	05	-18	00	-01	03	17	15	-10	-25	03	-12	14	07	01	-03	00
14	-02	-05	16	04	03	-03	-01	03	-01	01	01	-12	10	03	-19	-11	09	-05	-06	-15	-19
	07	07	03	08	00	01	-09	01	-02	02	03	-01	01	-01	-09	-06	07	-05	-02	-08	-07
	20	35	08	20	-03	09	-02	-04	04	-17	-07	-05	-09	-05	05	-10	-06	-12	-03	-13	-09
	01	-16	-05	21	-01	-03	09	-09	-08	02	04	04	03	-01	-19	-23	-14	-12	04	-17	-19
15	-07	04	07	08	04	14	10	-16	08	10	-27	-10	00	07	04	02	03	-07	-08	-18	-04
	04	07	01	16	00	06	06	-09	01	-03	-09	-03	-03	01	-03	-09	-07	-11	-01	-15	-11
	08	26	-22	19	13	07	04	09	02	17	-03	00	-11	01	-01	-03	-16	12	03	03	-10
	-10	-02	-16	18	13	-01	09	04	06	-04	-19	-12	16	-15	08	08	10	-13	-36	-12	-17
16	06	12	06	10	22	-05	25	09	08	18	-10	-06	13	10	-16	-04	-12	-11	-16	-10	-13
	01	10	-10	16	16	02	13	08	05	08	-11	-06	05	-02	-03	01	-05	-04	-16	-06	-13
	-14	-13	10	-06	-20	02	-09	-05	-06	-09	04	07	-01	-03	09	01	17	05	06	06	16
	01	-04	30	-09	02	08	-11	-01	02	-15	13	03	-12	17	02	09	10	03	16	18	17
17	05	06	-06	-09	-08	08	-08	06	-07	-16	12	-09	01	00	03	-09	07	07	-07	-04	00
	-03	-03	10	-08	-09	06	-10	-01	-04	-13	09	01	-04	03	05	00	12	05	05	06	11
	-07	-01	-03	-10	-03	-13	09	-05	04	16	05	07	07	-01	28	01	-06	13	02	05	04
	-09	06	-14	05	-17	-03	-18	-08	-15	-20	11	12	-08	16	25	25	20	-03	-11	05	17
18	-11	-03	-19	10	-17	-04	01	-07	-11	-09	13	22	-13	-03	-08	18	01	-02	14	12	09
	-09	01	-13	02	-13	-06	-03	-07	-08	-05	09	14	-05	04	15	15	06	03	02	07	10
	-01	-01	07	03	-01	-17	05	02	-13	22	-02	00	19	10	26	01	-02	12	-06	05	13
	02	15	20	-09	-09	05	-34	-07	-19	-17	27	09	-07	04	01	00	14	15	-04	11	14
19	-01	10	02	-04	-01	-11	-01	-09	-17	-01	06	05	-02	10	-17	03	14	12	06	15	16
	01	08	10	-03	-04	-07	-12	-05	-16	02	11	04	04	07	.04	00	09	14	-02	10	14

SUMMARY OF INTERCORRELATIONS
(continued)

	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	11	28	-22	-27	56	31	50	53	30	38	44	48	17	19	16	15	19	26	45	58	44
	26	32	-35	-40	36	29	37	36	38	30	41	41	13	30	42	-10	10	40	46	47	33
13	17	18	-39	-29	31	19	29	35	27	27	34	30	01	02	10	-01	17	15	42	45	24
	18	26	-32	-32	41	26	38	41	32	32	39	39	10	18	21	00	14	27	44	50	34
	16	15	-02	-06	20	12	18	20	24	30	29	25	16	16	14	-04	16	23	05	06	16
	08	-08	12	03	-03	-16	-11	01	-04	07	02	-03	01	01	-05	09	-03	-05	-03	-10	-04
14	20	05	02	-06	03	-03	-01	12	01	04	08	08	08	00	-08	-04	-08	-11	-02	01	01
	14	04	04	-03	07	-02	03	11	08	14	14	11	09	06	02	00	01	02	00	-01	05
	-07	07	-02	01	32	32	37	36	33	48	45	43	-02	00	09	11	16	18	11	22	31
	21	32	-08	-02	45	43	49	46	39	32	44	47	18	27	38	01	24	39	47	50	51
15	-02	13	-20	02	26	15	23	34	10	19	23	23	13	13	17	-15	04	15	38	35	26
	05	18	-10	-01	35	30	37	40	29	34	39	39	08	12	21	01	18	26	33	37	36
	-04	-07	-08	-10	09	09	08	08	09	05	07	07	-02	-02	00	08	02	-08	08	01	15
	16	15	-18	-18	03	03	05	-02	10	05	06	06	04	05	-09	-09	-01	01	14	06	07
16	21	09	-17	-30	06	16	14	11	06	07	09	11	20	19	-03	-10	-28	-04	19	20	11
	10	06	-14	-19	06	09	08	06	09	07	08	09	06	06	-02	-03	-06	-02	14	09	11
	-05	-11	16	11	-02	-08	-04	-11	-12	-06	-10	-08	-11	-10	-14	-01	-09	-11	-08	-12	-09
	-12	-09	15	14	-17	-07	-13	-07	-17	-06	-11	-12	02	02	-09	04	-04	-11	-27	-25	-15
17	01	07	18	15	-08	-01	-06	-10	05	10	05	04	-04	-05	18	-01	18	12	-11	-19	-09
	-06	-05	17	13	-08	-05	-07	-10	-09	-01	-06	-06	-04	-04	-03	00	01	-04	-16	-19	-11
	-08	-14	-08	-23	-02	01	-01	06	03	-20	-05	-03	12	05	-17	-02	-20	-25	06	04	00
	-18	-10	-03	12	01	01	02	04	05	-18	-02	00	-08	-10	-28	-08	-24	-27	01	00	-08
18	-10	-11	04	02	-09	-05	-06	-09	02	-26	-12	-12	20	15	-08	-26	-36	-20	-06	-11	-10
	-12	-12	-02	-02	-03	-01	-01	00	03	-22	-06	-05	08	03	-17	-13	-26	-24	00	-03	-06
	02	-13	02	-03	-01	14	07	11	05	01	08	08	-04	-08	-23	-02	-05	-22	-23	-13	02
	-12	-20	28	30	-22	-[illegible]	23	-13	-20	-13	-16	-19	02	-01	-16	07	-18	-23	-26	-25	-20
19	-14	-04	-04	11	00	14	08	01	12	05	10	05	07	01	-15	-08	-19	-19	-04	07	04
	-08	-13	10	14	-08	01	-04	-02	-03	-03	-02	-04	03	-02	-18	02	-15	-22	-19	-12	-05

