FACTORS RELATED TO THE CHOICE OF SCIENCE AS A MAJOR AMONG NEGRO COLLEGE STUDENTS

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Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
May, 1971

FACTORS RELATED TO THE CHOICE OF SCIENCE

AS A MAJOR AMONG NEGRO COLLEGE

STUDENTS

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PREFACE

The present report was concerned with examining characteristics which might differentiate Negro college students who choose an academic major field of study in science from those students who choose non-science academic fields. The characteristics were selected to reflect those investigated in previous studies of scientists, used in theories of vocational choice, and several which were assumed to be especially pertinent to the choices of Negro college students. It is hoped that the results of this research effort may be utilized in "tapping" the reservoir of science talent among Negro students. It is further hoped that the findings will spur further investigations into the characteristics of Negro scientists.

The writer wishes to take this opportunity to express his appreciation to the many individuals and organizations whose encouragement and resources made the study possible. My sincere gratitude is extended to Dr. Kenneth Wiggins, Chairman of the advisory committee, and to Dr. John Hampton, Dr. Thomas Johnsten, and Dr. James Seals, for their consistent guidance. Thanks go, also, to Dr. Donald Allen, who, as a member of the advisory committee, and Coordinator of Research for the Langston College Maturation Study Project, gave untiringly of himself in guiding and encouraging the investigator in all phases of the effort culminating in this document.

I would like to thank Mr. Richmond Kinnard, Director of the Langston College Maturation Study Project, and to the team members:

Mrs. Zella Patterson, Mr. John Bourdette, and Mrs. Rosetta Williams for their many helpful suggestions throughout this endeavor. I am grateful to Langston University, its administration, faculty, and students, for their cooperation; and for financial resources used in carrying out this investigation. A debt is owed, also, to the administration and students of the colleges in Alabama and Texas for their cooperation.

Finally, there was the contribution of my wife, Marilyn, whose love, understanding, devotion, and effort, aided and sustained me throughout. Acknowledgement is given our children, Mark and Michelle, in hope that they, though too young now, will grow to understand and appreciate "why daddy had to go to the library."

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CHAPTER I

INTRODUCTION

Determining and evaluating the characteristics of scientists has long been a topic of investigation. This activity has been prompted by the important role that science and scientists play in modern society and in the academic institutions. This interest has been sharpened by the ever-increasing need for scientific manpower, and by the assumption that a knowledge and understanding of various factors relative to the development of scientists can be used to identify potential scientists among the youth.

Do the conclusions reached thus far regarding characteristics of scientists in general also apply to Negro scientists? Can these criteria be used in the identification of scientific talent among Negro youth? Davis (1965), in a recent study of the career decisions of 33,000 undergraduates, among which were 1,778 Negroes, appears to speak to these questions when he says: "Just as the social experiences of American Negroes are unique, the career plans and choices of the Negro students were found to be distinctive." Knapp and Goodrich (1952) made a similar statement in explaining their reasons for eliminating Negro colleges from their study:

> Negro colleges were excluded from the college sample since it was felt that they were subject to special social situations which would prevent fair comparison with the other institutions in a homogeneous sample.

The unique experiences of the Negro in America are best summed up in the words of John F. Kennedy in his message to Congress on February 28, 1963:

> The Negro baby born in America today--regardless of the section or State in which he is born--has about one-half as much chance of completing high school as a white baby born in the same place on the same day; one-third as much chance of completing college; one-third as much chance of becoming a professional man; twice as much chance of becoming unemployed; about one-seventh as much chance of earning $10,000 per year; a life expectancy which is 7 years less; and the prospects of earning only half as much (Fichter, 1967).

It is because of the unique experiences of the Negro in America, and the relationship of these experiences to the development of scientific talent, that this study of factors related to the choice of science as an academic major among Negro college students is undertaken.

Need for the Study

American Negro scientists have made many significant contributions to the evolution of the modern scientific and technological society. Some examples are: Benjamin Banneker in engineering; George W. Carver in agricultural chemistry; Earnest Just in biology; and Charles Drew in medicine. The contributions of these men and other Negro scientists are well documented (Aptheker, 1956) (Drew, 1950) (Taylor, 1956).

Despite the accomplishments of Negro scientists, the proportion of Negro youth in high school and college who are taking science courses or majoring in science fields is unduly small, and appears to be declining. Jaffe (1965) reports a decrease in the proportion of students in predominantly Negro colleges majoring in the physical sciences between 1930 and 1965. McGrath (1965) also reports a decrease in the percentage of seniors in predominantly Negro institutions majoring in the physical sciences between 1940 and 1963, although not as large as that reported by Jaffe. A decrease in the proportion of Negro students majoring in the biological sciences can be ascertained from data in Caliver's (1933) study in 1930 and Fichtner's (1967) study in 1964. Both of these studies were of students in predominantly Negro institutions.

During the fall semester of 1969, in two large high schools in a Midwestern city, 24 per cent of the Negro students were enrolled in elective science courses in contrast to the 40 per cent enrollment of white students. Also, the number of Negro students enrolled in elective science courses in a large high school in Illinois was 6 per cent of the Negro student population of that school. However, a larger percentage of these students were enrolled in a biology course required for college bound students.[1]

In a time when Negro Americans are striving for social and economic equality and the nation is in need of persons skilled in the science fields, it is imperative that more Negro youth be attracted to these fields as a means to serving both of these ends. This need is expressed by Dr. Montague Cobb (1958), when he says:

> The Negro's ability to do high caliber work in the sciences has long been demonstrated beyond challenge. He has not, however, been attracted to these fields in sufficient numbers, nor have the motivations which inspire and sustain men through frustrating experience been sufficiently operative with him.

Moreover, the loss to society as a result of neglecting the scientific talent among Negro youth is embodied in the words of Cole (1956):

---

[1]Private communication from two teachers at the schools.

> The welfare of science has become a common concern; its fate and the destiny of our civilization appear synonymous. Any depletion in the ranks of science is a debit all society must record. Any substantial waste of scientific talent can do our society irreparable harm.

This study of factors which relate to the choice of a science major among Negro college students is a needed initial step in opening the question relative to factors associated with the pursuit of education in science of Negro college youth.

Statement of the Problem

Information regarding the characteristics of scientists and potential scientists has been accumulating for a number of years. However, studies designed to determine these characteristics have not included Negro scientists in the samples or the data were not analyzed with reference to them. The resulting gap in man's knowledge of the characteristics of scientists and potential scientists needs to be filled. The problem underlying this investigation, simply stated, is that man's knowledge of the characteristics of Negro scientists and potential scientists is insufficient.

Purpose of the Study

This study is an initial step in the direction of solving the problem stated above. The method chosen is to survey a large sample of Negro college students in three predominantly Negro institutions, including science and non-science majors, using a questionnaire as the survey instrument. The information to be obtained from the students is suggested from theories of vocational choice and previous studies of scientists, potential scientists, and Negro college students. The purpose of this study is to identify some of the characteristics of Negro college students who major in science in comparison to those who are non-science majors.

Definition of Terms

The first three definitions are based upon the Langston University curriculum.

Pure Science Major - A student whose major field of study is chemistry, biology, mathematics, pre-medicine, or pre-dentistry.

Applied Science Major - A student whose major field of study is business, home economics, animal science, medical technology, or whose minor field of study is mathematics, chemistry, or biology, exclusive of pure science majors.

Non-Science Major - A student whose major field of study does not require the taking of a course in biology, physics, chemistry, or mathematics beyond the freshman level.

Academic Ability and Achievement - The students' ACT scores or other college entrance examinations which can be converted into ACT score equivalents, and cumulative grade point ratio.

Student - A person enrolled in a four-year degree program at a college or university on a full-time basis.

Research Questions

In view of the stated problem and the purpose of this research effort, the following general questions are put forth:

1. Do the science fields attract Negro college students of greater academic ability and achievement than the non-science fields?

2. Are the family backgrounds of Negro college students who major in science different from those of non-science majors?

3. Are there characteristics of the high school attended which would tend to affect the choice of a science or non-science major field of study?

4. What influences within the family, in high school, and in college are pertinent to the choice of a science or non-science major?

5. Is there a difference in the attitude toward science of science and non-science majors?

Answers to these general questions are indicated from statistical analysis of the data generated by the survey. The following specific relationships are statistically analyzed at the 0.05 level of probability:

1. The difference and interaction between pure science majors, applied science majors, and non-science majors; and colleges in Alabama, Texas, and Oklahoma, on each of the following independent variables:

    a. academic ability as determined by ACT composite scores,

    b. academic ability as determined by ACT science scores,

    c. academic achievement as determined by cumulative grade point ratios,

    d. family socioeconomic level,

    e. number of siblings,

f. ordinal position among siblings,

g. the degree of integration of their high school,

h. high school science activity,

i. high school influences on choice of major,

j. family influences on choice of major,

k. college influences on choice of major,

l. attitude toward science.

2. The difference and interaction between science majors and non-science majors; and colleges in Alabama, Texas, and Oklahoma, on each of the independent variables stated above.

3. For science majors only, what is the relationship between:

   a. father's education,

   b. mother's education,

   c. grade point ratio,

   d. siblings with some college,

   e. science courses taken in high school,

   f. science attitude,

   g. socioeconomic status,

   h. size of high school,

   i. degree of racial integration of high school,

   j. high school influences on choice of major.

4. Is there a statistically significant difference (0.05 level) in the attitude toward science of science and non-science majors of comparable achievement as determined by grade point ratios?

5. What is the relationship of ability, family background variables, high school factors, and college factors; and

the attitude toward science of the students in the study?

6. Do science majors consider their choice of field at an earlier time in life than non-science majors?
7. How do science and non-science majors compare in their rating of various persons and activities within the family, in high school, and in college on their choice of major field?

Limitations

1. Interpretation of the results of this investigation should be limited to the students involved in the study at the three predominantly Negro institutions.
2. The groupings of students into major fields of study are based on the Langston University curriculum.
3. The questionnaire will be used as an exploratory survey instrument together with relevant school records.
4. The investigator is aware of the significance of interests, values, and other factors of personality in the decision-making process of a choice of major not controlled in this study.
5. It should be noted that the data are primarily the result of the student's willingness to recall and share information as he now perceives it.

Assumptions

1. That the students at the institutions involved in the study are representative of students in predominantly Negro, public, four-year colleges.

2. That factors related to Negro students majoring in biology, chemistry, mathematics, pre-medicine, and pre-dentistry are basically representative of Negro students in other science fields.
3. That the factors operating in the choice of a major field and in the choice of an occupation are similar.
4. That the responses of the sample students are valid and represent a substantial portion of determinants pertinent to choice of major.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter is divided into four sections, the first of which is a review of theories of occupational development and choice. In the second section, studies related to the characteristics of scientists and potential scientists are presented. The third section is a review of studies which have been made of student attitudes toward science and scientists. The fourth and final section deals with the characteristics of Negro college students with particular emphasis on those in predominantly Negro institutions.

Theories of Vocational Choice

Among the more prominent theories of vocational development, or choice, are those of Anne Roe (1957), Donald Super (1953), Eli Ginzberg and Associates (1951), David Tiedeman (1961), and John Holland (1959). Differences in these theories can be perceived in terms of the generality or specificity of application, and in the degree of emphasis on the structural or developmental view of the individual. Bordin, Nachman, and Segal (1963) describe the differences as:

> The structural view analyzes occupations within some framework for conceiving personality organization. The developmental view attempts to portray the kinds of shaping experiences that can account for personality organization and concomitant vocational pattern.

The structural view is emphasized in Holland and Roe's theories. Both group occupations according to personal characteristics or activities. Holland (1959) defines six different personal orientations corresponding to six occupational environments: motoric, intellectual, supportive, conforming, persuasive, and esthetic. Roe (1957) uses Maslow's hierarchical classification of needs to construct her categories of occupations.

Super, Ginzberg et al., and Tiedeman portray the developmental view in their theories. Super and Tiedeman use the term "self" and speak of the process of acquiring self knowledge and of implementing it. The perspective of Ginzberg et al. (1951) is developmental in that the individual is seen as passing through successive stages of fantasy, tentative and then crystallized choice in which fantasy has been tempered by reality.

Another way of considering vocational choice is that which Osipow (1968) calls the "social systems", or "sociological" approach. This view is based on the notion that elements beyond the individual's control exert a major influence on the course of his entire life, including his educational and vocational decisions. Related to this belief is the proposal that chance plays a major role in occupational decisions. Osipow (1968) discusses this view in comparison to the above theories as follows:

> The psychological theories of career decision do not exclude the possibility that chance factors influence decisions, though psychologists do not often discuss the effects of chance on careers explicitly. What differentiates the sociological and psychological approaches to the chance issue is a matter of emphasis. To psychologists, the chance variable represents an irritant, hopefully to be minimized, so that better decisions can be made and brought under the control of the individual. The psychologist strives to understand the nonchance variables better in order to reduce the effect of

> chance elements in his predictions. The sociologist, on the other hand, is likely to focus his attention on chance (extraindividual) variables themselves and seeks to understand the forces that operate in that dimension in order to introduce some systematic organization of these apparently unsystematic aspects of life.

Lipsett (1962) also emphasizes the importance of social influences upon the individual as well as individual factors in vocational development. He lists social class as being probably the broadest and most significant social factor affecting human behavior. He supports this conclusion by citing the results of studies by Ginzberg and Associates, Havighurst and Rogers, Mcquire, and Wilson. Data from Stetler's study causes Lipsett (1962) to suggest that the ethnic factor as a particular aspect of social class membership may be one of the important elements which contribute to vocational choice, although other factors, such as urban residence, may have been contributing to the apparent ethnic differences.

Several nonclass social factors contributing to vocational choice as given by Lipsett (1962) are the home and school. In discussing the influence of the home, Lipsett stresses the importance of the influence of siblings on the vocational decisions of each other:

> The oldest child's success and satisfaction in an occupation may influence his younger brothers in that direction. On the other hand, sibling rivalry may induce a younger brother to make a definite effort to avoid following in an older sibling's footsteps. Older siblings are an important source of information about colleges and jobs. To an even greater extent than in the case of parental influences, however, it is difficult to generalize about sibling influences or to make predictions without knowing the quality of relationships in the particular family.

The school, cutting across class lines, may often be an important influence on vocational choice. This influence is exerted by peers and teachers and is manifested to a degree in curriculum choices. Smith and

Lipsett (1952), on a questionnaire designed to determine reasons for a student's choice of a college, found that 22 per cent first heard about the college through high school teachers or counselors and 10 per cent were most influenced in their decisions by teachers and counselors.

The importance of the influence of sociological factors are reflected in several of the aforementioned theories of vocational development and choice. Holland (1959) states that:

> Within a given class of occupations, the level of choice is a function of intelligence and self-evaluation. Self-evaluation, in turn, is a function of the life history in which education, socio-economic origin, and family influences are major determinants.

Ginzberg et al. (1951) list three basic elements in their theory, the third of which states that "compromise is an essential aspect of every choice." According to Ginzberg et al.:

> It reflects the fact that the individual tries to choose a career in which he can make as much use as possible of his interests and his capacities in a manner that will satisfy as many of his values and goals as possible. But in seeking an appropriate choice, he must weigh his opportunities and the limitations of the environment, and assess the extent to which they will contribute to or detract from his securing a maximum degree of satisfaction in work and life.

Propositions 6 and 9 of Super's (1953) developmental theory of vocational development refer to the importance of sociological variables in the choice process:

> 6. The nature of the career pattern is determined by the individual's parental socioeconomic level, mental ability, and personality characteristics, and by the opportunities to which he is exposed.
>
> 9. The process of compromise between individual and social factors, between self-concept and reality, is one of role playing, whether the role is played in fantasy or in real life activities such as school classes, clubs, part-time work and entry jobs.

Blau et al. (1966) have developed a "conceptual framework" of vocational choice which attempts to bring together perspectives from the disciplines of psychology, economics, and sociology. Stressing that theirs is not a theory of occupational choice, but a conceptual framework, they describe the difference as:

> The function of a conceptual scheme of occupational choice and selection is to call attention to different kinds of antecedent factors, the exact relationships between which have to be determined by empirical research before a systematic theory can be developed.

They agree with Super and Ginzberg that occupational choice is a developmental process that extends over many years:

> There is no single time at which young people decide upon one out of all the possible careers, but there are many crossroads at which their lives take decisive turns which narrow the range of future alternatives and thus influence the ultimate choice of an occupation (Blau et al., 1966).

Their conceptual framework is developed around the basic theme of the "social structure". They describe the social structure as "the more or less institutionalized patterns of interactions, activities, and ideas among various groups". The social structure has a dual significance and is further described as follows:

> On the one hand, it influences the personality development of the choosers; on the other, it defines the socioeconomic conditions in which selection takes place. These two effects, however, do not occur simultaneously. At any choice point in their careers, the interests and skills in terms of which individuals make their decisions have been affected by the past social structure, whereas occupational opportunities and requirements for entry are determined by the present structure.

It is within this framework that the present study is undertaken.

Characteristics of Scientists and Potential Scientists

A review of the literature reveals a number of studies which have attempted to identify characteristics of scientists and potential scientists. One of the major investigations was that of the Science Careers Project of the Horace Mann-Lincoln Institute of School Experimentation at Columbia University in 1956. One phase of this investigation was a review of more than two hundred research studies in the identification of scientific capabilities and in motivation in scientific career selection. Donald E. Super and Paul B. Bachrach (1957) are the authors of the monograph containing the published findings of this research.

In an overview of the findings of their review of literature on the characteristics of scientists, Super and Bachrach (1957) use three classifications: natural scientist, mathematician, and engineer. Regarding intellectual status, they say:

> The investigations which are more scientific in their methods show that the science student or scientist has intelligence equal or superior to that of the average college student. However, he and his fellows exhibit a rather wide range of intellectual ability. He is capable of rigorous and abstract thinking and of a high level of achievement. ... Superior scholarship is characteristic of the natural scientist. In both high school and college he makes a very good scholastic record. ... The mathematics major and mathematician emerge from the scant available literature surveyed as persons of superior intelligence with superior academic records. Measures of intellectual factors, however, yield only moderate correlations with mathematics achievement.

