A COMPARISON STUDY OF THE DEGREE TO WHICH SYSTEMIC TECHNIQUES AND TRADITIONAL TECHNIQUES MOTIVATE BLACK JUNIOR HIGH SCHOOL STUDENTS WITH LOW SOCIAL ECONOMIC STATUS TOWARDS ENGINEERING CAREERS

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ABSTRACT

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By

William Henry Powers

The purpose of this study was to compare the results of traditional and systemic techniques, i.e., lectures and slide-audio presentations, in motivating black eighth grade junior high school students with low socio-economic status toward careers in engineering. Briefly, the traditional techniques were directed at the general population and showed the importance of engineering to society as a whole. The systemic techniques were aimed at blacks who have been victimized by social and technological systems and illustrated how engineering could be used to change these systems to meet the needs of black people.

The specific aim of this study was to determine whether there are differences in motivational learning as a result of experiencing four different forms of treatment: i.e., systemic slide-audios and a systemic lecture;

systemic slide-audios and a traditional lecture; traditional slide-audios and a traditional lecture; and traditional slide-audios and a systemic lecture. Since the systemic and traditional lectures were five minutes in length and the systemic and traditional slide audios were the same length, the length of the the lectures and the slide-audios were considered constants rather than variables.

The population for this study consisted of 200 black eighth grade junior high school students with low S.E.S. who attend a junior high school whose composition was 99% black and located in the inner city of Cleveland, Ohio. Utilizing a random sampling procedure, 100 male subjects and 100 female subjects were selected from this population. These 200 students were randomly assigned to one of five treatment groups. Immediately following treatment, a self-reported motivation posttest was administered to the groups. One week later, a behavioral motivation posttest was administered to the same groups. Self-reported motivation toward engineering careers for the groups was measured by a 30 item five point Likert scale which had been pretested for internal consistency. The instrument was composed of four sub-scales: (1) interest, (2) relevancy, (3) attitude, and (4) general motivation. Behavioral motivation toward engineering careers for the treatment groups was measured by response to a sign-up card for an engineering class or club.

Analysis of variance was used to test for statistical significance between treatment groups on the self-reported and behavioral measures of motivation. All hypotheses were tested at the .05 level of significance.

The results of this experiment can be summarized as follows:

1. The groups that received the systemic slide-audio presentations had a significantly higher amount of self-reported motivation toward engineering careers than the groups receiving the traditional slide-audio presentations.
2. The lecture presentations produced no significant differences between groups on the measures of motivation.
3. The male students who received treatment had a significantly higher amount of self-reported and behavioral motivation toward engineering careers than the female students who received treatment.
4. Although there were no significant interactions between slide-audio presentations, lectures, and sex on either the self-reported or behavioral measures of motivation, the interaction between slide-audio presentations and sex on the self-reported measure approached significance ($P < .0596$). A graph of this interaction seems to suggest that the systemic slide-audio presentations

could have a more profound effect on increasing the amount of self-reported motivation toward engineering careers for female students than the traditional slide-audio presentations.

5. The groups that received the systemic slide-audio presentations had a higher percentage of "yes" responses (indicating behavioral motivation toward engineering careers) than the groups that received the traditional slide-audio presentations. This difference was not statistically significant. However, the fact that the groups receiving the systemic slide-audio presentations gave 17% more "yes" responses than the groups receiving the traditional slide-audio presentations could have practical significance.

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DEDICATION

To my devoted wife, JoAnn, for her love, faith, encouragement, patience, and support and my daughter, TuShun, for being the sources of my inspiration.

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I am indebted to the Division of Research and Development in the Cleveland Public School System who granted me permission to study low S.E.S. black eighth grade junior high school students attending one of their

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My deepest appreciation especially to my parents, Mr. and Mrs. John Powers, for their continuing interest in, encouragement and support of, my educational endeavors.

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CHAPTER I

THE PROBLEM

Purpose of the Study

The purpose of this study is to compare the results of traditional and systemic techniques, i.e., lectures and slide-audio presentations, in motivating black eighth grade junior high school students with low socio-economic status (Socio-economic status will be referred to as S.E.S. throughout the paper.) toward careers in engineering. Briefly, the traditional techniques are directed at the general population and show the importance of engineering to society as a whole. The systemic techniques will be aimed at blacks who have been victimized by social and technological systems and will illustrate how engineering can be used to change these systems to meet the needs of black people.

The specific aim of this study is to determine whether there are differences in motivational learning as a result of experiencing four different forms of treatment: i.e., systemic slide-audios and a systemic lecture; systemic slide-audios and a traditional lecture; traditional slide-audios and a traditional lecture; and traditional

slide-audios and a systemic lecture. Since the systemic and traditional lectures are 5 minutes in length and the systemic and traditional slide-audios have the same length, the length of both the lectures and the slide-audios will be considered constants rather than variables.

This study will specifically test the following hypotheses:

1. The systemic slide-audio presentations will result in a greater gain in motivation toward engineering careers than will the traditional slide-audio presentations.

2. A systemic lecture will result in a greater gain in motivation toward engineering careers than will a traditional lecture.

Need for the Study

Professionals and practitioners in the fields of psychology, counseling, engineering, and other areas who are specifically concerned with increasing the numbers of black engineers in this nation will find this study significant because they have a tremendous need for programs and techniques which are effective in motivating black junior high school students toward engineering careers.

The engineering profession in the United States has a long-standing racial imbalance. Percy Pierre (1972), dean of engineering at Howard University, calls engineering an alien profession for blacks and points out that few professions have been more successful in consciously or unconsciously excluding blacks. Blacks make up 10% of all

United States college students, but they only account for 3% of the enrollment in engineering curriculums (Hendrix, 1973). John Alden (1974a) of the Engineering Manpower Commission (EMC) estimates that about 8,100 blacks have degrees in engineering or closely related fields, i.e., technical, scientific and technical managerial fields. A follow-up study to the 1970 census directed by the National Science Foundation (NSF) has found that of the physical sciences surveyed, engineering had the least minority representation (Chemical and Engineering News, 1973). Post census data indicate that of the 37,000 non-whites in the 1970 engineering count only approximately 14,800 or 1.2% of the occupational total were blacks (Alden, 1974b).

Today, as a result of black militancy and government pressure, there are excellent employment opportunities and even fierce competition for the few black engineers available (Smith, 1973). The origin of this intense demand for black engineers and recruitment at black colleges only dates back to 1965 and is a direct result of the passage of the Civil Rights Act and the subsequent formation of the Federal Equal Employment Opportunity Commission (Hendrix, 1973; Ross, 1973). Presently, excluding government pressures there are three distinct requests made by business, industry, and others in regards to increasing the number of black engineers.

The first request for enhancing the number of black engineers evolves from the growing power and consciousness of the black consumer. Roy Wilkins (1972), executive director of the National Association for the Advancement of Colored People (NAACP), declares that the patronage which black consumers give to certain products warrants the inclusion of more black men and women in executive positions in the engineering profession. Wilkins (1972) also feels that corporations which utilize the talents of blacks would not only have a better image but greater profits as well; this is as a direct result of the steady growth and affluence of the black community. General Electric vice president, J. Stanford Smith, is advocating a tenfold increase in the number of minority engineering graduates in the next decade. Smith (1973) states:

> In addition to the crucial reason of providing equal opportunity for all, there are added business reasons for wanting to recruit and develop black leadership. Many of our plants are located in major urban areas where a high percentage of the employees are black. Black participation in management in such locations will become increasingly important since black consumers are an important market for consumer products. Black leadership in marketing, as well as other functions, is good customer relations. We are completely aware of the importance of accelerating progress in black leadership, and that is why the need for a manyfold increase in minority engineering graduates is being emphasized (p. 33).

The second request for greater numbers of black engineers relates to the potential role of blacks in alleviating some of the manpower needs in the forecasted

engineer shortage in this country (Senhouse, 1974), In a third report of the opportunities for blacks in engineering, Robert Kiehl (1971) concludes that the gap between the many engineering job opportunities and few applicants was narrowing slowly, and the rate of improvement was far too slow for our dynamic society. The Manpower Report of the President, delivered to Congress in March 1972, predicted that there would be an average demand for 48,000 engineering graduates each year to meet the nation's manpower needs during the 1970-80 decade (Manpower Report of the President, 1972). The latest official estimate of the U.S. need for engineers contained in the Occupational Outlook Quarterly predicts annual openings averaging 53,000 a year through the mid 1980s (Slowitsky, 1974). In contrast to this demand, 36,520 students with B.S. degrees in engineering were expected to graduate in 1975 (The Planning Commission for Expanding Minority Opportunities in Engineering, 1974). The annual enrollment surveys of the Engineering Manpower Commission indicate that a factor contributing to the 10,000 plus gap between supply and demand for engineers has been a continual decline in engineering enrollments (Alden, 1974a).

According to college placement officials, the demand for new engineering graduates is continuously increasing. In November 1973, the College Placement Council surveyed a large number of employers about their

1974 recruiting plans and found that compared to the numbers actually hired by the same companies in the previous year, hiring goals for engineering graduates were up by 30% at the bachelor's level, 35% at the master's level, and 20% at the doctorate level (Alden, 1974a). Lionel Senhouse (1974), executive secretary of the Minority Engineering Education Effort (ME^3), states:

> In view of a predicted engineering shortage of at least 10,000 engineers a year and the ever increasing need for persons educated in engineering, every possible source of future engineers should be explored. A comparatively untapped source of engineering talent lies in the minorities that presently supply only 1% of our engineers. If minority potential were suitably utilized, over half of the predicted deficit in engineers could be replenished (p. 31).

The third request for expanding the proportion of black engineers in this country grows out of an interrelationship with blacks and an awareness of black self-determination. Considering that blacks compose between 40% and 50% of the population of most major cities in the nation and are continuously gaining positions where they perform greater roles in managing these cities, it is essential that they be able to deal not only with the social problems but also with the technical ones (Pierre, 1972). Pierre (1972) states:

> It is my contention that engineering can meet the real needs of black people and is a vital element in the self-determination of black people. Few of the problems of our cities are purely social or legal or medical. More often, they are interwoven with severe technological and management problems. Only by attacking and solving all of these problems will we be able to deliver to people the services needed (p. 13).

Similarly, Reginald Amory (1972), dean of the School of Engineering at North Carolina Agricultural and Technical State University, emphasizes the special training which a black engineer should receive to work effectively on technological problems challenging Black communities. Amory (1972) states:

> In addition, the black engineering school must create engineering programs which will provide graduates with the special tools needed to help solve the community-oriented problems presently in existence. Issues such as urban planning and development, transportation, low cost housing, the creation of more effective teaching methods for pre-university level students, the effect of factors such as noise and crime on the well-being of the individual, and the relative control of environmental factors should be worked into engineering curriculums (p. 56).

As a result of being so deeply affected by inadequacies in many areas, Senhouse (1974) anticipates that blacks and other minorities will have the greatest dedication toward solving such technological problems as urban planning, pollution, and mass transportation.