SUMMARY OF INTERCORRELATIONS
(continued)

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
		04	14	-09	-20	-04	41	-06	01	-08	-24	08	11	13	08	20	-27	30
20		18	06	08	-22	-03	51	-08	05	09	-09	00	04	03	-06	-08	-23	27
		08	28	-10	-10	-06	47	03	23	-20	-23	20	14	12	-01	01	10	13
		10	15	-09	-18	-03	46	-05	09	-07	-20	10	10	09	00	03	-12	23
			-21	-38	-48	-25	-02	-29	-23	-18	-07	09	17	12	14	24	-05	19
21			-24	-25	-45	-30	32	-37	-20	-08	-15	10	-13	-05	-27	-04	-10	11
			-14	-16	-50	-18	31	-51	-21	-23	-14	-02	09	19	07	06	10	14
			-19	-26	-48	-24	21	-39	-21	-16	-12	06	05	09	-03	09	-01	15
				-14	19	-16	12	01	71	08	06	-19	10	11	10	10	06	07
22				-35	30	-13	-06	24	76	14	01	08	14	09	14	-03	30	-03
				01	18	-07	02	-05	72	-01	-11	27	32	22	16	08	18	09
				-16	23	-12	02	07	73	07	-01	07	19	14	13	06	18	04
					30	38	-13	29	-16	25	-07	-11	-20	00	-02	03	-06	05
23					15	34	-11	-02	-33	16	03	-05	-14	04	03	02	01	-02
					24	39	03	06	-06	06	13	-09	-13	-13	-15	-10	-09	-08
					23	37	-07	10	-19	16	02	-08	-15	-02	-05	-02	-04	-01
						13	-31	22	24	06	04	-01	-03	-09	06	-05	07	-07
24						06	-27	44	28	13	-02	02	06	-03	22	-02	28	-24
						10	-38	35	17	26	07	02	-22	-12	-05	-04	-04	-06
						09	-32	34	23	15	03	01	-06	-08	08	-03	10	-12
							11	09	-16	06	-11	13	-01	-03	-06	01	-01	-06
25							-04	03	-15	06	01	-16	-16	03	-09	-18	-13	02
							21	-02	-17	06	03	-09	-02	-05	-08	15	09	00
							10	03	-17	06	-03	-04	06	-02	-08	-01	-01	-02
								-14	-03	-02	-09	02	07	01	-10	22	-14	13
26								-20	-09	12	01	-05	-26	01	-17	-06	-34	27
								-30	-09	-36	-06	-03	22	12	06	-04	08	20
								-21	-07	-10	-06	-02	02	04	-07	04	-11	19

SUMMARY OF INTERCORRELATIONS
(continued)

	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
	18	22	25	02	20	03	-19	-19	09	-10	-08	-05	-17	-25	-04	-03	-28	22	40	-28	-17
20	08	10	33	07	21	11	-27	-14	13	-22	-12	-15	-06	-34	-10	-06	-24	37	34	-30	-42
	22	10	30	16	30	14	-19	-31	-06	-01	02	-16	-24	-29	-16	-17	-38	33	30	-20	-30
	16	15	30	08	23	08	-22	-21	05	-10	-06	-11	-16	-29	-09	-08	-30	31	35	-26	-29
	06	-15	07	01	-10	12	-05	00	05	09	14	16	-15	-10	01	-05	-10	15	05	-09	-06
21	-11	01	-08	01	01	-04	03	01	00	-13	02	-07	07	-02	-27	13	-06	22	07	01	-04
	15	-02	03	00	11	17	-01	02	-10	10	-26	-08	-15	09	[illegible]	13	-05	07	00	00	-16
	03	-05	01	00	01	07	-01	01	-01	03	-03	00	-08	-01	-09	-02	-07	15	04	-03	-09
	02	01	-08	04	08	-06	-07	-11	04	-09	-17	-02	05	-17	-01	-15	-08	13	24	04	08
22	27	08	05	14	24	13	05	-05	-10	-17	-28	-19	-25	01	12	-17	-02	06	-06	06	-04
	19	07	02	16	16	08	-15	-16	07	-03	03	-09	-09	-15	-12	-05	-12	04	23	-15	-09
	15	05	00	11	16	05	-05	-10	00	-09	-14	-10	-10	-10	-01	-12	-08	07	12	-02	-02
	05	-01	05	02	-01	-06	-11	-07	00	-15	18	-11	00	-04	-02	07	-05	-09	03	-08	-06
23	-17	-16	-01	-20	-16	-04	13	09	13	13	12	18	09	-04	12	-08	11	-13	01	-02	09
	-13	-07	04	-11	-01	08	-03	23	-05	-04	08	10	02	01	22	12	11	-12	-14	-06	01
	-08	-08	03	-09	-07	-02	-01	08	03	-03	13	05	03	-03	10	04	06	-11	-03	-06	01
	-04	01	-07	-05	-14	-18	08	-04	-05	-05	-11	-04	13	-08	-07	-09	01	-06	-04	14	10
24	-01	-08	-14	-03	05	-02	12	06	-10	04	-08	13	-01	03	29	06	25	-27	-19	16	15
	03	08	-10	-02	-15	-05	07	03	-05	00	19	00	04	15	08	-07	14	-16	-07	09	08
	-01	00	-11	-03	-07	-08	09	01	-06	-01	00	03	05	04	11	-03	14	-17	-11	13	11
	01	-10	00	-18	-05	-05	04	02	-04	-01	12	-02	-06	04	-01	-04	07	-23	-12	03	-05
25	-01	-15	20	-01	15	05	-21	-16	16	07	-04	13	03	-14	-09	-19	-09	-12	14	-24	-28
	-09	-01	04	-09	-03	-06	13	12	14	08	15	24	16	00	-01	19	08	-10	-01	-05	-09
	-03	-08	09	-09	02	-02	-02	-01	07	04	07	12	04	-04	-03	-01	02	-15	01	-09	-14
	-02	18	10	-05	12	-12	07	-03	-14	-04	-14	-09	-02	03	-04	-08	-11	-08	15	-16	-06
26	13	03	43	09	19	06	-49	-26	24	-26	-12	-16	-11	-24	-21	04	-45	51	24	-44	-39
	26	14	24	-03	31	13	-14	05	-07	02	12	00	-17	-19	09	06	-22	18	13	-21	-27
	13	13	25	01	20	01	-17	-07	00	-08	-05	-08	-10	-13	-04	01	-25	19	18	-26	-24

