ENDURING EFFECTS OF EDUCATION ON COGNITIVE SKILLS, PRESTIGE OF OCCUPATION, AND AFFECTIVE BEHAVIORS OF SELF-CONCEPT AND LOCUS OF CONTROL

by

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(ABSTRACT)

Measuring long-term effects of education has been an obvious concern for both educators and researchers. There has been a considerable body of research on effects of education on cognitive skills, prestige of occupation, self-concept, and locus of control. However, there are some limitations to previous studies, either because of short-term perspectives or because of lack of controls for earlier measures of intelligence, self-concept, or locus of control.

This study served to estimate models of the enduring effects of education on cognitive skills and its subsequent effect on prestige of occupation. In addition, the study estimated models of long-term effects of education on affective behaviors of self-concept and locus of control. Since this was a longitudinal study, it was able to examine enduring effects of education. It had the additional strength of controlling for earlier measures of intelligence, self-concept, and locus of control.

This study showed that the long-term enduring effect of education on occupational achievement was substantial. In addition, education increased cognitive skills. However, with a longer-term perspective including a prior measure of

aptitude, the effect was much less than those reported in previous studies. As far as affective behaviors of self-concept and locus of control were concerned, the enduring effects of education were nearly nonexistent.

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Chapter 1. Introduction

Introduction

Schools have an obvious concern for the cognitive effects of education. As Hyman, Wright, and Reed (1975) have pointed out, "to increase knowledge is a fundamental purpose of the entire educational enterprise" (p. 111). There have been many studies to indicate that students made substantial gains in knowledge during primary and secondary school years (Coleman, 1966; Shaycoft, 1967) and during college (Bowen, 1977; Feldman and Newcomb, 1969). It has been well known, however, that the half-life of memorized details from academic learning is short unless reenforced by frequent use. What we would like to know is "the residue left over from academic learning when the details have been forgotten" (Harnqvist, 1977, p. 64). While many studies have investigated the significant knowledge gains from short-term studies during academic years, not many studies have been conducted to measure the long-term enduring effects of education on

knowledge after students left educational institutions (Harnqvist, 1977). Harnqvist (1977) has noted that even though measuring the long-term effects of education is difficult, such research is worthwhile.

However, there is an increasing amount of research studying the long-term effects of education. The main research on long-term effects of education includes: self-reported effects by alumni (Spaeth & Greeley, 1970; Pace, 1974; Solmon, Bisconti, & Ochsner, 1977; Harnqvist, 1988), socioeconomic achievements (Blau & Duncan, 1967; Sewell & Hauser, 1975), and tests of public knowledge (Harnqvist, 1977, 1988; Hyman, Wright, & Reed, 1975).

Self-reported effects by alumni measured effects of education by asking alumni to assess the impact of college upon them. The respondents were asked to respond to questions on the extent to which college developed their knowledge. Another way of measuring effects of education was to assess the importance of education on subsequent socioeconomic achievement. Blau and Duncan's (1967) as well as Sewell and Hauser's (1975) contributions to the field showed that the most important determinant of occupational status was education.

The method of testing public knowledge was used by Harnqvist (1977) and Hyman, Wright, and Reed (1975). Harnqvist (1977) studied long-term effects of education using surveys of public knowledge among populations stratified by level of education. Basing Harnqvist's analysis on the survey of the Educational Progress, he reported that the frequency of correct answers was strongly related to the level of education.

Hyman, Wright, and Reed (1975) studied the long-term effects of education on knowledge, using a secondary analysis of responses to knowledge questions in public opinion surveys. Their data measured the ability to:

(1) correctly identify prominent public figures and major events;

(2) respond correctly to questions on vocabulary, humanities, history, government, geography, and so on ; and

(3) respond correctly to miscellaneous questions on popular culture and sports.

Basically, on almost all questions in these three areas, correct responses were closely related to the amount of schooling. The differences between college graduates and high school graduates were substantial.

Hyman, et al. (1975) were able to make conclusions on the cognitive effects of education by introducing a variety of statistical controls. They found that retention of knowledge and the propensity to seek new knowledge were directly related to the respondent's educational attainment, regardless of sex, religion, ethnicity, geographic origin, age, and socioeconomic origin, and concluded that education produced large, pervasive, and enduring effects on knowledge. However, the study's major weakness was that it did not control for intelligence or propensity to learn (Astin, 1976), which led to specification errors. Specification errors arise, for example, when education, outcome variables, and intelligence are all correlated, but intelligence is not included in the equation. As a result, the influence of education on the outcome variables will be overestimated.

In the causal analysis of effects of education, which included a model that extended and elaborated the basic Hyman, et al. causal model, Wolfle (1980a) also gave an evidence on long-term effects of education. He concluded that education increased scores on a vocabulary test, due to the indirect effect of education through adult intelligence. Different from Hyman, et al. (1975), Wolfle included an intelligence variable in the equation estimating the effect of education on vocabulary, in order to eliminate specification errors which had plagued previous analyses. In Wolfle's analysis, he expected the reduction of the measured effect of education on vocabulary. In fact, the direct effect of education on vocabulary was negligible. However, one weakness of Wolfle's study was that he used cross-sectional data from a variety of sources rather than longitudinal data from a single data source. As a result, one must consider all of Wolfle's (1980a) conclusions tentative until demonstrated in a real data set.

In an analysis of a National Assessment of Educational Progress survey (1976) data, Harnqvist (1977) showed that knowledge among adults was related to the amount of education received. Harnqvist analyzed tests which measured vocational knowledge, both general and specific, and basic skills in four areas of computation and measurement: use of graphic and reference materials, written communication, and manual perceptual skills, among a national sample of young adults (age 26-35). He reported that the number of correct answers was strongly related to the number of years of schooling. Furthermore, Harnqvist pointed out that researchers did not fully understand the determinants of enduring effects of

schooling and called for research which measures the long-term effects of education.

Harnqvist (1988) surveyed his cohort of subjects 19 years after the initial survey. He was primarily interested in measuring the influence of education on adult capabilities, while controlling for entry characteristics. His data were based on: school records, ability tests, self-reported facts about education and occupation, vocabulary used in the interviews, and self-ratings of verbal and civic skills. His data indicated that education influenced the general language component directly and also indirectly through self-directive work. It also indicated that a person's reading and writing skills were strongly influenced by educational level. Harnqvist (1988) concluded that educational level has a crucial influence on verbal and language skills. However, one flaw of this study was its use of the respondents' own subjective ratings of their own capabilities rather than direct measure of ability achievement.

Furthermore, many studies have been conducted on the relationship between education and socioeconomic status (Blau & Duncan, 1967; Sewell & Hauser, 1975). Blau and Duncan's (1967) study, which provided an assessment of the antecedent conditions of socioeconomic achievement and of the relative importance of social origins and educational level for the first job and current occupation, indicated that education played a crucial role in socioeconomic achievement. Sewell and Hauser (1975) also contributed to the literature. They principally focused on post-high school education to emphasize the central role of schooling, both directly and indirectly, in socioeconomic achievement and affirmed that

post-secondary education was the chief direct access to occcupations of higher social standing and higher income.

In addition to the cognitive effect on students and its subsequent effect on occupational achievement, education has other effects. Bowen (1977) pointed out that the goals of higher education should be to develop the whole person: affective dispositions as well as the intellect and practical competence.

One of the areas in which education influences affective behavior is self-concept (Wolfle, 1988) and locus of control (Wolfle and Robertshaw, 1982). Based on the study of changes in self-concept four years after entering college, Astin (1977) showed that college attendance increased the individual's self-concept. Similar changes have been reported by Chickering (1969).

The construct of internal-external control is a developing social learning theory thoroughly discussed by Rotter (1966). Briefly, if a person believes that an event is contingent upon his behavior, this is called belief in internal control. On the other hand, a person who perceives luck, chance, or fate to be the primary determiners of his/her fate, manifests belief in external control (Rotter, 1966).

Locus of control is fairly stable over time; however, studies showed that in some situations it can be changed. Acquisition of higher status is achieved as a result of influential events (Wolfle and Robertshaw, 1982). Those who hold internal control expectancies are those who hold educational and occupational positions which have gradually increased the internal attitude (Wolfle and Robertshaw, 1982; Harvey, 1971).

Wolfle and Robertshaw's (1982) study, which included a measure of an earlier locus of control, pointed out that the correlation between postsecondary educational attendance and locus of control was .25. However, only 20 percent of that was a direct effect of college education on locus of control, and most of the association was spurious, due to the mutual dependence of college attendance and locus of control on the pre-existing locus of control and ability.

The present study attempts to measure the long-term effects of education, while controlling for earlier measures of intelligence, self-concept, and locus of control through estimating several causal models with nonexperimental, longitudinal data. Using longitudinal data, this study provides information about enduring effects of education seven and fourteen years after the subjects left high school.

Statement of the Problem

The basic purpose of the present study is to examine the enduring effects of education on verbal and mathematical skills; its subsequent effect on occupational achievement; and affective behaviors of self-concept and locus of control, after the students left high school and as they engaged in higher education and entered the working world.

The present study attempts to measure long-term cognitive effects of education through the use of a large representative data bank. In this case, the National Longitudinal Study (NLS) of the High School Class of 1972 (Riccobono,

Henderson, Burkheimer, Place, & Levinsohn, 1981) from across the U.S. was employed. The present study first determines whether Wolfle's (1980a) recursive path model of vocabulary recognition holds up when estimated with real, representative data. In addition, it extends his previous work by examining the effects of education on mathematics skills, its subsequent effect on occupational achievement, and affective behaviors of self-concept and locus of control. Since Wolfle's (1980a) study used cross-sectional data, his results were conditional, pending confirmation by longitudinal studies of a representative sample of students and their subsequent levels of educational, intellectual, and verbal achievement.

Using cross-sectional data, he could only assess the current reciprocal effects of education. Furthermore, it was not possible to control for earlier levels of intelligence, self-concept, or locus of control. Longitudinal data, on the other hand, provides an understanding of change (history) over a long period of time. Thus, the present study overcomes the methodological limitation of using cross-sectional data by using longitudinal data with a large cohort of students in order to confirm or disconfirm Wolfle's results. This reexamination of Wolfle's (1980a) study focuses particularly on the long-term effects of education on cognitive skills, occupational achievement, and affective behaviors of self-concept and locus of control when earlier intelligence, self-concept, and locus of control are taken into account.

Significance of the Study

Cognitive outcomes of education have long been of interest to American educators, who have striven to gain insight into the factors that affected and, conversely, were affected by knowledge. There have been a host of studies to indicate evidence of cognitive outcomes of education. However, according to Harnqvist (1977), there is a demand for investigation of the long-term effects of education, even though there are many difficulties in designing research to measure them.

As Wolfle (1980a) pointed out in the study of enduring effects of education on verbal skills using NORC's general social surveys of 1974 and 1976, intelligence is a useful variable to employ in the explanation of cognitive abilities. Thus, the inclusion of intelligence in the current study helped to eliminate specification errors. Otherwise, according to Wolfle (1980a), the analysis would "lead to serious overestimates of the effects of other variables, particularly educational attainment" (p.113).

This study extends Wolfle's causal analysis of enduring effects of education on verbal skills. Estimating causal models using longitudinal data provides better understanding of the cause-effect relationship of long-term outcomes of education.

Research Questions

The primary purpose of the present study was to test causal models of the effects of education. These effects can be broadly categorized as cognitive skills, its subsequent effect on occupational achievement, and affective behaviors of self-concept and locus of control. Specifically the study was guided by the following research questions:

1. What effects do the exogenous variables of race, aptitude, sex, father's education, and father's occupation have on vocabulary and mathematics achievements, using longitudinal data with a large cohort of students?
2. What effects do the intervening variables of occupational status and high school sector have on vocabulary and mathematics achievements, using longitudinal data with a large cohort of students?
3. What effect does educational attainment have on vocabulary and mathematics achievements, using longitudinal data with a large cohort of students?
4. What effects do the exogenous variables of aptitude, sex, father's education, and father's occupation have on prestige of occupation, using longitudinal data with a large cohort of students?
5. What effects do educational attainment and high school sector have on prestige of occupation, using longitudinal data with a large cohort of students?

6. What effects do the exogenous variables of prior self-concept, race, sex, aptitude, father's education, and father's occupation have on self-concept, using longitudinal data with a large cohort of students?
7. What effects do the intervening variables of prestige of occupation and high school sector have on self-concept, using longitudinal data with a large cohort of students?
8. What effect does educational attainment have on self-concept, using longitudinal data with a large cohort of students?
9. What effects do the exogenous variables of prior locus of control, aptitude, sex, race, father's education, father's occupation have on locus of control, using longitudinal data with a large cohort of students?
10. What effects do the intervening variables of prestige of occupation and high school sector have on locus of control, using longitudinal data with a large cohort of students?
11. What effect does educational attainment have on locus of control, using longitudinal data with a large cohort of students?

Definition of Terms

Cognitive skills = "ability to manipulate words and numbers, the ability to understand written or oral instructions, and the ability to make logical inferences from written material" (Jencks, 1972, p. 52). They can be measured by standardized tests of intelligence,

verbal ability, reading comprehension, mathematical skills, and so forth.

Exogenous variable = "A variable whose variability is assumed to be determined by causes outside the causal model" (Pedhazur, 1982, p. 581).

Endogenous variable = A variable whose variability is assumed to be determined by causes inside the causal model.

Path analysis (causal modeling) = "A method for studying the direct and indirect effects of variables hypothesized as causes of variables treated as effects" (Pedhazur, 1982, p. 580).

Path coefficient = A numerical value which indicates the magnitude of the effect of one variable on another variable (Pedhazur, 1982).

Recursive model = A model in which the causal flow is unidirectional. At a given point in time a variable cannot be both a cause and an effect of another variable.

Causal model = A model in which a hypothesis is made on the cause-effect relationship among the variables being studied.

Self-concept = Self-concept is conceived as an attitude toward oneself. The attitude includes facts, opinion, and values with regard to seeing the self, as well as a favorable or unfavorable orientation toward the self (Rosenberg, 1965). The four item self-concept inventory included in the NLS is used as the self-concept measure for this study. The Likert-scale responses reflect the

respondent's agreement with a particular statement (i.e., "I take a positive attitude toward myself"). The measure of self-concept ranged from "disagree strongly" to "agree strongly". The self-concept score is determined by summing the respondent's responses to each of the four items and then calculating the mean. Scores range from 1 to 4, with higher scores indicative of greater self-concept.

Locus of control = Locus of control is generally conceptualized as whether an individual considers circumstances of well-being to be a function of his own action (internal) or of outside forces such as luck, fate, or chance (external) (McGhee and Crandall, 1968). The four item locus of control inventory included in the NLS is used as the measure for this study. The Likert-scale responses reflect the respondent's agreement with a particular statement such as "Good luck is more important than hard work for success." The measure of locus of control ranged from "agree strongly" to "disagree strongly". The locus of control score is determined by summing the respondent's responses to each of the locus of control items and then calculating the mean. Scores range from 1 to 4, with higher scores indicative of greater internal control.

Overview and Organization of the Study

Chapter 1 presents the introduction, the statement of the problem, significance of the study, and research questions which served as the basis of the investigation. In addition, key terms are defined.

In chapter 2 the pertinent related literature is reviewed.

In chapter 3 the methodology used in the study including introduction, the data, the causal model, and analytic procedure are discussed.

Chapter 4 includes testing the models and the interpretation of the results. Finally, in chapter 5 a summary of the investigation is presented followed by recommendations for further research.

Chapter 2. Review of the Literature

This chapter presents a review of literature which is relevant to the purposes of the present study. The chapter is divided into the following sections:

(1) Effects of education on cognitive skills;

(2) Effects of education on prestige of occupation; and

(3) Effects of education on self-concept and locus of control.

Effects of Education on Cognitive Skills

"Cognitive skill" is the ability to manipulate words and numbers, the ability to understand written instructions, and the ability to make logical inferences from written materials (Jencks, 1972). One study of long-term effects of education was done by Spaeth and Greeley (1970). In 1968, Spaeth and Greeley surveyed college graduates to assess the impact of college upon them. For the question on the extent to which college developed their ability to think and express themselves,

87 percent responded that their colleges actually influenced them "greatly or somewhat", and 41 percent responded that their colleges actually influenced them "greatly". For the question on the extent to which college gave them a broad knowledge of arts and sciences, 77 percent responded that their colleges influenced them "greatly or somewhat", and 35 percent responded that their colleges actually influenced them "greatly". One flaw in their study was that there was no objective criterion to compare with their self-reporting. Even though this study had the flaw of being based on subjective data instead of objective data, the results at least showed that college graduates have thought that the benefits of their education have persisted through time.

Comparing cognitive development during summer months with that observed during the school year, Heyns (1978) also found that schools played an important constructive role in fostering cognitive development, especially for disadvantaged minorities. Schooling, in effect, compensated partially for cognitive deficits in the home and community environments of disadvantaged students; thus, were it not for the school's intervention, the gap between the test scores of advantaged and disadvantaged students would be even greater.