One most pressing issue confronting the engineering profession, business, industry, and the nation as a whole is the scant supply of black engineers. The prime source of black engineers to date has been seven predominantly black engineering schools--Howard University, North Carolina Agricultural and Technical University, Prairie View Agricultural and Mechanical University, Southern University, Tuskegee Institute, Tennessee State University, and Hampton (Amory, 1972; Pierre, 1972). Although these

schools only represent approximately 2.5% of an estimated 275 engineering schools in this country, they are responsible for about 65% of all black engineering graduates (Amory, 1972). In 1973, blacks earned 104 or 0.6% of the engineering master's degrees, 13 or 0.3% of the engineering doctorates, and 657 or 1.4% of the nation's bachelor's degrees in engineering (Engineering and Technology Graduates, 1973). These figures indicate that while blacks have been dramatically underrepresented in undergraduate engineering education the underrepresentation is even greater at the graduate level.

Time alone is not a key factor in increasing the representation of the U.S. blacks in the engineering profession (Manpower, 1971). Kiehl (Manpower, 1971) concludes:

> During the last eight years, there has been virtually no increase in the percentages of blacks in engineering education except for the special programs that some colleges have instituted to encourage and retain these students (p. 8).

It seems apparent that if the meager supply of black engineers is to ever be multiplied to meet the various requests for their talent, that special efforts and programs have to be developed and instituted. While time alone is not a key factor in increasing black representation in the engineering profession, it is a very key factor in the upward mobility of engineers into upper and middle management jobs with major industrial businesses (Sears, 1974). It generally takes approximately 15 to 25 years after

formal college training for engineers to amass the variety of job experiences which would qualify them to compete for top leadership in industry (Sears, 1974; Smith, 1973; Smith, Kearney & Scales, 1973). Therefore, the 1.5% of black engineers who were employed by industry in 1973 would not move into top leadership positions until 1990.

If American industrial firms are ever to provide job opportunities for black engineers at middle and top management levels, then thousands of black youth must enroll in and successfully complete courses of study that are engineering prerequisites and courses of study that will help them to complete college (Smith, Kearney & Scales, 1973). Speaking to the same issue Sears (1974) warns:

> Thus if significantly increased numbers of minorities and women are not encouraged to enter and complete engineering and related studies, so that in the near future they can enter the job "pipeline" and begin working their way toward the corporate hierarchy, then such companies will quite likely remain devoid of significant minority and female representation at the policy-making levels forever (p. 107).

Smith (1973) supports the need for immediate action on this problem and states that:

> . . . unless colleges and universities can start producing not 400, 4,000 to 6,000 minority engineers a year within the decade, industry will not be able to achieve its goals of equality and the nation is going to face social problems of unmanageable dimensions (p. 34).

In face of the enormous supply of black engineers needed within a decade, it is imperative to vigorously attack the circumstances which attribute to black high

school graduates avoiding enrollment in engineering programs. Many writers have attempted to explain the nature of these circumstances; among these writers are Smith (1973), Kiehl (1971), Hendrix (1973), Pierre (1972), Thompson, Smithberg & Anderson (1972), Amory (1972), and Smith, Kearney & Scales (1973). A summary of these circumstances is presented by Amory (1972):

> Many reasons have been advanced to explain why more black high school graduates have not enrolled in engineering programs. The more well-known include: limited employment opportunities in the past, lack of knowledge about and image of the engineering profession, weak high school preparation in mathematics and science, lack of student-engineer relationships, lack of finances to pay for an engineering education, lack of motivation, improper counseling, and demanding entrance requirements (p. 54).

Based upon the many circumstances, this investigation focuses on alleviating lack of motivation as it relates to black junior high students avoiding engineering careers. A number of articles have appeared in various professional journals stressing the need for new special programs and techniques which would motivate black students to pursue careers in engineering (Jackson, Wedekind, & Gibson, 1971; Thompson, Smithberg & Anderson, 1972; Sannwald, 1972; The Planning Commission for Expanding Minority Opportunities in Engineering, 1974). Motivation seems to be a basic element needed for pursuing engineering careers. Jackson, Wedekind, and Gibson (1971) state that "one thing is certain: without a minimum level of motivation, it is virtually impossible to cope with the academic demands and

self discipline needed to obtain a degree in engineering" (p. 11).

Sannwald (1972) stresses the importance of "attracting blacks to engineering careers at an early age" (p. 4). A critical decision point in a student's education occurs in the ninth grade when this student must decide whether to follow an academic or a vocational curriculum, how much mathematics and natural science to schedule, and what type career to pursue (The Planning Commission for Expanding Minority Opportunities in Engineering, 1974). A committee of the American Society for Engineering Education (The Planning Commission for Expanding Minority Opportunities in Engineering, 1974), in an analysis of engineering enrollments, concludes among other things, that:

> 1. The process by which young people select careers is very complicated and begins early in life with the junior high school level recognized as a critical choice point for potential engineers.
> 2. Substantial numbers of engineers are produced by all socio-economic levels and predictive models based on socio-economic origin of engineering students have little value.
> 3. There is little likelihood the field of engineering can substantially increase the percentage of the very bright students it attracts since other fields draw competitively from the same source of manpower (p. 61).

These conclusions support the need to motivate eighth grade black junior high school students with low S.E.S. toward engineering careers.

Finally, due to the tremendous need for engineers and the lack of previous research in this area, the present

study has key significance to counseling professionals and practitioners. The results could possibly provide practitioners with effective techniques in motivating black students in populations with similar characteristics as the population used for this study. Thus, this study could improve the counselor's effectiveness in helping to alleviate the proposed problem. For the professionals this investigation would yield knowledge and a starting point for future research.

Definitions

Specific terms used in this study are defined as follows:

Slide-Audio Presentation

An audio program which is synchronized with a series of single-image projections.

Motivation

> An intervening variable which is used to account for factors within the organism which arouse, maintain, and channel behaviors toward a goal (Chaplin, 1975, p. 325).

In this study relevancy, attitude, and interest will be considered factors of motivation.

Motivational Slide-Audio Presentation or Lecture

The motivational slide-audio presentation or lecture is one that can be recognized as primarily concerned with

increasing motivation towards engineering careers and is not primarily concerned with explanation or description of factual subject-matter information, such as is usually found in a slide-audio presentation or lecture correlated to the content of an engineering course. It should be pointed out that this recognition of the slide-audio presentation or lecture as one type or another is extremely difficult since there is no clear dichotomy of the two types (motivational and factual). Rather, there is a blending of the characteristics of each so that a continuum is formed and slide-audio presentations or lectures most polar can be readily identified as to their primary function.

Systemic Counseling

> This is the art of intervening into lives of individuals through systems understanding and modification (Gunnings, 1976, p. 1).

Systemic Techniques

This includes motivational slide-audio presentations and/or lectures which are aimed at blacks who have been victimized by social and technological systems and illustrate through an awareness process how engineering can be used to change these systems to meet the needs of black people.

Traditional Techniques

This includes motivational slide-audio presentations and/or lectures which are directed at the general

population and show the importance of engineering to society as a whole.

Theory

Improper counseling has been advanced as a major cause of the low enrollment of black high school graduates in engineering programs (Amory, 1972). Therefore, factors of key importance to the population of this investigation (black eighth grade students with low S.E.S.) are counseling theories which address their needs and difficulties in a meaningful and positive manner. Gunnings (1971) points out that traditional counseling and psychological theories are white oriented and counselors trained in such theories are deficient when it comes to working with blacks.

> Such theories as those of Freud, Jung, Adler, Fromm, Horney, Rank, Reich and Sullivan, are generally considered to be the foundation of any counseling psychology training program. They are looked upon as being the knowledge base from which many methods of counseling are taught. Yet as I look at this eminent list I fail to find a black theorist or one who has done any in-depth work with blacks. These theorists cannot speak to the frustrations, intimidations and experiences of blacks. Their methods of counseling are necessarily inadequate for most blacks since there is no linkage between the theories and the lifestyles of blacks (p. 100).

Similarly, in the last decade, a major criticism wagered at traditional counseling models has been the placement of blame and the treatment in the therapeutic process when working with oppressed people. The traditional approach to counseling has historically placed the

responsibility and onus of problems on the individual and implies that something is wrong with him or her (Gunnings & Simpkins, 1972). In addition, research shows that the goals of the traditional clinical approach to counseling has been to treat the individual or family unit for their internal problems by counseling them to adjust to or cope with society and/or its' institutions (Gunnings & Tucker, 1974). The individual is counseled that he/she must straighten up and get in line with white middle-class values and standards because he/she is facing a problem that he/she has brought upon himself/herself. Contrary to this traditional approach to counseling, Gunnings (1972) points out that "the disadvantaged person is not the problem or even the cause of the problem; it is the system in which we live that forces certain segments of our society to be unemployed, poorly educated, in poor health, and to reside in dilapidated housing (p. 278). Caplan and Nelson (1973) also address this issue of placing the blame on the individual for his or her difficulties. They examine psychological research in which the individual is held accountable for problems while situational external variables, such as those created and maintained by the societal system, are not taken into account. A number of critics (Gordon, 1968; Gunnings, 1971; Mayfield, 1972; Smallenburg & Smallenburg, 1968; Thomas, 1973; Warnath, 1971) have concluded that the counseling of poor and oppressed people

would be more effective if it focused on changing the social conditions under which these people live.

In response to the failure of traditional counseling theories to address the needs and difficulties of oppressed people in a positive and meaningful manner, Gunnings (1971) develops and advocates a systemic approach to counseling. Gunnings and Simpkins (1972) describe the basic theme of systemic counseling:

> The systemic model is based on the assumption that most of the problems that have heretofore been labeled client problems are in actuality system problems. The main emphasis of this approach, then, is for the clinician to treat the system for its problems thereby bringing about changed individuals. The systemic approach stresses a reordering of priorities, emphasis, and goals and is strategic in bringing about long term effects on behavioral changes and personality development. This model integrates the cognitive, affective, and psychomotor areas of the individual into an organic whole (p. 4-5).

Using this theme as a foundation, Gunnings and Tucker (1974) briefly comment on the role of a systemic counselor in assessing the cause of a client's difficulty:

> The systemic counselor must look at the basic underlying causes of the individual's problems; he must carefully and completely define the problem. Problem definition assumes that the counselor must take a global view of the situation. He must begin by asking and assessing some basic questions. How do this person's actions reinforce and complete the cycle of oppression? What forces in our society were the underlying causes of the difficulty this individual is facing? Is the individual's problem of his own making or the result of unfair, unreasonable, and biased expectations placed upon him by our societal system? Is the individual's living and working environment vastly different from the acceptable, middle-class environment on which societal standards are based? By assessing these kinds of questions,

> the systemic counselor and client can move a step closer to the solution of the problem at its source, at its causes (p. 214).

Utilization of the systemic model of counseling will come to fruition when there is a complete understanding and acceptance of the following assumptions and goals (Gunnings, 1976):

A. Assumptions

1. Man's environment is the key factor in determining his attitudes, values, and his behavior.
2. The client's behavior is a symptom of the system(s) problem(s).
3. The cause of the client's symptom(s) can be traced to the negative effect of social system(s) or subsystem(s) on the client's affective and cognitive functioning.
4. Systemic change is always possible, however, it is often a long term process.
5. Systems change is a continuous process because of the dynamic nature of social systems.
6. The system(s) or subsystem(s) with the problem(s) must be changed in order for the problem to be eliminated.
7. If the problem has been correctly identified, elimination of the problem results in elimination of the symptom.
8. Although clients are not responsible for the existence of the problem(s), they do have control over their response to the problem(s).