SUMMARY OF INTERCORRELATIONS
(continued)

	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	05	03	04	07	14	05	10	08	02	14	20	10	27	33	28	25	11
	12	05	09	19	18	25	24	19	-15	01	28	25	33	35	20	28	07
20	19	05	14	17	04	11	11	10	02	13	22	-04	19	27	12	13	14
	12	05	09	15	13	14	16	13	-05	08	24	11	28	32	21	22	11
	21	25	25	29	27	23	30	29	-04	06	14	14	19	09	17	15	19
	-01	-10	-05	06	00	04	04	01	17	15	00	-12	-14	10	07	09	-07
21	07	06	03	09	05	-02	06	05	11	02	-16	-03	-23	-23	04	04	08
	09	07	10	15	11	09	14	12	08	07	01	-01	-07	-01	10	10	07
	12	08	10	07	-03	23	11	11	01	08	26	07	20	27	04	11	09
	-05	-08	-08	-07	-12	06	-06	-07	12	13	17	-02	14	18	-08	-10	-04
22	18	-05	06	22	-02	29	17	17	-07	-02	17	15	24	23	15	14	11
	09	-02	03	07	-06	19	07	07	02	06	19	07	18	21	03	05	06
	-07	-17	-12	-22	-26	-16	-25	-21	-15	-13	-10	25	03	-07	-06	00	-15
	12	11	12	02	03	-03	00	04	-19	-21	-07	15	05	-10	00	06	05
23	01	-12	-08	-04	-08	-05	-06	-06	12	06	-05	-05	-07	-01	14	06	-07
	02	-06	-02	-08	-10	-08	-11	-08	-09	-11	-08	12	02	-06	03	04	-06
	-01	-07	-04	-11	-11	00	-08	-06	-01	-07	-08	-09	-11	03	-04	-06	-02
	-11	-11	-13	-14	-23	-06	-18	-	00	-11	-05	04	01	-06	-18	-12	-16
24	-05	-11	-09	-04	-13	04	-05	-09	-17	-18	-06	17	16	05	-09	-07	-13
	-06	-10	-09	-10	-16	-01	-11	-10	-05	-11	-06	04	02	00	-11	-09	-10
	08	01	05	08	-05	-03	-04	00	04	-04	-12	-03	-05	-04	05	05	06
	14	11	13	02	04	-07	-01	04	-01	01	04	09	06	02	09	17	05
25	18	-06	07	06	-05	04	-01	05	-03	-03	01	09	-05	07	15	08	08
	13	02	08	06	-01	-01	-01	03	-01	-02	-02	00	00	02	10	10	07
	09	03	06	05	09	07	08	08	11	10	16	-08	13	21	18	11	10
	-04	06	01	14	12	11	13	10	06	14	18	-08	15	31	26	31	03
26	19	17	21	17	15	19	18	18	16	19	21	-05	03	20	26	20	20
	09	09	10	12	12	13	13	12	10	14	18	-06	11	24	24	20	11

SUMMARY OF INTERCORRELATIONS
(continued)

	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
		02	04	04	-08	-15	-08	-03	-06	-02	-07	-18	05	01	-02	00	-13
		17	09	-10	08	06	12	11	-08	15	-16	-12	11	-11	-03	-04	-15
27		10	22	11	-01	-20	-14	-02	-09	-13	-04	-09	05	04	09	-05	-11
		10	12	02	00	-10	-04	02	-07	00	-09	-12	07	-03	01	-03	-12
			01	05	11	12	00	02	-04	06	-05	05	13	-14	10	00	-10
			08	02	-01	21	-05	05	-10	18	-09	20	08	07	14	18	14
28			-05	01	26	23	15	04	08	24	-07	06	06	-13	05	02	02
			01	03	12	18	03	04	-01	16	-07	10	09	-07	09	07	03
				03	-15	-21	-20	-18	06	24	-07	03	08	-11	16	11	00
				-03	12	-02	-04	-12	-11	22	-13	-08	-02	-01	12	-01	03
29				07	01	-26	-09	-21	04	04	-09	04	-01	-05	11	-09	-03
				03	00	-17	-11	-17	01	16	-09	-01	02	-06	13	00	00
					-36	-23	-23	-05	-08	21	-27	-15	-22	-19	00	-21	02
					-11	00	-05	-02	-09	10	-13	-06	-05	-07	05	-09	-12
30					-52	-14	-12	-07	-01	09	-02	-25	03	-26	-17	-11	-23
					-33	-13	-14	-04	-06	13	-15	-15	-10	-17	-03	-14	-09
						10	16	15	13	-04	09	13	16	01	09	07	-05
						-03	21	-01	13	06	-15	-04	03	-05	02	05	08
31						09	02	02	-06	02	-24	17	-09	10	14	03	16
						05	13	05	06	02	-10	08	04	02	08	05	06
							33	22	25	-07	26	17	23	06	00	05	-03
							04	18	03	-07	-03	08	07	-03	03	01	08
32							21	37	04	07	10	02	15	-03	12	11	08
							20	25	11	-02	12	09	15	00	05	05	04
								51	23	-16	33	08	07	15	-02	08	-03
								47	28	-08	19	03	02	07	-13	-01	03
33								54	24	09	32	07	10	05	-07	23	06
								50	25	05	28	05	06	09	-07	09	01