Studies by Vineyard (1959), Allen (1959), and Cooley (1963) tend to support these conclusions.

In a study of the life history background of 600 senior high school students in science, Cline and Richards (1962) concluded:

> The results of this research tend to support the notion that excellence in science studies is related to more than just intelligence. The family climate and social milieu in which the child is raised have a tremendous impact on his attitude toward education, his motivation in science studies, and probably his selection of a science area as a career.

Of the family and social background as revealed by earlier studies, Super and Bachrach (1957) report:

> An upward mobile middle-class family background, characterized by favored parental economic, educational, and occupational status is common among natural scientists in America. The scientist is typically either the only boy or the eldest child. He may be of either rural or urban origin, and he comes from a northern or western region. ... The general conclusion is that the future scientist tends to come from an intellectually stimulating and well-endowed environment. ... The mathematician appears to come from a superior socio-economic and cultural background. Family composition and general interpersonal relationships have been important.

Krinsky (1963), in a study of the relationship between birth order and choice of a scientific career, reported findings which contradict previous finds regarding the birth order of scientists. From the results of a comparison study of 310 scientists and non-scientists, classified into four groups, she concludes, "no relationship was found between the subjects' choice of a scientific career and his being first born (only and eldest children combined or separate) or any other chronological birth order position."

Factors perceived as directly influencing the natural scientist to choose this career include key figures such as the father and high school or college teachers; academic opportunities; and experiences of an educational nature, such as a laboratory project or the reading of certain influential books (Super, 1957). Of the influence of science teachers in the development of potential scientists, Cole (1956) says:

> The importance of individualized encouragement in the shaping of future scientists cannot be overemphasized. The teacher, whether in the elementary school, high school, or college, who

can ignite that spark of interest in the talented, who can make his subject live in the minds of his pupils, and who, despite the routine drudgery of an underpaid, harassed profession, can stimulate, fascinate, and inspire; he, in the final analysis, is the one who can most effectively encourage scientific talent.

The period during which the decision was made to pursue a science vocation varies from before high school to sometime during college with almost all having decided before college graduation (Brandwein, 1952) (Visher, 1948) (Welch, 1959).

A major five-year study of the career development process of potential scientists was made by William W. Cooley (1963). The general purpose of the study was to examine the process of becoming a scientist, from elementary school through four years beyond college, in order to determine the major factors affecting the process.

A five-year overlapping longitudinal design (see Table I below) was employed in order to investigate in only five calendar years the critical sixteen years of the developmental process of becoming a scientist. This was accomplished by selecting 700 male students from five different grade levels, three grades apart.

Cooley (1963) wished to identify the factors which are related to educational and career decisions made at the various stages of development, and to be able to predict from one stage to another. "Factors" here included dimensions of individual personality (including ability), and also dimensions of the environment (family, school, community, etc.).

TABLE I

GRADES COVERED AND SIZE OF THE FIVE GROUPS

Sample Group	Number of Students	Grades Covered
Grade 5	143	5 6 7 8 9
Grade 8	167	8 9 10 11 12
Grade 11	192	11 12 13 14 15
Grade 14	105	14 15 16 17 18
Grade 16	93	17 18 19 20

Using modern techniques of multivariate analysis, Cooley found the following to be related to the choice of a science career:

1. ability,
2. extra-class science activities,
3. high school courses,
4. science interest (in high school),
5. socioeconomic status.

Harmon (1961) found that the size of high school graduating class was strongly correlated with doctoral productivity in the sciences, with schools below 100 per graduating class generally lower, proportionately, in doctorate origins.

Several investigators whose studies had the primary objective of identifying factors associated with the development of science vocations, have also discussed factors which tend to deter choices in science. Finkel (1956), in a study of factors affecting the high school student's choice regarding a science career, listed the following as reasons the students gave for not taking more science courses while in high school:

1. science was too difficult and involved too much mathematics,

2. the students' background in science while in elementary school had been poor and uninteresting,

3. the school offers so many important and desirable courses in competition with science that students found it difficult to make the proper choice.

Cole (1956), after analyzing the results of 32,750 questionnaires administered to a five per cent sample of the public high schools with seniors in the United States, gives the following as deterrents to capable students entering careers in science:

1. those pertaining primarily to the individual himself,

2. those related to his family, community, or environmental circumstances,

3. those of a societal nature or based on racial or religious grounds,

4. those reflecting some accepted political or economic policy of the government at either the local or national level,

5. those reflecting what in oversimplification might be termed the American character.

Allen (1961), after analyzing the results of his follow-up study of over 3,000 New Jersey high school seniors, hypothesizes that:

> Underestimated intelligence and lack of motivation seem to be deterrents to preparation for careers in the scientific enterprise. Students who abandon scientific careers exhibited a tendency to question their intellectual ability, and to ask whether the education in science was worth the time and energy required.

Attitudes Toward Science and Scientists

The majority of studies on attitude toward science have been mostly concerned with affect or feeling--like versus dislike--toward science in general or a particular science. Other investigations have dealt with "attitude toward scientists", which refers to like versus dislike or approval versus disapproval of the activities engaged in by scientists and the kinds of people that scientists are (Aiken and Aiken, 1969).

Greenblatt (1962) approached his study of the attitudes of elementary school students toward science by having them rank science in comparison with other subjects. His results indicated that science was less popular than art, reading, and arithmetic, but more popular than writing, language, and health. This same medium preference rank was given by the subjects in Powell's (1962) study of high school seniors and Kane's (1968) study of prospective elementary teachers (college students).

Haun (1959) administered a 13-item attitude scale, which he developed, to 714 students (254 high school, 340 non-science major among college freshmen and sophomores, and 112 science majors). His findings are summarized as follows:

1. Attitudes toward science - nearly 90 per cent agreed that science is interesting and that science has value even for non-technical vocations. About 80 per cent agreed that all students should take biological science and physical science.
2. Attitude toward teachers and high school - over-all, 74 per cent deny that their teachers are poor. Ninety-five per cent deny that students are advised not to take science.

3. Attitude toward others and themselves - 90 per cent deny that "most students razz others who express an interest in science". Over two-third agreed that "students want easy courses", and nearly as many said "science courses require too much time and work".

4. Attitudes toward science courses - 75 per cent of the students say science courses are hard, but this percentage varies with the amount of science taken.

Allen (1959) used a Likert-type scale consisting of 95 items to study the attitude toward science and scientists of 3075 high school seniors. The student responses were compared with responses made by a jury of scientists. He found, over-all, that the students seemed to have more constructive attitudes toward the scientific enterprise than had been indicated by other studies of a similar nature. Regarding the image of the scientist held by the students, Allen says:

> While the image of the scientist which characterized the group as a whole seemed favorable and constructive, substantial numbers of the seniors (from 17 to 27 per cent) thought that scientists are too narrow in their views, too emotional, essentially magicians, and willing to sacrifice the welfare of others to further their own interests. This latter view is serious, and may be due in part to the publicity given scientists for their work on the A-bomb and other instruments of destruction.

Of special relevance to this investigation is Allen's (1959) findings after analyzing the results of his study on the basis of a science versus a non-science career choice. For this analysis, the science and non-science groups included only those in the upper one-eighth in intelligence of the total group as determined by a short vocabulary test which was part of the attitude inventory. His results indicated rather definitely that there were no significant differences between the high-ability science and non-science groups with respect to their attitudes toward science, either when the responses of each group were correlated with one another or separately with the judges' scale score.

Several investigations of attitudes toward science and scientists have resulted in information on the relationship of science attitude to variables such as socioeconomic status, school marks, and intelligence. Lowery (1966) found that the students from an upper socioeconomic area had more positive attitudes toward science than those from middle and lower socioeconomic areas.

Aiken and Aiken (1969) report the results of several studies in which positive relationships were found between intelligence and favorable attitudes toward science and scientists. This was also a finding of Allen (1959) in his study of attitudes.

Aiken and Aiken (1969) also report the review of a study in which there was no observed relationship between college students' attitudes toward science and their high school backgrounds in science, although attitude was correlated positively with final exam grades and final course grades in college chemistry.

Negro College Students

A. J. Jaffe, Walter Adams, and Sandra G. Meyers (1965) conducted a major survey of predominantly Negro colleges in 1965 and 1966 to determine the characteristics of students attending these colleges in 1965. Their findings were compared with those of two previous studies involving large numbers of Negro college students in 1930 and again in 1940, both conducted by the United States Office of Education (Caliver, 1933) (Office of Education, 1942). The 1940 study deliberately attempted to duplicate, insofar as possible, the 1930 survey. Jaffe et al. designed their questionnaire to include a number of items of information in the earlier studies. Upon comparing their findings with those of the earlier studies, they concluded that "students enrolled in 1930 and in 1965 closely resemble each other".

More specifically, Jaffe et al. cited the following as indicative of the similarity between the students in 1930, 1940, and 1965:

(1) Fewer men than women attended the Negro colleges.

(2) Between 8 and 9 of every 10 students had attended high school in the south.

(3) In 1940 and in 1965, about half of all students expected to become teachers following graduation.

(4) In 1940, 9 out of 10 students expected to enter white-collar occupations, and by 1965 this aspiration has become virtually unanimous.

(5) In 1940 and 1965, the students rank well below all students in the country on academic attainment.

Caliver (1933) found that Negro college freshmen men have a higher degree of scholastic aptitude than women as measured by the American Council on Education Psychological Examination. His data also showed a definite relationship between the amount of schooling possessed by parents and the scholastic aptitude of their children. He found that the students in his sample who were planning to major in biology, chemistry, mathematics, and engineering scored higher in ability than students planning to major in other fields.

Jaffe (1965) reports that over 75 per cent of the southern Negro high school graduates entering college in the Fall, 1965 ranked in the top one-half of their high school graduating classes. Bindman (1966) found no significant differences in the ability of the students in his sample as determined from ACT scores, and their socioeconomic background.

Over a period of thirty-five years (1930-1965), the student body in predominantly Negro colleges has come from essentially the same family background. Based on occupational changes in the total southern Negro labor force, it is inferred that more Negroes from lower socio-economic families attended college in 1965 than in 1930. However, very large proportions of Negro college students in 1965 as well as in 1930, came from families of upper socioeconomic status (Jaffe et al., 1965).

Thomas E. Posey (1933), in a study of 110 freshmen, found that the education of the mothers, in general, was superior to that of the fathers. Two-thirds of the mothers and three-fourths of the fathers had attained no education beyond that of the elementary school. Using the United States census method of classification, he found that 36 per cent of the parents had occupations in the domestic and personal services class with 27 per cent from professional classes.

Thompson (1933), in a study of 542 students at Howard University, found that the median family income was $1,559 compared to a median family income of $3,129 for students in white liberal arts colleges. Two thirds of the students in his study came from two general parental occupation groups, manual labor and professional service, with 40 per cent from the manual labor group. This is in contrast to the 4.7 per cent of students from the manual labor group at white liberal arts colleges.

In a study of 1,768 students at the 14 predominantly Negro institutions in North Carolina, Cooper (1937) found that the largest number of fathers, other than those who were in farming were engaged in unskilled labor.

Compared with the general college student population, the socioeconomic scores of Negroes are much lower. Only 15 per cent of the Negroes, compared with 54 per cent of the white students, scored high on socioeconomic status in Davis' (1965) study of undergraduate career decisions. The following table compares the family income of the Negro students in Jaffe's study (1965), McGrath's study (1965), and all college students.

TABLE II

FAMILY INCOME DISTRIBUTION FOR STUDENTS IN PRIMARILY NEGRO COLLEGES, AND FOR ALL COLLEGE STUDENTS

Annual Family Income	Jaffe et al.	McGrath	All College Students[a]
Under $4000	51	42	8
$4000 - 5999	22	26	14
$6000 - 9999	18	22	37
$10,000 and over	9	10	41
TOTAL	100	100	100
Number of students	5,826	6,323	---
Number of colleges	68	89	---
Median income	$3,921	$4,626	$8,064

[a]McGrath (1965) reports these figures as estimated from Rexford G. Moon, Jr., "A Model for Determining Future Student Aid Needs in the United States for the Support of Full-Time Undergraduate Education."

Gurin (1966) reports that among the male students in her sample, the higher the father's education the more likely it is that the son's occupational choice will be highly prestigeful and highly demanding of ability. Mother's education and the family income operate much as father's education. Of the influence of social class on choice of occupation, she says:

> Mothers are more important than fathers, both in their influence on the decision to go to college and the choice of occupation to pursue. The influence of the father on these two decisions is greater the higher the family income, the higher the education of both parents, and the more intact the home. Intactness of the home is the primary differentiator of the mother's role in the student's decision to go to college; family income and the amount of her own education are the major determinants of her importance in the student's occupational choice process.

The degree of segregation of high schools is now being investigated for its possible effects on Negro students. St. John (1966) found no significant relationship between the degree of segregation and the educational aspirations of Negro high school seniors. Bindman (1966), using a much smaller population, found that the degree of preparation for college was not indicated by the degree of segregation of the high school.

Fichter's (1967) study of 1964 college graduates showed that 30 per cent of the students were members of a science club while in high school. However, only two per cent had the opportunity to participate in such programs as the National Science Foundations' summer training program or being finalists in a science talent search. The extracurricular activity that most of the students participated in during high school was "officer in senior class".

Fichter also reports that 10 per cent and 20 per cent of the 1964 college graduates had taken three years of biological and physical sciences, respectively, while in high school, while the percentage taking mathematics was much higher (68 per cent). Caliver (1933) found that mathematics and science courses were in the middle and lower ranks of courses taken during high school.

As in the studies on scientists, the persons influencing the choice of major or career among Negro students appears to be very important. The encouragement to enter college is greatest from the mother, with that of the father second, and that of a high school teacher fourth, as reported by Jaffe (1965). The person exerting the greatest influence on career decisions is listed as college instructor, prominent adult who the student knew well, regular high school teacher, aptitude tests, and high school counselor, as given by the students in Fichter's study (1967).

Froe (1968), in a study of 600 freshmen students, found that typically, the decision on major field had been made several years back. High school teachers were most influential in major field choice -- often more influential than either parent.

Fichter (1967) found that 68 per cent of his sample had decided on their career choice before entering college. All of them, except for a few female students, had decided before completing their college work. Studies show that more than one-half of the students choose teaching as a career (Fichter, 1967) (Jaffe et al., 1965) (McGrath, 1965). McGrath (1965) reports two major shifts in the choice of major field between the students in 1940 and in 1963. One is a decrease in the crafts of agriculture, industrial arts, and home economics. The other is an increase of 143 per cent majoring in business.

These results of studies of Negro college students over a period of years, in the broad areas of ability, socioeconomic background, and occupational choice, lend credence to the conclusion of Jaffe et al. (1965) that, "the southern primarily Negro college, in terms of its students, is a remarkably stable institution".

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Research Design

The design for this study is the cross-sectional survey design, often referred to as the basic survey design. Survey research, though widely practiced, has almost as many definitions as there are people who have written about surveys. Charles Glock (1967) discusses survey research as follows:

> To begin, there is a concensus among authors that survey research is a quantitative rather than a qualitative method, requiring standardized information from and/or about the subjects being studied. Who these subjects are, how they are selected, what data are collected from or about them and in what way, and how the collected data are to be analyzed are subject to variation. Whatever the differences in these respects, however, the starting point for all the authors is that the collected data be standardized.

Trow (1963), after noting the negative and limiting view of survey research found in most texts in educational research discusses the aspects of survey research that make it of such great potential value to education. He says:

> The great advances in survey research in recent decades have been in the analysis and interpretation of survey data, advances which have taken survey research considerably beyond the primitive stage of merely asking a lot of questions and reporting the answers. The chief gains have been in our ability to study the relationships between and among variables. And since a great part of social theory consists of statements about the relationship between and among variables under specified conditions, these developments in survey analysis open up the use of survey data for the testing and refinement of complex sociological theories. ... Through

> survey research we can study, on a broad scale and under a variety of conditions, how the social origins of students affect their educational aspirations and achievement. Moreover, we can do this while simultaneously taking into account other factors, such as their academic aptitudes, which also affect educational achievement.

The data produced by a survey comprise the answers to the questions which the subjects of the survey have been asked, or which have been collected through secondary sources. These data are assumed to be time-orderable since the questions asked vary with respect to the point in time to which they refer. The following chart taken from Glock (1967), depicts symbolically the data produced by a typical cross-sectional survey:

	Time Dimension				
	1	2	3	4	5
	A	B	C	D	E
	A1	B1	C1	D1	E1
Questions	A2	B2	C2	D2	E2
	A3	B3	C3	D3	E3
	etc.	etc.	etc.	etc.	etc.

The letters each represent a different question asked in a survey. Thus, all questions symbolized by the designation A are of the same time order--1--which is the earliest time order about which data have been collected. At the opposite extreme, all questions symbolized by the designation E fall into the fifth time dimension, which is the latest point in time about which data were collected.

Glock (1967) discusses the three basic statistical operations which can be performed on a body of data of this kind:

> First, the distribution of the subjects' answers to each individual question can be tabulated. Two, distributions of answers to questions located at the same point in time can be related to each other. Three, distributions of answers to questions located in different time dimensions can be related to each other.

Description and Selection of the Sample

There are 106 institutions of higher education attended predominantly by Negroes (McGrath, 1965). Of these, 34 are public institutions. Sixteen of the colleges were founded in the Nineteenth Century as land-grant colleges or later given this status to conform with federal requirements that benefits of land-grant programs be available to both Negroes and Whites. The 34 public Negro colleges enroll 93,470 students which represents three-fifths of all students in predominantly Negro colleges (Fact Book, 1969).

The sample for this survey consists of 1,006 students at three predominantly Negro institutions. These colleges are located in the states of Alabama, Oklahoma, and Texas. Following is a table showing the number and percentage of the subjects in the study from each state.

TABLE III

NUMBER AND PERCENTAGE OF SUBJECTS IN SURVEY BY STATE

State	Number	Per Cent
Alabama	195	19.39
Oklahoma	557	55.36
Texas	254	25.25
TOTAL	1,006	100.00

The method by which the total sample and the sample from each college was selected is that of judgment sampling. Ackoff (1953) discusses judgment sampling as follows:

> In some cases there are well-defined subgroups of a population which seem to be representative of the population to be studied. In other cases practical considerations seem to preclude the use of probability sampling, and the researcher looks for a representative sample by other means. That is, he looks for a subgroup which is typical of the population as a whole. This subgroup is used as a 'barometer' of the population. Observations are then restricted to this subgroup, and conclusions from the data obtained are generalized to the total population.