Alexander, et al. (1985), in their study to assess the contribution of formal schooling to cognitive development, using data from the High School and Beyond Study of 1980 (HSB), compared patterns of cognitive development for graduates and dropouts over a two-year interval. Their sample subjects were tested in 1980 as sophomores and retested two years later in 1982. The test included vocabulary, mathematics, and reading, as well as science, writing, and civics. They attempted

to isolate which portion of the difference was attributable to persistence in school, as distinct from differences in the kinds of youngsters found in the two groups. Thus, the changes in cognitive performance were compared, holding statistically constant the kinds of background and performance characteristics known to differentiate students who left high school early from those who graduated.

As a result, they found that dropouts performed much more poorly on these tests than students who stayed in school: cognitive skills of students who stayed in school improved more than those of dropouts. The average difference in cognitive test performance between high school dropouts and graduates that was attributable to the effect of staying in school was about one-tenth of a standard deviation. This benefit of schooling was calculated from the sophomores' test performance, while controlling for the two important measures of prior academic adjustment and commitment. They concluded that the contributions of schooling were entirely independent of such attributes. Their results indicated that schooling played an important role in fostering cognitive growth. Jencks (1972) also indicated that if students left school early, their verbal and numerical skills did not develop as much as if they had remained in school. Jencks inferred that equalizing the amount of schooling people attain might do a lot to equalize cognitive skills.

Hyman, Wright and Reed (1975) examined the cognitive outcomes of the long-term effects of schooling, using large-scale survey data to assess the impact of formal education on performance. Their basic methodology was that persons of different ages and levels of educational attainment were polled on their know-

ledge of a wide range of facts. As a result of their study, they concluded that "education produces large, pervasive, and enduring effects on knowledge" (p.109).

In spite of the strength of the long-term study method, the principal weaknesses of their study were that the data were cross-sectional rather than longitudinal and lack of a measure of intelligence. The most serious defect of cross-sectional data was that they did not provide corrections for persons exposed to different initial levels of independent variables. For example, if educational attainment was initially measured in terms of personal attributes such as initial knowledge or potential for learning, subsequent performance on the dependent variable (later knowledge) would be affected. The analyses of educational effects that did not control for intelligence suffered severe, but unknown specification errors. Thus effects were attributed to education that should have been attributed to intelligence (Wolfle, 1980a).

Wolfle (1980a) gave evidence on long-term effects of education in a model that extended and elaborated the basic Hyman, et al. causal model. In Wolfle's (1980a) analysis of the causal model of the enduring effects of education, which included an intelligence measure to eliminate specification errors, he expected to observe a reduction of the measured effect of education on vocubulary. The path coefficient from adult intelligence to vocabulary of .80 showed that adults of greater intelligence had higher scores in language skills (Wolfle, 1980a). In fact, the estimated direct effect of education on the vocabulary test was small, with a path coefficient of .03. This means that when schooling increases by one standard deviation, the vocabulary test increases by .03 of a standard deviation. However,

the indirect effect through intelligence (.19 x .80 = .152) of education was five times the size of the direct effect, and the total effect (.03 + .152 = .182) was about one-third of the zero-order association (r = .511). Different from Hyman, et al. (1975), Wolfle's results indicated that nearly two-thirds of the zero-order association between educational level and vocabulary scores was a spurious association due to correlated exogenous variables (including intelligence), which directly and indirectly affected education and vocabulary. However, one flaw of Wolfle's study was that he used cross-sectional data from a variety of sources rather than longitudinal data from a single data source.

Wolfle (1983) studied the effects of higher education on vocabulary and mathematics achievements for blacks and whites. In the causal model, Wolfle (1983) included the independent variables of race, father's education, mother's education, father's occupational status, and vocabulary and mathematics test scores measured in high school. In the study, Wolfle (1983) focused on the differential impact of postsecondary education on vocabulary and mathematics achievements between blacks and whites. Wolfle's (1983) study showed that postsecondary educational experience tended to enhance performance in academic achievement and that the impact of college was similar for whites and blacks.

In addition, Wolfle (1987) examined the enduring effects of high school type on vocabulary and mathematics achievements. Wolfle's (1987) main interest was long-term effects of school type (public or Catholic schools) on cognitive achievement. In the study, he included the independent variables of region, race,

sex, socioeconomic status, handicap status, type of high school attended, number of semesters of mathematics completed, vocabulary and mathematics test scores measured in high school, and highest level of college education. As a result, Wolfle (1987) concluded that the total effect of Catholic schooling on vocabulary achievement was no different from the effect of public schooling. The total effect of Catholic schooling on mathematics achievement was negative.

In 1961, Harnqvist (1968) collected basic data for a ten percent sample of all Swedes born in 1948. The subjects were 13 years old and in the sixth grade of elementary schools. The information collected in 1961 were achievement scores in reading, writing, and mathematics, test scores in verbal, reasoning and spatial abilities, family background and educational plans. In 1980, Harnqvist (1988) resurveyed his subjects 19 years after the initial survey. Harnqvist (1988) intended to measure the influence of education on adult capabilities, while controlling for entry characteristics: ability test, achievement test, and school grades at the end of grade 6. His data were based on self-ratings of verbal and civic skills, self-reported facts about education and occupation, and vocabulary used in the interviews. Harnqvist (1988) found that education influenced general language skills and concluded that educational level was much more important than any other variable influencing verbal and language skills. However, one flaw of Harnqvist (1988) study was its use, as a measure of capability, of the respondents' own subjective ratings of their own capabilities.

Effects of Education on Prestige of Occupation

Prestige of occupation is the importance to society of a person's occupation. Many studies have been conducted on the relationship between education and socioeconomic status. Hauser (1977) has suggested that schooling is a part of the life-long process of stratification, which Duncan (1961) has called the socioeconomic life-cycle.

Blau and Duncan (1967), in their *The American Occupational Structure,* proposed a causal model of status attainment, using data from a 1962 national sample survey of males 20-64 years old. The model began with educational and occupational status of the father, followed by respondent's education, first job, and occupation in 1962. They estimated the dependence relationships through a series of recursive equations, which provided an assessment of the antecedent conditions of socioeconomic achievement and of the relative importance of social origins and educational level for the first job and current occupation.

In the basic model of Blau and Duncan (1967), they assumed that a father's educational and occupational status influenced respondent's educational attainment and occupational achievement. Their results found that the influence of socioeconomic background on the respondent's occupational achievement was mainly indirect by way of educational attainment. In addition, education was more influential than the first job in determining later occupational status when social background status was held constant. This study indicated that education played a crucial role in achievement of socioeconomic status. One flaw of their

study was that the data showed improper age at first job, possibly due to improperly reporting of a part-time or vacation job. The authors suggested that if they had measured "job after completing education" instead of "first job", the job variable between education and occupational status would probably have been larger. In addition, some of data included men who had not finished their schooling or taken their first jobs, resulting in a distortion of the data. When Featherman and Hauser (1978) resurveyed to correct this measurement flaw, they found a much higher effect of the first job on current occupatioanl status than the result of Blau and Duncan (1967).

Spaeth (1976), in the extension of the model of the achievement process proposed by Blau and Duncan (1967) and others (Duncan, Featherman, & Duncan, 1972; Sewell & Hauser, 1975), showed that socioeconomic status (SES) was an indicator of the cognitive complexity of an occupation. He indicated that the level of education was a measure of exposure to educational environments of increasing complexity and to increasing cognitive complexity. Parental SES also indicated the complexity of a child's cognitive environment.

Having established that educational attainment related to SES, Sewell and Hauser (1975) showed that ability contributed to educational attainment. Sewell and Hauser (1975), in a sample of Wisconsin men, taken ten years after their graduation from high school, analyzed the influences of social origins on educational attainment, occupational achievement, and earnings. They provided a rather powerful predictor of occupational status attainment. Their model, which included education, ability, mother's education, parents' income, father's occu-

pation, and father's education, showed the critical importance of ability in the determination of educational attainment. Sewell and Hauser (1975) principally focused on post-high school education to emphasize the central role of schooling, both directly and indirectly, in socioeconomic achievement and affirmed that post-secondary education was the chief direct access to occcupations of higher social standing and higher income. Ability was the second in importance for predicting socioeconomic status.

In their study of *Education, Income, and Ability,* Griliches and Mason's (1972) findings supported the economic and statistical significance of schooling as an explanation of observed differences in income. They pointed out a relatively low independent contribution of ability on income. One additional year of schooling would add 4.6 percent to income when age, father's status, region of origin, length of military service, and ability score were held constant. At the same time, a 10 percent improvement in the ability score would add only 1 percent to income. They concluded that, while the usual estimates of the contribution of education may be biased upward due to the omission of background and ability measures, that bias is smaller than the 40 percent originally suggested by Denison (1962). Thus, education does make a significant independent contribution to the explanation of income.

Effects of Education on Self-Concept and Locus of Control

An individual's education is not limited to the accumulation of academic information; neither is it limited to adherence to standards of academic achievement. The development of an individual includes development of values, self-concept, and of relations between the self and other people. This is an ongoing process that involves input and evaluation from all aspects of an individual's environment and from the individual himself.

One goal of higher education is to create and stimulate the kind of learning that fosters strength and humor and hope within a person, so that he can help to build a society that engenders pride and commands his affection (Heard, 1973).

In one large-scale study of the effects of education on values, and in addition to the effects of education on knowledge in Hyman, et al.'s (1975) earlier study, Hyman, et al. (1979) studied the effects of education on values of 80,000 white adults of all ages from 25 to 72, drawn from 38 national sample surveys conducted from 1949 to 1975. Their data came from many national samples representative of students taught in all the nation's schools and colleges over a long period. They found that adults with more education were more likely to value: civil liberties for nonconformists as well as for conformists; due process of law; freedom for dissemination of all kinds of information; social, economic, and political equality; measures to reduce suffering; morals and good conduct instead of merely good manners toward others.

Furthermore, these values were most prevalent among those who have gone to college. Hyman, et al. found the large, lasting, and diverse good effects on values (1979) and also found very large, pervasive, and enduring effects in heightening knowledge (1975). They (1979) concluded that all of these effects have combined to become an important force throughout America in molding character as well as intellect.

One of the areas in which education influences affective behavior is in self-concept and locus of control. Broadly, locus of control can be viewed as internal and external. In general, one who is self-directed and who perceives himself as the primary determiner of his own fate is said to hold internal-control expectancies (Lefcourt, 1976). One who considers circumstances of well-being to be a function of outside forces such as luck, fate, or chance is said to hold external-control expectancies (McGhee and Crandall, 1968). Self-concept, a person's evaluation of himself, can be positive or negative. Positive self-concept is highly correlated with the internal locus of control (Dickstelle, 1977).

A person's locus of control is relatively stable through time (Feather, 1967). However, studies indicated that it can be changed in certain situations. Some studies have reported apparent changes in locus of control, as measured by the Rotter-External Scale (I-E Scale) (Rotter, 1966). Feather (1967), in *Some Personality Correlates of External Control,* showed that older female students (29 to 30 years old) scored higher on internal than younger women (18 years old) and concluded that more years of experience and responsibility contributed to the

internality. Smith (1970) found that persons suffering a sudden life crisis may be driven toward external attitudes as a psychological defense.

Acquisition of higher status is one of the strong influential interventions. Harvey (1971) offered evidence of a shift in locus of control toward the internal direction and discussed its possible causes. He studied 50 upper-level government administrators and found that internality increased signigicantly with number of years in the position, indicating that the administrators' positions supplied strong reinforcement which gradually caused a shift to an internal attitude. He added that possible internalizing components of the positions included practice in decision-making and problem-solving, the opportunity to observe the results of their decisions, and a general feeling of personal importance. The feeling of personal importance was derived from an atmosphere of respect and a belief that their tasks were of significance to others.

Different environments, experiences, or social conditions could lead a person to have different personality characteristics. A person who had an increased capacity to affect his circumstances by virtue of his social standing expressed a high degree of internal control. However, it was assumed by Wolfle and Robertshaw (1982) that variations in personality characteristics led people to expose themselves to different social environments. They suggested that a person who held internal locus of control expectancies was one, who acquired the educational and occupational standing that led to his internalized locus of control.

Therefore, in their 1982 study on the effects of postsecondary education on the social psychological concept of locus of control, Wolfle and Robertshaw

(1982) controlled for earlier levels of locus of control. They tried to find the relationship between the two variables, education and locus of control, mutually dependent on common antecedent causes, particularly earlier expressions of locus of control.

In addition, Wolfle and Robertshaw (1982) introduced into their analysis two exogenous variables, ability and socioeconomic status of family of origin. These variables were added because they have been shown to influence educational attainment (Blau and Duncan, 1967; Hauser, 1973). Ability is known to influence locus of control (Crandall, Katkousky, and Preston, 1962) and socioeconomic status is also known to influence locus of control (Battle and Rotter, 1963; Franklin, 1963; Stephens and Delys, 1973; Strodtbeck, 1958). As a result, Wolfle and Robertshaw found the correlation between postsecondary attendance and locus of control was .252. However, they said that 20 percent of the correlation was a direct effect of college attendance on locus of control, and the remainder was spurious due to the mutual dependence of college attendance and locus of control on their antecedent causes, mainly earlier measures of locus of control and ability.

Some research has been done on the effects of socioeconomic achievement on personality characteristics. One of the studies was done by Featherman (1972). Featherman investigated the effects of socioeconomic achievement on personality characteristics and indicated that both work orientation and materialism increased with additional years of education.

In a study relating the impact of socioeconomic status to the development of self-concept, Sewell (1963) found that those with lower socioeconomic backgrounds were more likely to hold lower self-perceptions. Ford and Muse (1972) reported a positive correlation between self-concepts of high school students and their parents' socioeconomic status and concluded that the lower the status, the lower the students' self-concept. In the study of the effect of social-stratification on self-concept, Kohn and Schooler (1983) indicated that the higher men's social-stratification positions, the more self-confidence and the less self-deprecation they expressed.

In a study of the importance of the impact of college on self-concept, Astin (1977) discussed 57 different affective-psychological items on questionnaires on students in the Cooperative Institutional Research Program over four years (1966-1970). The study, which included students' entry characteristics and college characteristics that related to change, contained pretests and posttests of student self-ratings. The analyses of college impact on self-concept were based on the data from 25,000 students. Students compared themselves with students their own age and responded to the questions, "Rate yourself on each of the following traits as you really think you are when compared to the average person of your own age" (p. 33).

The findings showed that most students considered themselves improved in self-concept four years after entering college. The positive changes in measures of self-esteem suggested that college attendance may have increased the individual's sense of competence and self-worth (Astin, 1977). Frankel (1964) attempted

to devise a special summer program for high school students which would provide for academic learning and improvement in self-concept. Frankel (1964) found that the students gained significantly in their self-concept. Dansereau (1969) stated that community college education provided students an opportunity to structure experiences that helped them to improve self-concept.

Black (1970) compared the level of self-concept of students enrolled in a 2-year college with those enrolled in a 4-year college. He found that students in 4-year colleges had slightly higher self-concepts. Bachman, O'Mally, and Johnston (1978), however, controlled for earlier levels of the psychological constructs before attributing changes in psychological constructs to socioeconomic achievement. They examined educational attainment and self-esteem and found that educational attainment did not greatly affect self-esteem when earlier self-esteem levels were taken into consideration.

Wolfle (1988) examined the influence of postsecondary education on the development of self-esteem. Using longitudinal data, he controlled for pre-college characteristics. In the causal model, he introduced ability and socioeconomic status of the family of origin. He found that the zero-order correlation between postsecondary educational attainment and self esteem was .14, and only about half of it (.074) was a direct causal effect of the postsecondary education on self-esteem. The rest of it was spurious, due to the mutual dependence of postsecondary education and self-esteem on their antecendent causes in the model.

Despite a number of previous studies of the effects of education, we still do not know much about the effects of education and other independent variables on the outcome variables. In addition, most of the previous studies did not control for initial characteristics of intelligence, self-concept, and locus of control. Thus, we still do not know a great deal about enduring effects of education on cognitive skills, occupational achievement, and affective behaviors of self-concept and locus of control. This study attempts to investigate the enduring effects of education, while controlling for initial characteristics. Using national longitudinal data, it examines the cause-effect relationship of the long-term effects of education by extending and estimating several causal models.

Chapter 3. Methodology

Introduction

This study is an investigation of enduring effects of education on cognitive skills, its subsequent effect on occupational achievement, and affective behaviors of self-concept and locus of control. For the purpose of the study, five basic causal models are proposed. Furthermore, this study uses longitudinal data with a large cohort of students and is based on causal models, that incorporate multiple measures of young adults' characteristics and dependent variables to be tested.