SUMMARY OF INTERCORRELATIONS
(continued)

	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
27	-08	-01	-03	02	01	04	20	-07	06	00	09	-05	02	15	12
	07	03	-15	04	-02	10	-03	10	27	28	18	-10	-09	12	14
	05	-06	09	00	13	07	07	-05	-06	00	-03	05	07	00	03
	02	-02	-03	01	03	07	08	01	10	10	08	-04	-01	10	10
28	07	-07	-11	-10	-19	03	11	-13	07	-05	-02	01	24	12	12
	07	02	-03	-08	-33	-18	-18	03	14	-08	-09	06	-05	13	01
	-09	-11	07	-10	04	-27	-07	-09	-06	-21	-08	15	10	00	01
	03	-06	-03	-09	-16	14	-04	-05	04	-11	-06	06	09	09	05
29	-10	-13	-06	-21	00	-10	08	-05	00	-05	-02	-11	-19	08	10
	00	09	02	01	-03	00	21	12	21	17	04	-05	-04	-04	-01
	-03	-01	10	07	03	-03	19	15	02	13	12	-11	-05	12	03
	-05	-02	01	-05	01	-05	15	07	07	08	05	-09	-10	05	04
30	07	14	02	08	-10	-12	09	15	06	-01	20	-11	-40	07	17
	10	06	-04	11	07	-11	-19	10	12	18	-01	-21	-02	00	04
	03	22	-13	-08	02	13	-22	20	17	10	19	-06	-31	24	23
	07	14	-04	04	-01	-04	-08	15	11	08	13	-13	-24	10	15
31	11	-01	-07	-11	06	11	04	-05	-03	11	-08	-21	09	10	02
	-03	-06	-05	-06	03	07	06	08	01	08	07	-04	03	08	-10
	-10	-14	18	04	-03	-16	22	-09	-05	01	-22	07	08	-19	-07
	-01	-07	01	-04	02	01	10	-01	-02	07	-07	-06	06	00	-05
32	-09	-06	-12	05	-13	-14	-27	-04	-04	-11	-13	13	17	-12	-20
	13	-03	03	-06	-02	-21	02	07	00	-04	-07	07	-04	-01	-13
	00	03	-06	05	-01	13	-09	00	10	14	03	-06	18	-07	03
	01	-02	-05	02	-06	-07	-12	01	02	-01	-06	05	09	-07	-11
33	-09	02	01	06	07	07	02	-01	-05	01	-06	16	17	-11	-08
	-01	01	05	-17	-03	07	12	-02	06	-12	01	10	05	-05	-14
	-06	-10	-01	06	05	-04	-04	-13	-09	04	-16	09	21	-05	-09
	-05	-02	02	00	04	04	03	-05	-03	-03	-07	12	14	-08	-11

SUMMARY OF INTERCORRELATIONS
(continued)

	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	-15	-12	-14	-21	-13	-11	-16	-16	00	07	06	-11	01	09	-09	-13	-19
	-24	-19	-25	-20	-26	-19	-25	-26	-01	-03	-05	01	-07	-07	-31	-37	-27
27	-08	-08	-07	-09	06	10	04	-01	-07	04	14	-07	11	09	-07	-09	-13
	-16	-13	-16	-17	-13	-07	-14	-15	-02	04	05	-06	00	02	-17	-21	-20
	17	05	13	07	-03	35	16	16	16	24	30	-09	03	21	04	09	15
	-06	-04	-08	00	-09	11	-01	-04	18	15	23	-01	14	19	-05	-07	-01
28	15	-11	00	13	-02	35	17	13	04	08	24	03	25	25	06	04	07
	09	-03	02	06	-05	27	10	08	13	16	25	-02	13	21	01	02	08
	-28	-44	-41	-37	-42	-28	-42	-43	-23	-18	-17	02	-21	-25	-27	-33	-47
	-10	-20	-18	-02	-23	-04	-13	-15	-03	-11	-03	-12	-17	-08	-24	-11	-25
29	-20	-18	-22	-17	-18	-13	-17	-18	-24	-30	-11	09	-13	-14	-19	-22	-32
	-19	-27	-27	-19	-28	-16	-25	-26	-17	-19	-11	00	-16	-15	-23	-22	-35
	-22	-02	-15	-20	-22	-26	-25	-22	01	09	-10	-21	-22	-29	-31	-41	-19
	-08	10	01	02	00	13	05	04	10	08	-08	-14	03	-01	05	-01	03
30	-31	-33	-34	-31	-33	-23	-34	-41	-01	-03	-12	06	-11	-18	-22	-36	-38
	-21	-08	-16	-17	-19	-14	-19	-20	04	-01	-10	-10	-10	-16	-17	-27	-18
	12	18	17	07	12	21	15	16	02	02	03	-07	-15	04	14	08	20
	-05	-17	-14	00	-13	06	-05	-08	-09	-11	-02	04	-06	-06	-05	-13	-08
31	07	09	09	14	06	10	12	14	-05	-10	-09	-02	-06	-05	-07	09	08
	04	03	04	07	01	13	07	07	-05	-07	-02	-01	-08	-02	00	01	07
	29	24	30	27	22	32	28	29	11	07	08	11	08	11	24	26	37
	15	00	07	03	12	24	16	13	03	05	17	06	08	09	05	-01	10
32	22	22	25	21	14	33	26	24	04	11	14	04	08	20	14	17	27
	23	16	22	17	16	30	24	22	05	06	12	08	08	13	15	15	26
	22	25	27	26	23	27	27	28	08	-02	12	06	25	20	19	30	24
	30	09	22	26	18	28	27	27	-09	02	21	04	02	10	17	09	21
33	06	03	04	17	-04	17	09	08	16	22	24	-05	14	24	15	17	11
	21	14	19	23	14	24	22	22	04	04	17	03	13	17	17	19	20