B. Goals

1. To enable clients to identify the cause(s) of the symptom(s) through recognition of the influence of selected environmental variables on their psychological functioning as reflected in behavior.
2. To assist clients in developing and implementing problem solving strategies and techniques that will eliminate or reduce the barriers to their achievement of desired goals.
3. To raise the clients level of functioning, affectively and cognitively (p. 1).

When viewed in the context of systemic theory, the problem concerning the relationship between blacks and the engineering profession takes on a different perspective. Instead of characterizing circumstances such as limited employment opportunities in the past, lack of knowledge about and image of the engineering profession, weak high school preparation in mathematics and science, lack of student-engineer relationships, etc. as causes of the disproportionate number of black engineers (Amory, 1972), the systemic theory views these circumstances as symptoms caused by an ill-fated engineering system. This system needs modification because its components, i.e., education, counseling, employment, and priorities are biased against blacks and other oppressed people.

Of the problems mentioned above, motivation is an imperative if a change is to be affected. Motivation in the systemic process results from systemic awareness. This awareness consists of exposing oppressed and alienated people to three elements: (1) the role one's environment plays in determining one's attitudes, values and behavior, (2) the system(s) or subsystem(s) which cause the problems and oppressive conditions they are forced to live under, and (3) the reality that these problems and conditions will not change until effective strategies are developed to modify these system(s) or subsystem(s). Oppressed people may become positively motivated through systemic awareness

when they realize that: (a) they have undiscovered potentials and capacities which have been oppressed by ill-fated societal systems and not by some inherent faults within themselves, (b) any of their present responses to these systems that reinforce the cycle of oppression have to be changed, (c) ill-fated systems have to be modified so that they can obtain the resources and experiences needed to develop their full potentials. Systemic awareness techniques may be used to motivate black students toward the engineering profession if engineering careers are presented as viable strategies for changing oppressive systems.

The role that improper counseling has played in maintaining the disproportionate number of black engineers and the failure of traditional counseling approaches to effectively deal with the needs and difficulties of oppressed people seem to suggest the need for innovative approaches to meet the present demand for black engineers. The systemic model of counseling which specifically addresses the needs of oppressed people seems to offer viable techniques for motivating black eighth grade students with low S.E.S. toward engineering careers. Therefore, it is because of the aforementioned information about systemic theory that this study which represents the first investigation on the motivational aspects of the systemic theory is undertaken.

Limitations of Study

There are specific limitations to this study which must be considered in correctly interpreting the findings.

The results of this study can be generalized to other populations only to the extent that other populations are similar in characteristics to the population used in the experiment and only in relation to the specific presentations used. This generalization aspect of the study is in agreement with commonly accepted research principles.

This study will concern itself only with the broader issues of motivation comparisons between lectures and slide-audio presentations which are either traditional or systemic in nature. Further, the traditional slide-audio presentations are restricted to those presently available for practical use.

Other variables of interest, such as the creative process or art of producing traditional or systemic slide-audio presentations are beyond the scope of this study. In addition, the reader is cautioned against applying the findings of the study to all systemic techniques or inferring a similar relationship between all systemic and traditional techniques.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents a review of the literature related to motivating black students with low socio-economic status toward engineering careers by means of slide-audio presentations. The chapter consists of two sections which constitute the main variables of interest in this study, i.e., audiovisual presentations and related research. In the first section, audiovisual studies will be reviewed which demonstrate that, (1) audiovisuals are effective mediums for factual, attitudinal, and motivational learning and (2) slide-audio presentations are very appropriate tools for motivating the population of this study towards engineering careers. The second section will (1) identify and briefly summarize investigations which relate to the present area of inquiry and (2) establish the uniqueness of the proposed study.

Audiovisuals Studies

While many empirical studies of audiovisuals and their use in education have been conducted, it remains a difficult area of research. The major problem centers

around the fact that media production is an act which is highly creative in many respects (Hoban, 1960). Hoban (1960) illustrates this problem in the area of film-making.

> The creative nature of film-making increases the difficulty of film research since (a) independent variables are embedded in an art form, and (b) the art of film-making itself is a variable. In the creative process, the artist, knowingly or unknowingly, may introduce additional variables which have not yet been identified as variables in theory or research. Consequently, there is a consensus rather than an invariance in film research findings supporting the relatively certain policies of knowledge, in that "pure" research in educational films is practically impossible (p. 104).

Despite research problems, there is a great deal of evidence which supports the effectiveness of audiovisuals. The entire audiovisual movement was justified and based upon the results of hundreds of instructional media studies prior to 1950 (Allen, 1960; Saettler, 1968). With some notable exceptions, this type of research was characterized by evaluative comparisons between learning from some unspecialized film or other medium (Allen, 1971). This line of research lasted for over 30 years and their findings show almost without exception, decided advantages for films and other audiovisual materials over the usual kinds of classroom instruction (Allen, 1971).

In summarizing research on the kinds of learning which occur when people are exposed to films, Hoban (1960) utilizes four criteria of confidence:

1. Reasonable intuition. Essentially, this criterion specifies that if "facts" (meanings, numbers, and statements about numbers upon which statistical

operations have been performed) conflict with what is intuitively reasonable, the "facts" are suspect (p. 96).

2. Demonstrated competence of the investigator as an imaginative observer in the field of psychology, sociology, education, communication, or a related discipline (p. 96).

3. Relatability to a consensus of theoretical formulation (p. 97).

4. Replication of the investigation of problem (p. 97).

Utilizing these four criteria of confidence in his summary of film research, he concludes:

> . . . the evidence that factual, attitudinal, opinional, and perceptual motor learning occurs when people are exposed to films is overwhelming. On the basis of satisfaction of all four criteria of confidence, it can safely be said that people learn from films (p. 105).

In a review of research in educational media, Allen (1959) also concludes that films can be effective in both affective and cognitive learning. He likewise found that "Filmstrips and slides appear to be at least as effective as motion pictures in teaching factual information" (p. 85). Allen (1959) similarly supports the ability of audiovisuals to effect motivational change.

> There is evidence that motion pictures, television, and radio will have an influence on attitudes, opinions, and motivations if they stimulate or reinforce existing beliefs of the audience (p. 85).

Of particular interest to the present investigation were research studies which directly support the use of slide-audio presentations to affect motivational learning. However, research in this area is sparse due to a

preoccupation with studies on the major mediums. In commenting on this problem Allen (1959) states:

> A tabulation of the experimental studies appearing in the literature over the past 40 years reveals that motion pictures and television have received the greatest research attention and the less expensive, more rapidly available materials have received the least (p. 84).

In one of the more penetrating summaries of audio-visual research, Lumsdaine (1963) concludes that slide-audios are capable of providing the same learning as larger media formats at minimum expense.

> . . . reproducible, carefully planned instruction, as represented by film and its television cousins can be valuable even where the visual material is largely static. Similar instruction can often be provided by a sound-accompanied series of still pictures requiring simpler equipment and less expensive materials (p. 589).

If slide-audios are capable of providing learning experiences similar to those offered by films, it would seem plausible that they could also parallel the effect of films on motivation.

In comparing the abilities of slides or filmstrip media to motion picture films, Lumsdaine (1963) indicates that:

> Some devices for sequenced still-picture projection are not only capable of regulating the timing of successive frames or scenes by automatic signals from the accompanying sound recording, but also of changing frames rapidly enough to stimulate motion, pop-on effects, and other characteristics of motion picture presentation. When one considers also the absence of motion, and frequent lack of need for it, in many sequences in the "motion picture" film, it is evident that the distinction between "film" and "filmstrip" media is a hazy and shifting one, clear only in the extremes, and better specified in terms of specific

> stimulus properties of motion and transition, than by characterization in terms of "media" properties (p. 589).

This distinction is noteworthy in relation to the present study since motion is not considered a necessary attribute for the motivational learning which is to be measured.

Still another important consideration is cost. Cost of media format is also a crucial factor in relation to present investigation because of inadequate financial support for inner-city schools (Spratlen, 1973). The fact that these schools receive less on a per capita basis and, therefore, expend less on a per-student basis than schools located outside the central city has been well documented in the literature (Riles, 1970; Spratlen, 1973). It, therefore, seems more likely that an inner-city school would purchase a slide-audio presentation and obtain equipment to accommodate such media than the more expensive media formats.

In light of the enormous need for black engineers, slide-audio presentations seem to have wider potential as tools designed to expose greater numbers of black students with low S.E.S. to motivational stimuli than film and other expensive formats.

Related Research

An examination of the standard sources reveals no doctoral dissertations specifically related to the proposed

study. The sources examined were Comprehensive Dissertation Index, 1861-1973; and Dissertation Abstracts International, 1972-January 1976.

Doctoral theses which appear to be related to this investigation include the following:

Allison, Roy William, The Effect of Three Methods of Treating Motivational Films Upon the Attitudes of Fourth-, Fifth-, and Sixth-Grade Students Toward Science, Scientists, and Scientific Careers. Pennsylvania State University, 1966.

Wickline, Lee Edevin, The Effects of Motivational Films on the Attitudes and Understandings of High School Students Concerning Science and Scientists. Pennsylvania State University, 1964.

In looking at other research, it was found that Wickline (1964) investigated the effect of ten science motivational films on the attitudes and understandings of high school students. Two groups of students from different classes from a high school located in a middle to upper socio-economic residential area were chosen. Both groups were pretested with the Allen Attitude Scale and the Facts About Science Test. The experimental group was then shown one film per week until all ten films in the Horizons of Science Series had been shown and the two tests were repeated.

Further, an analysis of variance of the pretest and posttest differences on the Allen Attitude Scale determined that there was no significant difference in changes in attitude between the two groups. Furthermore, changes in attitude were not significantly related to the student's grade level, course content, mental age, total SCAT score, sex, and elective science courses. Wickline concludes that the attitudes of these high school students towards science and scientists were relatively stable. However, he does not rule out the possibility that these motivational films could have a greater impact on the attitudes of students in lower grades. In his recommendations for further investigations, Wickline states:

> Similar investigations should be continued at lower grade levels to determine whether or not students' understandings and attitudes concerning science and scientists may be changed favorably at the lower grade levels (p. 59).

Since the present investigation is concerned with aspects of motivation, only findings related to changes in attitude will be of interest to this inquiry.

The present study and Allison's (1966) dissertation both deal with motivating students in lower grade levels by means of audiovisuals. Although Allison's (1966) study may be said to parallel that of Wickline, it has a narrower focus since it considers only the problems of changing the attitudes of a selected group of fourth, fifth, and sixth-grade students toward science, scientists, and

scientific careers as a result of treatments applied in ten motivational films. It is, therefore, of more significance to the proposed study.

Allison used the same science motivation films and an adapted version of the attitude measure that Wickline used in his investigation. Six groups (A, B, C, D, E, and F) of fourth, fifth, and sixth-grade students were selected from six similar schools. All of these students had high S.E.S. and were pretested with the Allison adaptation of the "Allen Attitude Scale."