The Data

Data for this study were taken from the National Longitudinal Study (NLS) of the High School Class of 1972 (Riccobono, Henderson, Burkheimer, Place, &

Levinsohn, 1981). Sponsored by the National Center for Education Statistics, the NLS was a long-term educational research program. The NLS was designed to discover what happened to young people after they left high school, as measured by their subsequent educational and vocational activities, plans, aspirations, and attitudes, and to relate this information to their prior educational experiences and to their personal histories.

The full-scale data collection began in the spring of 1972, their senior year of high school. A two-stage stratified national probability sample of 19,001 seniors from 1,061 public and private high schools from across the United States participated in the base-year survey. Each student was asked to complete a Student Questionnaire and to take a 69-minute test battery. School administrators completed information forms for each student as well as the School Questionnaire, which provided information about the school's program, resources, and grading system. In addition, school counselors were asked to complete a special questionnaire designed to provide data about their training and experience. The student questionnaire was completed by 16,683 seniors.

The first follow-up survey began in October 1973, and ended in April, 1974. Added to the base-year sample were 4,450 students of the class of 1972 from 257 additional schools that had been unable to participate earlier. Ninety-four and two-tenths percent of the sample completed the first follow-up questionnaire, with first follow-up questionnaires sent to 22,654 sample members and obtained from 21,350 sample members. The first follow-up sample retention rate among the 16,683 seniors completing the base year questionnaires was 93.7 percent.

The second follow-up survey began in October, 1974 and ended in April 1975, with forms mailed to 22,364 sample members. The second follow-up questionnaires were obtained from 20,872 sample members by mail, telephone interview, or personal interview. The response rate on this survey was 93.3 percent. Among the 21,350 persons who completed the first follow-up survey, sample retention rate for the second follow-up was 94.6 percent.

The third follow-up began in October 1976 and ended in May 1977. It resulted in a response rate of 92.1 percent. The third follow-up sample forms were mailed to 21,807 sample members, and 20,092 were obtained. The third follow-up sample retention rate for the second follow-up respondents was 93.9 percent.

The fourth follow-up survey began in October 1979 and ended in May 1980, with the fourth follow-up questionnaires mailed to 20,862 sample members and returned by 18,630 sample members. Some 5,548 sample members were requested to complete a Supplemental Questionnaire in order to collect key information concerning work and educational history that was missing from previous surveys. Additionally, a subgroup of 2,648 sample members were retested during the fourth follow-up on a subset of the base-year test battery. In the fourth follow-up sample, retention among the respondents to the third follow-up was 90.8 percent. At the conclusion of the fourth follow-up activities a total of 12,980 individuals had provided information on all questionnaires (base year and all four follow-up studies), bringing the overall response rate of the initial sample after seven years to 78 percent of the 16,683 base year respondents.

The fifth follow-up survey began October 1985 and ended September 1986. The fifth follow-up sample was an unequal probability subsample of the 22,652 students, who completed at least one of the five surveys of the NLS-72. A mail questionnaire was sent to a subsample of 14,489 members of the original sample of 22,652. A total of 12,841 completed the fifth follow-up questionnaire, and the response rate was 88.6 percent. By the time of the last survey, the sample members averaged 32 years of age and had been out of high school for fourteen years.

For this study, five subsamples were drawn from the NLS data. The first subsample consisted of the 2,037 students for whom all data on antecedent independent variables were available among the students who took vocabulary tests in 1979. The second subsample consisted of the 2,037 students for whom all data on antecedent independent variables were available among the students who took mathematics tests in 1979. The third subsample consisted of the 5,014 students for whom all data on antecedent independent variables were available among the students who responded to the questions regarding prestige of occupation in 1986. The fourth subsample consisted of the 4,802 students for whom all data on antecedent independent variables were available among the students who answered the questions on self-concept in 1986. The fifth subsample consisted of the 4,796 students for whom all data on antecedent independent variables were available among the students who answered the questions on locus of control in 1986.

For each of the five subsamples, frequencies and percentages of respondents' sex and race were calculated in order to compare each subsample with the total

sample to determine whether the subsample was representative of the total sample.

The variables used in the analysis are shown in Tables 1 and 2, including their sources and codes. For Models 1 and 2 (Figures 1 and 2), a vocabulary test and a mathematics test that were administered in 1979 were used as the dependent measures of cognitive effects of education. The vocabulary and mathematics tests were taken by approximately 2,650 members of the original NLS sample in 1979, seven years after the initial survey. The vocabulary test used a synonym format in which the items were selected to be on a level of difficulty appropriate for high school seniors. The mathematics test was based on algebraic comparisons in which the respondents determined whether one quantity was greater than, equal to, or less than a second quantity.

The respondents were told they would be penalized for guessing on the test, and the NLS corrected formula scores were used for this study. The reliability of the vocabulary test was estimated to be .81, and the reliability of mathematics test was estimated to be .85 (Heyns and Hilton, 1982). Due to some attrition for missing values on other variables included in the analysis, the final listwise sample included 2,037 students.

The following variables, hypothesized to be important in Model 1 and Model 2, were used in the analysis: aptitude, high school sector, educational attainment, and prestige of occupation. Aptitude was measured by the sum over four standardized NLS base-year test scores, each with a mean of 50 and a standard deviation of 10: vocabulary, reading, letter groups, and mathematics. This index was

Table 1. Variables Used in Regression Analyses (Base through 4th)

Variable	Variable name	Codes and Sources
School sector	SCHCNTL	1 if Catholic; 0 if public (NLS #0016)
Race	CRACE	1 if whites; 0 if blacks (NLS #1625)
Sex	CSEX	1 if males; 0 if females (NLS #1626)
Educational attainment	EDATT	Highest level of education; 1 if no coll. no voc.; 2 if no coll. some voc.; 3 if lt 2yrs coll.; 4 if gt 2yrs coll.; 5 if 4-5 yrs coll.; 6 if advanced degree (NLS #3281)
Prestige of occupation	SEIF12	Occupational status Coded with Duncan's SEI score (NLS #3277)
Aptitude	APTRAW	Aptitude score (NLS #1069)
FaEduc	CFAED	Father's education 1 if lt high sch.; 2 if high sch.; 3 if some coll.; 4 if 4 yr coll.; 5 if Masters or Ph.D. (NLS #1672)
FaSEI	SEIFAOCP	Father's socioeconomic status; Coded with Duncan's SEI score (NLS #2468)
Verbal score	VOCFOR2	Vocabulary test score; range -3.75 to 15.00 (NLS #3523)
Math score	MATHFOR2	Math score; range -7.00 to 25.00 (NLS #3524)
Self-concept, 1972	CONCPT	Self-concept score (NLS #1614)
Locus of control, 1972	LOCUS	Locus of control score (NLS #1613)

Table 2. Variables Used in Regression Analyses (5th follow-up survey)

Variable	Variable name	Codes and Sources
Educational attainment, 1986	EDATT86	Educational attainment as 1 if some high sch.; 2 if high sch.; 3 if 2 yr or more voc. sch.; 4 if some coll.; 5 if coll. graduate; 6 if Master's degree; 7 if Ph.D. or advanced degree (NLS EDATT86)
Prestige of occupation, 1986	FI7A	Occupational status Coded with Duncan's SEI score (NLS FI7A)
Self-concept, 1986	CONCPT86	Self-concept score (NLS FI115B,E,F,G)
Locus of control, 1986	LOCUS86	Locus of control score (NLS FI115A,C,D,H)

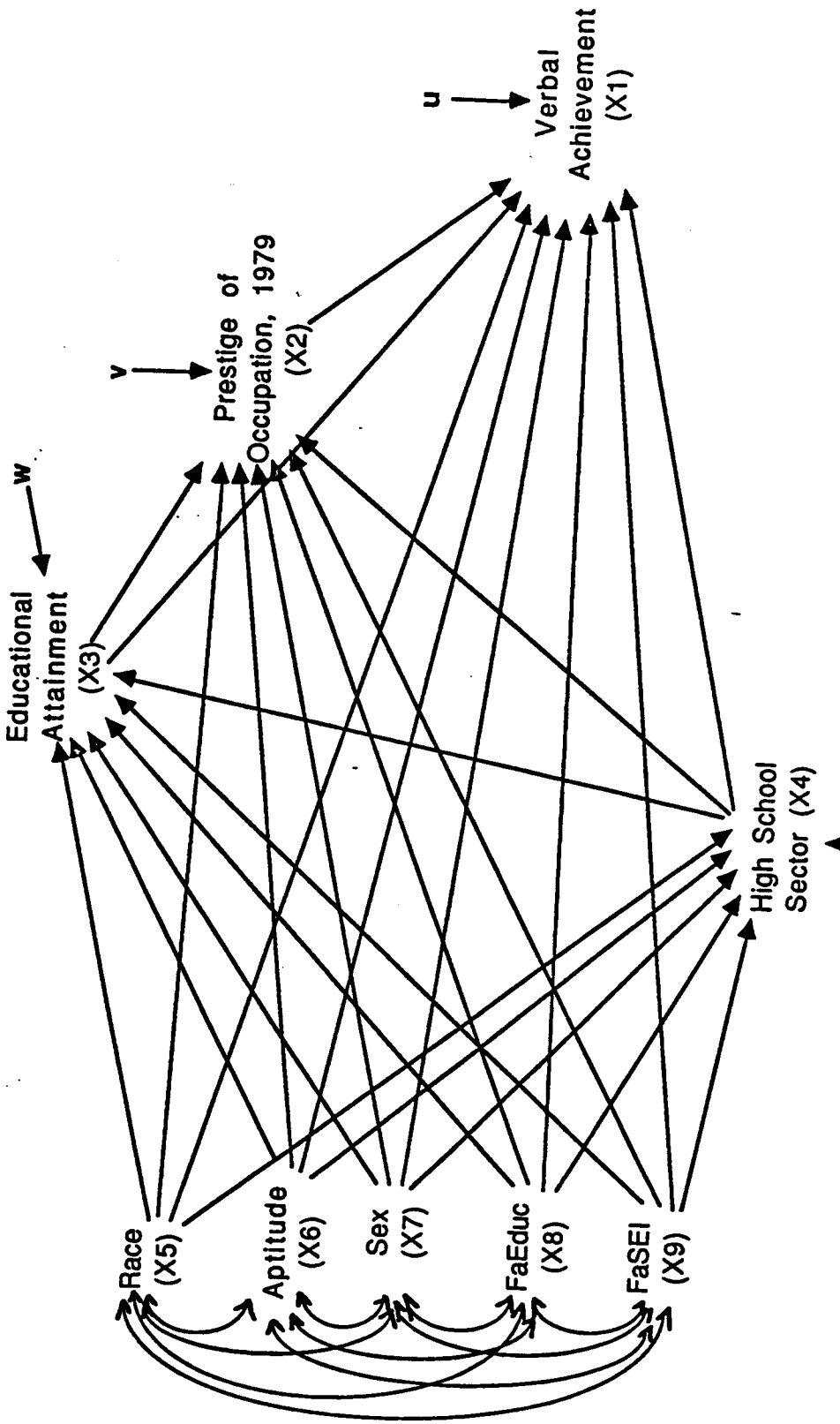

Figure 1. Recursive Path Model of Verbal Achievement, National Longitudinal Study of the High School Class of 1972

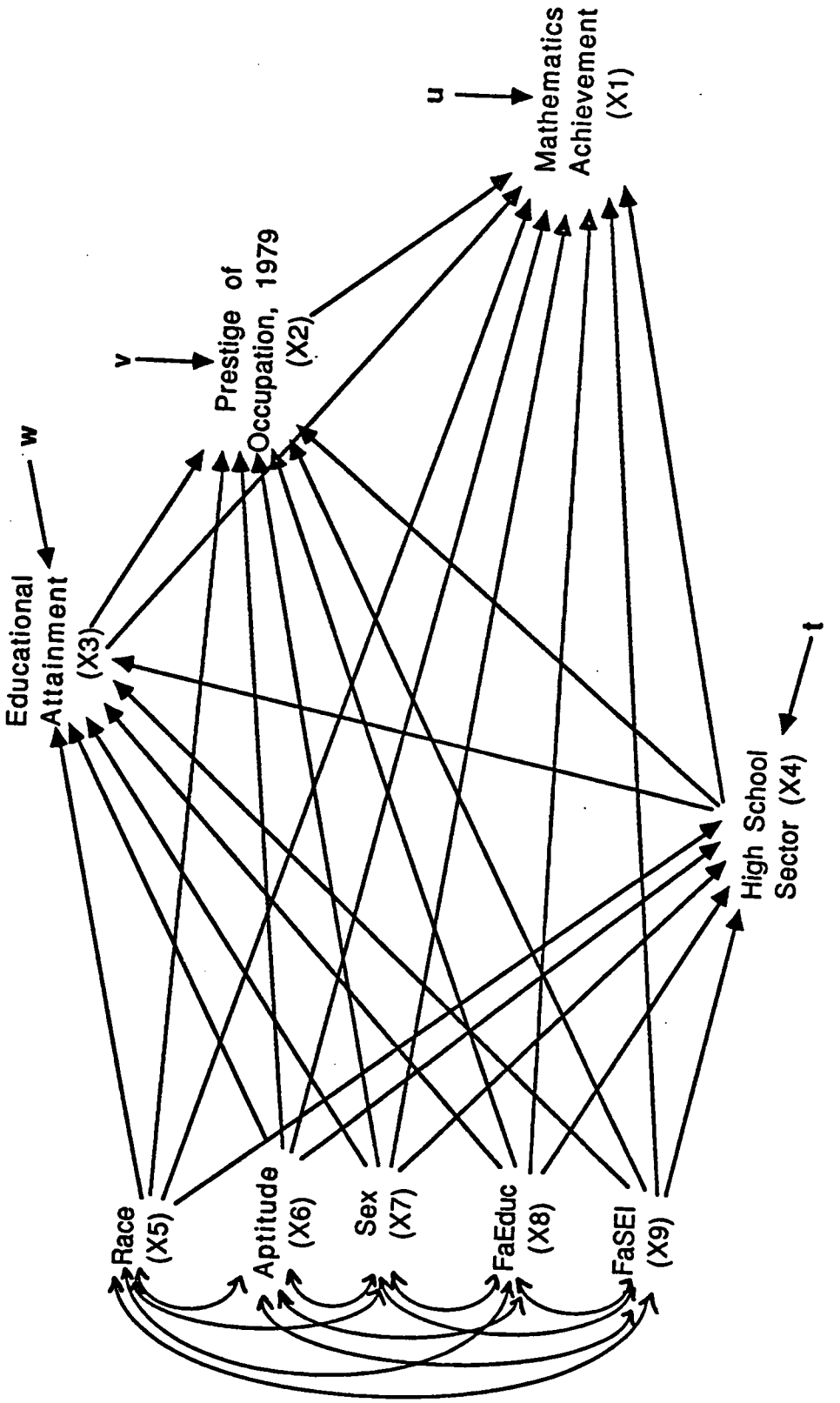

Figure 2. Recursive Path Model of Mathematics Achievement, National Longitudinal Study of the High School Class of 1972

based on a series of cognitive tests, that were developed by the Educational Testing Service and administered to subjects in the NLS Student Test book.

High school sector, educational attainment, and prestige of occupation were hypothesized to be important intervening variables which influenced vocabulary and mathematics achievements. The only private schools included in this study were Catholic schools, because of the small numbers and heterogeneity of the other private schools. High school sector was dummy coded, with Catholic schools coded 1 and public schools coded 0.

The educational attainment variable used in Model 1 and Model 2 was the composite educational attainment as of October 1979, based on the two questions: "How many years of education have you received at vocational, trade, or business schools?" and "What was your highest level of college education?" The educational scale ranged from 1 to 6, with the individual values representing

(1) No college, no vocational school

(2) No college, some vocational school

(3) Less than 2 year college

(4) Greater than 2 year college

(5) 4-5 year degree

(6) Advanced degree

The prestige of occupation used in Model 1 and Model 2 was based on the respondent's responses to the fourth follow-up questionnaires in 1979. This variable was scaled with Duncan's (1961) Socioeconomic Index (SEI), as amended

to match the Census Bureau's 1970 categorization of detailed occupations (Hauser and Featherman, 1977).

The other variables used in the Model 1 and 2 included four measures of socioeconomic background. Those variables were race, sex, father's education, and father's occupation. Since subjects were asked to indicate their race and sex on several instruments, there were multiple records of these variables. The creation of composite scores maximized the posibility of identifying the race or sex of a subject by consolidating all of the sources for background information.

The measure of race was a composite of the respondent's responses indicating race in the base year, first, and second follow-up questionnaires. Race was dummy coded, with whites coded 1 and blacks coded 0.

The measure of sex was a composite of the respondent's responses indicating sex in the base year, first, second, and fourth follow-up questionnaires. Sex was dummy coded, with males coded 1 and females coded 0.

The education of the subjects' fathers was also the composite score of fathers' education reported in the base-year and first follow-up surveys. This variable was coded:

(1) less than high school

(2) if high school

(3) if some college

(4) if 4-year college

(5) if masters or Ph. D.