SUMMARY OF INTERCORRELATIONS
(continued)

	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
		21	-08	21	00	-01	08	-01	04	-04	-06	-02	02	-11	19	07	04	06	-11	05	-12
		25	-07	13	10	-02	02	-05	01	08	17	00	03	-10	-08	-02	01	-06	06	-19	04
34		20	11	22	04	08	-01	-13	01	00	05	03	-12	07	21	04	01	-05	-01	16	08
		22	-01	18	05	01	03	-06	02	02	06	00	-02	-05	10	03	02	-01	-02	00	00
			-07	24	08	10	07	-07	03	00	-05	-05	-03	-04	07	-23	-17	-08	-04	-03	-15
			02	19	12	04	05	-08	-02	00	06	-04	-03	-12	06	05	-03	-13	-04	-07	04
35			03	24	-10	-04	-03	-12	-16	-05	15	00	03	13	11	13	08	00	00	14	14
			-01	22	03	03	03	-09	-05	-02	05	-03	-01	00	08	-02	-04	-07	-03	01	01
				-33	17	-07	-20	12	07	-01	12	14	00	01	-09	-10	21	17	06	19	22
				-29	01	09	-32	11	-01	01	27	21	-16	06	03	04	05	15	22	13	27
36				-37	-07	-01	-12	-07	08	-08	06	09	00	03	01	02	02	16	03	03	06
				-33	04	00	-21	06	05	-03	15	14	-05	03	-02	-01	09	16	11	12	18
					11	19	13	-06	00	-04	-16	-11	-07	-01	11	07	-06	-23	00	-15	-15
					28	23	51	04	26	-03	-31	-26	01	-20	-13	-07	-15	-38	-46	-34	-42
37					04	05	09	-03	08	-12	-06	-03	04	16	03	-03	-06	-26	05	02	-07
					14	16	25	-02	11	-06	-18	-13	-01	-01	01	-01	-09	-29	-14	-16	-21
						12	44	57	40	40	-37	-32	18	-39	-08	-42	-22	00	-25	09	-44
						07	44	52	49	46	-40	-38	13	-40	-19	-18	-19	-20	-23	-29	-49
38						18	48	44	35	57	-33	-23	07	-26	-08	-29	-13	-02	-14	-34	-31
						13	45	51	42	47	-37	-32	13	-36	-12	-30	-18	-08	-21	-17	-41
							03	06	13	-13	16	26	-56	04	14	-02	-03	24	35	18	13
							-02	-02	06	-09	11	24	-61	02	04	08	-16	11	10	19	10
39							-04	-18	16	12	13	13	-49	06	12	01	-21	16	12	-10	08
							-01	-03	11	-05	13	21	-55	04	10	02	-12	17	19	11	10
								40	40	33	-60	-55	39	-43	-01	-22	-11	-27	-48	-02	-60
								32	40	21	-66	-54	24	-20	-21	-18	-17	-41	-35	-38	-70
40								34	35	42	-48	-52	14	-08	-22	-19	-21	-32	-44	-27	-66
								35	38	30	-59	-53	26	-25	-14	-19	-16	-34	-41	-22	-65

SUMMARY OF INTERCORRELATIONS
(continued)

	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	09	10	-05	-02	18	23	24	19	12	15	17	20	-04	-10	16	09	26	16	09	19	23
	-02	10	-03	04	27	07	20	11	07	08	11	15	-25	-12	10	20	14	07	08	05	18
34	-14	09	02	07	14	12	16	16	05	23	15	19	-07	01	18	11	16	17	15	15	17
	-02	10	-02	03	19	14	20	15	08	15	14	17	-12	-07	15	14	17	13	10	12	19
	-03	17	-05	-12	23	23	24	20	18	25	22	23	-01	04	17	07	23	28	24	22	21
	-12	04	08	03	-06	04	00	00	02	07	03	02	-04	-02	05	-04	-09	-03	-02	-05	02
35	-15	12	10	02	05	01	04	10	03	09	07	03	02	-03	08	03	-06	00	03	03	08
	-10	10	04	-02	09	10	10	10	08	14	10	10	-01	00	09	02	01	07	08	07	11
	-07	-36	26	30	-22	-21	-26	-13	-31	-19	-26	-26	-22	-28	-08	09	-14	-30	-24	-32	-25
	-33	-30	46	40	-14	-25	-23	-24	-36	-08	-27	-26	02	-05	-20	05	04	-17	-33	-29	-18
36	-03	-11	08	10	-03	-13	-09	03	-27	-07	-15	-15	-07	-08	-05	12	00	-07	-06	-11	-12
	-14	-25	27	26	-13	-20	-19	-11	-31	-11	-22	-22	-09	-13	-10	09	-02	-17	-20	-24	-18
	22	24	-26	-23	32	15	29	24	23	24	27	28	11	20	29	15	30	34	16	29	26
	58	49	-34	-34	31	11	23	23	27	21	27	26	22	30	51	-22	24	55	36	51	28
37	13	28	-06	-09	06	-04	02	08	06	08	10	06	09	15	29	06	25	30	16	18	02
	31	34	-23	-22	24	08	19	19	19	18	22	21	14	22	35	00	26	40	23	33	20
	34	17	-22	-11	13	09	11	15	11	12	13	13	00	-01	00	12	-02	-05	13	13	14
	27	09	-36	-30	05	-04	00	-03	04	05	03	01	00	01	03	-07	12	08	07	12	05
38	33	28	-35	-41	22	12	20	15	11	18	16	15	-18	-10	05	13	-01	11	23	21	14
	31	18	-30	-26	12	05	09	08	08	12	10	09	-05	-02	03	05	03	08	13	15	10
	02	07	08	07	01	-12	-04	-04	-01	14	06	01	05	09	07	-04	-07	05	11	-07	00
	19	-08	11	09	-13	-19	-20	-11	-13	-02	-10	-15	00	-03	10	01	-07	05	02	-07	-15
39	-02	-05	19	04	19	05	13	18	05	11	11	09	04	01	07	13	-04	05	17	04	14
	07	-01	12	07	02	-09	-04	00	-03	08	02	-02	03	03	09	03	-06	05	09	-04	-01
	53	61	-49	-38	07	08	10	18	15	00	12	13	-07	-03	00	14	21	21	27	37	03
	56	56	-61	-57	21	16	18	14	21	10	16	17	00	14	43	-06	33	51	42	52	22
40	43	55	-64	-61	13	25	21	15	24	13	20	18	-01	10	28	-03	00	19	28	42	16
	51	57	-57	-51	14	16	16	16	20	08	17	16	-03	07	22	02	21	33	33	44	13