Group A (the control group) did not view the films. Groups B, C, D, and E viewed one of the Horizons of Science film series each week for ten weeks. The students in Group B viewed the films only. The students in Group C each received a series of multiple-choice questions to read prior to the time they viewed each of the ten films. After viewing each film, they answered the questions, submitted their answers, and then listened as their teachers discussed each question and indicated the correct choice. The students in Group D viewed the films, and the investigator led a discussion immediately following each film using suggested topics recommended by Horizons of Science, Educational Testing Service, Princeton, New Jersey. The students in Group E viewed the films, and the classroom teachers led a discussion immediately following each film

using the same topics as were presented to Group D. The students in Group F (quasi-control group) did not view the films.

At the conclusion of the showing of the ten films, all six groups were posttested with the Allison adaptation of the Allen Attitude Scale. The same posttest was again given to these groups at the end of ten additional weeks. The purpose of the posttest was to check for retention of attitudinal changes. On the basis of data analysis the following conclusions were reached:

1. Attitudes toward science, scientists, and scientific careers were changed favorably as a result of all the treatments given during a series of ten motivational films.

2. Some methods of treatment produced favorable change in attitude toward science, scientists, and scientific careers more rapidly than other methods (p. 103).

In addition, Allison found that changes in attitudes toward science, scientists, and scientific careers were not related to: (1) the grade level of the student tested, (2) student's mental age as measured by the Lorge-Thorndike Intelligence Tests, (3) the means of the achievement scores as measured by the Stanford Achievement Test, (4) the science achievement score as measured by the Stanford Achievement Test, (5) the sex of the student, (6) the student's plans to elect science, (7) the science training of parents as recorded on student's permanent record card, and (8) the economic status of parents as determined by

the parent's occupational title recorded on the student's permanent record card.

It would seem, then, that both Wickline's (1964) and Allison's (1966) research support the conclusion that audiovisuals can motivate students in grade levels lower than high school toward scientific careers. However, some caution must be taken in generalizing the results of these investigations to the field of engineering; this would be due mainly to the differences between a scientific career and an engineering career. McCain and Segal (1969) characterize a scientific career:

> To summarize, the work of a basic scientist is to organize natural processes through conceptual schemas and to collect data that test and give depth and detail to the schema. The basic scientist's primary task is to develop the concepts or principles that become more and more abstract as the science develops (p. 20).

In contrast, the engineer is more closely identified with the application of principles and concepts to a specific and generally limited problem (McCain & Segal, 1969).

Considering this difference, it seems possible for a student interested in solving some of the technical problems confronting our society to be motivated towards an engineering career and not a scientific career. It also seems possible for a student to fall into one of four categories after viewing science motivational audiovisuals; the student could (1) be motivated toward both scientific and engineering careers, (2) be motivated toward scientific and not engineering careers, (3) be motivated toward

engineering and not scientific careers, (4) be motivated toward neither engineering nor scientific careers.

With the pressing demand for techniques to motivate black students toward engineering careers, the need for research in this area which yields clear and direct generalizations becomes crucial. The present investigation by utilizing audiovisuals, lectures, and posttests which are specifically related to the field of engineering attempts to address this need. In addition, this study has as its target population for potential black engineers, students with low S.E.S. rather than the students with middle to high S.E.S. as has been the direction in past research.

Summary

The literature on audiovisual research revealed a number of empirical studies demonstrating the capability of audiovisuals to effect factual, attitudinal, and motivational learning. Few empirical studies have been conducted using slide-audio presentations as motivational tools; this reflects, in part, the research emphasis on the major media formats. However, if slide-audios can parallel the effect of films on motivation, the fact that they are less expensive to produce, appears to make them a more practical means of exposing a large number of black students to motivational stimuli. Cost is an important factor, since many black students attend schools with strictly limited budgets.

An examination of the standard sources revealed no doctoral dissertations related specifically to the proposed study. Doctoral theses which appeared to be related to the present investigation supported the conclusion that audio-visuals can motivate students in grade levels lower than high school toward scientific careers. Due to the differences between engineering and scientific careers, the degree to which research on scientific careers can be generalized to engineering is not clear. The present investigation is unique in its attempt to provide generalizations specific to black students with low S.E.S. and engineering careers.

CHAPTER III

DESIGN OF THE STUDY

Introduction

The primary purpose of this study was to investigate the comparative effect of traditional and systemic techniques in motivating black students toward engineering careers. In this chapter, the characteristics of the population and sample, procedures, the nature of the stimulus material, and the experimental design are presented. Following this, the research hypotheses are stated and the method used for statistical analysis is reported.

Population and Sample

The experimental population selected for this study consisted of black eighth grade junior high school students with low S.E.S. who attend a junior high school whose composition is 99% black and located in the inner city of Cleveland, Ohio.

The number of students qualifying for a federally funded lunch program was used as a criterion for S.E.S. The guidelines for this program make eligible only those students whose families are considered to have low level

incomes. Since 99% of the students attending the junior high school selected for this inquiry qualify for this federal lunch program and the average family income for the community within the school's boundaries was below the poverty level, the entire eighth grade population of this school was characterized as having low S.E.S. The specific school used in this study was obtained through the assistance of the directing supervisor of guidance and the approval of the director for the Division of Research and Development in the Cleveland public school system.

Although the statistical findings will infer directly to the population used in this study, it should be noted that this population is characteristic of other junior high schools in Cleveland and other large urban areas. Therefore, the results of this investigation will be generalizable to other populations which are similar in characteristics to the population used in this study and only in relation to the specific treatments used.

A stratified random sampling procedure was utilized for this investigation. A list of black students within the population was obtained and each student was assigned a unique number. The list was then divided into male and female groups. By means of a random number table, 100 subjects from the male group and 100 subjects from the female group were selected. These 200 subjects were randomly assigned to five treatment groups: (A) the three systemic

slide-audio presentations and the systemic lecture, (B) the three systemic slide-audio presentations and the traditional lecture, (C) the three traditional slide-audio presentations and the systemic lecture, (D) the three traditional slide-audio presentations and the traditional lecture and (E) no treatment (the control group). Each group consisted of 20 male students and 20 female students.

Procedures

Using the student schedule cards, passes were written for the students in groups A, B, C, and D for days and times they were to receive treatment, and passes were written for group E for the day and time they were to receive the first posttest. The passes were placed in the mailboxes of the students' classroom teachers for the respective times and days written on them. The passes were placed in these mailboxes on the mornings of the respective days of the study. Neither the staff (teachers and counselors) nor the students of the school selected for this study received knowledge of the nature and intent of the investigation. The school's staff was notified by a bulletin message that selected eighth grade students would be viewing engineering films. The following notice was placed in the school's weekly bulletin on the first and second Mondays of the weeks of the study.

> Selected eighth grade students will be viewing engineering slide-tapes programs this week. Homeroom and classroom teachers will be notified as to time and

> place. Students should not be marked as cut. Please encourage those students who have been selected to view the slide-tape programs, to report promptly to the room indicated on the student's pass.

On each treatment day the students in groups A, B, C, and D were informed by their homeroom teachers that they would be viewing an engineering slide-audio presentation, the time and place of the viewing, and that they would receive a pass from their classroom teachers. Each homeroom teacher of the students in groups A, B, C, and D received on the morning of each treatment day a list indicating the students who were to view the engineering slide-audio presentations, the time, place, and where to obtain passes.

The students in groups A, B, C, and D received treatment for three sessions, each lasting approximately 25 minutes. During the first two sessions the students viewed the first two slide-audio presentations (one per session) of their treatment modality. In the final session students in groups A, B, C, and D received first the lecture and then the last slide-audio presentation in their treatment modality. The lectures were delivered by one of the school's eighth grade counselors and the slide-audio presentations were shown by the investigator. The sessions were given in the school library and took place on Tuesday and Thursday of the first week and Tuesday of the second week of the study. Monday and Friday were eliminated as possible session days because of higher absentee rates on these days.

Immediately following the third treatment session, groups A, B, C, and D were administered the first posttest, which consisted of a Likert scale questionnaire. On the same day, group E, the no treatment control group, also received this posttest. One week following this posttest a second posttest was given to the entire eighth grade population of the school. The posttest consisted of a sign-up card to which the students were asked to respond. This instrument was administered by the eighth grade homeroom teachers. In an attempt to eliminate a connection between the investigation and the second posttest, the investigator was not present during the testing. All of the sign-up cards were mailed to the investigator. Out of these cards only the cards of the students in groups A, B, C, D, and E were used as data for the second posttest. The entire study lasted approximately two and a half weeks, beginning September 30 with the first treatment session and ending October 14, 1975, with the second posttest.

Stimulus Materials

The stimulus materials for this study consisted of lectures and slide-audio presentations which were traditional or systemic in nature. In this section, the origin and basic theme of these materials will be presented.

The traditional lecture was developed by Dr. Lawrence W. Von Tersch, dean of the college of engineering

at Michigan State University. Dr. Von Tersch was specifically asked to develop a five-minute lecture that he would use to motivate eighth grade students toward engineering careers. The systemic lecture was created by the originator of the systemic approach to counseling, Dr. Thomas S. Gunnings, assistant dean for health programs at Michigan State University. Dr. Gunnings was requested to design a five-minute systemic lecture that he would use to motivate black eighth grade students with low S.E.S. toward engineering careers. Both the traditional and systemic lectures were prepared by timed dictation and the number of words in each lecture is reflective of the individual pacing of its developer. (The written systemic lecture is actually one and a half pages longer.) However, since the actual presentation of both lectures was timed at five minutes, the time length of the lectures will be considered a constant in the present inquiry. The traditional and systemic lectures used in this investigation are presented in Appendix A.

Three traditional engineering motivational sound filmstrips or slide-audio presentations averaging 15 minutes in length were selected from four sources: Commercial and Industrial Guidance Material (Berger, 1974), Engineering Guidance Material - A Directory (Engineering Education, 1974), the sixth edition of the Educator's Purchasing Guide (Cylinder & Rossi, 1974), and the sound

filmstrips collection of the College of Engineering at Michigan State University. The presentations were selected on their appropriateness for use with eighth grade junior high school students. Only three sound filmstrips presentations were found to meet the content, time and population criteria for the media to be used in the present investigation. The selected presentations were converted into slide-audio presentations to match the systemic media productions and thereby eliminated mode of audiovisual presentation as a variable in this study.

The slide format was chosen for the original production work in this investigation, i.e., the three systemic audiovisual presentations, due to production and editing limitations of the filmstrip format. Kemp (1968) presents three limitations related to filmstrip production:

1. Are relatively difficult to prepare locally
2. Require film-laboratory service to convert slides to filmstrip form
3. Are in permanent sequence and cannot be rearranged or revised (p. 36).

However, slide series offer a number of production and editing advantages:

1. Require only filming with processing and mounting by film laboratory
2. Result in colorful, realistic reproductions of original subjects
3. Prepared with any 35mm camera for most uses
4. Easily revised and up-dated
5. Easily handled, stored, and rearranged for various uses
6. Increased usefulness with magazine storage and automatic projection

7. Can be combined with taped narration for greater effectiveness
8. May be adapted to group or to individual use (Kemp, 1968, p. 36).