Father's occupational status was obtained from the base-year survey in 1972 and from the first follow-up survey in 1973. This variable was scaled with Duncan's (1961) Socioeconomic Index (SEI), as amended to match the Census Bureau's 1970 categorization of detailed occupations (Hauser and Featherman, 1977). Duncan's SEI scores are widely accepted as a useful way to include various occupations as a continuous variable and thus usable in multiple regression.

In Model 3 (diagramed in Figure 3), prestige of occupation was used as the dependent measure of the subsequent effects of education. Prestige of occupation was assumed to be an indication of cognitive complexity of occupations, with exposure to educational complexity enabling one to have cognitively complex occupations (Spaeth, 1976).

In addition to the enduring effects of education on cognitive skills and its subsequent effects on socioeconomic attainments, education seems to produce affective behaviors of self-concept and locus of control. For Models 4 and 5 (Figures 4 and 5), the measures of self-concept and locus of control were used as the dependent measures of effects of education. The self-concept inventory used for this study consisted of four NLS items that were selected from the Rosenberg Self Esteem Scale (Rosenberg, 1965).

The four self-concept items used four choice response options, ranging from "disagree strongly" to "agree strongly". Individuals who selected "no opinion" were excluded from the analysis. The items were scored so that higher scores indicated greater self-concept. The respondents were asked to indicate the extent of their agreement with each of the following statements:

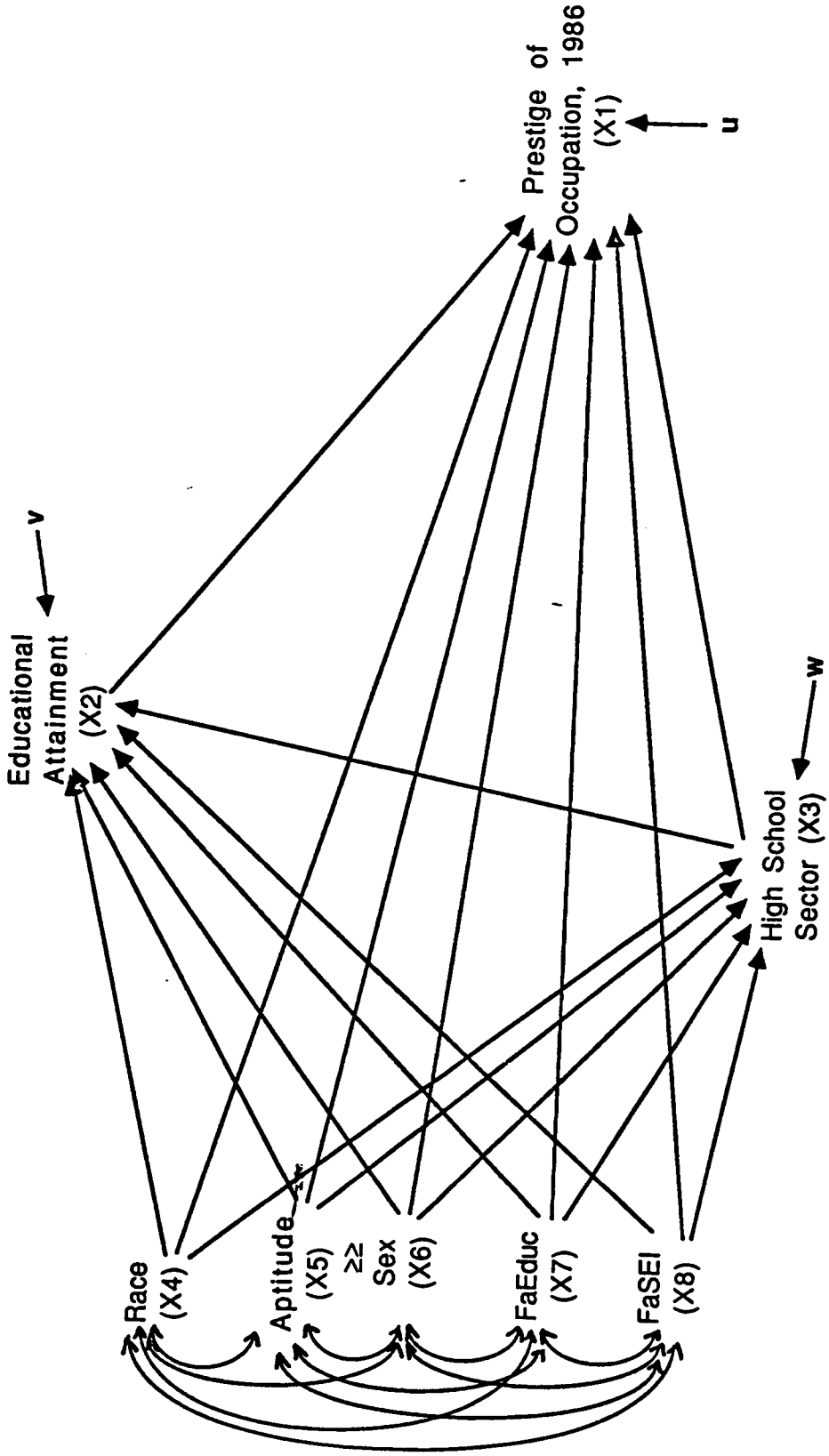

Figure 3. Recursive Path Model of Occupational Prestige, National Longitudinal Study of the High School Class of 1972

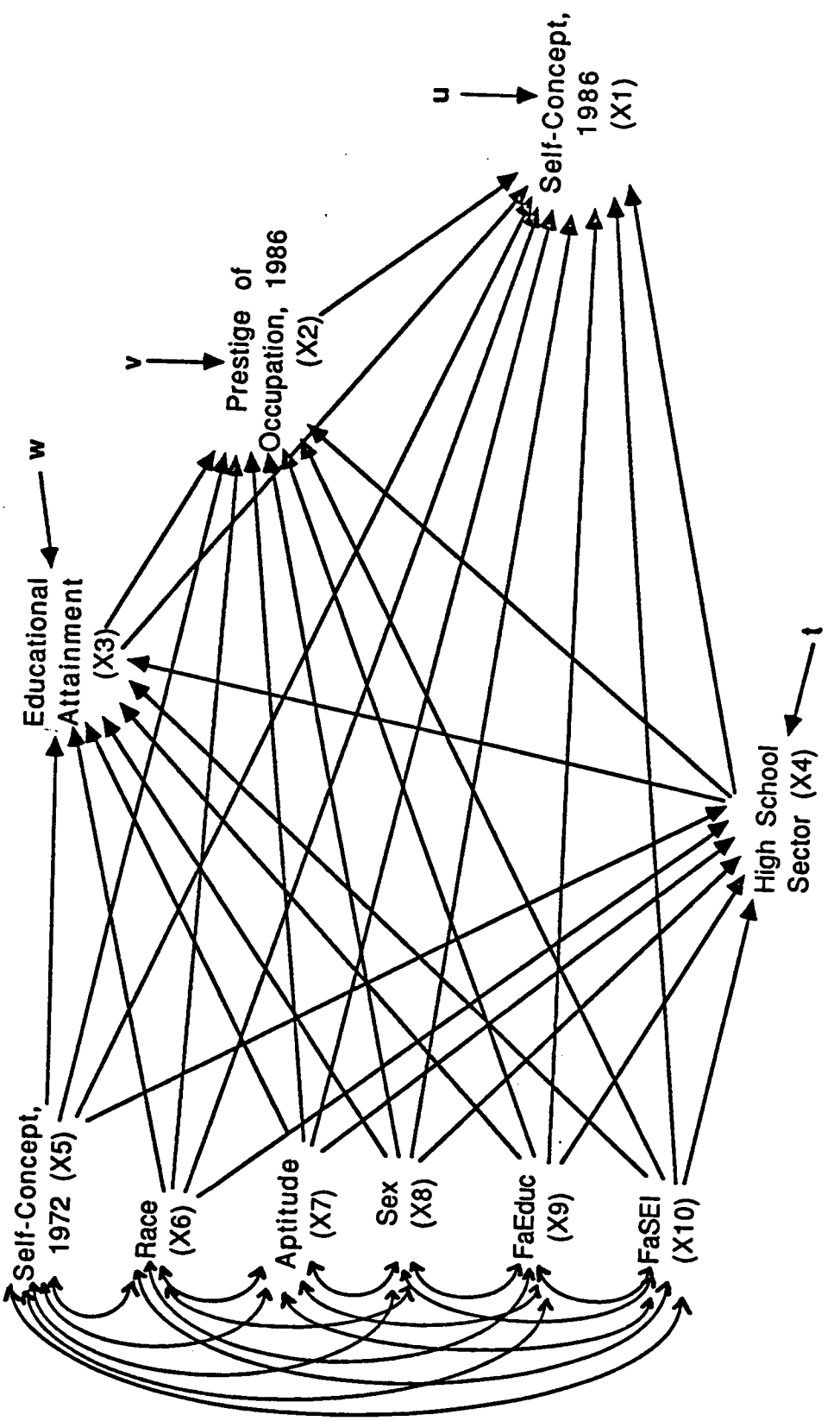

Figure 4. Recursive Path Model of Self-Concept, National Longitudinal Study of the High School Class of 1972

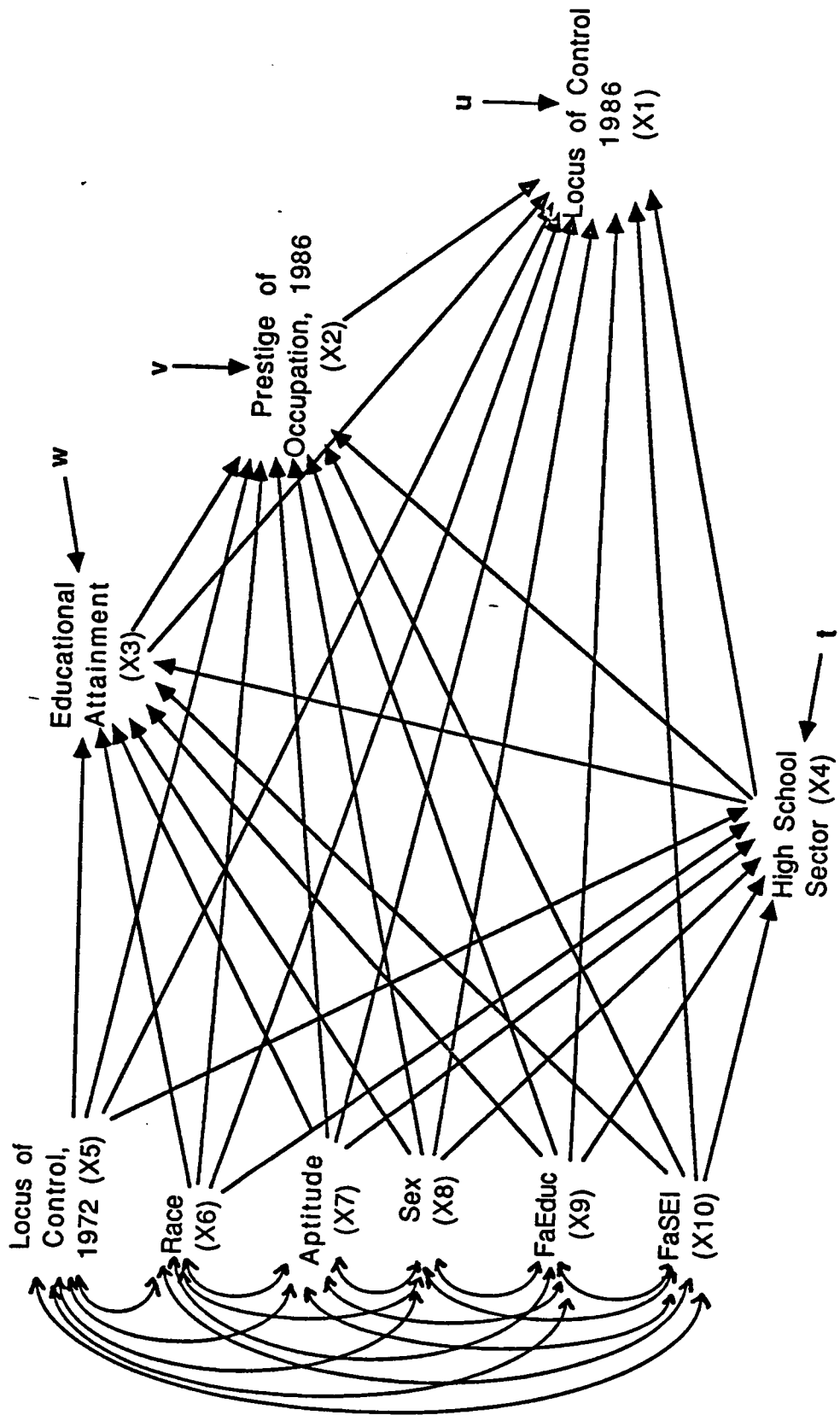

Figure 5. Recursive Path Model of Locus of Control, National Longitudinal Study of the High School Class of 1972

a. I take a positive attitude toward myself.

b. I feel I am a person of worth, on an equal plane with others.

c. I am able to do things as well as most other people.

d. On the whole, I am satisfied with myself.

The items that were used for this study were asked once during the respondents' senior year of high school in 1972 and again in 1986 in the NLS fifth follow-up survey. The internal consistency (.66) and test-retest reliability (.66) were reported by Conger, Conger, and Riccobono (1976). In Wolfle's (1988) study, the correlation between self-concept in 1972 and 1979 was estimated to be .26.

The measures of locus of control were based on a short form of Rotter's (1966) scale. Four items were selected to measure the variable, locus of control, each with four response options, ranging from "agree strongly" to "disagree strongly". Individuals who selected "no opinion" were excluded from the analysis. The items were scored so that disagreement indicated internal locus of control and received larger numeric values. Lower scores indicated an external orientation.

The respondents were asked to indicate the extent of their agreement with each of the following statements:

a. Good luck is more important than hard work for success.

b. Every time I try to get ahead, something or someone stops me.

c. Planning only makes a person unhappy, since plans hardly ever work out anyway.

d. People who accept their condition in life are happier than those who try to change things.

The measures of locus of control in this study were based on the sum of responses to the four items. The items which were used for this study were asked once during the respondents' senior year of high school in 1972 and again in 1986 in the NLS fifth follow-up survey. Conger, Conger, and Riccobono (1976) reported the internal consistency (.56) and test-retest reliability (.71). Wolfle and Robertshaw (1982) reported the correlation (.442) between locus of control measured in 1972 and again in 1979.

The other variables used in Models 4 and 5 included prestige of occupation, educational attainment, high school sector, sex, race, aptitude, father's education, and father's socioeconomic status. The important variables used in these models were earlier measures of locus of control and self-concept obtained in the base year of the survey.

The Causal Models

The primary interest in this study was the long-term effects of education on cognitive skills, prestige of occupation, and affective behaviors of self-concept and locus of control. For this purpose, simple multiple regression equations were used, and the causal order of the variables in the equations were specified to determine how the effects of antecedent variables were manifested through other

causally intervening variables. Figures 1, 2, 3, 4, and 5 depict the complete models used in this study.

The path models 1 and 2 to be tested in this study (Figures 1 and 2) proposed the performance on the vocabulary and mathematics tests administered in 1979 to be a function of race, aptitude, sex, father's education, father's socioeconomic status, educational attainment, school sector variable, and prestige of occupation. Five of these variables were exogenous, in which sources of variation lay outside the model. Those were race, aptitude, sex, father's education, father's socioeconomic status. These variables have been shown in other studies to have an impact on the vocabulary achievement (Wolfle, 1980a).

Three endogenous independent variables which were considered causally antecedent to the measures of academic achievement were educational attainment, high school sector, and prestige of occupation. These variables were hypothesized to have positive effects on achievements. In other words, a higher level of education and occupational status were expected to be associated with higher levels of vocabulary and mathematics achievement. In the case of school sector variable, students who attended Catholic schools were expected to have higher scores than students who attended public schools (Wolfle, 1987; Coleman, Hoffer, & Kilgore, 1982).

The Models in Figures 1 and 2 represent a set of four recursive regression equations:

$$x1 = p12x2 + p13x3 + p14x4 + p15x5 + p16x6 + p17x7 + p18x8 + p19x9 + u$$

$$x2 = p23x3 + p24x4 + p25x5 + p26x6 + p27x7 + p28x8 + p29x9 + v$$

$$x3 = p34x4 + p35x5 + p36x6 + p37x7 + p38x8 + p39x9 + w$$

$$x4 = p45x5 + p46x6 + p47x7 + p48x8 + p49x9 + t$$

where the pij's are standardized partial regression coefficients, called path coefficients. The xj variables represent standardized variables as labeled Figures 1 and 2. u, v, w, and t are residual factors assumed to be randomly distributed and uncorrelated with each other and with explicitly measured variables that preceded them in the Model.