The same procedure for selecting the samples was used at each of the three institutions. The academic dean or other administrative officer of the institution was consulted regarding those classes which would be representative of the total student population in terms of classification, sex, and major field of study. These students constitute the sample of this survey.

Collection of Data

The data for this study were obtained from student responses to free-choice items of a questionnaire developed in conjunction with the Langston College Maturation Study Project. (See Appendix A.) This project is funded through Grant No. 916-15-40-AR3 of the United States Department of Agriculture Cooperative State Research Service. The six members of the research team met each Saturday morning beginning in September, 1969 for the purpose of planning, developing, and administering a questionnaire for a study of Negro college students. This instrument consisted of items designed to obtain information relative to factors associated with choice of major field, college expenses and diet. A fact sheet was designed to record information from student records (see Appendix A).

The questionnaire and fact sheet were pre-tested, using a sample of 195 students at a predominantly Negro land-grant college in Alabama, during the third week of February, 1970. Two other predominantly Negro colleges were initially contacted for permission to obtain a pre-test sample. They were unable to cooperate, however, because of administrative inconvenience and student unrest. Standard, written procedures for administering the questionnaire were also pre-tested on the Alabama sample (see Appendix B).

The investigator administered the questionnaire to students in selected classes. The classes were chosen after consultation with the Dean of Administration in whose judgment the classes would contain a representative subgroup of the student population.

The fact sheet was used to record the ACT scores and grade point ratio of each respondent. The other items of information on the fact sheet were not obtained for these students because they were not available in the students' records.

The research team edited the responses of the pre-test sample, revised several items on the questionnaire, and prepared copies for administering to other samples. The decision was made to insert the fact sheet in the questionnaire and ask the students to provide the information requested except for ACT scores and cumulative grade point averages.

The questionnaire was administered to 254 students at a predominantly Negro land-grant college in Texas during the second week of March, 1970. The method of selecting the students and administering the questionnaire were the same as those used for the Alabama sample. A departure from the written instructions was taken due to the requirement by state law that written student permission be given before information can be obtained from student records. Therefore, this request was added to the instructions for administering the questionnaire to this sample. Thirty-five of the subjects refused to grant their permission and are not included in the analysis of data containing ACT scores and grade point ratios.

The questionnaire was administered to 557 students at Langston University, a predominantly Negro land-grant institution in Oklahoma, during the latter part of March, 1970. Since the 557 students are over one-half the total of approximately 900 students attending Langston during the spring semester, they are a representative subgroup of the student population of that institution. The administration procedures used were the same as those in Alabama and Texas. The investigator administered over three-fourths of the questionnaires. The remainder were administered by the director of the research team who followed the written instructions.

Development of Attitude Scale

Item No. 18 of the questionnaire is a Likert-type scale designed to measure the respondent's attitude toward science. It contains 21 statements to which the respondent makes one of five responses: strongly agree, agree, undecided, disagree, or strongly disagree.

The attitude scale was formulated from a list of 35 statements. These statements were obtained as a result of a search of the literature, from other members of the Langston College Maturation Study

Project team, and from several Negro science professors. They were included as a part of the questionnaire administered to the 195 students in Alabama.

The responses of the Alabama students to the thirty-five statements were analyzed by means of a computer program to determine the alpha coefficient of internal consistency which reflects the degree of reliability among the items of a scale in terms of overlapping variance. The computer program used was written by Veldman (1967) and modified for this analysis by Allen.[1] The formula, taken from Veldman (1967) is a generalization of the Kuder-Richardson Formula 20 for dichotomous items:

$$\alpha = \frac{K}{K-1}\left(\frac{\sigma_T^2 - \sum^{k}\sigma_I^2}{\sigma_T^2}\right)$$

where

K = the number of items in the scale

I = the item

T = total

σ^2 = variance.

The alpha coefficient for the 35 statements based on the responses of the 195 students in Alabama was .7715. (See Appendix C for the mean, standard deviation, and reliability coefficient of the initial scale and of each item in the initial scale. Also included is a percentage distribution of the responses of the 195 Alabama students.)

The correlation of each statement with the total score was obtained and was used as a basis for eliminating statements. Only those items

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[1]Dr. Donald E. Allen is the research coordinator of the Langston College Maturation Study Project.

which correlated .3+ with the total score were retained to comprise the attitude scale used in the survey. (See Appendix D for the 14 statements eliminated from the scale.) This was done to increase the "uni-dimensionality" of the scale. Festinger (1947) describes a uni-dimensional instrument as:

> ... one such that a given score on that instrument could be obtained only from one pattern of responses. The scores, in order to represent an ordering of individuals with respect to some variable, would have to have a certain type of consistency among the various items making up the measuring instrument.

Cronbach (1951), on speaking of the relationship of the alpha coefficient to the uni-dimensionality of a scale, says,

> From the viewpoint of both interpretability and efficient prediction of criteria, the smallest element on which a score is obtained should be a set of items having a substantial alpha and not capable of division into discrete item clusters which themselves have high alphas.

The alpha coefficient of the 21-item scale based on the responses of the 195 Alabama students is .8074. (See Appendix E for the mean, standard deviation, and reliability coefficient of the revised scale and of each item in the scale.)

Analysis of Data

<u>Scored Variables (Analysis of Variance and Correlation Matrix)</u>

The variables under investigation have been assigned a numerical score based on standard measures or a composite of measures of several items from the questionnaire and fact sheet (see Appendix A). The variable names and derived measures are given below.

1. ACT Composite - From student records. A composite measure of English, mathematics, social studies, and science scores from the ACT battery.

2. ACT Science - From student records. The science score from the ACT battery.

3. GPA - From student records. The cumulative grade point ratio at the end of the first semester of the 1969-70 academic year.

4. Science attitude - Item No. 18 of questionnaire. Score is the sum of 21 Likert scale response items, scaled: strongly agree = 5, agree = 4, undecided = 3, disagree = 2, strongly disagree = 1.

5. High School Influence - Item No. 13 of questionnaire. Score is the sum of five responses: no contact = 1, unimportant = 2, fairly important = 3, very important = 4.

6. Family Influence - Item No. 16 of questionnaire. Score derived from sum of five responses relating to family members, scaled: no influence = 1, weak influence = 2, strong influence = 3, very strong influence = 4.

7. Number of siblings - Item No. 4 of fact sheet. Score is the number entered by the student +1.

8. Ordinal Position Score - Item No. 5 of fact sheet. Score derived as follows: $100/\sqrt{(\text{No. of children X ordinal position } +1)}$.

9. Socioeconomic - Items 7, 8, 9, and 10 of fact sheet and Item No. 7 of questionnaire. Score is the sum of scores marked for these items. Occupational score based on Duncan's ratings of occupations (1961).

10. College Influence - Item No. 17 of questionnaire. Score is the sum of eight responses: no contact = 1, unimportant = 2, fairly important = 3, very important = 4.

11. High School Science Activity - Item 12 of fact sheet and Items No. 10, 11-4, 11-10, 11-13, and 11-15 of questionnaire. Score derived as follows: Item 12 + (Item 12 X 8)/Sum of Items 10, 11.4, 11.10, 11.13, and 11.15.

12. Degree of Integration of High School - Item No. 9 of questionnaire. Score is the number marked.

Scored Variables (Correlation Matrix - Science Majors Only)

1. Father's Education - Item 8 of fact sheet. Score is the number marked.

2. Mother's Education - Item 9 of fact sheet. Score is the number marked.

3. GPA - Same as above.

4. Siblings With Some College - Item 11 of fact sheet. Score is the number marked.

5. Science Courses in High School - Item 12 of fact sheet. Score is the sum of semesters of courses marked.

6. Science Attitude - Same as above.

7. Socioeconomic - Items 7 and 8 of fact sheet and Item No. 26 of questionnaire. Score is the sum of the numbers marked.

8. Size of High School - Item No. 8 of questionnaire. Score is the number marked.

9. Degree of Racial Integration - same as above.

10. High School Influence - same as above.

Statistical Methods

Although the students at the college in Alabama constituted the pre-test sample, it was decided to include them in the total sample for analysis of the data. The bases for this decision are as follows:

1. The college is similar to the other two institutions represented.
2. Because of the method of selecting the students, they would tend to be a representative subgroup of the larger student population of that institution.
3. The procedure for administering the questionnaire was similar to that at the schools in Texas and Oklahoma.
4. The only change in the questionnaire pertinent to this study is in Item No. 9. For the Alabama students, the first possible response was "0-10% white students". The response "no white students" was added as the first response for the Texas and Oklahoma students. Otherwise, all items are the same and in the identical order.

The investigator is aware of several limitations created by this decision. First, the questionnaire used in Alabama was printed on a different size paper, and had a larger type. Second, the Alabama students responded to 35 attitude statements in Item No. 18 of the questionnaire (see Appendix F).

A double-classification analysis of variance statistical design will be used to examine the data for statistically significant differences between major field, school, and the interaction of major field and school for each of the variables as stated in research questions 1 and 2 (see Chapter I).

The analysis of variance design is used because of its greater sensitivity (power for avoiding type II errors) in comparison to non-parametric analysis of variance models. Although the data collected in this study do not reach the criteria of an interval level of measurement, usually an assumption when using a parametric statistical design, there is evidence that this assumption is not valid under all circumstances. McNemar (1962), with reference to this point, says:

> The crucial question, however, is whether or not the F, t, or z tests can, in view of their dependence on means and variances, be safely used when the scale of measurement is, as is the rule in psychology, somewhere between the ordinal and interval scales. The question boils down to this: Will Fs, ts, and zs follow their respective theoretical sampling distributions when the underlying scores are not on an interval scale? The answer is a firm yes provided the score distributions do not markedly depart from the normal form. Nowhere in the derivations purporting to show that various ratios will have sampling distributions which follow either the F or t or the normal distribution does one find any reference to a requirement of equal units. The attaining of an interval scale of measurement, though desirable for some reasons, will not alter the risks of type I and type II errors when statistical inferences are made.

The following figure represents the manner in which the data is organized for the analysis of variance computations:

		SCHOOL		
		Alabama	Texas	Oklahoma
MAJOR FIELD	Pure Science	ΣX ΣX^2 n	ΣX ΣX^2 n	ΣX ΣX^2 n
	Applied Science	ΣX ΣX^2 n	ΣX ΣX^2 n	ΣX ΣX^2 n
	Non-Science	ΣX ΣX^2 n	ΣX ΣX^2 n	ΣX ΣX^2 n

The number of subjects (n) in each cell of the figure will be different. Therefore, the data will be analyzed by the method of unweighted means. This method is described by Winer (1962) and is used by Veldman (1967) in his computer program for the analysis of variance.

According to Winer (1962), this method "considers each cell in the experiment as if it contained the same number of observations as all other cells (at least with regard to the computation of main effects and interaction effects)".

The value 1/n for each cell is calculated and the sum of these values, divided into the number of cells (pq) gives the harmonic mean of the number of observations per cell (Winer, 1962)

$$\bar{n}_h = \frac{pq}{(1/n_1) + (1/n_2) + \ldots + (1/n_c)}$$

where

p = number of rows

q = number of columns

$\bar{n}_h$ = harmonic mean.

For the computation of main effects and interactions, each cell is considered to have $\bar{n}_h$ observations. (See Appendix G for analysis of variance formulas using the harmonic mean to adjust for unequal n's.)

Correlation matrices will be computed to analyze the relationships among variables for the total sample and for science majors as stated in research questions 3 and 5.

An independent t-test will be computed to test for a significant difference between the attitude toward science scores of science and non-science majors as stated in research question 4.

Percentages and a Kolmorogov-Smirnov test will be computed to test for a statistically significant difference between science and non-science majors in the time they first considered their choice of major field as stated in research question 6. Percentages will be computed to show the proportions of science and non-science majors who rate various persons and activities in high school, within the family, and in college as having an important influence on their choice of major field, as stated in research question 7.

For the science activity and socioeconomic status variables of the Alabama sample, the composite scores are constituted from two sources. The total means of the missing elements are calculated from the Langston and Texas samples, and added to the appropriate items for the Alabama respondents. The means for the number of siblings and ordinal position variables for the Alabama sample are constituted in total from the Texas and Langston samples. This procedure is taken so information that is available on these measures for the Alabama sample can contribute to the variance between and within the variables in the analysis of variance and correlations. Interpretation of the results of the statistical analysis of the data for these variables will take this procedure into account.

The sample from each college included some students for whom Scholastic Aptitude Test (SAT) scores, rather than ACT scores, were available. Each SAT score was converted into its comparable ACT score through utilization of a conversion table obtained from the Registrar's Office at Oklahoma State University. (See Appendix I.) A table to convert SAT scores into comparable ACT science scores was not available.

All computations for this study are made by the IBM 360-Model 50 computer at the Oklahoma State University computer center. The computer program used was written by Dr. Donald Allen, using a modification of Veldman's (1967) Anovar program, in part.

CHAPTER IV

STATISTICAL ANALYSIS AND INTERPRETATION OF THE DATA

The results of the statistical analysis of the data generated by the present survey are presented in terms of the specific relationships stated in Chapter I. An analysis of variance statistical design was used to investigate the relationships between "major field of study" and "college"; and variables represented by measures of academic ability and achievement, characteristics of the high school attended, attitude toward science, influences on the choice of major field of study, and family background characteristics.

Relationships between measures representing characteristics of the family, high school, and college among all subjects; and among science majors only, were examined from computations of Pearson Product-Moment Correlation Coefficients. (See Appendix H for formula.)

An independent t-test was used to compare the mean of the "attitude toward science" scores of students majoring in science with that of students majoring in non-science fields of study, and whose cumulative grade point average was 3.00 or higher. Percentages were computed to indicate the time when the major field of study was first considered, and the perceived influence of specific individuals and activities on the choice of academic major field. A Kolmogorov-Smirnov test was computed to examine the relationship between the proportions of science and non-science majors who first considered their choice of academic major field of study at various times. (See Appendix H for formula.)

The distribution of scores on each measure, for the total sample, is indicated by computations of the mean, standard deviation, skewness, and kurtosis. Each of these measures can be expressed in terms of "moments about the mean" (McNemar, 1962), where:

$$\text{First moment } m_1 = \frac{\sum x}{N} = \frac{\sum(X-\bar{X})}{N} = 0$$

$$\text{Second moment } m_2 = \frac{\sum x^2}{N} = \frac{\sum(X-\bar{X})^2}{N} = \text{standard deviation}$$

$$\text{Third moment } m_3 = \frac{\sum x^3}{N} = \frac{\sum(X-\bar{X})^3}{N}$$

$$\text{Fourth moment } m_4 = \frac{\sum x^4}{N} = \frac{\sum(X-\bar{X})^4}{N}$$

The measures of skewness and kurtosis were calculated using the following formulas:

$$g_1 = m_3/m_2\sqrt{m_2}$$

$$g_2 = m_4/m_2^2 - 3$$

where:

g_1 = skewness

g_2 = kurtosis.

For ungrouped data as in this study, Croxton (1960) gives the following formulas which simplify the computation of m_2, m_3, and m_4:

$$M_1 = \frac{\sum X}{N} \qquad M_2 = \frac{\sum X^2}{N} \qquad M_3 = \frac{\sum X^3}{N} \qquad M_4 = \frac{\sum X^4}{N}$$

Thus, the second, third, and fourth moments about the mean are calculated as:

$$m_2 = M_2 - M_1^2$$

$$m_3 = M_3 - 3M_1 M_2 + 2M_1^3$$

$$m_4 = M_4 - 4M_1 M_3 + 6M_1^2 M_2 - 3M_1^4$$

Major Field, College, and Measures of Academic Ability and Achievement

An Analysis of Variance was computed to determine the difference and interaction between pure science, applied science, and non-science majors; and colleges in Alabama, Texas, and Oklahoma, on each of the variables: ACT composite score, ACT science score, and Grade Point Average. These measures were obtained from student records at the three institutions involved in the study. Those students for whom these measures were not obtained were not included in the analysis.

Table IV reveals the results of the analysis of variance for each of the variables, treated independently. The F value for major field of study was statistically significant beyond the 0.01 level on each of the three measures. There was also a statistically significant F value for college on each of the variables. The interaction between major field of study and college was statistically significant beyond the 0.05 level on the variable of ACT science score. These results indicated that the difference in ACT science scores between the three major field groups depended on the college that the group attended.

TABLE IV

EFFECT OF ACT COMPOSITE SCORE, ACT SCIENCE SCORE, AND GRADE POINT AVERAGE ON PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
<u>ACT Composite</u>:				
Total	770			
Major Field	2	381	23.96	<.001
College	2	116	7.32	<.01
Interaction	4	29	1.84	.118
Error	762	16		
<u>ACT Science</u>:				
Total	673			
Major Field	2	416	16.96	<.001
College	2	279	11.36	<.001
Interaction	4	80	3.28	<.05
Error	665	25		
<u>Grade Point Average</u>:				
Total	910			
Major Field	2	3	8.07	<.01
College	2	3	16.31	<.001
Interaction	4	.37	1.22	.301
Error	902	.3		

p = probability of an F value occurring by chance.

Table V reveals the number of subjects and mean of each major field and college group for each of the variables. The mean score for pure science majors was the highest on each of the measures in comparison to applied science and non-science majors. The mean ACT composite score of the Texas college was higher than the Alabama and Oklahoma colleges. On the measures of ACT science score and grade point average, the Oklahoma college revealed the highest mean scores.