The titles and themes of the three traditional engineering motivational slide-audio presentations which were used in this investigation are as follows:

An Education in Engineering and Applied Science (Storm, 1963)

This audiovisual presentation describes the basic fields of engineering and characterizes a modern engineer as one who combines a creative engineering specialty with a very broad knowledge of many scientific fields to solve practical problems facing mankind. It accents the close relationship between engineering and other scientific fields and differentiates the work of an engineer from that of a pure scientist. This program traces the historical development of energy conservation for societal use and relates the rapid rate of this development to the growing demand for modern engineers. It also addresses the high school preparation and the types of knowledge needed to become a modern engineer.

Careers in Engineering - Part I (Morris & Teodorini, 1973)

This audiovisual production attempts to provide students with a broad picture of engineering careers, with interviews of people presently involved in the profession. It highlights the relationship between specific engineering

jobs and the profession as a whole. It stresses the relative importance of engineering careers to society in general. In addition, this program points out some of the material, social and personal rewards implicit in engineering careers. In effect, this audiovisual presentation attempts to illustrate (a) the kind of work typical engineers do, (b) how they do it, (c) where they work, and (d) the people with whom they work.

Careers in Engineering - Part II
(Morris & Teodorini, 1973)

This slide-audio presentation focuses on the details of a number of issues: (a) the type of person who is suited for engineering careers, (b) the necessary aptitudes and attitudes, and (c) what it takes to become academically qualified for these careers. The method of development, as in Part I, is a series of interviews with engineers who are presently involved in various careers, with their supervisors, and with the people who either hire or recruit engineers.

Three systemic engineering motivational slide-audio presentations were produced by the investigator. (The investigator has a B.A. degree in television and radio and has produced a number of slide-audio presentations on a variety of subjects.) Since these presentations have the same total time length as the traditional audiovisuals, the length of the slide-audio presentations was considered as a

constant in this study. The systemic slide-audio presentations were judged by originator (Dr. Thomas S. Gunnings) of the systemic model as being valid applications of the theory. The titles and themes of the three systemic slide-audio presentations which were used in this investigation are as follows:

Modern Black Engineer - Part I

This presentation illustrates how the surroundings in which one lives determine one's life expenctancy, health, lifestyle, employment and housing conditions. It examines systems operating in the United States in light of founding documents, goals, and the function of a society. In this light it characterizes the American society as being responsible for engineering systems (i.e., adequate housing, transportation, health, gainful employment, education, and recreation) to guarantee the pursuit of happiness and safety for all people. This presentation offers a criterion for evaluating the effectiveness of the system and illustrates how the housing and employment systems are malfunctioning in that they discriminate against black people. The slide-audio ends with the theme that modern black engineers are needed to redesign and engineer these systems that cause and maintain a number of negative conditions in which blacks are forced to live.

Modern Black Engineer - Part II

This slide-audio presentation characterizes a modern black engineer as one who believes that: (1) the way you act is determined to a large extent by your surroundings; (2) your surroundings are made up of systems such as housing, employment, transportation, and education; and (3) the majority of black people's problems are caused by poorly designed systems. It further develops the theme that modern black engineers are needed to redesign and engineer systems to improve the quality of life for black people. This presentation examines in depth the transportation and recreation systems in this society in relationship to their negative impact on the lives of black Americans. It illustrates some ways in which a modern black engineer can redesign and change these systems to equally meet the needs of all individuals included in this society.

Modern Black Engineer - Part III

This audiovisual presentation shows how the present housing, employment, and sanitation systems are biased against blacks and cause a number of negative responses. It suggests ways which a modern black engineer can redesign and change these systems so that they meet the needs of the black community. This program outlines the academic requirements which are necessary to pursue a career in engineering. It also presents some of the social,

personal, and material rewards a modern black engineer would receive.

Instrumentation

Self-Report Measure

Self-reported motivation toward engineering careers for the treatment groups was measured by a five-point Likert scale created specifically for this study. The instrument was composed of four sub-scales and was developed in the following fashion. Thirty-three items were written on three affective aspects of motivation: (1) interest, (2) relevancy, and (3) attitude. Each aspect was represented by a sub-scale composed of 11 items. In addition, seven items were written for a fourth sub-scale labeled "general motivation." The items for each sub-scale were written carefully in an attempt to avoid a response set. Some items in each sub-scale were worded so that they required a positive response and others were written so that they required a negative response to indicate motivation toward engineering careers. Each of the 40 items on the Likert instrument contained five possible responses: (a) strongly agree, (b) agree, (c) not sure, (d) disagree, and (e) strongly disagree.

For each item the response indicating the highest degree of motivation toward engineering careers was scored five, the next highest response was scored four, the "not

sure" response was scored three, the next highest response was scored two, and the lowest response was scored one.

The interest sub-scale measured the degree of positive or negative affect associated with engineering activities (Mehrens & Lehmann, 1969). The relevancy sub-scale measured the degree to which any activity, person, group, or event related to engineering has a logical positive connection to one's personal values, needs and goals. The attitude sub-scale measured the degree of positive or negative affect connected to any person, group, event, concept, or institution related to engineering (Chaplin, 1975). The general motivation sub-scale measured the degree of affective motivation related to aspects of engineering not measured by the other sub-scales.

The instrument was tested on a random sample of black eighth grade students attending a junior high school in Lansing, Michigan. This school population was selected since, of the populations available for testing the instrument, it was closest in characteristics to the population to be used in the study. The 40 item Likert instrument was given to 43 black eighth grade students. These questionnaires were scored and a reliability analysis was conducted to obtain coefficients of internal consistency for each sub-scale and for the entire instrument. The coefficients of internal consistency for the sub-scales were smaller than the coefficient for the instrument as a whole. Based

upon these results, it was decided to use only the total instrument as a self-report measure of affective motivation toward engineering careers. For the pilot study sample, the internal consistency of the entire instrument measured by the coefficient alpha was .89.

The least discriminating items were dropped from each sub-scale. The final instrument which was used in the investigation consisted of 30 items, items 1-8 represented the interest sub-scale, items 9-16 represented the relevance sub-scale, items 17-24 represented the attitude sub-scale, and items 25-30 represented the general motivation sub-scale. After dropping ten items, the reliability for the shortened version of the scale was found to be .90. The final self-report measure and the scores given to each of the five possible responses for each item are presented in Appendix B.

Behavioral Motivation

Behavioral motivation toward engineering careers for the treatment groups was measured by a sign-up card developed specifically for this investigation. The sign-up card consisted of a 3x5 index card with two boxes in the middle, one labeled "yes" and the other labeled "no." Homeroom numbers were placed in the top right corner of the sign-up card and the word name was printed in the opposite corner. Fifty sign-up cards were developed for each eighth grade homeroom in the population chosen for this study.

Each eighth grade homeroom teacher received these cards on the morning of the second posttest with the following instructions:

(1) Distribute cards to students and have students fill out name only.
(2) Read the following quote--"(the name of the school) is considering starting an engineering class or club. The purpose of this class or club is to take an in-depth look at the different areas of engineering and the things you need to do to become an engineer. If you want to be in this class or club, check Yes on your card. If not, check No."
(3) Make sure students responses are individual and not influenced by classmates. Each student should make a response.
(4) After collecting cards, return as soon as possible to (the assistant principal).

The sign-up cards were scored in the following fashion: yes responses = 1, and no responses = 2. A yes response on the sign-up card indicated behavioral motivation toward engineering careers.

Experimental Design

The design used for this study was a modification of Campbell and Stanley's (1963) Posttest Only Control Group Design. Figure 1 illustrates this design in Campbell and Stanley's terms. Figure 2 shows a graphic model of the modified design that was utilized in study.

In the modified design the control group was excluded from the analysis and was used only as a baseline for the population, since it is expected that any kind of treatment in this experiment would be better than no treatment.

R	X_1	O_1	O_2
R	X_2	O_1	O_2
R	X_3	O_1	O_2
R	X_4	O_1	O_2
R		O_1	O_2

Key: R = random assignment

X = experimental treatment

1 = systemic slide-audio presentations and the systemic lecture

2 = systemic slide-audio presentations and the traditional lecture

3 = traditional slide-audio presentations and the traditional lecture

4 = traditional slide-audio presentations and the systemic lecture

O = observation, posttest of the dependent variable

1 = self report measure

2 = behavioral measure

Fig. 1.--Design of the Study in Campbell and Stanley's (1963) Terms.

Design Factors				Measures Factors	
Slide-audio Presentations	Lectures	Sex	Subjects	Self-report Motivation	Behavioral Motivation
Systemic Slide-audio Presentations	Systemic Lecture	Male	20		
		Female	20		
	Traditional Lecture	Male	20		
		Female	20		
Traditional Slide-audio Presentations	Systemic Lecture	Male	20		
		Female	20		
	Traditional Lecture	Male	20		
		Female	20		

Fig. 2.--Design for the Study.

Data Matrix for the Design of the Study

I. Independent variables

   a. sex (fixed)

   b. slide-audio presentations (fixed)

   c. lectures (fixed)

II. Inter-relationships

   a. sex, slide-audio presentations, and lectures are crossed

III. Levels in variables

   a. sex has two levels (male and female)

   b. slide-audio presentations have two levels (systemic and traditional)

   c. lectures have two levels (systemic and traditional)

Hypotheses

The following hypotheses were generated and tested to compare the relative effectiveness of the traditional and systemic techniques in motivating low S.E.S. black eighth grade students toward engineering careers.

1. There will be no significant difference between the scores on the measure of self-reported motivation of students receiving the traditional slide-audio presentations and students receiving the systemic slide-audio presentations.

1a. Those students receiving the systemic slide-audio presentations will score significantly higher on

the measure of self-reported motivation than will the students receiving the traditional slide-audio presentations.

2. There will be no significant difference between the scores on the measure of self-reported motivation of students receiving the traditional lecture and students receiving the systemic lecture.

2a. Those students receiving the systemic lecture will score significantly higher on the measure of self-reported motivation than will the students receiving the traditional lecture.

3. There will be no significant difference between the scores on the measure of self-reported motivation of male students and female students.

4. There will be no significant interaction between slide-audio presentations and lectures on the measure of self-reported motivation.

5. There will be no significant interaction between lectures and sex on the measure of self-reported motivation.

6. There will be no significant interaction between slide-audio presentations and sex on the measure of self-reported motivation.

7. There will be no significant interaction between slide-audio presentations, lectures, and sex on the measure of self-reported motivation.
8. There will be no significant difference between the "yes" responses on the measure of behavioral motivation of students receiving the traditional slide-audio presentations and students receiving the systemic slide-audio presentations.

8a. Those students receiving the systemic slide-audio presentations will give significantly more "yes" responses on the measure of behavioral motivation than will the students receiving the traditional slide-audio presentations.

9. There will be no significant difference between the "yes" responses on the measure of behavioral motivation of students receiving the traditional lecture and students receiving the systemic lecture.

9a. Those students receiving the systemic lecture will give significantly more "yes" responses on the measure of behavioral motivation than will the students receiving the traditional lecture.

10. There will be no significant difference between the "yes" responses on the measure of behavioral motivation of male students and female students.
11. There will be no significant interaction between slide-audio presentations and lectures on the measure of behavioral motivation.