The path model 3 to be tested in this study (Figure 3) proposed that prestige of occupation was a function of race, aptitude, sex, father's education, father's socioeconomic status, educational attainment, and high school sector variable. The Model in Figure 3 represents a set of three recursive regression equations:

$$x1 = p12x2 + p13x3 + p14x4 + p15x5 + p16x6 + p17x7 + p18x8 + u$$

$$x2 = p23x3 + p24x4 + p25x5 + p26x6 + p27x7 + p28x8 + v$$

$$x3 = p34x4 + p35x5 + p36x6 + p37x7 + p38x8 + w$$

Five of these variables are exogenous, in which sourses of variation lie outside the model: race, aptitude, sex, father's education, and father's socioeconomic status. These five variables were considered causally antecedent to educational attainment and to attendance at either a public or a Catholic school. Two endogenous variables were educational attainment and high school sector. Educational attainment was hypothesized to be causally prior to and predictive of prestige of occupation, after controlling for the effects of other antecedent variables.

The primary question to be tested in Models 4 and 5 (Figures 4 and 5) was whether education increased one's self-concept and locus of control. The Models in Figures 4 and 5 represent a set of four recursive regression equations:

$$x1 = p12x2 + p13x3 + p14x4 + p15x5 + p16x6 + p17x7 + p18x8 + p19x9 + p110x10 + u$$

$$x2 = p23x3 + p24x4 + p25x5 + p26x6 + p27x7 + p28x8 + p29x9 + p210x10 + v$$

$$x3 = p34x4 + p35x5 + p36x6 + p37x7 + p38x8 + p39x8 + p310x10 + w$$

$$x4 = p45x5 + p46x6 + p47x7 + p48x8 + p49x9 + p410x10 + t$$

To examine the effects of education on self-concept or locus of control, three endogenous variables of educational attainment, prestige of occupation, high school sector and six exogenous variables were introduced in the model. The six exogenous variables were: prior measure of self-concept or locus of control, aptitude, sex, race, father's education, and father's socioeconomic status. In these models, educational attainment was hypothesized to have positive effects on self-concept and locus of control.

Analytic Procedure

To examine the research questions and the related hypotheses, first, the NLS data were merged using the SAS program because the data used in this study were from four different tapes: base year through fourth follow-up surveys, fifth

follow-up surveys, test information, and school information. Then, path analyses using SPSSx and GEMINI were used to test the causal models.

The causal model shows a cause-effect ordering of variables, and the magnitude of the direct and indirect influences of each variable on the others was estimated using path analysis. Path analysis, which is the principal statistical technique used in this study, is a technique for examining interrelated variables in a causal model. Path analysis is a powerful research tool for estimating direct, indirect, and non-causal effects among variables. Causal modeling can estimate and statistically test the strengths of a priori set causal relationships under mathematical and experimental constraints. It provides a link between a priori theoretical notions of causal connections and quantitative estimates of causal impact (Wolfle, 1980b).

In this study, five recursive equation models are examined to assess the extent of intervening or spurious causal effects. The causal flow of influences between variables in the recursive model is unidirectional and have no feedback loops either directly or indirectly. Zero-order Pearson Product Moment correlation coefficients are used to define the relationships between the variables used in this study. In addition to metric regression coefficients, path coefficients, expressed as standardized regression coefficients, are estimated using a series of multiple regression equations. If it is assumed that the variables are standardized, the intercept terms are all zero and the path coefficients are the average number of standard deviations that xi changes when xj changes by one standard deviation, with the other predictor variables in the equation held constant.

Multiple regression allows the simultaneous examination of the magnitude of direct effect of one variable on another. The computer program GEMINI (Wolfle & Ethington, 1985) is used to estimate and statistically test the sum of indirect effects between two variables.

Two assumptions must be made for the beta (B), here pij, to be unbiased in the use of multiple regression (Kenny,1979). First is the assumption of independence, which means that the errors are statistically independent; in other words, the covariances of errors are zero. The other is the assumption of homoscedasticity, which means that the variance of errors is the same across all values of the predictor variable. As a result, error variance should not be related to any of the predictor variables.

The implicit assumptions of regression analysis become explicit statements of theoretical relationships in path analysis (Wolfle,1980b). Wolfle added that "the advantage of path analysis over multiple regression is not computational; the advantage lies in what is done with the computational results" (p. 184). The underlying statistical assumptions, the equations, and the interpretations of path coefficients are similar to those in least squares regression. However, in path analysis, cause-effect relationships have been specified, and thus the interpretive power is greater. One major advantage of path analysis over multiple regression is that path analysis estimates indirect causal effects through intervening variables, and also noncausal effects as well as direct causal effects.

Consider a simple recursive path diagram (Figure 6).

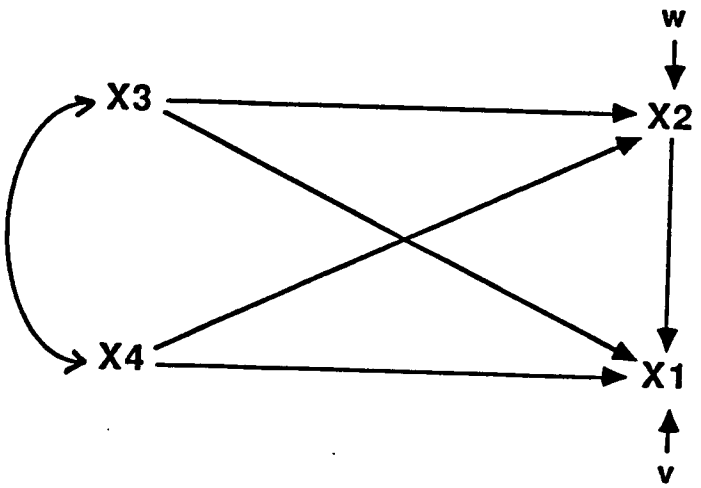

Figure 6. A Simple Recursive Path Diagram

Arrows leading from one variable to the other variable indicate causal effects. Arrows pointing to variables from outside the model, v and w, indicate the influences of error terms, i.e. effects not specified in the model. The curved line with the double arrow represents the correlation between disturbances or indicates unanalyzed relations between variables. Not only does X4 have a direct effect on X1, but it also has indirect effects on X1 through X2. It is calculated by the product of the paths p24 and p12. Furthermore, part of the association between X1 and X4 exists because X3 and X4 covary. As indicated by the bidirectional double arrow line, no causality is implied between X3 and X4. It allows no causal interpretation of the effect of X4 on X1 via X3 (called noncausal effect).

One strategy of analysis by recursive models is to obtain estimates of the extent to which intervening variables account for relationships among prior and subsequent variables (Wolfle, 1980b). The total association between the two variables may be measured by their correlation coefficient, and it may be decomposed into differently interpretable parts. One way to accomplish this is to use the fundamental theorem of path analysis (Duncan, 1966);

$$r_{ij} = \text{sigma } p_{iq} r_{jq}$$

where r denotes a correlation coefficient, and p represents a standardized regression coefficient. The i and j represent the two variables whose correlation is to be decomposed, and q runs over all variables in the model with direct paths to xi. In Figure 6, i = 1 and j = 3.

$$r13 = p12r23 + p13r33 + p14r34$$

(i= 1, j=3, q=2, 3, 4)

r23= p23r33 + p24r34

(i=2, j=3, q=3,4)

substitution yields

r13= p13 + p12p23 + p12p24r34 + p14r34

where p13 is the direct causal effect of X3 on X1, and the product of p12p23 represents the indirect causal effect of X3 on X1 through the intervening variable X2. The remaining two products are noncausal effects, since they include r34, which remains causally unanalyzed in the model.

In the multiple regresssion procedure, the F-test is used to test the hypotheses, and the t-test is used to test the significance of the individual regression coefficients. The coefficient of determination, which is the amount of variance of the dependent variable explained by the independent variables, is calculated. The residual term is the amount of variance not explained by the model, and its path is estimated by square root of one minus R square.

In this analysis, regression equations with listwise deletion and pairwise deletion of missing data are compared for each model. Under listwise deletion option, cases with missing values on any of them are eliminated. Under the pairwise deletion of missing data, a missing value for a particular variable causes that case to be eliminated from the calculations involving that variable only. But the variable would be included in other analyses for which it had necessary data. The advantage is that it includes as much of the data as possible in the computation

of each coefficient; however, the disadvantage is that it produces coefficients based on different numbers of cases (Norusis, 1983).

Chapter 4. Results

The basic purpose of the present study was to determine whether Wolfle's (1980a) recursive path model of vocabulary achievement holds up when estimated with real, representative data. In addition, the present study attempted to examine the enduring effects of education on mathematics achievement, occupational achievement, and psychological attitudes of self-concept and locus of control, after the students left high school and as they engaged in higher education and entered the working world.

The data were analyzed as they related to the research questions in each of the five models. The means, standard deviations, and number of cases for all of the variables employed in the analysis for this study are shown in Table 3. The genders of participants in this study were identified (in Table 3), with males comprising 49.6 percent (n = 11,222) and females 50.4 percent (n = 11,387), for a sample total of 22,609.

Table 3. The means, standard deviations, & number of cases for the total sample

Variables	Mean	S.D.	Number of cases
Race	.846	.361	20,278
Apt	200.250	33.722	15,860
Sex	.496	.500	22,609
FaEd	2.217	1.236	21,890
FaSEI	40.478	23.266	20,453
School	.060	.238	21,594
Educ	3.066	1.576	18,580
SEI, 1979	45.109	21.694	17,700
Voc	8.207	4.556	2,648
Math	10.263	7.460	2,648
Ed86	4.533	1.107	8,439
SEI	50.185	21.897	12,310
Locus	2.988	.547	16,497
Concpt	3.116	.485	16,485
Locus86	3.145	.478	12,197
Concpt86	3.339	.454	12,215

Table 3 also shows data related to racial identity of participants in this study. Whites comprised 84.6 percent (n = 17,159), and blacks comprised 15.4 percent (n = 3,119). For each of the five subsamples employed in each of the five models, the means and standard deviations are presented. In addition, for each model, regression coefficients, standard errors, R squares, and sample sizes are reported with both listwise and pairwise deletion of missing data.

Enduring Effects of Education on Vocabulary Achievement.

Table 4 presents means, standard deviations, and correlations for the variables used in Model 1, with listwise deletion of missing data. The genders of participants used in Model 1 were identified (in Table 4), with males comprising 54.8 percent(n = 1,116) and females 45.2 percent (n = 921), for a sample total of 2,037 (the large reduction in sample size was due to subsampling of respondents who took the tests in 1979). Table 4 also presents data related to racial identity of participants in this sample. Whites comprised 80.3 percent (n = 1,636), and blacks comprised 19.7 percent (n = 401). The correlations showed that all of the predictor variables were positively related to vocabulary skills. These positive correlations indicated that those respondents from families of higher socioeconomic status and respondents with higher aptitude scores and education tended to have higher scores on the vocabulary test. The positive correlation between vocabulary test scores, and race and sex, respectively, indicated that males and whites generally scored higher on the vocabulary test than females and

blacks, respectively. The best zero-order predictor of vocabulary achievement was aptitude scores.

The results of the regression of vocabulary achievement on aptitude, race, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and prestige of occupation are shown in Table 5. The net effect of each variable on vocabulary achievement was determined by the metric coefficients. With both listwise and pairwise deletion of missing data, the regression coefficients for the variables of race, aptitude, and level of education clearly indicated that there were significant advantages for whites, for those with higher aptitude scores, and for those with higher levels of education.

For each increment in the level of schooling, the vocabulary test scores increased an average of .326 points. This increase indicated that those students who completed a four- or five-year college scored an average of 1.304 points higher on the vocabulary test than those who only completed high school. With listwise deletion of missing data, the school sector regression coefficient of .166 (less than two-thirds of the standard error) for the vocabulary test was not significant, even at the .05 level of probability.

To test whether females, blacks, and students who attended public schools, respectively, received the same increments in vocabulary achievement in return for the level of schooling as did males, whites, and students who attended Catholic schools, respectively, three interaction terms (between educational attainment, and sex, race, and school type, respectively) were added to the regression equation. These interactions were not significant.

Table 4. The means, standard deviations, & correlations used in Model 1

	Race	Apt	Sex	FaEd	FaSE	Sch	Educ	SE12	Voc
Race	1.0								
Apt	.453	1.0							
Sex	.060	-.003	1.0						
FaEd	.246	.333	.015	1.0					
FaSE	.273	.315	.012	.575	1.0				
Sch	.095	.133	.013	.006	.024	1.0			
Educ	.057	.476	.011	.342	.285	.066	1.0		
SE12	.109	.336	-.144	.213	.229	.048	.450	1.0	
Voc	.378	.757	.002	.331	.284	.110	.451	.301	1.0
Mean	.803	199.817	.548	2.225	39.824	.064	3.001	43.296	8.546
S.D.	.398	33.464	.498	1.192	23.131	.245	1.531	21.938	4.483

Table 5. Metric regression coefficients for model 1

	Listwise		Pairwise	
Variable	b	SE	b	SE
Intercept	-11.055*	.406	-11.839*	.373
Race	.680*	.188	1.406*	.185
Apt	.088*	.003	.087*	.002
Sex	.002	.130	-.054	.120
FaEd	.237*	.068	.148	.062
FaSE	-.002	.003	.002	.003
Sch	.166	.262	.239	.251
Educ	.326*	.053	.285*	.049
SE12	.003	.003	.002	.003
R square	.591		.602	
n	2,037		2,372	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

The coefficient of determination for the vocabulary test increased from .59809 to .59818 with the addition of interaction terms. Thus, females, blacks, and students who attended public schools, respectively, received the same increments in vocabulary achievement as a result of increases in years of schooling as did males, whites, and Catholic school students, respectively.

Tables 6, 7, and 8 show the direct, indirect, and total path coefficients of independent variables on vocabulary achievement. Figure 7 shows the direct path coefficients used in the model for vocabulary achievement. All of the exogeneous variables of race, aptitude, sex, father's education, and father's socioeconomic status were expected to have strong effects on vocabulary achievement. Coeffcients whose absolute values exceeded 2.57 times their standard errors were asterisked to indicate statistical significance at the .01 level of probability.

Table 6. The matrix of standardized direct effects for Model 1

To:	Voc	SE12	Educ	Sch
From:				
Voc	.0000	.0000	.0000	.0000
SE12	.0132	.0000	.0000	.0000
Educ	.1113*	.3676*	.0000	.0000
Sch	.0093	.0051	.0197	.0000
FaSE	-.0095	.0843*	.0874*	-.0025
FaEd	.0632*	-.0056	.1862*	-.0472
Sex	.0000	-.1497*	.0227	.0112
Apt	.6528*	.1274*	.4921*	.1274*
Race	.0607*	.0172	-.2388*	.0489

* indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 7. The matrix of standardized indirect effects for Model 1

To:	Voc	SE12	Educ	Sch
From:				
Voc	.0000	.0000	.0000	.0000
SE12	.0000	.0000	.0000	.0000
Educ	.0049	.0000	.0000	.0000
Sch	.0024	.0073	.0000	.0000
FaSE	.0112*	.0321*	.0000	.0000
FaEd	.0210*	.0678*	-.0009	.0000
Sex	.0008	.0085	.0002	.0000
Apt	.0604*	.1825*	.0025	.0000
Race	-.0270*	-.0872*	.0010	.0000

* indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 8. The matrix of standardized total causal effects for Model 1

To:	Voc	SE12	Educ	Sch
From:				
Voc	.0000	.0000	.0000	.0000
SE12	.0132	.0000	.0000	.0000
Educ	.1162	.3676	.0000	.0000
Sch	.0117	.0124	.0197	.0000
FaSE	.0017	.1164	.0873	-.0025
FaEd	.0842	.0622	.1852	-.0472
Sex	.0008	-.1412	.0229	.0112
Apt	.7131	.3099	.4946	.1274
Race	.0337	-.0700	-.2379	.0489