SUMMARY OF INTERCORRELATIONS
(continued)

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
		50	45	-45	-36	09	-46	-18	-35	-08	05	-22	06	-44	33	20	-14	00
		43	47	-29	-21	06	-37	-15	-28	-10	-04	-17	-12	-26	13	-03	-23	-21
41		26	24	-29	-37	33	-27	-30	-23	-02	-20	-33	-13	-36	37	25	-23	-22
		40	40	-35	-31	14	-37	-20	-28	-07	-05	-23	-05	-35	27	13	-20	-14
			30	-31	-30	05	-37	-09	-25	-18	04	-20	02	-42	30	33	-34	-14
			30	-34	-39	14	-31	-14	-17	-25	-26	-28	-27	-32	29	23	-31	-30
42			37	-28	-30	-11	-15	-20	-16	-34	-04	-21	-12	-42	38	34	-30	-23
			32	-31	-33	03	-28	-14	-19	-25	-10	-23	-13	-38	32	29	-32	-22
				-29	-34	29	-37	-02	-31	-12	07	-29	-02	-26	25	10	-15	-09
				-21	-17	16	-38	-25	-18	03	00	-02	-24	-25	04	01	-20	-15
43				-29	-19	03	-27	-18	-27	-14	04	-20	-30	-21	14	13	-32	-26
				-26	-24	17	-35	-15	-25	-07	04	-17	-18	-24	14	07	-21	-15
					65	-35	42	18	38	03	39	50	14	56	-47	-42	44	26
					66	-32	24	16	11	06	36	44	22	61	-40	-38	61	56
44					43	-21	09	28	29	18	40	28	19	39	-42	-35	44	40
					59	-30	27	20	25	08	38	40	18	53	-43	-39	50	40
						-45	43	16	25	07	56	74	20	73	-42	-51	40	32
						-46	31	14	27	10	53	62	31	61	-31	-50	52	53
45						-36	00	29	28	21	35	74	20	57	-41	-56	44	54
						-42	25	19	27	12	47	70	24	63	-38	-52	45	45
							-26	-12	-16	02	-35	-42	-14	-32	28	22	-29	-23
							-19	-15	-14	11	-40	-33	-27	-34	07	30	-24	-26
46							04	-10	-02	26	-29	-37	06	-25	21	22	-23	-29
							-15	-12	-11	12	-35	-37	-12	-30	18	24	-25	-26
								-09	18	03	08	35	-03	53	-24	-25	22	11
								19	26	-08	17	16	13	30	-25	-05	32	18
47								09	13	01	-12	13	03	13	-12	16	11	-01
								05	19	-02	04	22	03	33	-21	-07	21	08