TABLE V

NUMBER OF SUBJECTS AND MEAN SCORE OF PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJORS; AND COLLEGES, FOR ACT COMPOSITE SCORE, ACT SCIENCE SCORE, AND GRADE POINT AVERAGE

Variable	Major Field			School		
	Non-Science	Applied Science	Pure Science	Ala.	Texas	Okla.
ACT Composite:						
Number	379	232	160	171	146	454
Mean	12.12	11.94	14.55	11.94	13.40	13.26
ACT Science:						
Number	340	210	124	105	136	433
Mean	12.12	12.01	15.08	11.48	13.51	14.22
Grade Point Avg.:						
Number	439	280	192	183	203	525
Mean	2.28	2.33	2.53	2.38	2.20	2.53

Table VI reveals the total number of subjects, mean, standard deviation, skewness, and kurtosis for each variable used as a measure of academic ability and achievement. The positive values for skewness for ACT composite and ACT science scores indicated that the frequency curves for these measures were skewed positively with respect to the curve of a normal distribution. The negative value for grade point average indicated a negative skew. Since the mean and median of a normal distribution have the same value, these measures indicated that the value of the mean was greater than the median (positive skew), or less than the median (negative skew). They also indicated that the proportions of scores at the tails of the distributions were greater or less than a group of measures distributed normally.

The positive values of kurtosis for the distribution of ACT composite and ACT science scores in the sample represented a frequency distribution curve that was more peaked (leptokurtic) than a normal distribution curve, for which $g = 0$. The negative value of kurtosis for "grade point average" indicated a curve that was flatter (platykurtic) than the normal curve. A leptokurtic distribution indicates that the proportion of items near the mean and far from it is greater than expected in a normal distribution. A platykurtic distribution indicates an excess of deviations near the center in comparison to a normally distributed variate.

TABLE VI

POPULATION CHARACTERISTICS BY ACT COMPOSITE SCORES, ACT SCIENCE SCORES AND GRADE POINT AVERAGES

Variable	n	Mean	Std. Dev.	Skewness	Kurtosis
ACT Composite	771	12.55	4.12	0.36	0.35
ACT Science	674	13.03	5.13	0.29	0.15
Grade Point Avg.	911	2.40	0.61	-0.01	-0.07

Interpretation of the foregoing results warrant a discussion of the effect of departure from normality on probabilities generated by F ratios in analysis of variance, since the assumption of normality, along with homogeneity of variance, is basic to this statistical design. The effect of violating the assumptions underlying use of the t-test is discussed by C. Alan Boneau on page 251 of Readings in Statistics:

> We may conclude that for a large number of different situations confronting the researcher, the use of the ordinary 't' test and its associated table will result in probability statements which are accurate to a high degree, even though the assumptions of homogeneity of variance and normality are untenable. This large number of situations has the following general characteristics: (a) the two sample sizes are equal or nearly so, (b) the assumed underlying population distributions are of the same shape or nearly so. (If the distributions are skewed they should have nearly the same variance.) If these conditions are met, then no matter what the variance differences may be, samples as small as five will produce results for which the true probability of rejecting the null hypothesis at the .05 level will more than likely be within .03 of that level. If the sample size is as large as 15, the true probabilities are quite likely within .01 of the nominal value. That is to say, the percentage of times the null hypothesis will be rejected when it is actually true will tend to be between 4% and 6% when the nominal value is 5%.

The assumption relative to the shape of the underlying populations is further discussed by Boneau on page 252 of the same publication:

> If the two underlying populations are not the same shape, there seems to be little difficulty if the distributions are both symmetrical. If they differ in skew, however, the distribution of obtained t's has a tendency itself to be skewed, having a greater percentage of obtained t's falling outside of one limit than the other. This may tend to bias probability statements. Increasing the sample size has the effect of removing the skew, and, due to the Central Limit Theorem and others, the normal distribution is approached by this maneuver. By the time the samples reach 25 or 30, the approach should be close enough that one can, in effect, ignore the effects of violations of assumptions except for extremes. Since this is so, the t-test is seen to be functionally distribution-free.

The relationship of his findings concerning the t-test to the F-test of analysis of variance is stated by Boneau: "Since the t and F tests of analysis of variance are intimately related, it can be shown that many of the statements referring to the t-test can be generalized quite readily to the F-test."

The pure science majors and applied science majors were combined into a single group (science majors) for the analysis of variance results presented in Table VII. The F value for ACT composite score between major field groups was statistically significant, but not between the colleges as above. There was a statistically significant difference between major field of study and college on the measures of ACT science score and grade point average, however, the significant interaction on ACT science score disappeared.

The number of subjects and mean score for each major field and college group, for each variable, is presented in Table VIII. The science majors had a higher mean score than the non-science majors on each measure. The colleges maintained their relative positions with respect to ACT composite and ACT science mean scores, but the Alabama

TABLE VII

EFFECT OF ACT COMPOSITE SCORE, ACT SCIENCE SCORE, AND GRADE POINT AVERAGE ON SCIENCE AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
ACT Composite:				
Total	770			
Major Field	1	121	7.28	<.01
College	2	40	2.42	.088
Interaction	2	17	.99	.626
Error	765	17		
ACT Science:				
Total	673			
Major Field	1	184	7.21	<.01
College	2	98	3.84	<.05
Interaction	2	27	1.06	.346
Error	668	26		
Grade Point Average:				
Total	910			
Major Field	1	2	6.66	<.05
College	2	7	18.18	<.001
Interaction	2	1	1.41	.244
Error	905	.37		

p = probability of an F value occurring by chance.

college had the second highest mean grade point average, replacing in rank the Texas college on this variable.

TABLE VIII

NUMBER OF SUBJECTS AND MEAN SCORE OF SCIENCE AND NON-SCIENCE MAJORS; AND COLLEGES, FOR ACT COMPOSITE SCORE, ACT SCIENCE SCORE, AND GRADE POINT AVERAGE

Variable	Major Field		College		
	Non-Science	Science	Ala.	Texas	Okla.
ACT Composite:					
Number	379	392	171	146	454
Mean	12.14	13.06	12.14	13.08	12.56
ACT Science:					
Number	340	334	105	136	433
Mean	12.12	13.43	11.82	13.18	13.32
Grade Point Avg.:					
Number	439	472	183	203	525
Mean	2.28	2.40	2.39	2.15	2.49

Major Field, College, and Measures of High School Science Activity, Attitude Toward Science, and White Students Enrolled in High School

Table IX reveals the results of the analysis of variance examining the relationship between pure science, applied science, and non-science majors; and the colleges in Alabama, Texas, and Oklahoma, on each of the independent measures of high school science activity, attitude toward science, and the percentage of white students enrolled in high school. The high school science activity score was derived from a formula presented in Appendix H.

The "attitude toward science" score was obtained by summing the responses to the 21 statements which comprised the science attitude scale of the survey instrument. The score for "white students enrolled" was the numerical value corresponding to the percentage category of white students in high school indicated by the respondent. (See Appendix A.)

Statistically significant values for F were obtained for major field, college, and the interaction of major field and college on the variable "high school science activity". The F value for the variable "attitude toward science" was statistically significant between major field groups. The F value for college was statistically significant on the variable "white students enrolled".

The number of subjects and mean scores for "high school science activity", "attitude toward science", and "white students enrolled" for each major field and college group are presented in Table X. The mean scores for the "science activity" variable were highest for the pure science majors and the Oklahoma college. The mean scores for the

TABLE IX

EFFECT OF HIGH SCHOOL SCIENCE ACTIVITY, ATTITUDE TOWARD SCIENCE, AND WHITE STUDENTS ENROLLED ON PURE SCIENCE, APPLIED SCIENCE AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
Science Activity:				
Total	933			
Major Field	2	736	11.24	<.001
College	2	214	3.26	<.05
Interaction	4	165	2.52	<.05
Error	925	66		
Science Attitude:				
Total	1005			
Major Field	2	9346	97.73	<.001
College	2	267	2.79	.06
Interaction	4	71	.74	.567
Error	925	96		
White Students Enrolled:				
Total	1001			
Major Field	2	4	.85	.571
College	2	117	25.18	<.001
Interaction	4	7	1.47	.209
Error	993	5		

p = probability of an F value occurring by chance.

variable, "attitude toward science", were highest for the pure science majors and the Alabama college. The high means for "white students enrolled", representative of a larger percentage of white students in high school, were those of non-science majors and the Oklahoma college.

TABLE X

NUMBER OF SUBJECTS AND MEAN SCORE OF PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJORS; AND COLLEGES, FOR HIGH SCHOOL SCIENCE ACTIVITY, ATTITUDE TOWARD SCIENCE, AND WHITE STUDENTS ENROLLED

Variable	Major Field			College		
	Non-Science	Applied Science	Pure Science	Ala.	Texas	Okla.
Science Activity:						
Number	452	285	197	195	201	538
Mean	12.42	13.32	15.94	12.77	14.30	14.60
Science Attitude:						
Number	480	319	207	195	254	557
Mean	71.65	74.45	83.58	77.41	76.87	75.39
White Students Enrolled:						
Number	479	317	206	195	254	553
Mean	2.40	2.16	2.20	1.57	2.21	2.97

The shape of the frequency curve for the variables of "high school science activity", "attitude toward science", and "white students enrolled", can be ascertained from measures of the mean, standard deviation, skewness, and kurtosis, presented in Table XI. The distribution of high school science activity scores was highly skewed and markedly leptokurtic. This situation was interpreted to indicate that most of the scores were near the mean, with little distribution in the normal sense.

TABLE XI

POPULATION CHARACTERISTICS BY HIGH SCHOOL SCIENCE ACTIVITY, ATTITUDE TOWARD SCIENCE, AND WHITE STUDENTS ENROLLED

Variable	n	Mean	Std. Dev.	Skewness	Kurtosis
Science Activity	934	13.38	8.21	9.06	147.81
Science Attitude	1006	74.60	10.88	-0.10	0.77
White Students Enrolled	1002	2.54	2.23	.97	-0.77

The distribution of "attitude toward science scores" had a slight negative skewness and were leptokurtic in comparison to a normal distribution. The "white students enrolled" scores were skewed in a positive direction in comparison to the mean of a normal distribution, and flatter at the top (platykurtic).

The results of the analysis of variance for science majors versus non-science majors, and the colleges in Alabama, Texas, and Oklahoma on the variables of "science activity" in high school, "attitude toward science", and "white students enrolled" are shown in Table XII. Statistically significant F's were obtained for major field of study on the "science activity" and "science attitude" variables, and for college on the variables of "science attitude" and "white students enrolled".

Table XIII presents the number of subjects and mean scores of the major field groups and for each of the colleges on the three variables. The mean score for science majors was highest for the measures of "science activity" and "attitude toward science". The non-science majors had the highest mean score on "white students enrolled".

Major Field, College, and Measures of Influence on Choice of Major

Table XIV presents the results of the analysis of variance examining the relationship between pure science, applied science, and non-science majors; and the colleges, on the measures of family, high school, and college influence on choice of major field. The scores used in the analysis of variance computations were derived from the subjects ratings of the perceived influence of various persons and activities in the home, high school, and college on their choice of major field.

Statistically significant values for F indicated a difference between the colleges on each of the three variables, treated independently, and between major field groups on the variable of "family influence". The number of subjects and mean score for each sample

TABLE XII

EFFECT OF HIGH SCHOOL SCIENCE ACTIVITY, ATTITUDE TOWARD SCIENCE, AND WHITE STUDENTS ENROLLED ON SCIENCE AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
Science Activity:				
Total	993			
Major Field	1	526	7.90	<.01
College	2	57	.85	.568
Interaction	2	95	1.42	.241
Error	928	67		
Science Attitude:				
Total	1005			
Major Field	1	8136	77.38	<.001
College	2	984	9.36	<.001
Interaction	2	300	2.86	.056
Error	1000	105		
White Students Enrolled:				
Total	1001			
Major Field	1	8	1.76	.182
College	2	117	25.23	<.001
Interaction	2	8	1.77	.168
Error	996	5		

p = probability of an F value occurring by chance.

group are presented in Table XV. The Texas college had the highest mean score among the college groups on each variable. Non-science majors had the highest mean score on the measure of family influence.

TABLE XIII

NUMBER OF SUBJECTS AND MEAN SCORE OF SCIENCE AND NON-SCIENCE MAJORS; AND COLLEGES, FOR HIGH SCHOOL SCIENCE ACTIVITY, ATTITUDE TOWARD SCIENCE, AND WHITE STUDENTS ENROLLED

Variable	Major Field		College		
	Non-Science	Science	Ala.	Texas	Okla.
Science Activity:					
Number	452	482	195	201	538
Mean	12.42	14.19	12.75	13.73	13.44
Science Attitude:					
Number	480	526	195	254	557
Mean	71.65	78.25	76.88	75.05	72.92
White Students Enrolled:					
Number	479	523	195	254	553
Mean	2.40	2.19	1.67	2.18	3.03

TABLE XIV

EFFECT OF HIGH SCHOOL, FAMILY, AND COLLEGE INFLUENCE ON CHOICE OF MAJOR FIELD, ON PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
High School Influence:				
Total	946			
Major Field	2	14	1.31	.268
College	2	84	7.94	$<.01$
Interaction	4	12	1.14	.336
Error	938	11		
Family Influence:				
Total	794			
Major Field	2	44	3.30	$<.05$
College	2	47	3.48	$<.05$
Interaction	4	2	0.17	.949
Error	786	13		
College Influence:				
Total	947			
Major Field	2	37	1.58	.205
College	2	106	4.53	$<.05$
Interaction	4	38	1.62	.167
Error	939	23		

p = probability of an F value occurring by chance.

TABLE XV

NUMBER OF SUBJECTS AND MEAN SCORE OF PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJORS; AND COLLEGES, FOR HIGH SCHOOL, FAMILY AND COLLEGE INFLUENCE ON CHOICE OF MAJOR FIELD

Variable	Major Field			College		
	Non-Science	Applied Science	Pure Science	Ala.	Texas	Okla.
High School Influence						
Number	444	303	200	186	245	516
Mean	8.85	8.58	8.36	8.84	9.03	7.90
Family Influence						
Number	373	264	158	156	209	430
Mean	7.93	7.47	6.96	7.43	7.96	6.97
College Influence						
Number	448	302	198	185	246	517
Mean	10.75	11.16	10.36	10.90	11.36	10.02

The distribution of the variables indicating the degree of influence on choice of major is indicated in Table XVI. The scores representing high school influence were slightly skewed negatively, and those of family and college influence were skewed positively. The distribution curve for each of the variables was platykurtic in relation to the curve of a normal distribution.

TABLE XVI

POPULATION CHARACTERISTICS BY HIGH SCHOOL, FAMILY, AND COLLEGE INFLUENCE ON CHOICE OF MAJOR FIELD

Variable	n	Mean	Std. Dev.	Skewness	Kurtosis
High School Influence	947	8.41	3.29	-0.11	-0.80
Family Influence	795	7.41	3.68	0.41	-0.81
College Influence	948	10.58	4.87	0.18	-0.71

The results of the analysis of variance between science and non-science majors and the colleges in Alabama, Texas, and Oklahoma on each variable indicating the degree of influence on choice of major are presented in Table XVII. The same pattern of statistically significant F values obtained when major field of study consisted of three levels occurred. Statistically significant differences between the colleges were indicated on each variable, and between the two major field of study groups on the variable representing family influence.

The number of subjects and mean of each sample group are presented for each variable in Table XVIII. The Texas college had the highest mean score among the college groups on each measure. The non-science majors had the highest mean score for "family influence".

TABLE XVII

EFFECT OF HIGH SCHOOL, FAMILY AND COLLEGE INFLUENCE ON CHOICE OF MAJOR FIELD, ON SCIENCE AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
High School Influence:				
Total	946			
Major Field	1	38	3.56	.056
College	2	90	8.55	<.001
Interaction	2	4	0.35	.709
Error	941	11		
Family Influence:				
Total	794			
Major Field	1	71	5.29	<.05
College	2	60	4.47	<.05
Interaction	2	4	0.30	.749
Error	789			
College Influence:				
Total	947			
Major Field	1	0.46	0.02	.891
College	2	118	5.03	<.01
Interaction	2	15	0.64	.534
Error	942	23		

p = probability of an F value occurring by chance.

TABLE XVIII

NUMBER OF SUBJECTS AND MEAN SCORE OF SCIENCE AND NON-SCIENCE MAJORS; AND COLLEGES, FOR HIGH SCHOOL, FAMILY, AND COLLEGE INFLUENCE ON CHOICE OF MAJOR FIELD

Variable	Major Field		College		
	Non-Science	Science	Ala.	Texas	Okla.
High School Influence:					
Number	444	503	186	245	516
Mean	8.85	8.39	8.84	9.09	7.91
Family Influence:					
Number	373	422	156	209	430
Mean	7.93	7.24	7.48	8.18	7.10
College Influence:					
Number	448	500	185	246	517
Mean	10.75	10.71	10.75	11.43	10.01

Major Field, College, and Measures of Family Background

An analysis of variance was computed to show the relationship between major field and college on each of the variables: "family socioeconomic status", "number of siblings", and "ordinal position among siblings". The socioeconomic status measure was based on the parents' occupation, education, and the parental family income. The number of siblings was the number indicated by the respondent, plus one.

A score for ordinal position was derived from a formula presented in Appendix H.

Table XIX presents the results of the analysis of variance when there were three levels on the major field factor (pure science, applied science, non-science). The F-ratios indicated no statistically significant differences between major field groups, college groups, or "interaction" on any of the measures. The reader is reminded that a portion of the mean score for the Alabama sample on the socioeconomic variable, comprising parental education and occupation, was the mean score of the Texas and Oklahoma samples. The measure of family income, however, did contribute to the total variance in socioeconomic scores for the Alabama subjects.

The reader is also reminded that, because of missing data, the mean scores for the Oklahoma and Texas samples were transferred in their entirety to constitute the mean score for Alabama students for the number of siblings and ordinal position measures only. These maneuvers do not appear to have affected differences between pure science, applied science, and non-science majors on either of the three variables; had such differences existed. The mean score of each major field and college sample for these variables is shown in Table XX.

The shape of the frequency distribution curve for each of the family background variables was indicated by measures of the mean, standard deviation, skewness, and kurtosis presented in Table XXI. The measures of skewness and kurtosis were representative of curves that were positively skewed and leptokurtic for each variable.