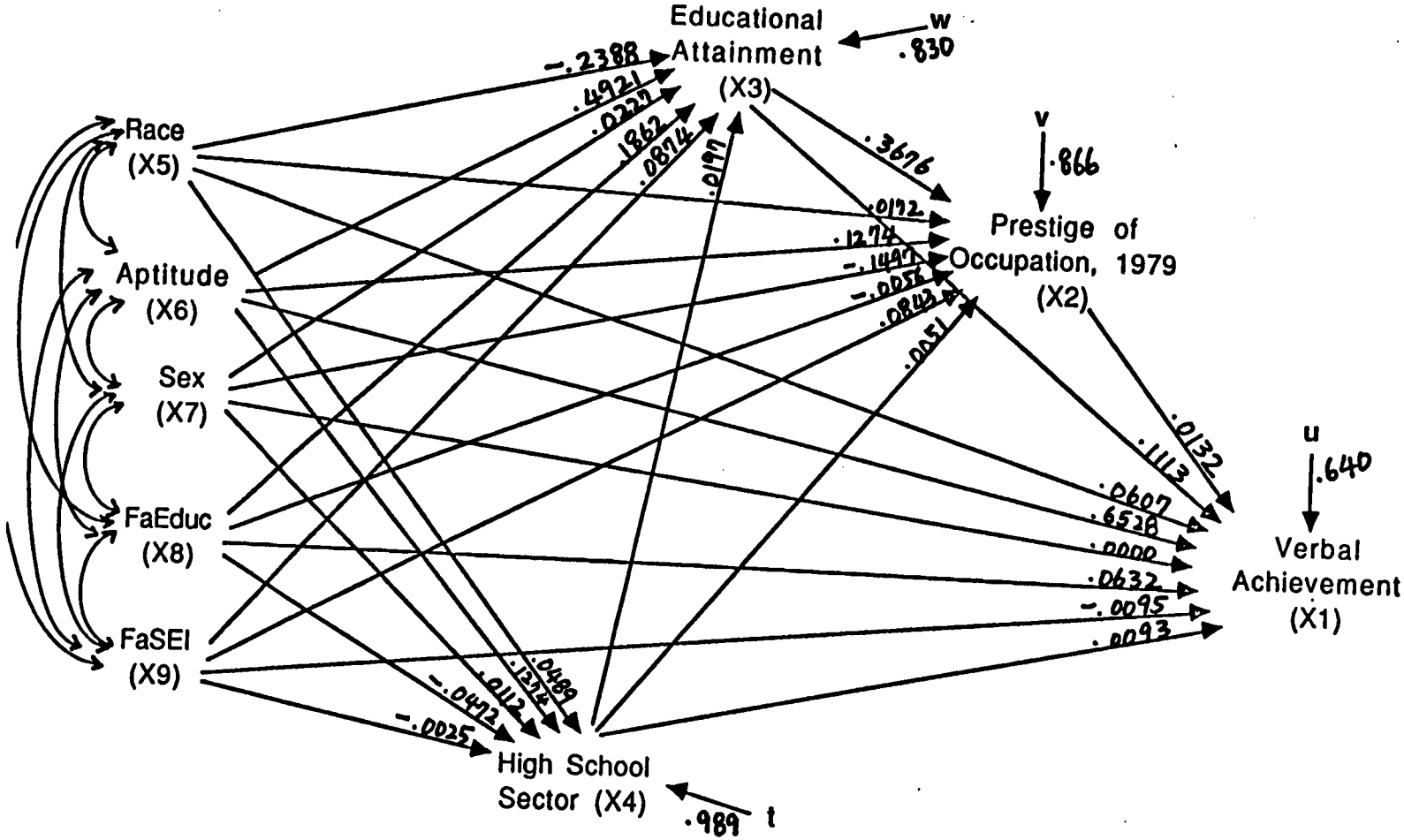

Figure 7. Recursive Path Model of Verbal Achievement, National Longitudinal Study of the High School Class of 1972

The direct effects of the exogenous variables are shown in Table 6. Aptitude had the strongest direct effect on vocabulary scores (beta = .6528). The higher the aptitude score, the higher the respondent's vocabulary achievement. Most of the total association (r = .7570) between aptitude and vocabulary scores was due to the direct effect. A relatively small amount of association was due to indirect effects (.0604) through the intervening variables (including educational attainment) between aptitude and vocabulary achievement, which was significant at the .01 level of probability. Most of the indirect effect was through educational attainment (.1113 x .4921 = .0548), suggesting that people with higher aptitude scores have had more education, which led in turn, to higher vocabulary achievement. The result suggested that, not surprisingly, aptitude was the most important variable affecting vocabulary achievement, both directly and indirectly.

The second most important direct effect on vocabulary achievement was educational attainment (beta = .1113). The sign of the standardized path coefficient indicated a positive relationship between educational attainment and vocabulary achievement. The zero-order correlation coefficient between education and vocabulary scores was .451. The indirect effect of education through prestige of occupation was .0049. The sum of the direct and indirect effects (.1113 + .0049 = .1162) was about one-quarter of the zero-order correlation coefficient, indicating that a large portion of the zero-order association between education and vocabulary achievement was a spurious association. The spurious

association was due to correlated exogenous variables (including aptitude), which directly and indirectly affected both education and vocabulary achievement.

The present study, which included the aptitude variable in the equation, confirmed the results of Wolfle's (1980a) result of the enduring effect of education on vocabulary achievement. However, using longitudinal data, instead of cross-sectional data as in Wolfle's (1980a) study, this study found a smaller zero-order correlation coefficient between education and vocabulary achievement ($r = .451$), and a smaller total causal effect. The present study indicated that nearly three-quarters of the zero-order association was a spurious association. This result suggests that when longer-term effects of education on vocabulary achievement are considered, while controlling for an aptitude score and using real representative longitudinal data, the total causal effect of education was not as strong as the results of Wolfle's (1980a) and other previous studies.

The third most influential significant variable on vocabulary achievement was father's education (beta = .0632). The zero-order correlation coefficient between father's education and vocabulary achievement was .331. This result suggested that people whose fathers had higher education probably learned more vocabulary in the home environment. The indirect effect of father's education through other intervening variables was .0210, which was significant at the .01 level of probability. The indirect effect through education (.0207) was the greatest, suggesting that the indirect effect of father's education was largely through respondent's own education and its subsequent effect on vocabulary achievement. The sum of direct and indirect causal effects ($.0632 + .0210 = .0842$) was a little

over one-quarter of the total association. Nearly three-quarters of the zero-order association between father's education and vocabulary achievement consisted of unanalyzed associations. These unanalyzed associations were mainly due to the fact that father's education was correlated with father's occupation as well as with aptitude, for reasons unanalyzed in this model.

The fourth most influential variable on vocabulary achievement was race. The positive direct effect indicated that whites were more likely to obtain higher vocabulary scores than blacks. The zero-order correlation coefficient between race and vocabulary achievement was .378. The direct effect of race on vocabulary achievement was .0607, which was significant at the .01 level of probability. The indirect effect of race on vocabulary achievement was -.0270, which was also significant at the .01 level of probability. The largest indirect effect was through education (-.2388 x .1113 = -.0266). Of the total zero-order correlation coefficient (r = .378), only 9 percent (beta = .0337) was due to the total causal effects. The remaining portion of the zero-order association was joint association mainly due to the fact that race was correlated with aptitude, father's education, and father's occupation, for reasons unanalyzed in this model.

Sex was coded 1 for males and 0 for females. The direct effect of sex on vocabulary achievement was .000. The indirect effect through education and prestige of occupation was .0008, which was 40 percent of the total association (r = .002) between sex and vocabulary achievement. The other 60 percent of the total association was noncausal components of the correlation. Neither the direct nor the indirect effect of sex had a significant effect on vocabulary achievement. This

result indicated that an individual's sex did not significantly affect vocabulary achievement.

High school sector was expected to have a positive effect on vocabulary achievement. The zero-order correlation coefficient between high school sector and vocabulary achievement was .110. However, the standardized regression coefficient was only .0093, which was not significant at the .05 level of probability. The indirect effect of high school sector through education and prestige of occupation was .0024. The greatest indirect effect was through education (.0197 x .1113 = .0022). Since the total effect (.0093 + .0024 = .0117) was slightly over one-tenth of the total association, almost nine-tenths of the total association was a spurious association due to correlated exogenous variables (including aptitude), which affected both school sector and vocabulary achievement. Neither the direct nor the indirect effect of high school sector had a significant effect on vocabulary achievement. This result indicated that whether persons attended public schools or Catholic schools did not affect vocabulary achievement seven years after finishing high school.

Occupational status was expected to have a positive effect on vocabulary achievement. The zero-order correlation coefficient between occupational status and vocabulary achievement was .301. However, the estimated direct effect of occupational status on vocabulary was only .0132 (4 percent of the zero-order correlation coefficient), which was not significant at the .05 level of probability. The path coefficient of .0132 indicated that one additional standard deviation of occupational status resulted in an increase of .0132 standard deviation on the

vocabulary achievement. The spurious association (.2878), accounting for 96 percent of the total association was due to correlated exogenous variables which affected both occupational and vocabulary achievements.

Father's socioeconomic status was expected to have a positive effect upon vocabulary achievement. However, the direct path coefficient of -.0095 was implausibly negative and was not significant at the .05 level of probability. However, the indirect effect of father's socioeconomic status on vocabulary achievement (beta = .0112) was significant at the .01 level of probability, and was about 4 percent of the total association (r = .284) between father's socioeconomic status and vocabulary achievement. The indirect effect of father's socioeconomic status through the respondent's education was the greatest indirect effect, suggesting that the influence of father's socioeconomic status occurred largely through the respondent's own education and its subsequent effect on vocabulary achievement. Most of the portion of the zero-order association was joint association, due to the fact that father's socioeconomic status was correlated with the other exogenous variables, particularly with father's educaion, for reasons unanalyzed in this model.

Enduring Effects of Education on Mathematics Achievement

The means, standard deviations, and correlations used in Model 2 are presented in Table 9, with listwise deletion of missing data. The genders of participants used in Model 2 were identified (in Table 9), with males comprising 54.8

percent (n = 1,116) and females 45.2 percent (n = 921), for a sample total of 2,037. Table 9 also presents data related to racial identity of participants in this sample. Whites comprised 80.3 percent (n = 1,636), and blacks comprised 19.7 percent (n = 401). The correlations showed that all of the predictor variables were positively related to mathematics achievement. These positive correlations indicated that whites, males, those respondents who had higher socioeconomic status, higher aptitude scores, and higher education, tended to have higher scores on the mathematics test. The best zero-order predictor of mathematics achievement was aptitude scores (r = .759) followed by education (r = .496).

The results of the regression of mathematics achievement on aptitude, race, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and prestige of occupation are presented in Table 10. With listwise deletion of missing data, the regression coefficients for the variables of sex, aptitude score, educational attainment, and occupational status clearly showed that there were significant advantages for males, for those with higher aptitude scores, for those with higher level of education, and for those with higher occupational status.

Table 9. The means, standard deviations, & correlations used in Model 2

	Race	Apt	Sex	FaEd	FaSE	Sch	Educ	SE12	Math
Race	1.0								
Apt	.453	1.0							
Sex	.060	-.003	1.0						
FaEd	.246	.333	.015	1.0					
FaSE	.273	.315	.012	.575	1.0				
Sch	.095	.133	.013	.006	.024	1.0			
Educ	.057	.476	.011	.342	.285	.066	1.0		
SE12	.109	.336	-.144	.213	.229	.048	.450	1.0	
Math	.342	.759	.198	.306	.265	.058	.496	.308	1.0
Mean	.803	199.817	.548	2.225	39.824	.064	3.001	43.296	10.74
S.D.	.398	33.464	.498	1.192	23.131	.245	1.531	21.938	7.396

Table 10. Metric regression coefficients for Model 2

Variable	Listwise b	SE	pairwise b	SE
Intercept	-23.557*	.626	-24.044*	.577
Race	.340	.289	1.272*	.286
Apt	.148*	.004	.145*	.004
Sex	3.035*	.200	2.950*	.186
FaEd	.160	.104	.009	.095
FaSE	-.007	.005	.002	.005
Sch	-1.422*	.404	-.976	.388
Educ	.755*	.082	.667*	.075
SE12	.014*	.005	.012	.005
R square	.64382		.64390	
n	2,037		2,372	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

To test whether females, blacks, and students who attended public schools, respectively, received the same increments in mathematics achievement in return for the level of schooling as did males, whites, and students who attended Catholic schools, respectively, three interaction terms (between educational attainment, and sex, race, and school type, respectively) were added to the regression equation. These interactions were not significant. The coefficient of determination for the mathematics test increased from .64822 to .64960 with the addition of interaction terms. Thus, females, blacks, and students who attended public schools, respectively, received the same increments in mathematics achievement as a result of increases in years of schooling as did males, whites, and Catholic school students, respectively.

Tables 11, 12, and 13 show the direct, indirect, and total path coefficients of independent variables on mathematics achievement. Figure 8 shows the direct path coefficients in the model for mathematics achievement. Aptitude had the strongest direct effect on mathematics scores. This positive effect (beta = .6670) indicated that the higher one's aptitude score, the more likely one was to obtain higher mathematics achievement. Most of the total association (r = .759) between aptitude and mathematics achievement was due to the direct effect (beta = .667). A relatively small amount of the total association was due to indirect effects (.0844) through the intervening variables of prestige of occupation, educational attainment, and high school sector.

Table 11. The matrix of standardized direct effects for Model 2

To:	Math	SE12	Educ	Sch
From:				
Math	.0000	.0000	.0000	.0000
SE12	.0424*	.0000	.0000	.0000
Educ	.1562*	.3676*	.0000	.0000
Sch	-.0471*	.0051	.0197	.0000
FaSE	-.0205	.0843*	.0874*	-.0025
FaEd	.0261	-.0056	.1862*	-.0472
Sex	.2038*	-.1497*	.0227	.0112
Apt	.6670*	.1274*	.4921*	.1274*
Race	.0177	.0172	-.2388*	.0489

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 12. The matrix of standardized indirect effects for Model 2

To:	Math	SE12	Educ	Sch
From				
Math	.0000	.0000	.0000	.0000
SE12	.0000	.0000	.0000	.0000
Educ	.0156*	.0000	.0000	.0000
Sch	.0036	.0073	.0000	.0000
FaSE	.0187*	.0321*	.0000	.0000
FaEd	.0338*	.0678*	-.0009	.0000
Sex	-.0029	.0085	.0002	.0000
Apt	.0844*	.1825*	.0025	.0000
Race	-.0424*	-.0872*	.0010	.0000

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 13. The matrix of standardized total causal effects for Model 2

To:	Math	SE12	Educ	Sch
From				
Math	.0000	.0000	.0000	.0000
SE12	.0424	.0000	.0000	.0000
Educ	.1718	.3676	.0000	.0000
Sch	-.0434	.0124	.0197	.0000
FaSE	-.0018	.1164	.0873	-.0025
FaEd	.0599	.0622	.1852	-.0472
Sex	.2009	-.1412	.0229	.0112
Apt	.7514	.3099	.4946	.1274
Race	-.0247	-.0700	-.2379	.0489

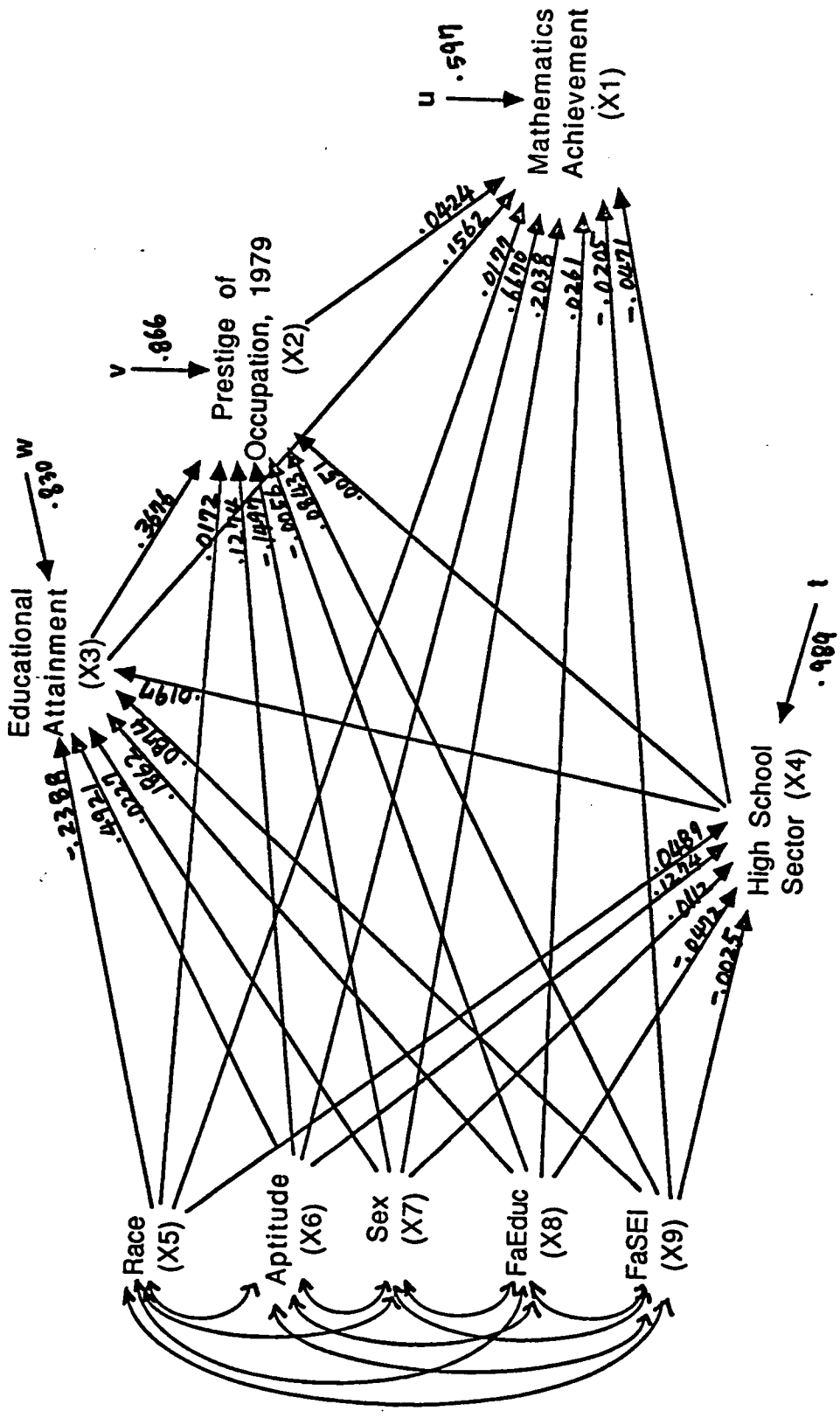

Figure 8. Recursive Path Model of Mathematics Achievement, National Longitudinal Study of the High School Class of 1972

Of those, the largest indirect effect was through educational attainment (.4921 x .1562 = .077), indicating that people with higher aptitude scores have had more education, which led in turn, to higher mathematics achievement. The result suggested that, not surprisingly, aptitude was the most important variable affecting mathematics achievement, both directly and indirectly through education.