	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
41	-14	-12	-16	-10	-12	-08	-11	-13	-19	-15	-04	10	-14	-05	-07	-06	-19
	-13	-20	-19	-20	-17	-13	-20	-21	-10	09	-08	-11	03	05	-12	-06	-16
	-09	-06	-09	-09	-02	-04	-06	-10	-05	02	02	-08	01	02	-05	-04	-14
	-12	-13	-15	-13	-11	-08	-12	-15	-12	-08	-03	-03	-03	01	-08	-05	-1[illegible]
42	-04	-02	-03	06	01	07	05	02	-11	-14	-06	11	-06	-01	13	19	02
	02	-08	-04	-03	01	01	00	-02	-08	-01	11	-02	13	20	07	14	-02
	25	10	21	27	06	13	15	15	04	14	15	-08	11	25	29	24	19
	07	00	04	09	02	07	06	05	-05	-01	05	00	06	15	16	19	05
43	-08	-02	-06	-03	-01	-15	-09	-08	03	-02	-19	-01	-06	-09	-16	-06	-11
	07	-01	03	-07	-02	02	-02	-01	-21	-18	-04	20	23	-02	05	06	09
	19	15	20	10	10	10	10	10	11	13	02	-12	-17	-03	24	19	21
	04	03	04	-01	01	-03	-02	-01	-02	-03	-08	02	02	-05	03	05	04
44	-09	-12	-11	-09	-17	01	-10	-11	08	-01	00	-11	-20	-21	-17	-35	-05
	-02	-13	-07	-07	-17	00	-09	-08	-05	-07	-20	12	-17	-28	-30	-34	-07
	-05	-05	-05	-11	-07	-09	-10	-06	03	-06	-19	07	-11	-16	-25	-33	-04
	-06	-10	-08	-09	-15	-03	-10	-09	02	-04	-11	02	-17	-22	-24	-34	-05
45	04	-03	00	01	00	02	01	00	05	-06	-06	-07	-08	-21	-06	-29	06
	-13	-18	-17	-13	-16	-16	-17	-18	-05	-16	-28	07	-23	-35	-25	-32	-15
	-11	-13	-13	-16	-20	-07	-17	-15	04	-09	-30	05	-18	-27	-18	-27	-10
	-06	-11	-09	-09	-11	-06	-10	-11	01	-11	-20	02	-16	-28	-16	-29	-05
46	11	10	11	15	01	-08	04	07	-08	-10	-16	12	19	08	09	18	03
	14	11	14	16	14	13	16	16	04	11	17	-05	25	23	11	10	16
	-15	-05	-11	-15	01	-04	-04	-05	-09	-03	02	02	00	-01	-08	01	-14
	04	06	05	06	05	-01	05	06	-04	00	-01	02	15	11	04	10	02
47	03	00	03	02	03	10	05	04	07	05	14	-09	05	03	-02	-03	04
	-02	06	02	-02	-03	-15	-07	-04	-01	-08	-17	00	-08	-18	02	-06	00
	-02	11	06	11	05	-07	05	08	10	11	05	00	-03	06	06	11	07
	01	05	04	04	02	-02	02	03	05	01	02	-02	-01	-03	02	01	05

SUMMARY OF INTERCORRELATIONS
(continued)

	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
		19	14	21	08	43	18	-19	-07	16	00	05	04	06	13
		-01	-12	12	16	01	12	-09	-07	09	17	-16	-11	-15	-16
48		19	09	-05	12	09	14	-37	-17	17	16	13	12	14	15
		12	04	10	12	18	15	-21	-10	14	11	01	02	02	03
			12	00	24	03	30	-21	-08	12	05	02	00	03	01
			25	04	12	22	42	-31	-24	28	24	-18	-14	-18	-11
49			23	05	19	23	31	-37	-14	11	14	12	06	10	07
			18	02	19	16	34	-28	-15	17	13	00	-02	-01	00
				04	-02	28	22	-16	-10	24	15	-04	-13	-09	-08
				07	05	13	20	-11	-19	07	09	-09	-13	-13	-03
50				-05	07	24	27	-19	-04	14	17	04	02	03	-01
				03	03	21	23	-15	-11	16	14	-04	-09	-07	-05
					43	28	47	-38	-53	23	36	-11	-07	-11	-08
					47	30	32	-30	-47	32	34	-24	-15	-23	-25
51					37	13	34	-40	-41	25	39	-04	-02	-03	-12
					42	24	37	-35	-47	27	36	-14	-09	-14	-16
						06	60	-29	-39	25	25	01	-15	-07	-04
						23	38	-29	-41	-30	45	-18	-13	-18	-08
52						28	46	-29	-43	39	47	-08	-13	-12	-10
						19	48	-29	-40	31	39	-08	-13	-12	-07
							20	-16	-05	22	15	03	-04	00	05
							39	-19	-27	31	20	-35	-16	-28	-18
53							29	-21	-15	17	29	-14	-07	-13	-15
							29	-18	-16	23	21	-14	-09	-13	-09
								-54	-55	49	37	-04	-09	-08	-04
								-60	-48	53	48	-26	-22	-25	-21
54								-59	-41	53	51	-06	-05	-06	-09
								-57	-48	52	45	-11	-12	-13	-12

SUMMARY OF INTERCORRELATIONS
(continued)

	63	64	65	66	67	68	69	70	71	72	73	74	75
	03	-03	05	06	17	12	-02	-07	-08	-04	-09	00	02
	-12	-13	-15	-15	-20	-20	-24	10	-18	-27	-10	-17	-15
48	12	13	15	16	-14	-09	03	16	20	09	15	08	15
	01	-01	01	02	-05	-06	-08	06	-03	-09	-02	-03	01
	-02	03	02	02	10	12	13	-07	-04	-03	-04	-05	00
	-10	-18	-14	-16	-02	-08	-20	-01	-16	-23	-22	-24	-20
49	02	-03	03	04	-05	-09	-11	09	-13	-12	06	-06	08
	-03	-05	-02	-03	00	-02	-03	01	-10	-13	-06	-11	-04
	-17	-09	-14	-13	14	06	08	-17	-01	04	-21	-11	-12
	-12	-09	-09	-11	-01	-07	-24	02	-18	-31	-32	-24	-14
50	02	06	04	04	-03	-10	-09	01	-09	-11	-05	03	03
	-10	-05	-08	-07	04	-02	-06	-05	-11	-14	-20	-11	-09
	-07	-08	-08	-10	04	-20	-20	-07	-31	-42	-21	-36	-02
	-19	-17	-23	-23	-02	-21	-34	00	-31	-43	-25	-35	-20
51	-13	-10	-14	-13	00	-15	-37	-10	-29	-36	-24	-25	-07
	-14	-12	-16	-16	02	-17	-28	-06	-31	-40	-24	-33	-10
	-07	07	00	-04	08	02	-01	00	-02	-12	-02	-25	-03
	-16	-08	-13	-15	-24	-30	-25	22	-07	-35	-25	-29	-21
52	-21	-13	-17	-17	09	00	-26	-06	-14	-20	-25	-25	-12
	-14	-04	-09	-11	-04	-10	-15	06	-07	-22	-17	-26	-11
	-01	01	-01	-01	01	-01	-06	-03	-15	-09	-04	-04	-03
	-23	-16	-22	-24	17	07	-22	-09	-39	-24	-27	-32	-29
53	-09	-10	-13	-14	01	-03	-07	04	-01	-09	-18	-16	-17
	-11	-08	-11	-12	06	01	-11	-03	-20	-14	-16	-17	-16
	-05	-10	-08	-09	17	02	-05	-19	-17	-24	-27	-36	-05
	-25	-20	-25	-25	-03	-13	-34	06	-30	-40	-40	-51	-30
54	-09	-10	-11	-09	08	-02	-16	01	-12	-15	-11	-23	-04
	-13	-14	-15	-14	07	-04	-17	-04	-20	-27	-26	-37	-12