TABLE XIX

EFFECT OF SOCIOECONOMIC STATUS, NUMBER OF SIBLINGS, AND ORDINAL POSITION ON PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
Socioeconomic Status:				
Total	1004			
Major Field	2	1016	0.52	.601
College	2	893	0.46	.639
Interaction	4	1376	0.70	.592
Error	996	1955		
Number of Siblings:				
Total	1005			
Major Field	2	1	0.12	.887
College	2	2	0.22	.807
Interaction	4	15	1.99	.092
Error	997	8		
Ordinal Position:				
Total	1005			
Major Field	2	177	0.53	.595
College	2	1	0.003	.997
Interaction	4	440	0.31	.262
Error	997	335		

p = probability of an F value occurring by chance.

TABLE XX

NUMBER OF SUBJECTS AND MEAN SCORE OF PURE SCIENCE, APPLIED SCIENCE, AND NON-SCIENCE MAJORS; AND COLLEGES, FOR SOCIOECONOMIC STATUS, NUMBER OF SIBLINGS, AND ORDINAL POSITION

Variable	Major Field			College		
	Non-Science	Applied Science	Pure Science	Ala.	Texas	Okla.
Socioeconomic Status:						
Number	480	319	206	195	254	556
Mean	90.80	92.36	94.87	91.76	91.38	94.89
Number of Siblings:						
Number	480	319	207	195	254	557
Mean	5.53	5.43	5.42	5.49	5.52	5.37
Ordinal Position:						
Number	480	319	207	195	254	557
Mean	30.98	30.39	29.29	30.19	30.16	30.29

TABLE XXI

POPULATION CHARACTERISTICS BY SOCIOECONOMIC STATUS, NUMBER OF SIBLINGS AND ORDINAL POSITION

Variable	n	Mean	Std. Dev.	Skewness	Kurtosis
Socioeconomic Status	1005	92.32	44.11	0.42	0.28
Number of Siblings	1005	5.49	2.75	0.91	1.37
Ordinal Position	1005	30.19	18.29	2.48	7.09

The results of the analysis of variance for science versus non-science majors; and college, on socioeconomic status, number of siblings, and ordinal position are presented in Table XXII. The effect of combining pure science and applied science majors into a single group was not statistically significant on either of the three measures. The means of the two major field groups and three college groups, for each "family background" variable, are shown in Table XXIII.

Relationships Among Selected Variables Among Science Majors

Table XXIV is a correlation matrix showing the relationships among measures of: father's education, mother's education, grade point average, siblings with some college, science courses taken in high school, "attitude toward science", socioeconomic status, size of high school, "white students enrolled", and high school influence on choice of major. The relationships among these measures were computed from the measures of 178 science majors (pure and applied) from the Texas and Oklahoma samples. Science majors, for whom information on any one of the factors was not available, were omitted in the computation of the correlation matrix. The socioeconomic status measure in this analysis was based on the parents' occupation and family income.

The values resulting from the computations are Pearson Product-Moment Correlation Coefficients, and were calculated using a formula presented in Appendix H.

The correlation coefficient needed for statistical significance at the 0.01 level was computed using the formula (Bruning and Kintz, 1968):

$$z = r\sqrt{N - 1}$$

TABLE XXII

EFFECT OF SOCIOECONOMIC STATUS, NUMBER OF SIBLINGS, AND ORDINAL POSITION ON SCIENCE AND NON-SCIENCE MAJOR; AND COLLEGE

Source	df	Mean Square	F	p
Socioeconomic Status:				
Total	1004			
Major Field	1	728	0.37	.549
College	2	281	0.14	.867
Interaction	2	449	0.23	.797
Error	999	1955		
Number of Siblings:				
Total	1005			
Major Field	1	1	0.09	.762
College	2	0.08	0.01	.994
Interaction	2	1	0.16	.853
Error	1000	8		
Ordinal Position:				
Total	1005			
Major Field	1	258	0.77	.615
College	2	63	0.19	.830
Interaction	2	123	0.37	.699
Error	1000	336		

p = probability of an F value occurring by chance.

TABLE XXIII

NUMBER OF SUBJECTS AND MEAN SCORE OF SCIENCE MAJORS AND NON-SCIENCE MAJORS; AND COLLEGES, ON SOCIOECONOMIC STATUS, NUMBER OF SIBLINGS, AND ORDINAL POSITION

Variable	Major Field		College		
	Non-Science	Science	Ala.	Texas	Okla.
Socioeconomic Status:					
Number	480	525	195	254	556
Mean	90.80	92.76	91.73	90.76	92.85
Number of Siblings:					
Number	480	526	195	254	557
Mean	5.53	5.47	5.49	5.51	5.50
Ordinal Position:					
Number	480	526	195	254	557
Mean	30.78	30.41	30.12	30.94	30.34

A z-score of ± 2.57 corresponds to a probability of 0.01 for a two-tailed test. With an N of 178, the value needed for statistical significance is .193. This criterion was used to identify those correlation coefficients that indicated relationships which were statistically significant from r = 0.

Using the above criterion for identifying statistically significant relationships, an inspection of Table XXIV revealed statistically significant relationships at the 0.01 level between:

TABLE XXIV

RELATIONSHIPS AMONG SELECTED VARIABLES FOR ONE HUNDRED SEVENTY-EIGHT SCIENCE MAJORS

	FATH EDUC	MOTH EDUC	GPA	SIBS COLL	HSCH SCI	SCI ATT	SOCIO ECON	SIZE HSCH	WHT ST ENROLL	HSCH INFL
FATH EDUC	1.000	.532*	.042	-.082	.039	-.007	.436*	.150	.045	-.135
MOTH EDUC		1.000	-.023	-.080	.016	.048	.485*	.198*	-.003	-.063
GPA			1.000	.107	.260*	.060	.074	-.009	.134	-.138
SIBS-COLL				1.000	.076	.116	-.057	-.057	.003	-.006
HIGH SCH SCI					1.000	.351*	.073	-.039	-.233*	-.008
SCI ATT						1.000	.012	-.081	-.141	.128
SOCIOECON							1.000	.186	.106	-.149
SIZE H SCH								1.000	.146	.083
WHT STUD ENROLL									1.000	-.063
HSCH INFLU										1.000

*Denotes statistically significant relationship at 0.01 level.

father's and mother's education,

father's education and socioeconomic status,

mother's education and socioeconomic status,

mother's education and size of high school,

grade point average and science courses taken in high school,

science courses taken in high school and "attitude toward science",

science courses taken in high school and "white students enrolled".

Some of these relationships, while statistically significant, were weak in terms of the proportion of total variation between the two variables accounted for by the magnitude of the correlation coefficient (Runyon and Haber, 1968). Thus, the correlation coefficient needed for significance (.193) accounts for only 3.72 per cent of the total variation between two variables.

Table XXV presents the mean, standard deviation, skewness, and kurtosis measures for each variable in the correlation matrix. The values indicated the shape of the distribution curves for the measures among the 178 subjects.

Attitude Toward Science and Academic Achievement

Research question No. 4 was: "Is there a significant difference (0.05 level) in the attitude toward science of science and non-science majors of comparable achievement as determined by grade point ratios?" An independent t-test was computed to examine the difference between the mean "attitude toward science" scores of those science and non-science majors with a cumulative grade point average of 3.00 or higher. The formula, given by Bruning and Kintz (1968), is presented in Appendix H.

TABLE XXV

POPULATION CHARACTERISTICS BY SELECTED VARIABLES AMONG ONE HUNDRED SEVENTY-EIGHT SCIENCE MAJORS

Variable	Mean	Std. Dev.	Skewness	Kurtosis
FATHER'S EDUC	11.62	3.83	-0.02	0.15
MOTHER'S EDUC	12.46	2.66	0.44	1.23
GRADE POINT AVG	2.48	0.63	0.15	-0.49
SIBLINGS COLL	1.79	0.81	0.41	-1.37
HIGH SCH SCI	8.21	3.29	0.28	0.12
SCI ATT	78.08	10.74	-0.28	-0.21
SOCIOECON	75.93	43.67	0.19	-0.60
SIZE HIGH SCH	4.30	1.91	-0.28	-1.29
WHT STU ENROLL	2.63	2.24	0.88	-0.92
HIGH SCH INFLU	8.43	3.23	-0.14	-0.71

The results of the t-analysis are shown in Table XXVI. The "t" value of -2.81 was statistically significant with a probability less than .01 that the difference in means would have occurred by chance.

Relationships Between Selected Variables Among All Majors

A product-moment correlation matrix was computed to examine the relationships among the variables: ACT composite score, ACT science score, grade point average, socioeconomic status, "high school science activity", "attitude toward science", high school influence on choice of major, family influence on choice of major, college influence on choice of major, "white students enrolled", number of siblings, and ordinal position among siblings. The relationships were computed for 470 of the 1006 subjects in the total sample. Subjects were omitted from the matrix if information on any one of the variables was missing.

TABLE XXVI

RESULT OF "t" TEST OF DIFFERENCE BETWEEN MEANS OF SCIENCE AND NON-SCIENCE MAJORS WITH GPA EQUAL TO OR GREATER THAN THREE, ON ATTITUDE TOWARD SCIENCE SCORE

Source	Mean	N	df	s^2	"t"	P
Attitude Toward Science:						
Science Majors	80.01	88	154	95.13	-2.81	.01
Non-Science Majors	75.42	73		113.10		

Using the formula, $z = r\sqrt{N - 1}$, and solving for r, a value of .118 was obtained when $z = \pm 2.57$. A z-score of ± 2.57 includes 99 per cent of the area of a normal curve, therefore, an r value of .118 or greater is statistically different from r = 0 at the .01 probability level. Using this criterion, the following measures in Table XXVII were found to be statistically related:

TABLE XXVII

RELATIONSHIPS BETWEEN SELECTED VARIABLES AMONG FOUR HUNDRED SEVENTY STUDENTS

	ACT SCI	GPA	SOCIO ECON	SCI ACT	SCI ATT	HSCH INFL	FAM INFL	COLL INFL	WHT ST ENROLL	SIBS	ORD POS
ACT COMP	.775*	.414*	.137*	.325*	.191*	-.164*	-.172*	-.144*	.150*	0.071	.005
ACT SCI	1.000	.271*	.077	.214*	.176*	-.140*	-.074	-.090	.132*	-.037	-.032
GPA		1.000	.039	.218*	.182*	-.097	-.185*	-.075	.136*	.076	-.120*
SOCIOECON			1.000	.070	.032	-.009	.031	.011	.003	-.334*	.292*
SCI ACT				1.000	.319*	-.027	-.095	-.045	-.150*	.002	-.046
SCI ATT					1.000	.095	.012	.191*	-.150*	-.043	-.047
HIGH SCH INFL						1.000	.364*	.539*	-.192*	-.015	.016
FAM INFL							1.000	.340*	-.063	-.018	-.038
COLL INFL								1.000	-.134*	.066	-.068
WHT STU ENROLL									1.000	.061	-.017
SIBLINGS										1.000	-.718*
ORD POSIT											1.000

*Denotes statistically significant relationship at 0.01 level.

1. ACT composite score and: ACT science score,
   grade point average,
   socioeconomic status,
   high school science activity,
   attitude toward science,
   high school influence on choice of major,
   family influence on choice of major,
   college influence on choice of major,
   white students enrolled in the high school.
2. ACT science score and: grade point average,
   high school science activity,
   attitude toward science,
   high school influence on choice of major,
   white students enrolled in the high school.
3. Grade point average and: high school science activity,
   attitude toward science,
   family influence on choice of major,
   white students enrolled in high school,
   ordinal position among siblings.
4. Socioeconomic status and: number of siblings,
   ordinal position among siblings.

5. High school science activity and: attitude toward science, white students enrolled in high school.

6. Attitude toward science and: college influence on choice of major, white students enrolled in high school.

7. High school influence and: family influence on choice of major, college influence on choice of major, white students enrolled in high school.

8. Family influence and college influence.

9. College influence and white students enrolled.

10. Number of siblings and ordinal position.

Choice of Major Field

Research question No. 6 was, "Do science majors consider their choice of major field at an earlier time in life than non-science majors?" The students in the survey sample were asked to respond to the question, "When did you first consider your original choice of major field?" (See Appendix A.) Table XXVIII reveals the proportion of science and non-science majors responding to each of ten possible choices.

TABLE XXVIII

NUMBER AND PERCENT RESPONSE OF SCIENCE AND NON-SCIENCE MAJORS TO QUESTION, "WHEN DID YOU FIRST CONSIDER YOUR ORIGINAL CHOICE OF MAJOR FIELD?"

Time	Non-Science		Science	
	N	%*	N	%*
Before High School	44	9	62	12
During High School	211	44	279	54
After High School, But Before College	110	23	118	23
Freshman Year College	72	15	33	6
Sophomore Year	20	4	6	1
Junior Year	5	1	4	1
Senior Year	5	1	7	1
While Out of College	4	1	1	0
During Military Service	6	1	6	1
Still Undecided	2	0	4	1

*Not exact due to rounding. $\chi^2 = 9.96$ $p < .01$

For both groups, the largest proportion of responses were for "during high school". The same percentage of responses (23 per cent) for both groups were given for "after high school but before college". Eighty-nine per cent of the science majors responded to choices relative to "before college" in comparison to 76 per cent of the non-science majors. The results of a Kolmorogov-Smirnov test indicated a statistically significant relationship between the responses of the science and non-science majors.

Influences on Choice of Major

Research question No. 7 was: "How do science and non-science majors compare in their ratings of various persons and activities within the family, in high school, and in college on their choice of major field?" These relationships were analyzed by computing the proportion of science and non-science majors who checked the categories of "fairly important", "very important", "strong", or "very strong" influence, on Items 13, 16, and 17 of the survey questionnaire (see Appendix A). These percentages are presented in Tables XXIX, XXX, and XXXI for high school, family, and college, respectively.

TABLE XXIX

NUMBER AND PERCENT OF SCIENCE AND NON-SCIENCE MAJORS WHO RESPONDED "FAIRLY IMPORTANT" OR "VERY IMPORTANT" TO THE INFLUENCE OF PERSONS AND ACTIVITIES IN HIGH SCHOOL ON CHOICE OF MAJOR FIELD

Person or Activity	Non-Science		Science	
	N	%	N	%
Science or Math Teacher(s)	228	48	321	62
Teacher - other subject(s)	367	77	358	69
School Counselor	272	52	177	37
Career Day or Special Speakers	265	51	211	44

NUMBER OF SCIENCE MAJORS - 526

NUMBER OF NON-SCIENCE MAJORS - 480

TABLE XXX

NUMBER AND PERCENT OF SCIENCE AND NON-SCIENCE MAJORS WHO RESPONDED "STRONG" OR "VERY STRONG" TO THE INFLUENCE OF FAMILY MEMBERS ON CHOICE OF MAJOR FIELD

Family Member	Non-Science		Science	
	N	%	N	%
Mother or Stepmother	272	57	291	56
Father or Stepfather	194	41	208	40
Brother(s)	272	52	177	37
Sister(s)	254	49	180	38
Other Relatives	211	44	223	43
SCIENCE MAJORS - 526				
NON-SCIENCE MAJORS - 480				

In the high school, the person receiving the largest proportion of responses as having important influence was "teacher (other subjects)" by both science and non-science majors. In the family, influence of the mother or stepmother was rated important most often by both groups. For college influence, the greatest proportion of non-science majors rated "books and magazines" as important. The largest proportion of science majors' responses of important influence in college went to "discussions with academic advisor."

TABLE XXXI

NUMBER AND PERCENT OF SCIENCE AND NON-SCIENCE MAJORS WHO RESPONDED "FAIRLY IMPORTANT" OR "VERY IMPORTANT" TO THE INFLUENCE OF PERSONS AND ACTIVITIES IN COLLEGE ON CHOICE OF MAJOR FIELD

Person or Activity	Non-Science		Science	
	N	%	N	%
Placement Office	114	24	116	22
Career Day Program	162	34	217	42
Discussions (Academic Advisor)	277	58	345	66
Discussions (other faculty)	263	55	285	55
Summer Job	194	41	231	44
Friend(s)	284	59	285	55
Magazines and Books	297	62	335	64

CHAPTER V

SUMMARY AND CONCLUSIONS

The Problem and Purpose of Study

The problem underlying this investigation was man's lack of knowledge concerning characteristics of Negro scientists or potential scientists. The present study focused on selected characteristics of the latter group, i.e., potential scientists, represented by students majoring in science at predominantly Negro land-grant colleges. The purpose of the study was to compare science majors with non-science majors by examining similarities and differences between the two groups.

Methods and Procedures

The present study was a part of the Langston University College Maturation Study Project, utilizing funds granted by the United States Department of Agriculture. The survey method of data collection was used since it facilitated the collection of a large amount of standardized information from a large number of subjects. The survey instrument, in the form of a questionnaire, was designed and developed by the project team. Items in the questionnaire, specifically designed to elicit responses relative to the factors under investigation in this study, were suggested by a review of previous studies, theories of vocational choice, several Negro science professors, and members of the research team.

Data were collected from students at three predominantly Negro land-grant institutions located in the states of Alabama, Texas, and Oklahoma. The sample of students at the college in Alabama was utilized to pre-test the survey instrument, and a decision made later to incorporate their responses in the analysis of the data. The investigator administered the questionnaire and collected related data from student records during February and March, 1970. The total sample consisted of 1,006 subjects.

Data from the questionnaire were coded and keypunched onto IBM cards. Each punched card was then checked against the questionnaire for each subject, thereby reducing the error of transfer of data to an estimated minute level.

Seven specific research questions stated in Chapter I were analyzed statistically using F-tests of analysis of variance, a t-test, product-moment correlations, and percentages. The results and interpretation of these analyses were presented in the preceding chapter.

Summary of Results and Conclusions

The summary of the results of this study and the conclusions to be drawn will center on the five general questions posed in Chapter I. Each question is restated to aid in establishing parameters for the discussion and conclusions which follow.

1. Do the science fields attract Negro college students of greater academic ability and achievement than the non-science fields?

The three measures of academic ability and achievement used in this investigation were defined as: ACT composite scores, ACT science scores, and cumulative grade point ratios. Analysis of variance statistical designs were used to examine differences that might exist between science and non-science majors on each of the ability and achievement measures. Two science versus non-science analyses were made on each variable: one, when science majors were separated into two levels, pure science and applied science; and two, when both levels of science majors were combined.