The second most important direct effect on mathematics achievement was sex (beta = .2038). The sign of the path coefficient indicated a positive relationship between sex and mathematics scores. This result suggested that males had higher mathematics achievement than females.

The third most influential variable on mathematics achievement was education. The path coefficient of educational attainment (beta = .1562) indicated that education had a positive significant effect on mathematics achievement. According to the metric regression coefficient, for each additional unit in the level of schooling, the mathematics score increased by .755. This increase means that students who completed a four- or five-year college scored an average of 3.02 points higher on the mathematics test than those who only completed high school. The zero-order correlation coefficient between education and mathematics achievement was .496. The indirect effect of education through prestige of occupation was .0156, which was significant at the .01 level of probability. The sum of the direct and indirect causal effects (.1562 + .0156 = .1718) was a little over one-third of the total association. Nearly two-thirds of the zero-order association between education and mathematics achievement was a spurious association due to correlated exogenous variables (including aptitude), which directly and indi-

rectly affected both education and mathematics achievement. The result indicated that education played an important enduring role on mathematics achievement. However, different from Hyman, et al.'s (1975), the present study, which included an aptitude variable in the equation, suggested that much of the total association of education with mathematics achievement was due to a spurious association.

The fourth most influential variable on mathematics achievement was high school sector (beta = -.0471), which was significant at the .01 level of probability. The negative direct effect indicated that students who attended public schools were more likely obtain higher mathematics scores. This result suggested that when long-term effects were considered and when aptitude scores were controlled, Catholic school students did worse in mathematics achievement. The total association (r = .058) between high school sector and mathematics was due to direct effect (beta = -.0471), indirect effects (beta = .0036), and unanalyzed joint association (.1015). The unanalyzed joint association was a spurious association due to correlated exogenous variables (including aptitude), which affected both high school sector and mathematics achievement.

The fifth most influential variable on mathematics achievement was prestige of occupation (beta = .0424), which was significant at the .01 level of probability. The positive path coefficient indicated that the more prestigious an occupation one obtained, the more likely one was to have higher scores in mathematics. Of the total zero-order association (r = .3080) between prestige of occupation and mathematics achievement, 14 percent was due to a direct causal effect and nearly

86 percent was unanalyzed joint associations. This result suggested that a large portion of the total association of prestige of occupation with mathematics achievement was a spurious association due to correlated exogenous variables, which affected both occupational and mathematics achievements.

The zero-order correlation coefficient between race and mathematics achievement was .342. The direct effect of race on mathematics achievement was .0177, which was not significant at the .05 level of probability. The indirect effect of race on mathematics achievement was -.0424, which was significant at the .01 level of probability. The greatest indirect effect was through education (-.2388 x .1562 = -.0373), suggesting that the primary process linking mathematics achievement to race was one that reflected differential educational attainment and its subsequent effects on mathematics achievement.

The zero-order correlation coefficient between father's education and mathematics achievement was .306. The direct effect of father's education on mathematics achievement was .0261, which was not significant at the .05 level of probability. The indirect effect of father's education on mathematics achievement was .0338. The indirect effect was 1.3 times its direct effect and significant at the .01 level of probability. The greatest indirect effect was through education (.1862 x .1562 = .029). This result suggested that the influence of father's education occurred largely through the respondent's own education, which subsequently affected mathematics achievement. Of the total association (r = .306) between father's education and mathematics achievement, 8.5 percent was due to direct effect, 11 percent was due to indirect effect, and about 80 percent was

due to noncausal components of the correlation. Most of the portion of the noncausal components was due to the fact that father's education was correlated with the other exogenous variables, particularly with father's socioeconomic status, for reasons unanalyzed in this model.

The zero-order correlation coefficient between father's socioeconomic status and mathematics achievement was .265. The direct effect of father's socioeconomic status on mathematics achievement was implausibly negative (beta = -.0205). However, it was also negligibly small, and was not significant at the .05 level of probability. The indirect effect of father's socioeconomic status on mathematics achievement was .0187, which was significant at the .01 level of probability. The greatest indirect effect was through education (.0874 x .1562 = .0137), suggesting that the indirect influence of father's socioeconomic status occurred largely through the respondent's education, which subsequently affected mathematics achievement. Most of the portion of the zero-order association was joint associations, due to the fact that father's socioeconomic status was correlated with the other exogenous variables, particularly with father's educaion, for reasons unanalyzed in this model.

Enduring Effects of Education on Prestige of Occupation

Tables 14 and 15 present means, standard deviations, and correlations for the variables used to analyze the enduring effects of education on prestige of occupation, with listwise deletion of missing data. The genders of participants used

in Model 3 were identified (in Tables 14 and 15), with males comprising 48.2 percent (n = 2,416) and females 51.8 percent (n = 2,598), for a sample total of 5,014. Table 14 and Table 15 also present data related to racial identity of participants in this sample. Whites comprised 91.1 percent (n = 4,566), and blacks comprised 8.9 percent (n = 448). The correlations shown in Table 14 are for males only, and show that all of the predictor variables are positively related to prestige of occupation. These positive correlations indicated that whites, respondents from families of higher socioeconomic status, and respondents with higher aptitude scores and education tended to have more prestigious occupations. The best zero-order predictor of occupation among males was educational attainment (r = .541).

Table 15 presents means, standard deviations, and correlations for the variables used to analyze the enduring effect of education on prestige of occupation among females, with listwise deletion of missing data. The correlations showed that all of the predictor variables were positively related to prestige of occupation. These positive correlations indicated that whites, respondents from families of higher socioeconomic status, and respondents with higher aptitude scores and education tended to have more prestigious occupations.

Table 14. The means, standard deviations, & correlations used in Model 3(males)

	Race	Apt	FaEd	FaSE	Sch	Ed86	SEI
Race	1.0						
Apt	.357	1.0					
FaEd	.186	.298	1.0				
FaSEI	.220	.263	.599	1.0			
Sch	.074	.108	.051	.057	1.0		
Ed86	.090	.468	.288	.249	.098	1.0	
SEI	.107	.346	.171	.214	.074	.541	1.0
Means	.935	217.793	2.682	47.304	.095	4.677	56.204
S.D.	.247	29.303	1.303	23.427	.294	1.139	22.207

Table 15. The means, standard deviations, & correlations used in model 3(females)

	Race	Apt	FaEd	FaSE	Sch	Ed86	SEI
Race	1.0						
Apt	.448	1.0					
FaEd	.244	.325	1.0				
FaSEI	.257	.279	.623	1.0			
Sch	.082	.087	-.012	.004	1.0		
Ed86	.092	.442	.290	.207	.045	1.0	
SEI	.061	.271	.178	.134	.032	.410	1.0
Means	.888	216.803	2.612	46.152	.074	4.523	55.165
S.D.	.316	29.571	1.322	23.705	.262	1.029	18.287

The best zero-order predictor of the occupation was, as among males, educational attainment (r= .410). However, the zero-order association between education and prestige of occupation was higher among males than among females. On examining the means for male and female respondents, it was discovered that male respondents had higher prestige of occupation as well as higher scores in other variables.

To test whether females, blacks, and students who attended public schools, respectively, received the same increments in prestige of occupation in return for the level of schooling as did males, whites, and students who attended Catholic schools, respectively, three interaction terms (between educational attainment, and sex, race, and school type, respectively) were added to the regression equation. The interaction of sex with educational attainment was significant. The coefficient of determination for the prestige of occupation increased from .24631 to .25385, with the addition of the interaction term between sex and education on prestige of occupation. This significant interaction indicated that males and females received a different increment in prestige of occupation as a result of increases in years of schooling. Therefore, the regression equations of males and females were separated.

The results of the regression of prestige of occupation on the independent variables for males and females are shown in Table 16 and Table 17.

Table 16. Metric regression coefficients for Model 3 (males)

	Listwise		Pairwise	
Variable	b	SE	b	SE
Intercept	-8.280*	2.884	-22.970*	2.227
Race	1.265	1.660	.406	1.153
Apt	.081*	.016	.137*	.013
FaEd	-1.092*	.369	.566	.367
FaSE	.096*	.020	.092*	.0194
Sch	.869	1.290	3.526	1.532
Ed86	9.394*	.383	8.428*	.362
R square	.311		.342	
n	2,416		2,893	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 17. Metric regression coefficients for Model 3 (females)

	Listwise		Pairwise	
Variable	b	SE	b	SE
Intercept	11.522*	2.458	2.091	1.990
Race	-2.174	1.182	-2.311	.933
Apt	.072*	.014	.117*	.012
FaEd	.542	.325	.648	.324
FaSE	.011	.018	.043	.017
Sch	.698	1.251	.297	1.322
Ed86	6.169*	.362	5.500*	.343
R square	.181		.201	
n	2,598		3,204	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

With listwise deletion of missing data, the regression coefficients for the variables of father's education, father's socioeconomic status, aptitude score, and level of education among males indicated that there were significant advantages for those with fathers of higher socioeconomic status, for those with fathers who had less education, for those with higher aptitude scores, and for those with higher levels of education.

However, among females, the regression coefficients for only the two variables of educational level and aptitude were significant at the .01 level of probability. Whites and those with higher socioeconomic backgrounds did not have significantly higher prestige of occupation.

For each increment in the level of schooling, prestige of occupation incresed on the average 9.394 points for males, compared with 6.169 for females. This result indicated that males had a much greater advantage of schooling on prestige of occupation than females. For males, an increase in the amount of school had a much greater increase in prestige of occupation than females.

Figure 9 shows the direct path coefficients in the model for prestige of occupation. The path coefficients for males are given first. The path coefficients for females are in parentheses. Tables 18, 19, and 20 show the direct, indirect, and total path coefficients of independent variables on prestige of occupation among males. Tables 21, 22, and 23 show the direct, indirect, and total path coefficients of independent variables on prestige of occupation among females.

Education had the strongest direct effect on prestige of occupation for both sexes. The direct effect of education (beta = .4819) indicated that each standard

Table 18. The matrix of standardized direct effects for Model 3 (males)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.4819*	.0000	.0000
Sch	.0117	.0474*	.0000
FaSE	.0996*	.0779*	.0235
FaEd	-.0624*	.1274*	.0040
Apt	.1065*	.4448*	.0875*
Race	.0145	-.1131*	.0369

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 19. The matrix of standardized indirect effects for Model 3 (males)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.0000	.0000	.0000
Sch	.0228*	.0000	.0000
FaSE	.0383*	.0011	.0000
FaEd	.0615*	.0002	.0000
Apt	.2174*	.0041	.0000
Race	-.0533*	.0017	.0000

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 20. The matrix of standardized total causal effects for Model 3 (males)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.4819	.0000	.0000
Sch	.0346	.0474	.0000
FaSE	.1379	.0790	.0235
FaEd	-.0009	.1276	.0040
Apt	.3238	.4490	.0875
Race	-.0388	-.1114	.0369

Table 21. The matrix of standardized direct effects for Model 3 (females)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.3470*	.0000	.0000
Sch	.0097	.0207	.0000
FaSE	.0145	.0133	-.0012
FaEd	.0397	.1740*	-.0509
Apt	.1166*	.4504*	.0769*
Race	-.0374	-.1574*	.0603*

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 22. The matrix of standardized indirect effects for Model 3 (females)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.0000	.0000	.0000
Sch	.0072	.0000	.0000
FaSE	.0046	.0000	.0000
FaEd	.0595*	-.0011	.0000
Apt	.1576*	.0016	.0000
Race	-.0536*	.0013	.0000

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 23. The matrix of standardized total causal effects for Model 3 (females)

To:	SEI	Ed86	Sch
From:			
SEI	.0000	.0000	.0000
Ed86	.3470	.0000	.0000
Sch	.0169	.0207	.0000
FaSE	.0191	.0133	-.0012
FaEd	.0992	.1729	-.0509
Apt	.2742	.4520	.0769
Race	-.0909	-.1561	.0603

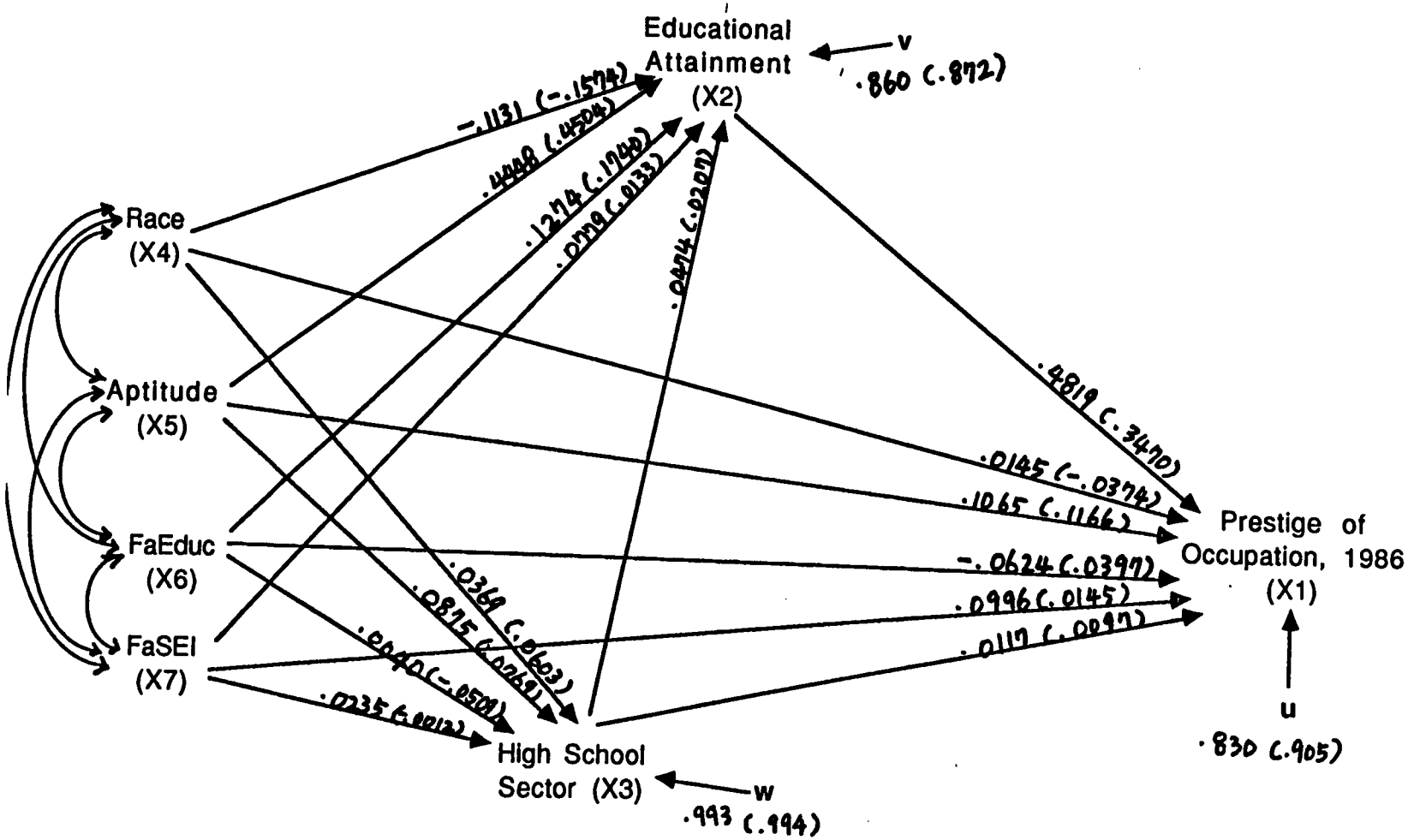

Figure 9. Recursive Path Model of Occupational Prestige, National Longitudinal Study of the High School Class of 1972

deviation increase in education resulted in .4819 standard deviation increase in prestige of occupation among males. The direct effect of education (beta = .3470) indicated that each standard deviation increase in education resulted in a .3470 standard deviation increase in prestige of occupation among females. Of the total zero-order association (r = .541) between education and prestige of occupation, almost 90 percent was a direct causal effect of education upon prestige of occupation for males. However, of the total associations between education and prestige of occupation (r = .410), almost 85 percent was direct causal effect of education upon prestige of occupation for females. Like previous studies, this result suggested that education had a substantial direct effect on occupational achievement for both males and females. Therefore, the occupational handicap of birth into a low social stratum might be overcome by education.