12. There will be no significant interaction between lectures and sex on the measure of behavioral motivation.
13. There will be no significant interaction between slide-audio presentations and sex on the measure of behavioral motivation.
14. There will be no significant interaction between the slide-audio presentations, lectures, and sex on the measure of behavioral motivation.

Statistical Analysis

A three-way fixed effects analysis of variance model was used to analyze the total score on the self-report measure and the "yes" responses on the behavioral measure comprising the dependent variables for the treatment groups. The three independent variables were slide-audio presentations, lectures, and sex.

The analysis of variance model assumes that:

1. Error is normally distributed with a mean of zero.
2. There is equality of variance.
3. Observations were made independently.

The methodology and selection procedures for this study were carefully assessed and designed to meet the assumptions. Equal cell sizes were maintained by randomly eliminating students from each treatment group which had a greater number of students responding to the first posttest than the treatment group with the smallest number of

students responding to this measure. A priori alpha level of .05 was selected as the point at which the null hypothesis could be rejected.

All statistical analyses were computed on a Control Data Corporation (CDC) 6500 computer at the Michigan State University (MSU) Computer Center. The two analyses of variance were performed utilizing the multivariance program developed by Jeremy D. Finn, modified and adapted for use of the CDC 6500 by Scheifley and Schmidt (1973).

Summary

The population selected for this study consisted of black eighth grade junior high school students with low S.E.S. who attend a junior high school whose composition is 99% black and located in the inner city of Cleveland, Ohio. Utilizing a random sampling procedure 100 male subjects and 100 female subjects were selected from this population. These 200 subjects were randomly assigned to five treatment groups: (A) the three systemic slide-audio presentations and the systemic lecture, (B) the three systemic slide-audio presentations and the traditional lecture, (C) the three traditional slide-audio presentations and the systemic lecture, (D) the three traditional slide-audio presentations and the traditional lecture, and (E) no treatment (the control group). Each group consisted of 20 male students and 20 female students. Immediately following treatment a self-report motivation posttest was

given to the treatment groups and one week following this testing a behavioral motivation posttest was administered to the same groups. Self-reported motivation toward engineering careers for the treatment groups was measured by a 30-item five-point Likert scale which had been pre-tested for internal consistency. The instrument was composed of four sub-scales: (1) interest, (2) relevancy, (3) attitude, and (4) general motivation. Behavioral motivation toward engineering careers for the treatment groups was measured by response to a sign-up card.

Statistical analysis of self-reported and behavioral motivation was by analysis of variance. All hypotheses were tested at the .05 level of significance.

CHAPTER IV

ANALYSES AND RESULTS

The purpose of this study is to compare the results of traditional and systemic techniques (i.e., lectures and slide-audio presentations) in motivating black eighth grade junior high school students with low socio-economic status toward careers in engineering. In this chapter, the results of the two analyses of variance performed on the dependent variables of this investigation are presented. First the statistical analysis of the hypotheses related to the self-report measure of motivation and second the statistical analysis of those hypotheses related to the behavioral measure of motivation are presented.

Self-Report Motivation

Null Hypothesis 1: There will be no significant difference between the scores on the measure of self-reported motivation of students receiving the traditional slide-audio presentations and students receiving the systemic slide-audio presentations.

Alternate Hypothesis 1a: Those students receiving the systemic slide-audio presentations will score significantly higher on the measure of self-reported motivation than will the students receiving the traditional slide-audio presentations.

As indicated in Table 2, a comparison of means between treatment groups yielded a F-statistic of 10.30 (df 1,88) which is significant at the .05 level (P < .0019). The null hypothesis was, therefore, rejected in favor of the alternate hypothesis. Table 1 indicates that the mean for the groups receiving the systemic slide-audio presentations was higher than the mean for the groups receiving the traditional slide-audio presentations.

> Null Hypothesis 2: There will be no significant difference between the scores on the measure of self-reported motivation of students receiving the traditional lecture and students receiving the systemic lecture.

> Alternate Hypothesis 2a: Those students receiving the systemic lecture will score significantly higher on the measure of self-reported motivation than will the students receiving the traditional lecture.

Table 2 shows that the comparison of scores between the treatment groups yielded an F-statistic of .31 (df 1,88) which is not significant at the .05 level (P < .5764). As a result, the null hypothesis was not rejected. Reference to Table 1 shows that there was little difference between the mean of the groups receiving the systemic lecture and the groups receiving the traditional lecture.

> Null Hypothesis 3: There will be no significant difference between the scores on the measure of self-reported motivation of male students and female students.

As indicated in Table 2, the obtained F ratio of 4.56 (df 1,88) was statistically significant (P < .0355).

Table 1.--Means for the Main Effects on the Self-Report Measure of Motivation.

	DESIGN FACTORS					
	SLIDE-AUDIO PRESENTATIONS		LECTURES		SEX	
Levels	Systemic	Traditional	Systemic	Traditional	Male	Female
Means	$\bar{x}$=112.8	$\bar{x}$=101.6	$\bar{x}$=108.2	$\bar{x}$=106.2	$\bar{x}$=110.9	$\bar{x}$=103.5

	NO TREATMENT CONTROL GROUP		
	Total	Male	Female
Means	$\bar{x}$=97.3	$\bar{x}$=96.5	$\bar{x}$=98

Table 2.--Analysis of Variance for the Self-Report Measure of Motivation.

SOURCE OF VARIANCE	MEAN SQUARE	DEGREES OF FREEDOM	F STATISTIC	SIGNIFICANCE PROBABILITY
Slide-audio Presentations (P)	3015.04	1	10.30	.0019
Lectures (L)	92.04	1	.31	.5764
Sex (S)	1335.04	1	4.56	.0355
PL	4.17	1	.01	.9054
PS	1066.67	1	3.64	.0596
LS	160.17	1	.55	.4615
PLS	551.04	1	1.88	.1736
Error	292.70	88		

The null hypothesis was, therefore, rejected. Table 1 shows that the mean for male students ($\bar{x}$ = 110.9) was higher than the mean for the female students ($\bar{x}$ = 103.5).

Null Hypothesis 4: There will be no significant interaction between slide-audio presentations and lectures on the measure of self-reported motivation.

The results in Table 2 indicate that there were no significant interactions between slide-audio presentations and lectures ($F = .01$, $P < .9054$). As a result the null hypothesis was not rejected.

Null Hypothesis 5: There will be no significant interaction between lectures and sex on the measure of self-reported motivation.

Table 2 shows the F ratio of .55 ($P < .4615$) was not significant at the .05 level. Thus, this hypothesis was not rejected.

Null Hypothesis 6: There will be no significant interaction between slide-audio presentations and sex on the measure of self-reported motivation.

The obtained F ratio (Table 2) of 3.64 ($P < .0596$) was not statistically significant and the null hypothesis was not rejected. However, since the obtained probability level was .0596 it was decided to graph the interaction to examine the possible relationship between type of presentation and sex. This graph is shown in Figure 3. It appears that the systemic presentations could be having a more profound effect on females.

Null Hypothesis 7: There will be no significant interaction between slide-audio presentations, lectures, and sex on the measure of self-reported motivation.

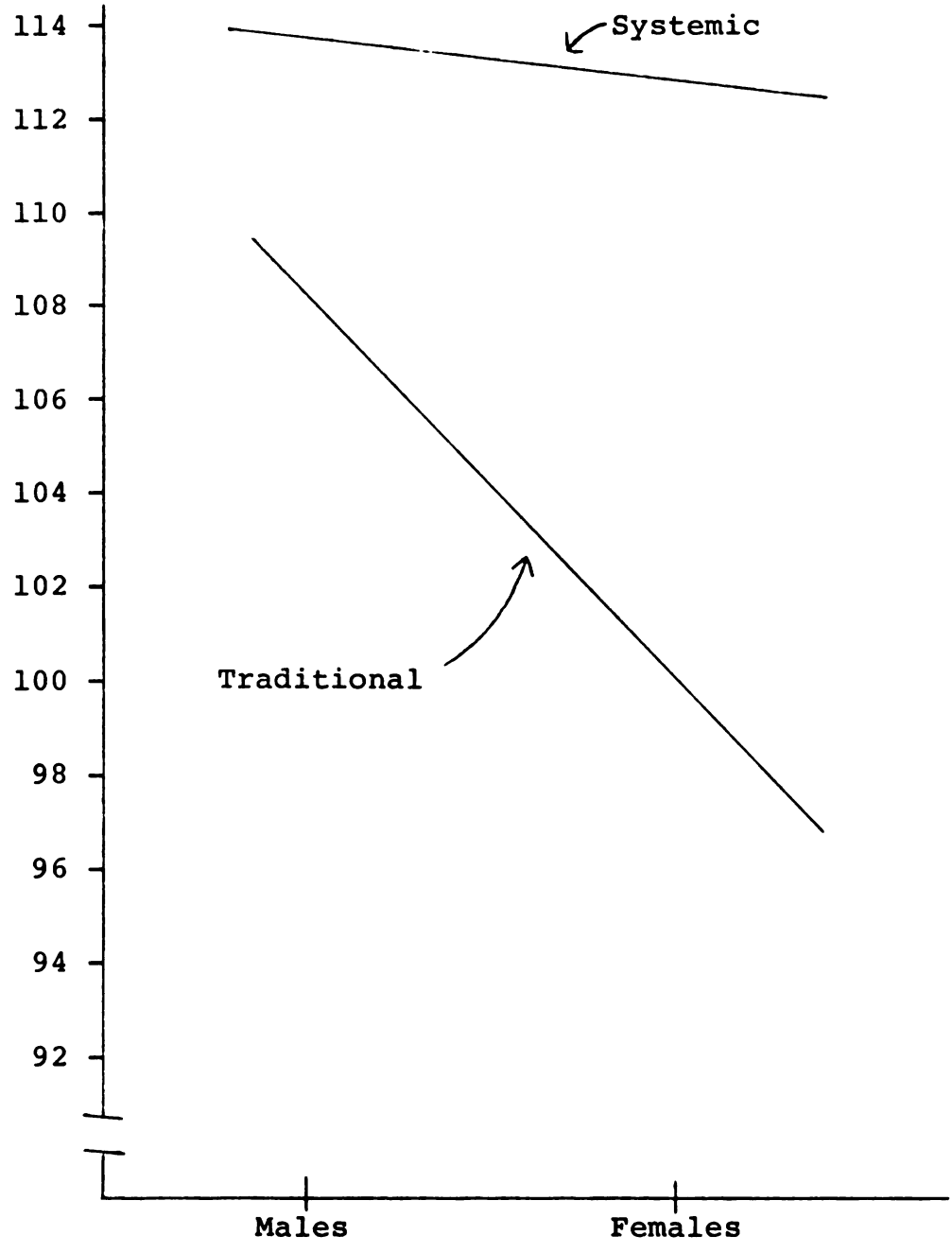

Fig. 3.--Interaction Between Slide-Audio Presentations and Sex on the Measure of Self-Reported Motivation.

Reference to Table 2 indicates that the F ratio of 1.88 (df 1,88) was not significant at the .05 level (P < .1736). Thus, this hypothesis was not rejected.

Behavioral Motivation

Null Hypothesis 8: There will be no significant difference between the "yes" responses on the measure of behavioral motivation of students receiving the traditional slide-audio presentations and students receiving the systemic slide-audio presentations.