Statistically significant F ratios were obtained between the major field groups, regardless of whether science majors were separated or combined, on each of the three independent variables. However, smaller F ratios were obtained when the applied and pure science majors were combined. An examination of the mean score of each major field group for each variable revealed the highest values for pure science majors, and science majors (combined group). It was noted that the mean scores of applied science majors were nearly the same as for non-science majors. The statistically significant differences between the means when applied science and pure science majors were combined suggested that most of the variance between the groups was contributed by the scores of pure science majors.

From the results of the analysis of variance on the measures of ACT composite score, ACT science score, and grade point ratio; and based on the samples used in this investigation, it was concluded that the science fields attracted Negro college students of greater academic ability and achievement than the non-science fields. However, since applied science majors appeared to be more like non-science majors on these measures, this conclusion was valid only for those Negro college students in the pure science fields as they were previously defined.

2. Are the family backgrounds of Negro college students who major in science different from those of non-science majors?

Three measures were used to investigate aspects of the family background of the students in the sample. These were: family socioeconomic status, number of siblings, and ordinal position among siblings. The F-tests of analysis of variance resulted in no statistically significant differences between science (separated or combined) and non-science majors on any of the measures. It was concluded, therefore, based on the measures used and the results of the distribution of scores of these measures among the sample population, that the family background factors of socioeconomic status, number of siblings, and ordinal position of Negro college students who majored in science, were not statistically different from those of non-science majors.

3. Are there characteristics of the high school which would tend to affect the student's choice of a science or non-science major field of study?

The variables tested for differences in means between science and non-science majors relative to the high school attended were "science activity" and "white students enrolled." A statistically significant F ratio in an analysis of variance was obtained, indicating differences between pure science, applied science, and non-science majors; and science majors (pure and applied) when compared with the non-science majors, on the science activity score. The mean for pure science majors was highest on the effect of the high school. Because of extreme violations of the assumption of normality as indicated by the measures of skewness and kurtosis, a conclusion that high school science activity, as defined, affected the choice of a science or non-science major among Negro college students, was untenable.

No statistically significant differences were indicated by the probability level of chance occurrence of the F ratio for the major field groups on "white students enrolled" in high school. Based on the measure used, it was concluded that the percentage of white students enrolled in high school did not affect the choice of a science or non-science major among Negro college students.

4. What influences within the family, in high school, and in college are pertinent to the choice of a science or non-science major?

The effect of measures of influence on choice of major from within the family, in high school, and in college were analyzed by F-tests of differences between means of the major field groups, and the percentages of science and non-science majors perceiving persons and activities in each milieu as having "important" or "strong" influence on their choice.

The F ratios between major field groups for the influence of persons and activities in the high school and in college on the choice of major field were not significantly different from chance occurrences. The F ratio was statistically significant for the influence of family members, whether the science majors were treated as a single group, or separated into pure and applied science groups.

Based on these results and the ratings of science and non-science majors of important influences on their choice of major, the following conclusions appeared tenable:

a. Science and non-science majors do not differ in degree of influence persons and activities in high school and in college have had on their choice of major field.

b. Non-science majors among Negro college students were influenced by family members in their choice of major field to a greater degree than non-science majors.

c. Negro college students perceived their high school teachers as important influences on their choice of major field. This influence was somewhat subject-matter oriented.

d. The influence of the mother on choice of major field tended to be strongest in comparison to other family members of Negro college students, regardless of major field.

5. Is there a difference in the attitude toward science of science and non-science majors?

The Likert-type scale used to measure "attitude toward science" appeared to be effective in discriminating between the academic major field groups, whether analyzed on three levels or two levels. Inspection of the mean scores suggested that it was more effective in discriminating between pure science and applied science majors than between applied science and non-science majors. The "attitude toward science" scale was similar to the ACT measures in this respect. However, Table XXVII did not reveal a strong relationship between the "attitude score" and the ACT score, though there was a statistically significant relationship, different from $r = 0$.

The twenty-one statements comprising the attitude scale were considered in terms of four broad categories; science teachers, science courses, science and scientists in general, and self-concept as it related to science. Therefore, a "favorable" or "unfavorable" attitude toward science was interpreted with reference to these dimensions.

A t-test for differences between means was computed to examine the "attitude toward science" of science and non-science majors with comparable academic achievement as determined by cumulative grade point average. This analysis resulted in a "t" value with a probability less than .01 of chance occurrence.

Defining "attitude toward science" as the score obtained on the measure used in this study, it was concluded; one, that science majors had a more favorable attitude toward science than non-science majors; two, that science and non-science majors with comparable academic achievement as determined by cumulative grade point averages, differed in their "attitude toward science," the attitude of science majors being more favorable.

Further Discussion of Results

Results were obtained and presented in Chapter IV which did not relate specifically to the general questions posed for investigation in this study. A discussion of those results is appropriate to the present study and in providing suggestions for future investigations of a similar nature. The discussion centers around the differences between the colleges and relationships among the variables.

Statistically significant differences between the three colleges were found on the measures of academic ability and achievement, high school science activity, percentage of white students enrolled in the high school, influence from family members, influence from persons and activities in high school, and influence from persons and activities in college on choice of major field of study. Telephone communication between the investigator and the registrar's office of each college revealed that three per cent, five per cent, and ten per cent of the students were from out-of-state at the Alabama, Texas, and Oklahoma colleges, respectively. Further analysis of the data might shed light on the effect of this factor in relation to the above measures.

The Alabama college had the lowest mean score for the percentage of white students enrolled in high school. A possible reason for this result is the lack of success of efforts to achieve racial integration of schools at the secondary level in Alabama, as reported by the various news media. It was noted in coding the responses to the question regarding percentage of white students in the high school, that the Alabama responses frequently indicated the range, 0 - 10 per cent. Provision for a response of "no white students" would have been more informative. This response was available to the Texas and Oklahoma subjects.

The mean scores of the Texas and Oklahoma colleges were highest on both ACT measures. The consistency was expected since the ACT science score was part of the composite measure. The difference between the colleges on ACT score might be due to the method of sampling used, or related to other factors, such as the degree of racial segregation or integration in high school. The difference between the colleges on grade point average could be attributed to different institutional philosophies or patterns of evaluation.

Statistically significant differences between the colleges on each of the three measures of influence on choice of major field of study were surprising since no differences were found on the measure of family socioeconomic status. Trent and Medsker (1968) found measures of these variables to be related in their study of 10,000 high school graduates. When the pure science majors and applied science majors were combined, the mean scores of the colleges were only slightly changed relative to each other, with the Texas college, first, the Alabama college, second, and the Oklahoma college, third. Further investigation is needed to uncover the meaning of this difference.

An extremely interesting aspect of the influence measures was the strength of the interrelationship among them. Inspection of Table XXVII revealed relatively large correlation coefficients, with the highest between high school and college influences. There appeared to be a "domino" effect in that the students who perceived influence from one source were likely to perceive it from the other two sources. Further investigations of these relationships might focus on the "receptivity" of the student to suggestions that would be categorized as influential on his choice of major field. Measures of personality would provide another dimension to help in understanding these relationships.

Several other relationships in the correlation matrices were worthy of note. Some of them were consistent with findings of previous studies, and as such, serve to strengthen the external reliability of the investigation. Among the science majors at the Texas and Oklahoma colleges, relatively strong correlation coefficients (.30) were obtained between measures of father's and mother's education; "high school science activity" and "attitude toward science;" and between each parents' education and socioeconomic status. Of interestwas the almost identical magnitude of the correlation coefficient between the mother's and father's education and the measure of socioeconomic status.

The strong correlation coefficient between the measures of "high school science activity" and the "attitude toward science" continued to exist when computed for all respondents, regardless of their major field of study. Departure from normality of scores on the variable "high school science activity" made relationships involving it extremely tenuous. However, inspection of the mean score of each major field and college group revealed a consistency in the measure. It also correlated consistently with the measures of academic ability and achievement which correlated with each other and were more normally distributed.

The strong relationship between the measures of socioeconomic status and number of siblings, as indicated by the magnitude of the correlation coefficient was not surprising. It appeared that among Negro families represented by the present sample, those with the highest socioeconomic status scores had the least number of children. It was also revealed that the students in the present sample are typically the youngest child in their families. This might be a reflection of efforts made to increase higher educational opportunity among Negroes.

Recommendations

In light of the problem underlying this investigation and the findings, the following recommendations are made:

1. That efforts be made to seek and identify those Negro youth with the aptitude for success in science. Coupled with this recommendation is that of finding avenues through which the parents of such youth can aid in the development of this talent.

2. That high school teachers of science and mathematics be made aware of their potential influence in the encouragement of Negro youth in the pursuit of science careers. This is particularly important as more schools become racially integrated.

3. That efforts be made at the elementary and secondary school levels, specifically, to develop favorable attitudes toward science among Negro youth.

4. That further investigations of the characteristics of potential Negro scientists be undertaken, and that a focal point be the pure science majors. It is further recommended that other variables, such as sex and grade classification, be analyzed to determine their relationship to the choice of science as a major.

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APPENDIX A

SURVEY INSTRUMENT

LANGSTON COLLEGE MATURATION STUDY

QUESTIONNAIRE

The purpose of this questionnaire is to obtain information from you which will aid the college in improving its services to the students. The questionnaire is divided into three parts: (1) major field of study, (2) college expenses, and (3) diet. In order to answer some of the questions you will need to think back 4 or 5 years. On some questions you are asked to indicate the way you feel. Please read the question or statement carefully and indicate your response according to the directions. We need and appreciate your interest and cooperation in this endeavor.

Instructions: Please mark the applicable choice for each item.

NAME (Print) ______________________________

SOCIAL SECURITY NUMBER (if known) ________________________

CLASSIFICATION (Please Circle)

Classification	Semester	
Freshman	.1	1st
	.2	2nd
Sophomore	.3	1st
	.4	2nd
Junior	.5	1st
	.6	2nd
Senior	.7	1st
	.8	2nd
Special	.9	

SEX (Circle) .1 Male .2 Female

1.* From the following list of degrees, and fields of study, write the number which corresponds to your major field of study (If you haven't declared a major, indicate the field you think you will choose). ________

Arts and Science Division (Preparation for the Profession)

A. Bachelor of Arts Degree
1. Art
2. English
3. Music
4. History
5. Sociology
6. Pre-Law
7. Social Work

B. Bachelor of Science Degree
8. Biology
9. Business Administration
10. Chemistry
11. Mathematics
12. Pre-Medical
13. Pre-Dentistry
14. Medical Technology
15. Secretarial Science
16. Physics
17. Biochemistry

Education Division (Teacher Preparation)

C. Bachelor of Arts in Education
18. Art
19. Language Arts (English)
20. Music
21. Social Science

D. Bachelor of Science in Education
22. Biology
23. Business Education
24. Chemistry
25. Elementary Education
26. Health and Physical Education
27. Home Economics
28. Industrial Arts
29. Mathematics

Applied Science Division (Preparation for Business and Industry)

E. Bachelor of Science Degree
30. Agricultural Economics
31. Animal Science
32. Industrial Arts
33. Engineering (Chemical, Electrical, etc.)

F. Associate Degree
34. Data Processing
35. Electronic Technology
36. Pre-Nursing

2.* Write the number which corresponds to your minor field of study (or your intended minor field if you haven't chosen). ________

3. Was the major field you indicated in response to item #1 your original choice of major field? (Please Circle) .1 Yes .2 No

4. If your answer to item #3 is no, write the number which corresponds to your original choice of major field. ________

5. If you answered item #4, which of the following best describes your reason (s) for changing majors? (Circle as many as apply)

.1 lost interest in original choice
.2 didn't have the background
.3 too much studying involved with original choice
.4 better job opportunities in present field
.5 didn't do too well grade-wise in original choice
.6 other reason. (Please specify) ________________________

6.* Circle the number which represents the size of the community in which you lived when you were a senior in high school. (Circle only one)

.1 Farm or open country
.2 Town less than 5,000
.3 Town between 5001 - 10,000
.4 Town between 10,001 - 20,000
.5 City Between 20,001 - 50,000
.6 City between 50,001 - 150,000
.7 City between 150,001 - 500,000
.8 City over 500,001

7.* Which of the following is the appropriate income category for your parental family? Consider total family income from all sources before taxes. (Circle only one from the most convenient category; weekly, monthly, or yearly.)

		Week	Month	Year
.1	Less than	$ 60.	$ 250.	$ 3,000
.2	Between	61.-80.	250.-330.	3,000-3,999
.3	Between	81.-120.	331.-500.	4,000-5,999
.4	Between	121.-150.	501.-670.	6,000-7,999
.5	Between	151.-190.	671.-830	8,000-9,999
.6	Between	191.-300.	831-1,250	10,000-14,999
.7	Over	300.	1,250	15,000

8.* Indicate the size of your high school graduating class. (Circle one)

.1 Less than 25
.2 25 to 49
.3 50 to 74
.4 75 to 99
.5 100 to 199
.6 200 to 499
.7 500 or more

9.* What percentage of white students were in your high school graduating class? (Circle one)

.1 No white students
.2 0 - 10% white students
.3 11% - 25% white students
.4 26% - 50% white students
.5 51% - 75% white students
.6 76% - 90% white students
.7 more than 90% white students

10.* Which of the following courses were offered in your high school? (Circle as many as apply)

.1 algebra	.2 trigonometry	.3 calculus
.1 biology	.2 geometry	.3 astronomy
.1 chemistry	.2 physics	.3 geology

11.* In which of the following activities did you participate while in high school? (Circle as many as apply)

.1 was officer in senior class
.2 won "letter" in athletics
.3 placed in advanced class
.4 member of a science or mathematics club
.5 took more courses than required
.6 worked on high school newspaper
.7 member of musical group (band, choir, etc.)
.8 had part in drama production
.9 in National Honor Society
.10 won award in science fair
.11 published paper, poem, story or article
.12 participated in Upward Bound Program
.13 finalist in mathematics contest
.14 won award for farm production
.15 National Science Foundation summer training
.16 member of FFA or FHA
.17 member of 4-H Club
.18 member of chess club
.19 member of pep club
.20 none of these applies to me
.21 Other (Please indicate) ________________

12.* When did you first consider your original choice of specific major field? (Circle one)

.1 before high school
.2 during high school
.3 after high school but before college
.4 freshman year of college
.5 sophomore year
.6 junior year
.7 senior year
.8 while out of college
.9 during military service
.10 still undecided

13.* Please rate the effect of each of the following persons on your choice of major while in high school. (Check one blank in each row)

	No Contact	Unimportant	Fairly Important	Very Important
Science or Math Teacher (s)	.11 ____	.12 ____	.13 ____	.14 ____
High School Teacher (Other subject (s)	.21 ____	.22 ____	.23 ____	.24 ____
School Counselor	.31 ____	.32 ____	.33 ____	.34 ____
School Friend (s)	.41 ____	.42 ____	.43 ____	.44 ____
Career Day or Special Speakers	.51 ____	.52 ____	.53 ____	.54 ____

14.* How much time elapsed after high school before you started college? (Circle one)

.1 went directly to college in the fall
.2 delayed 1 semester
.3 delayed 1 year
.4 delayed 2 to 3 years
.5 more than 3 years

15.* What has been the extent of interruption of your college studies since you started? (Circle one)

.1 none, so far
.2 out for less than 1 year
.3 out for less than 2 years
.4 out for 2 years or more

16.* What degree of influence has each of the following members of your family had on your choice of major field? (Place a check in one blank of each row)

	No Influence	Weak Influence	Strong	Very Strong
Mother or Step-Mother	.11 ____	.12 ____	.13 ____	.14 ____
Father or Step-Father	.21 ____	.22 ____	.23 ____	.24 ____
Brother (s)	.31 ____	.32 ____	.33 ____	.34 ____
Sister (s)	.41 ____	.42 ____	.43 ____	.44 ____
Other relatives	.51 ____	.52 ____	.53 ____	.54 ____

17.* Please rate the following in terms of their effect on your choice of major since you've been in college. (Check one blank in each row)

	No Contact	Unimportant	Fairly Important	Very Important
Placement Office	.11 ____	.12 ____	.13 ____	.14 ____
Career Day Program	.21 ____	.22 ____	.23 ____	.24 ____
Discussions with my Academic Advisor	.31 ____	.32 ____	.33 ____	.34 ____
Discussions with Faculty Members other than my Advisor	.41 ____	.42 ____	.43 ____	.44 ____
Summer Job	.51 ____	.52 ____	.53 ____	.54 ____
Friend (s)	.61 ____	.62 ____	.63 ____	.64 ____
Magazines and Books	.71 ____	.72 ____	.73 ____	.74 ____
Other (Specify)	.81 ____	.82 ____	.83 ____	.84 ____

18.* Please indicate your feeling regarding each of the following statements by circling the appropriate dash in each column. (SA = Strongly Agree; A = Agree; U = Undecided; D = Disagree; SD = Strongly Disagree)

		SA	A	U	D	SD
.1	The work in science is very interesting.	___	___	___	___	___
.2	I have the ability to do successful work in science.	___	___	___	___	___
.3	I think I could make more money in a field other than science.	___	___	___	___	___
.4	I have a strong aptitutde for science.	___	___	___	___	___
.5	I cannot afford the time and money it would take in preparing for a science occupation.	___	___	___	___	___
.6	My personality is not suitable for work in science.	___	___	___	___	___
.7	My parents would approve of my going into science.	___	___	___	___	___
.8	I couldn't major in science because I didn't take the proper courses in high school.	___	___	___	___	___
.9	Science is not challenging enough for me.	___	___	___	___	___
.10	I find science courses very interesting.	___	___	___	___	___
.11	Professors and teachers in science encouraged me to go on in this field.	___	___	___	___	___
.12	I admire my science teachers as persons; not just as teachers.	___	___	___	___	___
.13	Science teachers are too square for my tastes.	___	___	___	___	___
.14	Science teachers are inspiring.	___	___	___	___	___
.15	Science courses are dull.	___	___	___	___	___
.16	Science work is monotonous.	___	___	___	___	___
.17	Scientists are keenly intelligent.	___	___	___	___	___
.18	Science teachers are stuffy.	___	___	___	___	___
.19	I have enjoyed the science courses I've taken.	___	___	___	___	___
.20	Scientists must do very precise work.	___	___	___	___	___
.21	My high school science courses provided me with a good science background.	___	___	___	___	___

Some college students have financial needs that are not apparent to university officials. As a result, fewer funds are requested than are actually needed. It is hoped that results of this questionnaire can serve as a guide for requesting financial assistance for college students. Therefore, we solicit your cooperation in completing this part of the questionnaire.