SUMMARY OF INTERCORRELATIONS
(continued)

	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
		54	-37	-27	03	12	10	14	18	05	16	14	-12	10	16	22	30	35	20	31	03
		46	-36	-35	28	11	20	26	24	25	27	25	18	29	42	-10	22	54	41	47	29
55		37	-34	-34	-08	-11	-10	-09	-06	04	-04	-08	-02	08	16	00	11	22	01	12	-15
		46	-36	-32	08	05	08	12	14	11	15	12	00	15	24	04	22	38	22	31	06
			-34	-38	28	26	32	32	29	30	35	35	10	30	37	10	39	58	43	63	26
			-45	-48	39	35	41	37	33	36	39	41	10	28	52	-02	39	67	50	58	45
56			-38	-36	26	28	31	32	34	36	40	37	05	25	58	00	34	59	40	51	30
			-39	-41	31	29	34	34	32	34	38	37	08	28	48	02	37	62	44	57	33
				60	-16	-01	-12	-13	-07	01	-07	-09	15	19	07	-25	-15	00	-30	-36	-14
				64	-17	-24	-23	-19	-28	-07	-22	-23	07	-03	-21	01	-17	-26	-36	-44	-15
57				50	-10	-17	-16	-18	-12	-10	-15	-15	-04	-11	-11	00	06	-10	-30	-40	-10
				58	-15	-14	-17	-17	-16	-05	-15	-16	07	04	-07	-08	-11	-13	-32	-40	-13
					-23	-04	-17	-20	02	04	-04	-09	02	00	-04	-15	-08	-10	-29	-33	-17
					-27	-18	-25	-16	-21	-22	-23	-24	-15	-26	-38	08	-22	-44	-40	-45	-25
58					-12	-14	-16	-11	-22	-08	-17	-16	07	-04	-18	-04	12	-11	-30	-36	-11
					-21	-12	-19	-16	-13	-08	-14	-16	-01	-09	-18	-04	-08	-23	-33	-38	-18
						57	90	78	62	73	80	86	32	27	32	03	36	47	58	67	84
						52	86	73	65	63	77	82	12	23	51	-08	28	49	64	66	81
59						48	85	74	55	63	73	79	-01	10	37	00	19	42	65	61	83
						53	87	75	61	67	77	82	13	19	38	00	29	45	62	65	83
							86	57	77	55	73	81	28	27	33	-04	29	43	36	52	81
							88	62	80	48	74	81	10	20	31	02	27	35	55	56	80
60							85	49	76	49	70	75	17	17	37	-12	11	33	52	56	81
							86	56	77	50	72	79	18	21	33	-04	23	36	48	55	81
								77	78	74	88	95	34	31	38	-01	37	52	54	68	93
								77	83	63	86	94	12	24	44	-04	30	46	67	68	92
61								71	73	64	82	89	10	17	42	-08	14	43	66	66	94
								75	78	67	85	93	18	23	40	-03	28	46	62	68	93

SUMMARY OF INTER-CORRELATIONS
(continued)

	62	63	64	65	66	67	68	69	70	71	72	73	74	75
		67	63	85	84	28	22	25	-04	33	47	59	71	71
		73	66	90	88	19	32	48	-12	20	46	64	64	71
62		51	59	79	74	12	20	38	01	21	47	66	68	70
		64	63	84	83	19	24	36	-05	25	47	63	68	70
			60	87	87	35	34	27	-15	37	54	46	60	73
			56	90	90	09	20	43	-05	29	45	60	62	77
63			60	86	81	13	15	47	-07	23	39	54	57	72
			58	88	86	18	23	37	-08	30	46	54	60	74
				86	83	27	30	35	00	29	48	46	53	70
				82	78	15	27	52	00	38	52	49	49	63
64				86	80	07	16	50	05	39	57	50	54	64
				85	81	15	24	44	02	35	52	48	52	66
					98	35	34	33	-09	38	57	57	68	81
					98	14	30	53	-04	33	53	65	66	80
65					93	13	20	54	-01	33	56	65	69	80
					97	19	27	45	-04	35	55	63	68	80
						37	34	37	-07	39	57	57	70	88
						15	29	51	-05	33	52	68	68	86
66						11	17	50	-03	27	52	66	68	88
						20	26	44	-04	33	53	63	69	87
							81	39	-62	-06	34	13	24	33
							85	34	-75	-24	37	17	18	15
67							86	22	-72	-18	15	11	09	14
							84	32	-70	-18	28	12	16	20
								55	-50	12	56	13	30	24
								51	-53	-05	55	22	27	28
68								39	-65	-03	37	17	20	21
								49	-56	-01	50	16	25	23

SUMMARY OF INTERCORRELATIONS
(continued)

	69	70	71	72	73	74	75
		-10	26	63	22	36	35
		-17	36	88	49	57	47
69		-02	54	83	44	46	42
		-09	36	76	36	45	40
			26	-14	02	04	03
			41	-22	-09	-08	-01
70			30	02	-06	-05	-10
			34	-11	-04	-02	-02
				62	31	48	30
				49	29	35	35
71				70	24	27	18
				58	29	37	28
					46	63	41
					55	62	49
72					48	52	43
					50	59	44
						72	56
						82	65
73						81	66
						79	62
							63
							66
74							66
							65
75							