Alternate Hypothesis 8a: Those students receiving the systemic slide-audio presentations will give significantly more "yes" responses on the measure of behavioral motivation than will the students receiving the traditional slide-audio presentations.

As shown in Table 4, a comparison of the mean response between the treatment groups yielded a F ratio of 2.33 (df 1,69) which was not significant at the .05 level (P < .1315). Therefore the null hypothesis was not rejected although the mean response difference of the treatment groups was in the direction of the alternate hypothesis. Table 3 shows that the students receiving the systemic slide-audio presentations gave 17% more "yes" responses than the students receiving the traditional slide-audio presentations. This percentage difference could have practical significance.

Null Hypothesis 9: There will be no significant difference between the "yes" responses on the measure of behavioral motivation of students receiving the traditional lecture and students receiving the systemic lecture.

Table 3.--Means and Percent of Yes Responses for the Main Effects on the Behavioral Measure of Motivation.

	DESIGN FACTORS					
	SLIDE-AUDIO PRESENTATIONS		LECTURES		SEX	
Levels	Systemic	Traditional	Systemic	Traditional	Male	Female
Means	$\bar{x}$=1.45	$\bar{x}$=1.62	$\bar{x}$=1.58	$\bar{x}$=1.49	$\bar{x}$=1.40	$\bar{x}$=1.67
% Yes Responses	55%	38%	42%	51%	60%	33%

	NO TREATMENT CONTROL GROUP		
	Total	Male	Female
Means	$\bar{x}$=1.72	$\bar{x}$=1.60	$\bar{x}$=1.87
% Yes Responses	28%	40%	13%

Table 4.--Analysis of Variance for the Behavioral Measure of Motivation.

SOURCE OF VARIANCE	MEAN SQUARE	DEGREES OF FREEDOM	F STATISTIC	SIGNIFICANCE PROBABILITY
Slide-audio Presentations (P)	.57	1	2.33	.1315
Lectures (L)	.14	1	.58	.4508
Sex (S)	1.28	1	5.28	.0246
PL	.07	1	.27	.6059
PS	.14	1	.57	.4539
LS	.19	1	.80	.3745
PLS	.01	1	.06	.8067
Error	.24	69		

Alternate Hypothesis 9a: Those students receiving the systemic lecture will give significantly more "yes" responses on the measure of behavioral motivation than will the students receiving the traditional lecture.

The data presented in Table 4 indicate that the obtained F ratio of .14 (df 1,69) was not statistically significant. Thus, the null hypothesis was not rejected.

Null Hypothesis 10: There will be no significant difference between the "yes" responses on the measure of behavioral motivation of male students and female students.

Table 4 indicates that the F ratio of 5.28 (df 1,69) was significant at the .05 level ($P < .0246$). The null hypothesis was therefore rejected. Reference to Table 3 shows that the male students receiving treatment gave a higher percent of "yes" responses than the female students receiving treatment.

Null Hypothesis 11: There will be no significant interaction between slide-audio presentations and lectures on the measure of behavioral motivation.

The results in Table 4 shows that there was no significant interaction between slide-audio presentations and lectures ($F = .27$, $P < .6059$). Thus, the null hypothesis was not rejected.

Null Hypothesis 12: There will be no significant interaction between lectures and sex on the measure of behavioral motivation.

The obtained F ratio (Table 4) of .80 ($P < .3745$) was not statistically significant and the null hypothesis was not rejected.

Null Hypothesis 13: There will be no significant interaction between slide-audio presentations and sex on the measure of behavioral motivation.

As indicated in Table 4, the obtained F ratio of .57 (df 1,69) was not found to be significant at the .05 level ($P < .4539$). Thus, this hypothesis was not rejected.

Null Hypothesis 14: There will be no significant interaction between slide-audio presentations, lectures, and sex on the measure of behavioral motivation.

The results in Table 4 indicates that there were no statistically significant interactions between slide-audio presentations, lectures, and sex ($F = .06$, $P < .8067$). Therefore, the null hypothesis was not rejected.

Summary

The data from the two analyses of variance on the dependent variables (i.e., self-report and behavioral motivation) for this investigation can be summarized as follows:

1. The groups that received the systemic slide-audio presentations had a significantly higher amount of self-reported motivation toward engineering careers than the groups receiving the traditional slide-audio presentations.
2. The groups that received the systemic lecture and the groups that received the traditional lecture had no significant difference in the amount of self-reported and behavioral motivation toward engineering careers.

3. The male students who received treatment had a significantly higher amount of self-reported and behavioral motivation toward engineering careers than the female students who received treatment.
4. Although there were no significant interactions between slide-audio presentations, lectures, and sex on either the self-report and behavioral measures of motivation, the interaction between slide-audio presentations and sex on the self-report measure approached significance ($P < .0596$). A graph of this interaction seems to suggest that the systemic slide-audio presentations could have a more profound effect on increasing the amount of self-reported motivation toward engineering careers for female students than the traditional slide-audio presentations.
5. The groups that received the systemic slide-audio presentations had a higher percentage of "yes" responses (indicating behavioral motivation toward engineering) than the groups that received the traditional slide-audio presentations. This difference was not statistically significant. However, the fact that the groups receiving the systemic slide-audio presentations gave 17% more "yes" responses than the groups receiving the traditional slide-audio presentations could have practical significance.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to compare the results of traditional and systemic techniques, i.e., lectures and slide-audio presentations, in motivating black eighth grade junior high school students with low socio-economic status toward careers in engineering. Briefly, the traditional techniques were directed at the general population and showed the importance of engineering to society as a whole. The systemic techniques were aimed at blacks who have been victimized by social and technological systems and illustrated how engineering could be used to change these systems to meet the needs of black people.

The specific aim of this study was to determine whether there are differences in motivational learning as a result of experiencing four different forms of treatment: i.e., systemic slide-audios and a systemic lecture; systemic slide-audios and a traditional lecture; traditional slide-audios and a traditional lecture; and traditional slide-audios and a systemic lecture. Since the systemic and traditional lectures were five minutes in length and the systemic and traditional slide-audios were the same

length, the length of both the lectures and the slide-audios were considered constants rather than variables.

The research literature on audiovisual media revealed a number of empirical studies demonstrating their capacity to affect factual, attitudinal, and motivational learning. Few empirical studies have been conducted using slide-audio presentations as motivational tools; this reflects, in part, the research emphasis on the major media formats. However, if slide-audios can parallel the effect of films on motivation, the fact that they are less expensive to produce appears to make them a more practical means of exposing a large number of black students to motivational stimuli. Cost is an important factor, since many black students attend schools with strictly limited budgets.

The population for this study consisted of 200 black eighth grade junior high school students with low S.E.S. who attend a junior high school whose composition was 99% black and located in the inner city of Cleveland, Ohio. Utilizing a random sampling procedure, 100 male subjects and 100 female subjects were selected from this population. These 200 students were randomly assigned to one of five treatment groups. Immediately following treatment, a self-reported motivation posttest was administered to the groups. One week later, a behavioral motivation posttest was administered to the same groups.

Self-reported motivation toward engineering careers for the groups was measured by a 30-item five-point Likert scale which had been pretested for internal consistency. The instrument was composed of four sub-scales: (1) interest, (2) relevancy, (3) attitude, and (4) general motivation. Behavioral motivation toward engineering careers for the treatment groups was measured by response to a sign-up card for an engineering class or club.

Analysis of variance was used to test for statistical significance between treatment groups on the self-reported and behavioral measures of motivation. All hypotheses were tested at the .05 level of significance.

Conclusions

The results of this experiment can be summarized as follows:

1. The groups that received the systemic slide-audio presentations had a significantly higher amount of self-reported motivation toward engineering careers than the groups receiving the traditional slide-audio presentations.
2. The lecture presentations produced no significant differences between groups on the measures of motivation.
3. The male students who received treatment had a significantly higher amount of self-reported and

behavioral motivation toward engineering careers than the female students who received treatment.

4. Although there were no significant interactions between slide-audio presentations, lectures, and sex on either the self-reported or behavioral measures of motivation, the interaction between slide-audio presentations and sex on the self-reported measure approached significance ($P < .0596$). A graph of this interaction seems to suggest that the systemic slide-audio presentations could have a more profound effect on increasing the amount of self-reported motivation toward engineering careers for female students than the traditional slide-audio presentations.
5. The groups that received the systemic slide-audio presentations had a higher percentage of "yes" responses (indicating behavioral motivation toward engineering careers) than the groups that received the traditional slide-audio presentations. This difference was not statistically significant. However, the fact that the groups receiving the systemic slide-audio presentations gave 17% more "yes" responses than the groups receiving the traditional slide-audio presentations could have practical significance.

Discussion of Results

This experiment supports the hypothesis that low S.E.S. black eighth grade students who view the systemic slide-audio presentations will report a significantly higher motivation toward engineering careers than those students who view the traditional slide-audio presentations. On the self-reported measure of motivation, the students who viewed the systemic slide-audio presentations had a mean score which was 11.2 points higher than the students who viewed the traditional slide-audio presentations. This fact seems to have practical significance considering that (1) motivation has been isolated as an essential prerequisite for increasing the numbers of black engineers in this country (Jackson, Wedekind, & Gibson, 1971) and (2) the three systemic presentations used in this experiment could be marketed at a cost similar to that of the three traditional presentations which were utilized.

The lack of statistical significance in the amount of self-reported and behavioral motivation toward engineering careers between the students who received the systemic lecture and the students who received the traditional lecture could, in part, reflect the fact that these lectures were only five minutes in length. It is possible that systemic and traditional lectures of a longer duration could produce statistically significant results.

Traditionally, women have not chosen engineering as a career. This investigation seems to reflect this situation in that a greater proportion of the male subjects indicated self-reported and behavioral motivation toward engineering careers as compared to female subjects.

The interaction between slide-audio presentations and sex on the self-reported measure approached significance. This seems to suggest that the systemic slide-audio presentations could have a more profound effect on increasing the self-reported motivation toward engineering careers for black females than the traditional slide-audios. It is conceivable that this interaction could have reached statistical significance if initial differences that were not eliminated by random assignment had been controlled. The pretest-posttest control group design would have controlled for initial differences which random assignment failed to cancel out by using pretest scores as a covariate in analysis of covariance. Thus, any difference found on the posttests could be attributed to experimental treatments. However, the pretest-posttest control group design was not utilized in this investigation because of the short duration of the study (two and one half weeks). The use of a pretest in this investigation could have produced an interaction of testing and treatment and, therefore constitute a threat to the external validity of the experiment.

The nature of the sign-up card may have been a limiting factor in determining statistical differences in the amount of behavioral motivation toward engineering careers for the groups that received the slide-audio presentations. The sign-up card with its "yes" or "no" response options does not accurately measure the behavioral motivation of those students who were interested in an engineering career, but who for a variety of reasons, i.e., class conflict, involvement in other extracurricular activities, work schedule, etc., decided not to join the class or club. Another group of students who are not accurately measured by the sign-up card are those whose behavioral motivation toward an engineering career was not strong enough for a behavioral commitment, i.e., join a class or club, at the time of testing. It is conceivable that some of the students who checked "no" would have joined at a later date, due to peer influence or continued publicity on the activities of the club or class.