19. Indicate all the financial resources you use in order to stay in college. (more than one may apply).

    ________ .1 Earned money myself
    ________ .2 My parents earned money to assist me
    ________ .3 Received money gifts from friends or relatives
    ________ .4 Received a scholarship or grant
    ________ .5 Received a loan

20. Current Work Status:

    ________ .1 Not working at all
    ________ .2 Part-time on campus
    ________ .3 Part-time in Town
    ________ .4 Part-time elsewhere
    ________ .5 Full-time in Town
    ________ .6 Full-time elsewhere
    ________ .7 Other (please Specify) ____________________________

21. Please circle the number of hours you worked last week.

    0 2 4 6 8 10 12 14 16 18 20 22 24 26

    28 30 32 36 38 40 or more

22. Please estimate as exactly as you can the amount of money you spent yesterday for:

    .1 Snacks and refreshments $________
    .2 Cigarettes or other tobacco $________
    .3 Entertainment and recreation $________
    .4 Miscellaneous $________

23. Please estimate as currately as you can the amount of money you spent last week-end. (Friday evening to Monday morning).

    .1 Entertainment and recreation $________
    .2 Food and snacks $________
    .3 Beverages and drinks $________
    .4 Travel $________
    .5 Loans and Contributions $________
    .6 Cigarettes and other tobacco $________
    .7 Miscellaneous $________

Please estimate the amount of dues that you pay per year in the following:

24. <u>Fraternity or Sorority</u>

.1 None
.2 $11-$20
.3 $21-$40
.4 $41-$70
.5 $71-$100
.6 $101 or more

25. <u>All other Organizations</u>

.1 $1-$5
.2 $6-$10
.3 $11-$15
.4 $21 or more
.5 None

26. Indicate all the following financial sources that you have been using during the present academic year, 1969-1970.

.1 Allowances from Family
.2 Personal Savings
.3 Government Loans or Grants
.4 Sale of Personal Property
.5 Private Loans
.6 Scholarship(s)
.7 Wages or Salary
.8 Other (Please specify)__________

27. Please indicate as accurately as you can the amount of money that you have spent for school expenses and living from the start of the current semester.

.1 Tuition $________
.2 Fees $________
.3 Books $________
.4 Dormitory Fees $________
.5 Other expenses $________

28. Please indicate as accurately as you can the amount of money you have received from all sources during the last full week or the last full month.

Money from any other sources (Check One)	Earnings (Check One)	Allowance From Parents (Check One)
.6 Last Week $_____	.8 Last Week $____	.10 Last Week $____
.7 Last Month $____	.9 Last Month $___	.11 Last Month $___

29. Please indicate whether you have ever withdrawn from College for Financial Reasons:

.1 Have never withdrawn due to financial problems
.2 Less than one semester when I withdrew
.3 One semester when I withdrew
.4 Two semesters when I withdrew
.5 Three semesters when I withdrew
.6 Four semesters when I withdrew
.7 Five semesters when I withdrew
.8 Six semesters when I withdrew
.9 Seven semesters when I withdrew

NUTRITION QUESTIONNAIRE

30. Height 4 feet 1" 2" 3" 4" 5" 6" 7" 8" 9" 10" 11"
5 feet 1" 2" 3" 4" 5" 6" 7" 8" 9" 10" 11"
6 feet 1" 2" 3" 4" 5" 6" 7" 8" 9" 10" 11"

31. Weight ______________________________

32. Age ______________________________

33. Home State ______________________________

34. Indicate where you live (Circle One)

.1 Dormitory
.2 In Town
.3 At Home
.4 Other (Specify) __________

35. What is the name of the dormitory in which you live? ______________

Direction: Please place a check mark after each item that relates to your food habits:

How Many Days Per Week Do You Usually Eat The Following Meals?

36. Breakfast .1 .2 .3 .4 .5 .6 .7 .none

37. Lunch .1 .2 .3 .4 .5 .6 .7 .none

38. Dinner or Supper .1 .2 .3 .4 .5 .6 .7 .none

39. Snacks .1 .2 .3 .4 .5 .6 .7 .none

40. For breakfast yesterday I ate

.1 Fruit
.2 Juice
.3 Cereal
.4 Toast
.5 Pan Cake
.6 Muffins
.7 Biscuits
.8 Bacon
.9 Ham
.10 Sausage
.11 Eggs
.12 Milk
.13 Cocoa
.14 Coffee
.15 Other
.16 I did not eat breakfast yesterday

41. For lunch yesterday I ate

.1 Soup
.2 Sandwich
.3 Meat or meat salad
.4 Bread Stuff
.5 Green Vegetable
.6 Yellow Vegetable
.7 Potatoes
.8 Fruit Salad
.9 Green Salad
.10 Vegetable Salad
.11 Dessert (cake, pies, ice cream, cookies, etc.)
.12 Beverage (milk, coffee, fruit drink, coke, etc.)
.13 I did not eat lunch yesterday

42. For Dinner yesterday I ate
   .1 Soup
   .2 Meat
   .3 Bread
   .4 Green Vegetables
   .5 Yellow Vegetables
   .6 Potatoes
   .7 Fruit Salad
   .8 Green Salad
   .9 Vegetable Salad
   .10 Dessert (cake, pies, ice cream, cookies, etc.)
   .11 Beverage (milk, coffee, fruit drink, coke, etc.)
   .12 I did not eat dinner yesterday

43. Indicate which meals and snacks you ate yesterday (mark all that apply)
   .1 Breakfast
   .2 Morning Snack
   .3 Lunch
   .4 Afternoon Snack
   .5 Dinner
   .6 Evening Snack
   .7 None

44. Snacks
What foods did you eat yesterday other than the food you ate during meal time? (mark the ones that you ate)

   .1 Dessert (cakes, cookies)
   .2 Sandwiches (hamburger, hotdogs, grilled cheese
   .3 Beverage (soft drink, milk, coffee, coke)
   .4 Candy
   .5 Pop Corn
   .6 Peanut Butter
   .7 Nuts
   .8 Potato Chips and any type of chip
   .9 Other (specify) ____________________

What are your food likes and dislikes. (Mark One)

	Name of Food	Like	Dislike	Like Occasionally	Never Ate It
	Fruit				
45.	Oranges	.1____	.2____	.3____	.4____
46.	Apples	.1____	.2____	.3____	.4____
47.	Pears	.1____	.2____	.3____	.4____
48.	Prunes	.1____	.2____	.3____	.4____
49.	Plums	.1____	.2____	.3____	.4____
50.	Grapefruit	.1____	.2____	.3____	.4____
51.	Dates	.1____	.2____	.3____	.4____
52.	Cherries	.1____	.2____	.3____	.4____

Fruit Continued	Like	Dislike	Like Occasionally	Never Ate It
53. Peaches	.1____	.2____	.3____	.4____
54. Lemons	.1____	.2____	.3____	.4____
55. Cranberries	.1____	.2____	.3____	.4____
56. Grapes	.1____	.2____	.3____	.4____
57. Apricots	.1____	.2____	.3____	.4____
58. Pineapples	.1____	.2____	.3____	.4____
Vegetable				
59. Artichokes	.1____	.2____	.3____	.4____
60. Asparagus	.1____	.2____	.3____	.4____
61. Beans	.1____	.2____	.3____	.4____
62. Beets	.1____	.2____	.3____	.4____
63. Broccoli	.1____	.2____	.3____	.4____
64. Brussels Sprouts	.1____	.2____	.3____	.4____
65. Carrots	.1____	.2____	.3____	.4____
66. Celery	.1____	.2____	.3____	.4____
67. Corn	.1____	.2____	.3____	.4____
68. Okra	.1____	.2____	.3____	.4____
69. Peas	.1____	.2____	.3____	.4____
70. Potatoes	.1____	.2____	.3____	.4____
71. Tomatoes	.1____	.2____	.3____	.4____
72. Turnips	.1____	.2____	.3____	.4____
73. Onion	.1____	.2____	.3____	.4____
74. Spinach	.1____	.2____	.3____	.4____
75. Collards	.1____	.2____	.3____	.4____
76. Cabbage	.1____	.2____	.3____	.4____
77. Other	.1____	.2____	.3____	.4____

	Meat	Like	Dislike	Like Occasionally	Never Ate It
78.	Beef	.1____	.2____	.3____	.4____
79.	Pork	.1____	.2____	.3____	.4____
80.	Lamb	.1____	.2____	.3____	.4____
81.	Poultry	.1____	.2____	.3____	.4____
82.	Fish	.1____	.2____	.3____	.4____
	Dairy				
83.	Milk	.1____	.2____	.3____	.4____
84.	Cheese	.1____	.2____	.3____	.4____
85.	Ice Cream	.1____	.2____	.3____	.4____
86.	Butter	.1____	.2____	.3____	14____
	Bread and Cereal				
87.	White Bread	.1____	.2____	.3____	.4____
88.	Brown Bread	.1____	.2____	.3____	.4____
89.	Oat Bread	.1____	.2____	.3____	.4____
90.	Dry Cereal	.1____	.2____	.3____	.4____

Relationship between attitude and performance. (Mark One)

Yesterday for the evening meal I ate:

91. .1 Alone .3 With several friends

.2 With one friend

92. I usually eat:

	Alone	With one Friend	With Several Friends
.1 Breakfast	.11____	.12____	.13____
.2 Lunch	.21____	.22____	.23____
.3 Dinner	.31____	.32____	.33____
.4 Snacks	.41____	.42____	.43____

Please indicate how many minutes you spent at the table yesterday while eating:

		Time In Minutes											
93.	Lunch	5	10	15	20	25	30	35	40	45	50	55	60+
94.	Dinner	5	10	15	20	25	30	35	40	45	50	55	60+

95. How much do you enjoy food?

	I just eat No enjoyment	Enjoy food A little	Enjoy food Considerably	Enjoy food Very much
Breakfast	.11____	.12____	.13____	.14____
Lunch	.21____	.22____	.23____	.24____
Dinner	.31____	.32____	.33____	.34____
Snacks	.41____	.42____	.43____	.44____

*Responses to these items were used in the present study.

FACT SHEET

COLLEGE MATURATION STUDY

NAME (PLEASE PRINT)____

1. ACT Composite____________ 2. ACT Science________

3. Cumulative GPA____________ 4. Number of Siblings_____

5. Student's numerical order among siblings__________________________

6. Father's Occupation____

7. Mother's Occupation____

8. Father, years' schooling:

High College Graduate Student

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

9. Mother, years' schooling:

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

10. Siblings with some college: 1 2 3 More than 3

11. Science Courses in High School:

Course	Number of semesters	Course	Number of semesters
Astronomy	1 2 3 4	Algebra	1 2 3 4
Biology	1 2 3 4	Calculus	1 2 3 4
Chemistry	1 2 3 4	Geometry	1 2 3 4
Geology	1 2 3 4	Trigonometry	1 2 3 4
Physics	1 2 3 4		

APPENDIX B

PROCEDURES FOR ADMINISTERING QUESTIONNAIRE

LANGSTON COLLEGE MATURATION STUDY QUESTIONNAIRE

TO THE PERSON ADMINISTERING THE QUESTIONNAIRE:

(1) Distribute the questionnaires and ask the students to keep them closed until they are directed to open them.

(2) Read the following statement aloud to the students:

THE QUESTIONNAIRE BEFORE YOU IS DESIGNED TO OBTAIN INFORMATION AND ASSESS ATTITUDES REGARDING MAJOR FIELD OF STUDY, COLLEGE EXPENSES, AND DIET AMONG COLLEGE STUDENTS. YOUR COOPERATION AND SINCERE RESPONSES TO THE ITEMS ON THE QUESTIONNAIRE WILL BE GREATLY APPRECIATED. YOU ARE ASKED TO WRITE YOUR NAME IN THE APPROPRIATE SPACE. AFTERWARDS, A CODE WILL BE ASSIGNED AND NO NAMES WILL APPEAR IN THE COMPILATION OF RESPONSES OR IN REPORTS OF THIS STUDY.

(3) Ask the students to open the questionnaire to the first page.

(4) Read the following aloud to the students:

FOR QUESTION #1 AT THE BOTTOM OF THE PAGE: IF YOUR MAJOR FIELD OF STUDY IS NOT LISTED HERE OR ON THE FOLLOWING PAGE, WRITE THE NAME OF YOUR MAJOR FIELD , RATHER THAN THE NUMBER, IN THE SPACE PROVIDED. YOU ARE TO DO THE SAME FOR ITEM #2 IF NECESSARY.

FOR ITEMS 13, 16, and 17, YOU ARE TO INDICATE ONE OF THE FOUR POSSIBLE RESPONSES TO EACH OF THE PERSONS OR ACTIVITIES LISTED RATHER THAN ONLY ONE OR TWO OF THEM.

PLEASE READ EACH QUESTION CAREFULLY AND INDICATE YOUR RESPONSE AS DIRECTED.

IF YOU HAVE A QUESTION, RAISE YOUR HAND AND I WILL ASSIST YOU.

WHEN YOU FINISH, PLEASE CLOSE THE QUESTIONNAIRE AND WAIT FOR THEM TO BE COLLECTED.

YOU MAY BEGIN.

APPENDIX C

ANALYSIS OF THIRTY-FIVE STATEMENTS OF

ATTITUDE SCALE

INITIAL "ATTITUDE TOWARD SCIENCE" STATEMENTS

1. The work in science is very interesting.
2. I have the ability to do successful work in science.
3. Scientists earn a good income.
4. I think I could make more money in a field other than science.
5. I have a strong aptitude for science.
6. A science major has to spend too much time and energy studying.
7. I cannot afford the time and money it would take in preparing for a science occupation.
8. My personality is not suitable for work in science.
9. My parents would approve of my going into science.
10. Only "exceptional" black people go into science.
11. I couldn't major in science because I didn't take the proper courses in high school.
12. Science is not challenging enough for me.
13. I find science courses very interesting.
14. Professors and teachers in science encouraged me to go on in this field.
15. I admire my science teachers as persons; not just as teachers or professors.
16. Science teachers are too square for my tastes.
17. Science teachers are inspiring.
18. Science courses are dull.
19. Black persons trained in science would have a favorable influence on the black community.
20. Science work is monotonous.
21. Scientists are keenly intelligent.

22. Only smart students major in science.
23. Black people haven't had the background to enable them to succeed in science.
24. Science teachers are stuffy.
25. American Scientists are largely responsible for our status among nations.
26. I have enjoyed the science courses I've taken.
27. Girls are often discouraged from going into science.
28. Scientists must do very precise work.
29. Scientists are dedicated to their work.
30. The best field for a very bright student to enter is Science.
31. Scientific inventions and discoveries have done more good than bad for mankind.
32. The United States today needs topnotch scientists.
33. Scientists are smarter than other people.
34. Science and technology will solve the world's problems.
35. My high school science courses provided me with a good science background.

TABLE XXXII

MEAN, STANDARD DEVIATION, AND CORRELATION WITH THE TOTAL, OF EACH OF THE THIRTY-FIVE STATEMENTS OF THE ATTITUDE SCALE FOR THE ALABAMA RESPONDENTS

Item	Mean	Standard Deviation	Correlation With Total
1	4.29	0.801	.5741
2	3.70	1.008	.5572
3	4.36	0.840	.1913
4	2.70	1.214	.3558
5	3.15	1.289	.4357
6	3.36	1.486	.2409
7	3.30	1.332	.4121
8	3.66	1.145	.4927
9	3.97	1.117	.2999
10	3.97	1.178	.2229
11	3.73	1.210	.4636
12	4.21	0.939	.3977
13	3.87	1.178	.5921
14	2.89	1.376	.4723
151	3.70	1.144	.3708
16	4.06	0.891	.3153
17	3.74	1.075	.3970
18	3.84	1.127	.4677
19	3.81	1.076	.2530
20	3.40	1.201	.4423
21	3.93	0.961	.3426
22	3.79	1.068	.1476

TABLE XXXII (Continued)

Item	Mean	Standard Deviation	Correlation With Total
23	3.59	1.158	.2071
24	3.89	0.901	.3368
25	3.68	1.013	.2122
26	3.84	0.969	.5014
27	2.99	1.099	.1740
28	4.17	0.722	.3451
29	4.29	1.017	.1990
30	2.95	1.193	.1654
31	4.12	1.059	.3183
32	4.37	0.902	.2848
33	2.37	1.010	.1045
34	2.79	1.267	.2437
35	3.04	1.242	.3874

Mean = 127.54

Standard Deviation = 13.050

Alpha = .7715

TABLE XXXIII

CHOICE DISTRIBUTION PERCENTAGES ON THE THIRTY-FIVE ATTITUDE STATEMENTS AMONG THE ALABAMA RESPONDENTS

Item	No Response	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	0	48	37	12	3	0
2	0	21	45	20	11	3
3	1	42	48	7	2	0
4	1	18	27	30	19	5
5	1	11	31	19	32	6
6	3	7	23	20	39	8
7	1	8	24	20	32	16
8	0	4	16	15	39	26
9	1	32	40	18	8	2
10	1	5	9	11	37	37
11	0	7	15	4	48	27
12	0	2	5	9	38	46
13	1	30	45	8	12	5
14	1	10	31	8	33	17
15	0	26	42	13	13	5
16	0	3	4	7	56	30
17	1	16	52	19	11	2
18	1	5	9	10	51	25
19	1	24	46	19	8	4
20	1	4	21	25	36	13
21	1	24	53	13	8	1
22	1	3	11	17	47	22

TABLE XXXIII (Continued)

Item	No Response	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
23	0	5	19	12	42	22
24	1	1	6	18	55	19
25	0	21	42	24	9	4
26	0	22	58	5	14	2
27	0	7	31	24	30	8
28	0	32	56	8	4	0
29	3	28	59	8	2	1
30	1	11	16	36	27	9
31	1	38	38	17	5	2
32	1	46	42	8	3	1
33	1	2	8	27	47	16
34	2	4	13	46	21	15
35	1	6	39	17	26	12

APPENDIX D

STATEMENTS ELIMINATED FROM ATTITUDE SCALE

FOURTEEN STATEMENTS ELIMINATED FROM ATTITUDE SCALE

1. I think I could make more money in a field other than science.
2. A science major has to spend too much time and energy studying.
3. Only "exceptional" black people go into science.
4. Black persons trained in science would have a favorable influence on the black community.
5. Only smart students major in science.
6. Black people haven't had the background to enable them to succeed in science.
7. American Scientists are largely responsible for our status among nations.
8. Girls are often discouraged from going into science.
9. Scientists are dedicated to their work.
10. The best field for a very bright student to enter is science.
11. Scientific inventions and discoveries have done more good than bad for mankind.
12. The United States today needs top notch scientists.
13. Scientists are smarter than other people.
14. Science and technology will solve the world's problems.