The lack of statistical significance does not seem to exclude the practical significance of the finding that the groups that received the systemic slide-audio presentations gave 17% more "yes" responses (indicating behavioral motivation toward engineering careers) than the groups that received the traditional slide-audio presentations. In face of the enormous supply of black engineers needed within a decade, this finding seems to have practical application.

The viewing of the three systemic slide-audio presentations by black students in populations similar to the one used in this study could possibly result in an average of 17 additional students out of every 100 who will indicate behavioral motivation toward engineering careers, than if the same students viewed the three traditional slide-audio presentations.

It is recognized that subject attrition influenced the results of this study. The initial population consisted of 200 subjects who were randomly assigned to one of five treatment groups. A total of 134 subjects were administered the self-report measure. After random elimination of subjects to maintain equal cell sizes in the design, 120 subjects remained. However, only 95 subjects completed the behavioral motivation measure. Because of this high attrition rate, the lack of statistical significance between groups on the measure of behavioral motivation could reflect, in part, this reduction in subjects. It is recognized that the posttest only design used in this study does not control for the factor of attrition. However, since there was no significant difference in the attrition between treatment groups, the effect of this threat to validity is substantially reduced.

Implications for Future Research

This study also offers several directions for future research:

1. This study should be replicated with populations of varying socio-economic levels, ethnic backgrounds, and age groups to determine the generalizability of the results obtained in this investigation.
2. Research efforts should also focus on clarifying the effect of slide-audio presentations on motivation, particularly as they relate to vocational choice.
3. Work should be continued on the development of instruments for use in measuring motivation toward engineering careers.
4. Replication of this study should consider the use of designs employing a pretest to control for such variables as subject attrition.
5. Experiments should also be designed to determine the influence of longer treatment periods on subject motivation toward engineering careers. Not only should these studies expand the length of the lectures, slide-audio presentations, and actually implement the engineering class or club, they should also include larger samples.

These suggested areas for future research are attempts to expand present knowledge on how to motivate minority students toward engineering. The availability of such information would be of particular value to counseling

professionals engaged in career-vocational counseling with these students as well as those persons involved in the development of motivational tools.

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APPENDICES

APPENDIX A

LECTURES

APPENDIX A

LECTURES

Traditional Lecture*

Engineering very often identified as technology has been largely responsible for most of the material comforts we now enjoy. Its history started many centuries ago when primitive man was able to control fire to heat his cave and to cook his food. He later used this fire to refine metals and to shape crude tools as instruments for his use. The next stage in man's technological development probably was the development of the agriculture. This led to his being able to produce food for himself and later for the use of others. A look at any encyclopedia will soon convince you that the developments of farming were slow and tedious, but nevertheless they were developments for which today's technology can be justly proud. Perhaps the next item of importance was the development of the technology of printing for it was in this way that man could record his ideas so that they could be transmitted to others so that theories could continue to proceed from the minds of men. After the printing press the development of the steam engine probably will go down in history as the next phase in man's

engineering achievements. All of this has led to the modern production system responsible for the necessities and the luxuries we enjoy.

To name a few of these--our modern heat in the home, the automobile, the radio and television. Now a few decades ago another significant development of technology was the modern computer. This has led man to be able to do complex mathematical calculations and development of theory in relatively short periods of time, a process undreamed of when I was at your level in school. The things which I am speaking of have come from efforts of engineers who have dedicated themselves to using the things about them for the benefit of man. Actually what this means is that they ordered these things into systems such that they could be used to serve man.

The people responsible are the aeronautical engineers who have developed the airplane from a one-man device to a complex jet plane carrying 200 or more people with all of their luggage and equipment; the agricultural engineer who has developed machinery to aid the food industry so greatly, has benefitted us through automatic tilling, planting, and harvesting; the chemical engineer who has provided us with the petroleum and plastics and synthetic products which make our life more enjoyable; the civil engineer who has designed the transportation systems and the bridges which have enabled us to be an age of mobility;

the mechanical engineer who has designed the internal combustion engine and many of the machines of modern production, the automobile and the like; the electrical engineer who has given us not only electricity as our source of energy, but has produced for us modern radio, television, computers and electronic devices to serve in medicine and related fields; the metallurgical engineer who has developed not only steel, but other materials for the products we enjoy.

All of these are but beginnings for there is no less of a challenge for the engineer of today than there was for the engineer of two, three or four decades ago. There are always worlds to conquer for men of imagination.

*This lecture was developed by Dr. Lawrence W. Von Tersch, dean of the College of Engineering at Michigan State University.

Systemic Lecture*

Today I would like to speak to you briefly on the possibilities of using engineering in the black community. I am sure many of you are beginning to say, why engineering? What is engineering? Or, some of you might be afraid to seek an education in engineering because of the tools one would need to be successful--tools like mathematics and science.

While recognizing that many of you have not at this time mastered the sciences or mathematics, but who has at your age, at this given time? But the point I am trying to make is that the sciences and math will play a large role in shaping the structure of your communities. Mathematics and sciences in the hands of engineers in the past have been misused and abused in our communities.

Engineers have structured poor transportation; if you look around, you will find traffic jams, railroad tracks running between houses and dividing our communities into small sections. You will find huge transportation trucks riding by your front doors. You will find streets that are paved or half-way paved causing a greater percentage of accidents in our communities.

You will find houses placed close together, so as to cause undue hazardous conditions, overcrowdedness, poor ventilation, small rooms, houses loaded with lead paint, one bathroom, if there is a bathroom at all. Lead paint

that is hazardous to the health of your younger brothers and sisters peeling off the walls; and a lot of other things all related to engineering.

Stop for a moment and think about recreation. In most of our neighborhoods you will find only a basketball court, hastily placed in a very small area, in which all of the kids in the neighborhood must use. A skillful engineer would have planned for a swimming pool, a baseball diamond, and many other recreational activities, including more land for you to play on during your development time. Keep in mind that engineers in the past and engineers who are presently in training are not concerned about your conditions; they are mostly concerned about making sure that their neighborhoods get the best of housing, recreation and transportation. They go out of their way to make sure that mass transportation routes are routed through your back doors.

Have you looked outside recently at the garbage cans? The filth that we find in many streets because engineers have not seen fit to do their jobs of cleaning our streets, of picking up our garbage cans on time. And while I'm on that, let me bring to your attention another hazardous condition. When garbage isn't picked up at the appropriate time, you've seen maggots, which lead to flies and other insects swamped around the garbage and later you will find them in your bedroom, or you will find them

swamped in your kitchen. And, if you don't watch it, you'll find them swamped in your stomach.

All of this is due to a lack of engineers being concerned about conditions in the black communities. I can recall seeing my grandfather and grandmother when they were 50 years old, but looking like they were 75. Looking like they were 75 because of their stresses brought into their lives because of a lack of effective housing, good jobs, adequate health, adequate recreation, and these are the kinds of things we need which were eliminated from our communities by the lack of having good black engineers who looked out for our protection. We must put a stop to this condition by moving into these various fields of engineering ourselves.

We often wonder why we have so many fights in our neighborhoods. Why we have so many friends using drugs. We often wonder why so many of our friends are dropouts from school, why some of us don't go on to college, why we don't become lawyers, doctors, policemen, and many other professionals.

Yet it has been said it is because we are not motivated, we don't have the drive, we are not determined to succeed, that we don't like school. All of the above symptoms that have been caused by the conditions in which we have been forced to live under. Whether we continue to work under the above conditions will be up to you. Will

we continue to have high unemployment, poor health care, poor law enforcement, dirty drinking water, high crime in our neighborhoods, drugs being sold in our streets, poor housing, freeways running at our front doors, poor recreational areas?

Well, the answer is up to you. If you choose engineering, you can begin to bring about changes in the black communities. The communities are with us only because we haven't had people like you in positions of control to offer us protection from uncaring engineers. These conditions don't have to exist they are with us because we have not had enough black engineers.

If you decide to become an engineer, I am sure that in the very near future our streets will be brighter, our homes will be bigger, our recreation will be better, our water will be cleaner, we will have less crime in our neighborhoods, and more jobs for our people to have. And, transportation will be better and cheaper for black people in the inner cities. I ask you to strongly consider becoming an engineer.

I know the sciences and mathematics may turn you off, but you can use the sciences and math to turn our cities on. Come join us and become an engineer with a determination to aid inner city people. I eagerly await your reply.

*This lecture was developed by Dr. Thomas S. Gunnings, assistant dean for health programs at Michigan State University.

APPENDIX B

SELF-REPORT MEASURE OF MOTIVATION

(WITH SUB-SCALES AND SCORING VALUES)

NAME_____ MALE_____FEMALE_____

Directions: The following questions are designed to find out your feelings about engineering. There are no right or wrong answers. After reading each question, put an "X" next to the response that comes closest to expressing your true feelings. Respond to each question.

Interest Sub-Scale, 1-8

1. I would like to find out more about what a Black engineer can do to help Black people.

   5 strongly agree
   4 agree
   3 not sure
   2 disagree
   1 strongly disagree

2. I would like to do some of the things that engineers do.

   5 strongly agree
   4 agree
   3 not sure
   2 disagree
   1 strongly disagree

3. If math and science could be used to help Black people, I would be interested in learning more math and science.

   5 strongly agree
   4 agree
   3 not sure
   2 disagree
   1 strongly disagree

4. I would enjoy doing the work that a Black engineer does.

   5 strongly agree
   4 agree
   3 not sure
   2 disagree
   1 strongly disagree

5. Engineers have interesting jobs.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

6. I don't care for the type of work that engineers do.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

7. If I had a chance to help poor Blacks by using engineering, I would take it.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

8. I really like jobs that I can do without using math and science.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

Relevance Sub-Scale, 9-16

9. Engineering just isn't my thing.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

10. Given my personal values and needs, I can really see myself as an engineer.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

11. If I had to choose a future job, I would put engineering on the bottom of my list.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

12. It is worth my time and effort to become an engineer.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

13. I would really be satisfied with my life if I were an engineer.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

14. I find it hard to see myself as an engineer.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

15. Black engineers and I are pretty much alike in our basic interests.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

16. People like me should stay out of careers like engineering.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

Attitude Sub-Scale, 17-24

17. Black people need Black engineers.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

18. Black engineers are cool people.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

19. I like Black engineers because they can help Black people.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

20. It would be cool if I were an engineer.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

21. When you get right down to it, engineers are boring people.

1 strongly agree
2 agree
3 not sure
4 disagree
5 strongly disagree

22. I think Black engineers are important people.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

23. Actually the world can do without engineers.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

24. I would have to be crazy to spend five or more years of my life just to become an engineer.

__1__ strongly agree
__2__ agree
__3__ not sure
__4__ disagree
__5__ strongly disagree

General Motivation Sub-Scale, 25-30

25. I like to develop new and different ways of doing things.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

26. I like the money and other benefits that an engineer has.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

27. I like to build and design things.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

28. I am willing to take hard science and math classes so that I can be an engineer.

__5__ strongly agree
__4__ agree
__3__ not sure
__2__ disagree
__1__ strongly disagree

29. If I had the ability, I would want to be an engineer.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree

30. If I could make it, through math and science classes, I would want to be an engineer.

5 strongly agree
4 agree
3 not sure
2 disagree
1 strongly disagree