APPENDIX E

ANALYSIS OF REVISED ATTITUDE SCALE

TABLE XXXIV

MEAN, STANDARD DEVIATION, AND CORRELATION WITH THE TOTAL, OF EACH OF THE TWENTY-ONE STATEMENTS OF THE ATTITUDE SCALE FOR THE ALABAMA RESPONDENTS

Item	Mean	Standard Deviation	Correlation With Total
1	4.29	0.801	.6277
2	3.70	1.008	.6190
3	2.70	1.214	.3555
4	3.15	1.289	.4792
5	3.30	1.332	.4266
6	3.66	1.145	.5129
7	3.97	1.117	.3515
8	3.73	1.210	.4717
9	4.21	0.939	.4231
10	3.87	1.178	.6678
11	2.89	1.376	.5179
12	3.70	1.144	.3870
13	4.06	0.891	.3550
14	3.74	1.075	.4387
15	3.84	1.127	.5240
16	3.40	1.201	.4510
17	3.93	0.961	.3311
18	3.89	0.901	.3875
19	3.84	0.969	.5772
20	4.17	0.722	.3524
21	3.04	1.242	.3515

Mean = 77.41 Standard Deviation = 10.767 Alpha = .8074

APPENDIX F

QUESTIONNAIRE USED FOR ALABAMA SAMPLE

LANGSTON COLLEGE MATURATION STUDY

QUESTIONNAIRE

The purpose of this questionnaire is to obtain information from you which will aid the college in improving its services to the students. The questionnaire is divided into three parts: (1) major field of study, (2) college expenses, and (3) diet. In order to answer some of the questions you will need to think back 4 or 5 years. On some questions you are asked to indicate the way you feel. Please read the question or statement carefully and indicate your response according to the directions. We need and appreciate your interest and cooperation in this endeavor.

Instructions: Please mark the applicable choice for each item.

I. Major Field of Study

1. NAME (Print) ______________________________

2. SOCIAL SECURITY NUMBER (if known) _____ _____ _____

3. CLASSIFICATION (Please Circle)

Classification	Semester
Freshman	.1 1st
	.2 2nd
Sophomore	.3 1st
	.4 2nd
Junior	.5 1st
	.6 2nd
Senior	.7 1st
	.8 2nd
Special Student	.9

4. SEX (Circle) .1 Male .2 Female

1. From the following list of degrees, and fields of study, write the number which corresponds to your major field of study (If you haven't declared a major, indicate the field you think you will choose). _____

Arts and Science Division (Preparation for the Profession)

A. Bachelor of Arts Degree
   1. Art
   2. English
   3. Music
   4. History
   5. Sociology
   6. Pre-Law
   7. Social Work

B. Bachelor of Science Degree
   8. Biology
   9. Business Administration
   10. Chemistry
   11. Mathematics
   12. Pre-Medical
   13. Pre-Dentistry
   14. Medical Technology
   15. Secretarial Science
   16. Physics
   17. Biochemistry

Education Division (Teacher Preparation)

C. Bachelor of Arts in Education
  18. Art
  19. Language Arts (English)
  20. Music
  21. Social Science

D. Bachelor of Science in Education
  22. Biology
  23. Business Education
  24. Chemistry
  25. Elementary Education
  26. Health and Physical Education
  27. Home Economics
  28. Industrial Arts
  29. Mathematics

Applied Science Division (Preparation for Business and Industry)

E. Bachelor of Science Degree
  30. Agricultural Economics
  31. Animal Science
  32. Industrial Arts
  33. Engineering (Chemical, Electrical, etc.)

F. Associate Degree
  34. Data Processing
  35. Electronic Technology
  36. Pre-Nursing

2. Write the number which corresponds to your minor field of study (or your intended minor field if you haven't chosen). ______

3. Was the major field you indicated in response to item #1 your original choice of major field? (Please Circle) .1 Yes .2 No

4. If your answer to item #3 is no, write the number which corresponds to your original choice of major field. ______

5. If you answered item #4, which of the following best describes your reason (s) for changing majors? (Circle as many as apply)

   .1) lost interest in original choice
   .2) didn't have the background
   .3) too much studying involved with original choice
   .4) better job opportunities in present field
   .5) didn't do too well grade-wise in original choice

6. Circle the number which represents the size of the community in which you lived when you were a senior in high school. (Circle only one)

   .1) Farm or open country
   .2) Town less than 5,000
   .3) Town between 5,000 - 10,000
   .4) Town between 10,000 - 20,000
   .5) City Between 20,000 - 50,000
   .6) City between 50,000 - 150,000
   .7) City between 150,000 - 500,000
   .8) City over 500,000

7. Which of the following is the appropriate income category for your parental family? Consider total family income from all sources before taxes. (Circle only one from the most convenient category; weekly, monthly, or yearly.)

		Week	Month	Year
.1)	Less than	$ 60.	$ 250.	$ 3,000
.2)	Between	61. - 80.	250. - 330.	3,000 - 3,999
.3)	Between	81. - 120.	331. - 500.	4,000 - 5,999
.4)	Between	121. - 150.	501. - 670.	6,000 - 7,999
.5)	Between	151. - 190.	671. - 830	8,000 - 9,999
.6)	Between	191. - 300.	831 - 1,250	10,000 - 14,999
.7)	Over	300.	1,250	15,000

8. Indicate the size of your high school graduating class. (Circle one)

.1) Less than 25
.2) 25 to 49
.3) 50 to 74
.4) 75 to 99
.5) 100 to 199
.6) 200 to 499
.7) 500 or more

9. What percentage of white students were in your high school graduating class? (Circle one)

.1) 0 - 10% white students
.2) 11% - 25% white students
.3) 26% - 50% white students
.4) 51% - 75% white students
.5) 76% - 90% white students
.6) more than 90% white students

10. Which of the following courses were offered in your high school? (Circle as many as apply)

.1 algebra	.2 trigonometry	.3 calculus
.1 biology	.2 geometry	.3 astronomy
.1 chemistry	.2 physics	.3 geology

11. In which of the following activities did you participate while in high school? (Circle as many as apply)

.1) was officer in senior class
.2) won "letter" in athletics
.3) placed in advanced class
.4) member of a science or mathematics club
.5) took more courses than required
.6) worked on high school newspaper
.7) member of musical group (band, choir, etc.)

.8) had part in drama production
.9) in National Honor Society
.10) won award in science fair
.11) published paper, poem, story or article
.12) participated in Upward Bound Program
.13) finalist in mathematics contest
.14) won award for farm production
.15) National Science Foundation summer training
.16) member of FFA or FHA
.17) member of 4-H Club
.18) member of chess club
.19) member of pep club
.20) none of these applies to me
.21) Other (Please indicate) ____________________

12. When did you first consider your original choice of specific major field? (Circle one)

.1) before high school
.2) during high school
.3) after high school but before college
.4) freshman year of college
.5) sophomore year
.6) junior year
.7) senior year
.8) while out of college
.9) during military service
.10) still undecided

13. Please rate the effect of each of the following persons on your choice of major while in high school. (Check one blank in each row)

	No Contact	Unimportant	Fairly Important	Very Important
Science or Math Teacher(s)	.11 ___	.12 ___	.13 ___	.14 ___
High School Teacher (other subject (s)	.21 ___	.22 ___	.23 ___	.24 ___
School Counselor	.31 ___	.32 ___	.33 ___	.34 ___
School Friend (s)	.41 ___	.42 ___	.43 ___	.44 ___
Career Day or Special Speakers	.51 ___	.52 ___	.53 ___	.54 ___

14. How much time elapsed after high school before you started college? (Circle one)

.1) went directly to college
.2) delayed less than 1 year
.3) delayed 1 year
.4) delayed 2 to 3 years
.5) more than 3 years

15. What has been the extent of interruption of your college studies since you started? (Circle one)

.1) none, so far
.2) out for less than 1 year
.3) out for less than 2 years
.4) out for 2 years or more

16. What degree of influence has each of the following members of your family had on your choice of major field? (Place a check in one blank of each row)

	No Influence	Weak Influence	Strong	Very Strong
Mother or Step-Mother	.11 ___	.12 ___	.13 ___	.14 ___
Father or Step-Father	.21 ___	.22 ___	.23 ___	.24 ___
Brother (s)	.31 ___	.32 ___	.33 ___	.34 ___
Sister (s)	.41 ___	.42 ___	.43 ___	.44 ___
Other relatives (s)	.51 ___	.52 ___	.53 ___	.54 ___

17. Please rate the following in terms of their effect on your choice of major since you've been in college. (Check one blank in each row)

	No Contact	Unimportant	Fairly Important	Very Important
Placement Office	.11 ___	.12 ___	.13 ___	.14 ___
Career Day Program	.21 ___	.22 ___	.23 ___	.24 ___
Discussions with my Academic Advisor	.31 ___	.32 ___	.33 ___	.34 ___
Discussions with Faculty Members other than my Advisor	.41 ___	.42 ___	.43 ___	.44 ___
Summer Job	.51 ___	.52 ___	.53 ___	.54 ___
Friend (s)	.61 ___	.62 ___	.63 ___	.64 ___
Magazines and Books	.71 ___	.72 ___	.73 ___	.74 ___
Other (Specify)	.81 ___	.82 ___	.83 ___	.84 ___

18. Please indicate your feeling regarding each of the following statements by circling the appropriate dash in each column. (SA = Strongly Agree; A = Agree; U = Undecided; D = Disagree; SD = Strongly Disagree)

		SA	A	U	D	SD
.1)	The work in science is very interesting.	_	_	_	_	_
.2)	I have the ability to do successful work in science.	_	_	_	_	_
.3)	Scientists earn a very good income.	_	_	_	_	_
.4)	I think I could make more money in a field other than science.	_	_	_	_	_
.5)	I have a strong aptitude for science.	_	_	_	_	_
.6)	A science major has to spend too much time and energy studying.	_	_	_	_	_
.7)	I cannot afford the time and money it would take in preparing for a science occupation.	_	_	_	_	_
.8)	My personality is not suitable for work in science.	_	_	_	_	_
.9)	My parents would approve of my going into science.	_	_	_	_	_
.10)	Only "exceptional" black people go into science.	_	_	_	_	_
.11)	I couldn't major in science because I didn't take the proper courses in high school.	_	_	_	_	_
.12)	Science is not challenging enough for me.	_	_	_	_	_
.13)	I find science courses very interesting.	_	_	_	_	_
.14)	Professors and teachers in science encouraged me to go on in this field.	_	_	_	_	_
.15)	I admire my science teachers as persons; not just as teachers or professors.	_	_	_	_	_
.16)	Science teachers are too square for my tastes.	_	_	_	_	_
.17)	Science teachers are inspiring.	_	_	_	_	_
.18)	Science courses are dull.	_	_	_	_	_
.19)	Black persons trained in science would have a favorable influence on the black community.	_	_	_	_	_
.20)	Science work is monotonous.	_	_	_	_	_
.21)	Scientists are keenly intelligent.	_	_	_	_	_
.22)	Only smart students major in science.	_	_	_	_	_

		SA	A	U	D	SD
.23)	Black people haven't had the background to enable them to succeed in science.	_	_	_	_	_
.24)	Science teachers are stuffy.	_	_	_	_	_
.25)	American Scientists are largely responsible for our status among nations.	_	_	_	_	_
.26)	I have enjoyed the science courses I've taken.	_	_	_	_	_
.27)	Girls are often discouraged from going into science.	_	_	_	_	_
.28)	Scientists must do very precise work.	_	_	_	_	_
.29)	Scientists are dedicated to their work.	_	_	_	_	_
.30)	The best field for a very bright student to enter is Science.	_	_	_	_	_
.31)	Scientific inventions and discoveries have done more good than bad for mankind.	_	_	_	_	_
.32)	The United States today needs top notch Scientists.	_	_	_	_	_
.33)	Scientists are smarter than other people.	_	_	_	_	_
.34)	Science and technology will solve the world's problems.	_	_	_	_	_
.35)	My high school science courses provided me with a good science background.	_	_	_	_	_

APPENDIX G

ANALYSIS OF VARIANCE FORMULAS USING HARMONIC MEAN

Equations for Computation of Analysis of Variance,

Using the Harmonic Mean to Adjust

for Unequal N's

$$HM = \frac{K}{\Sigma \frac{1}{N_G}}$$

$$SS_W = \sum_{G=1}^{K} \left(\Sigma X^2 - \frac{(\Sigma X)^2}{N_G} \right)$$

$$\bar{X}_{ij} = \frac{\Sigma X}{N_{ij}}$$

$$\Sigma\bar{X}_R = \Sigma\bar{X}_{i.}$$

$$\Sigma\bar{X}_C = \Sigma\bar{X}_{.j}$$

$$\overline{\Sigma\bar{X}}_R = \frac{\Sigma\bar{X}_R}{N_C}$$

$$\overline{\Sigma\bar{X}}_C = \frac{\Sigma\bar{X}_C}{N_R}$$

$$SS_R = \frac{\Sigma(\Sigma\bar{X}_R)^2}{N_C}$$

$$SS_B = \Sigma\bar{X}_{ij}{}^2$$

$$SS_C = \frac{\Sigma(\Sigma\bar{X}_C)^2}{N_R}$$

$$SS_E = \frac{(\Sigma\Sigma\bar{X}_{ij})^2}{N_G}$$

$$SS_R = \left(\Sigma \frac{(\Sigma\bar{X}_R)^2}{N_C} - SS_E \right) \cdot HM$$

$$SS_C = \left(\Sigma \frac{(\Sigma\bar{X}_C)^2}{N_R} - SS_E \right) \cdot HM$$

$$SS_B = (\Sigma\bar{X}_{ij}^2 - SS_E) \cdot HM$$

$$SS_T = SS_B + SS_W$$

$$SS_I = SS_B - SS_R - SS_C$$

where:

HM = Harmonic Mean

K = Number of Cells

SS = Sum of Squares

i = Rows

j = Columns

G = Groups

N = Number

W = Within Groups

R = Rows

C = Columns

B = Between Groups

E = Error

I = Interaction

APPENDIX H

FORMULAS USED IN STATISTICAL ANALYSIS

Some Equations Used in Statistical Analysis of the Data

1. HSSA = NSS + 8(NSS/SCO + 1) + ESA

   where

   HSSA = high school science activity

   NSS = number of semesters of science courses taken

   ESA = participation in extracurricular science activities.

2. $OPS = 100\sqrt{(NS)(OP + 1)}$

   where

   OPS = ordinal position score

   NS = number of siblings

   OP = ordinal position

3. Pearson-Product Moment Correlation Coefficient (Bruning and Kintz, 1968)

$$r = \frac{\Sigma XY - \Sigma X\ \Sigma Y/N}{\sqrt{(\Sigma X^2 - (\Sigma X)^2(\Sigma Y^2 - (\Sigma Y)^2/N)}}$$

4. Independent "t" test (Bruning and Kintz, 1968)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(S_1^2/N_1 - 1\right)\left(S_2^2/N_2 - 1\right)}}$$

5. Kolmogorov-Smirnov Test for Two Samples (Siegel, 1956)

$$\chi^2 = 4D^2 \frac{n_1\ n_2}{n_1 + n_2}$$

APPENDIX I

SCALE OF COMPARABLE SAT AND ACT SCORES

TABLE OF ACT AND SAT COMPARABLE SCORES

ACT Verbal Mean of Tests 1, 3, and 4	SAT Verbal	ACT Test 2 Mathematics	SAT Math	ACT Composite	SAT Total (V+M)
32	721	34	755	32	1440
31	706	33	732	31	1405
30	690	32	705	30	1362
29	665	31	674	29	1317
28	643	30	650	28	1263
27	616	29	628	27	1201
26	588	28	603	26	1150
25	558	27	580	25	1100
24	532	26	558	24	1051
23	499	25	532	23	998
22	473	24	505	22	948
21	444	23	484	21	909
20	419	22	467	20	872
19	392	21	450	19	825
18	373	20	433	18	792
17	351	19	418	17	754
16	336	18	405	16	719
15	321	17	377	15	680
14	294	16	354	14	630
13	277	15	345	13	605
12	260	14	323	12	582
11	243	13	308	11	547
10	226	12	288	10	512
9	209	11	273	9	477

•This table of comparable scores on the *ACT* and *SAT* scales was established by means of the equal percentile method (see page 752 ff. in *Educational Measurement*, published by the American Council on Education, E. F. Lindquist, editor). The data were obtained from a sample of 1,656 high school students who took both the *SAT* and the *NMSQT* tests in the spring of 1959. Since the *NMSQT* uses the same scale as the *ACT* test, this table applies both to the *ACT* and *NMS* tests.

VITA

Michael Phillip Tilford

Candidate for the Degree of

Doctor of Education

Thesis: FACTORS RELATED TO THE CHOICE OF SCIENCE AS A MAJOR AMONG NEGRO COLLEGE STUDENTS

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Professional Experience: Taught general science in junior high schools in Baltimore, Maryland, from 1958-1964; taught mathematics and chemistry in high school in Wichita, Kansas, from September, 1964 - January, 1967; Director of Upward Bound project and Instructor in Education at Wichita State University, Wichita, Kansas, February, 1967 - June, 1969; currently on leave of absence from Wichita State University.