The second most important direct effect on the prestige of occupation for both sexes was aptitude. The direct effect of .1065 for males indicated that each standard deviation increase in aptitude resulted in a .1065 standard deviation increase in prestige of occupation for males. Of the total association (r = .346) between aptitude and prestige of occupation, about 31 percent was direct effect and about 63 percent was due to the indirect effect (beta = .2174) through educational attainment and high school sector. Most of the indirect effect was through education (.4448 x .4819 = .2143), suggesting that the effect of one's aptitude to occupational achievement was mainly through education and its subsequent effect on one's occupational achievement.

For females, the direct effect of aptitude upon prestige of occupation was .1166, indicating that each standard deviation increase in aptitude resulted in a .1166 standard deviation increase in prestige of occupation for females. Of the total association (r = .271) between aptitude and prestige of occupation for females, about 43 percent was direct effect (beta = .1166), and about 58 percent was due to the indirect effects (beta = .1576) through educational attainment and high school sector. The greatest indirect effect was through education (.4504 x .3470 = .1563). This result suggested that the primary process linking occupational achievement to aptitude was one that reflected differential educational attainment and its subsequent effect on occupational achievement.

Different from females, direct effects of father's education and father's socioeconomic status upon prestige of occupation were significant for males. The direct effect of father's socioeconomic status (beta = .0996) upon prestige of occupation indicated that each standard deviation increase in father's socioeconomic status resulted in a .0996 standard deviation increase in prestige of occupation for males. Of the total association (r = .214) between father's prestige of occupation and respondent's prestige of occupation, about 47 percent was direct effect (beta = .0996) and about 18 percent was due to the indirect effects (beta = .0383) through educational attainment and high school sector. The greatest indirect effect was through education (.0779 x .4819 = .0375), indicating that the indirect influence of father's socioeconomic status on son's occupational achievement occurred largely through son's education and its subsequent effect

on his occupational achievement. This result suggested that for males the benefit of a higher socioeconomic background to his prestige of occupation was great.

The direct effect of father's education (beta = -.0624) upon prestige of occupation indicated that each standard deviation increase in father's education resulted in a .0624 standard deviation decrease in son's prestige of occupation. The direct effect of father's education was implausibly negative; however, it was rather small and probably an artifact of multicollinearity between father's education and father's socioeconomic status. A relatively large indirect effect (beta = .0615) was positive and significant at the .01 level of probability. The greatest indirect effect was through education (.1274 x .4819 = .0614), suggesting that the influence of father's education occurred largely through son's education, which subsequently affected his occupational achievement.

The direct effect of father's education on prestige of occupation for females was .0397, which was not significant at the .05 level of probability. The indirect effect of father's education on prestige of occupation through education (.1740 x .3470 = .0604) was 1.5 times its direct effect. As for males, for females a relatively large indirect effect of father's education through education suggested that the influence of father's education occurred largely through the respondent's education, which subsequently affected her occupational achievement. Of the total associaiton (r = .178) between father's education and prestige of occupation for females, 22 percent was direct effect, 33 percent was indirect effect, and about 45 percent was noncausal component of the correlation. This noncausal component was due to the fact that father's education was correlated with the other

exogenous variables, particularly with father's socioeconomic status, for reasons unanalyzed in this model.

The direct effect of father's socioeconomic status on prestige of occupation for females was .0145, which was not significant at the .05 level of probability. The indirect effect of father's socioeconomic status on prestige of occupation through the intervening variables was .0046, which was not significant at the .05 level of probability. Different from males, this result indicated that for females the benefit of a higher socioeconomic background to prestige of occupation was negligible. Of the total association ($r = .134$) between father's socioeconomic status and prestige of occupation, 11 percent was direct effect, 3.4 percent was indirect effect, and about 85 percent consisted of noncausal component of the correlation. The large noncausal component between father's socioeconomic status and the respondent's occupational achievement was due to the fact that father's socioeconomic status was correlated with the other exogenous variables, particularly with father's education, for reasons unanalyzed in this model.

The direct effect of high school sector on prestige of occupation for males was .0117, which was not significant at the .05 level of probability. However, the indirect effect through education was greater than the direct effect and statistically significant. The indirect effect of .0228 (.0474 x .4819) was about twice its direct effect, and about 31 percent of the total association ($r = .074$) between high school sector and prestige of occupation for males. This result suggested that the primary process linking occupational achievement to high school sector was one

that reflected differential educational attainment and its subsequent effect on occupational achievement for males.

The direct effect of high school sector on prestige of occupation for females was .0097, which was not significant at the .05 level of probability. Unlike for males, the indirect effect through education was much less than the direct effect, and was not significant at the .05 level of probability. The indirect effect of .0072 (.0207 x .3470) was about 74 percent its direct effect, and about 23 percent of the total association (r = .032) between high school sector and prestige of occupation for females. This result suggested that whether females attended public schools or Catholic schools did not have significant enduring effect on occupational achievement 14 years after finishing high school.

The direct effect of race on prestige of occupation for males was .0145, which was not significant at the .05 level of probability. The indirect effect of race on occupational achievement through the intervening variables was negative (beta = -.0533), which was significant at the .01 level of probability. The direct effect of race on prestige of occupation for females was -.0374, which was not significant at the .05 level of probability. The indirect effect of race on occupational achievement through the intervening variables was negative (beta = -.0536), which was significant at the .01 level of probability. This result suggested that the direct effect of race on occupational achievement was negligible. The effect of race was mainly through education.

Enduring Effects of Education on Self-concept

Table 24 presents means, standard deviations, and correlations used in the analyses of enduring effects of education on self-concept, with listwise deletion of missing data. The genders of participants used in Model 4 were given (in Table 24), with males comprising 47.7 percent(n = 2,291) and females 52.3 percent (n = 2,511), for a sample total of 4,802. Table 24 also presents data related to racial identity of participants in this sample. Whites comprised 91.3 percent (n = 4,384), and blacks comprised 8.7 percent (n = 418). Examination of the means revealed that the average score on self-concept increased about .245 points between 1972 and 1986. The correlations between the independent variables and self-concept showed that those respondents from families of higher socioeconomic status and those with higher education tended to have higher self-concept. The positive correlations between sex and self-concept indicated that males tended to have higher self-concept. The negative correlations between race and self-concept indicated that blacks tended to have higher self-concept than whites. The best zero-order predictor of the self-concept in 1986 was an earlier expression of self-concept measured in 1972 (r = .266) followed by education (r = .103) and prestige of occupation (r = .100).

Table 25 presents the results of the regression of the 1986 self-concept on race, aptitude, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and an earlier measure of self-concept, with listwise and pairwise deletion of missing data.

Table 24. The means, standard deviations, & correlations used in Model 4

	Con	Race	Apt	Sex	FaEd	FaSE	Sch	Ed86	SEI	Con86
Con	1.0									
Race	-.058	1.0								
Apt	.050	.404	1.0							
Sex	.033	.084	.022	1.0						
FaEd	.026	.221	.313	.024	1.0					
FaSE	.013	.239	.269	.024	.612	1.0				
Sch	.010	.080	.103	.040	.019	.034	1.0			
Ed86	.077	.096	.454	.072	.285	.224	.079	1.0		
SEI	.063	.082	.310	.028	.173	.173	.059	.481	1.0	
Con86	.266	-.029	.071	.072	.052	.028	.002	.103	.100	1.0
Means	3.13	.913	217.74	.477	2.651	46.75	.084	4.602	55.80	3.38
S.D.	.474	.282	29.13	.500	1.312	23.62	.277	1.08	20.24	.44

These results clearly indicated that the best predictor of the 1986 self-concept was the earlier expression of self-concept measured in 1972; respondents who had high self-concept in 1972 tended to have high self-concept in 1986.

With listwise deletion of missing data, among the independent variables, race, sex, occupational status, and 1972 self-concept had significant effects at the .01 level of probability, while controlling for the other variables in the equation. Aptitude and level of education had significant effects upon 1986 self-concept at the .05 level of probability, while controlling for the other variables in the equation.

To test whether females, blacks, and students who attended public schools, respectively, received the same increments in self-concept in return for the level of schooling as did males, whites, and students who attended Catholic schools, respectively, three interaction terms (between educational attainment, and sex, race, and school type, respectively) were added to the regression equation. These interactions were not significant. The coefficient of determination for the self-concept incresed from .08679 to .08709 with the addition of interaction terms. Thus, females, blacks, and students who attended public schools, respectively, received the same increments in self-concept as a result of increases in years of schooling as did males, whites, and Catholic school students, respectively.

Tables 26, 27, and 28 show the direct, indirect, and total path coefficients of independent variables on self-concept. Figure 10 shows the direct path coefficient in the Model for self-concept. Not surprisingly, self-concept measured in 1972 had the strongest direct effect on 1986 self-concept.

Table 25. Metric regression coefficients for Model 4

	Listwise		Pairwise	
Variable	b	SE	b	SE
Intercept	2.409*	.060	2.312*	.049
Race	-.072*	.024	-.066*	.017
Apt	.0006	.0003	.0007*	.0002
Sex	.055*	.012	.070*	.011
FaEd	.010	.006	.008	.006
FaSE	-.0002	.0003	.0002	.0003
Sch	-.014	.022	.014	.023
Ed86	.014	.007	.014	.006
SEI	.001*	.0003	.001*	.0003
Concept	.235*	.0129	.243*	.0115
R square	.086		.099	
n	4,802		6,097	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 26. The matrix of standardized direct effects for Model 4

To:	Con86	SEI	Ed86	Sch
From:				
Con86	.0000	.0000	.0000	.0000
SEI	.0552*	.0000	.0000	.0000
Ed86	.0347	.4206*	.0000	.0000
Sch	-.0094	.0137	.0366*	.0000
FaSE	-.0112	.0622*	.0442*	.0170
FaEd	.0300	-.0174	.1452*	-.0300
Sex	.0626*	-.0060	.0660*	.0344
Apt	.0372	.1107*	.4426*	.0888*
Race	-.0457*	-.0133	-.1316*	.0442*
Concept	.2527*	.0240	.0403*	.0075

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 27. The matrix of standardized indirect effects for Model 4

To:	Con86	SEI	Ed86	Sch
From:				
Con86	.0000	.0000	.0000	.0000
SEI	.0000	.0000	.0000	.0000
Ed86	.0232*	.0000	.0000	.0000
Sch	.0029	.0154*	.0000	.0000
FaSE	.0059*	.0191*	.0006	.0000
FaEd	.0076*	.0602*	-.0011	.0000
Sex	.0033	.0287*	.0013	.0000
Apt	.0312*	.1887*	.0033	.0000
Race	-.0086*	-.0541*	.0016	.0000
Concept	.0036*	.0172*	.0003	.0000

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 28. The matrix of standardized total causal effects for Model 4

To:	Con86	SEI	Ed86	Sch
From:				
Con86	.0000	.0000	.0000	.0000
SEI	.0552	.0000	.0000	.0000
Ed86	.0579	.4206	.0000	.0000
Sch	-.0065	.0291	.0366	.0000
FaSE	-.0054	.0813	.0448	.0170
FaEd	.0376	.0428	.1441	-.0300
Sex	.0658	.0227	.0672	.0344
Apt	.0683	.2994	.4458	.0888
Race	-.0543	-.0674	-.1300	.0442
Concept	.2564	.0412	.0406	.0075

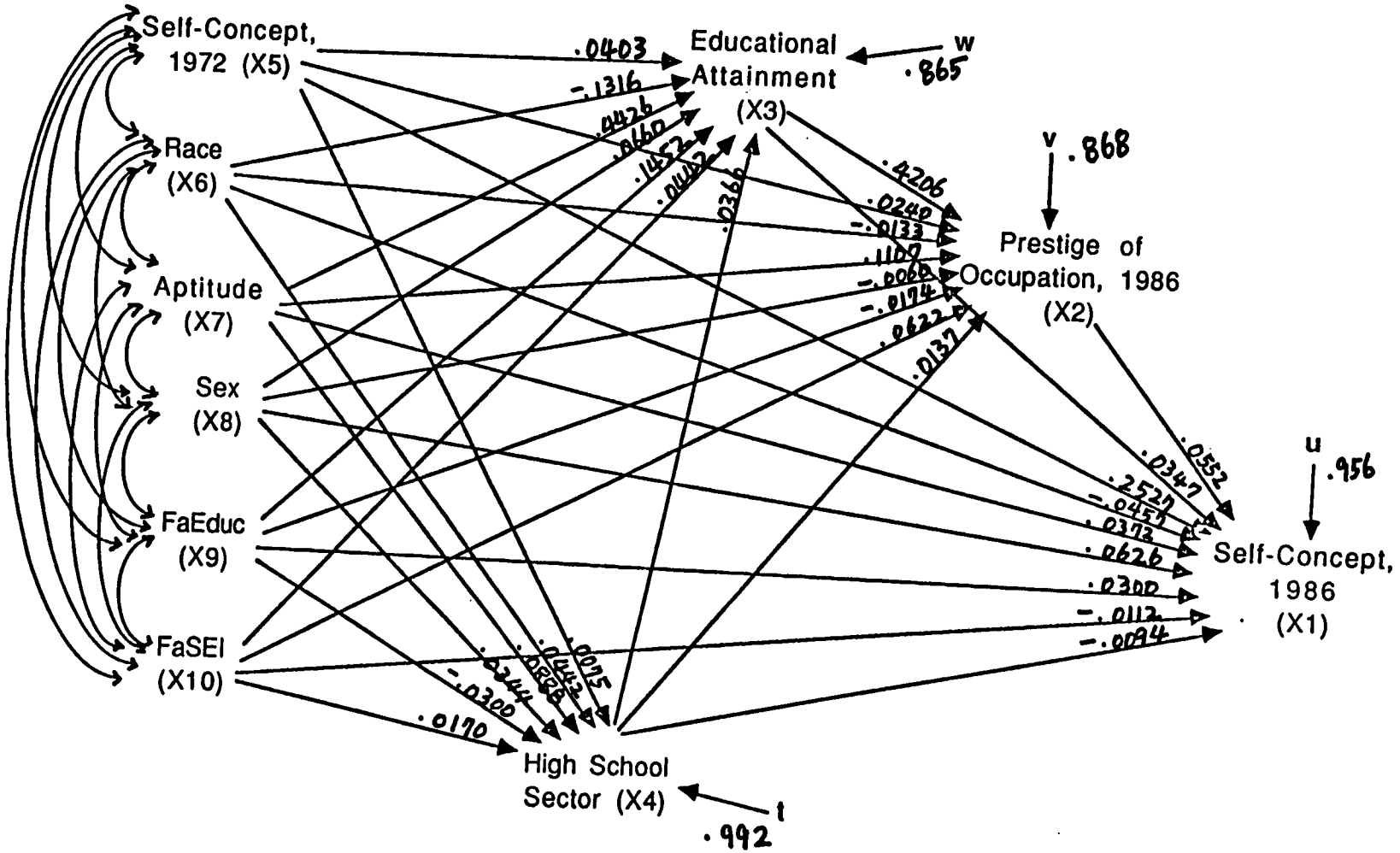

Figure 10. Recursive Path Model of Self-Concept, National Longitudinal Study of the High School Class of 1972

The positive effect (beta = .2527) indicated that the higher one's self-concept in 1972, the higher it was likely to be in 1986. Of the total association (r = .266) between the two measures of 1972 and 1986 self-concept, 95 percent was due to the direct effect (beta = .2527) and a relatively small amount of association was due to the indirect effects (.0036) through the intervening variables of prestige of occupation, educational attainment, and high school sector. Those were (.0403 x .0347) + (.0240 x .0552) + (.0075 x -.0094) + (.0403 x .4206 x .0552) + (.0075 x .0366 x .0347) + (.0075 x .0366 x .4206 x .0552) + (.0075 x .0315 x .0552) = .0036. Of those, the indirect effect through education (.0014) was the greatest, indicating that the indirect effect of childhood self-concept was largely through education and its subsequent effect on adulthood self-concept. This result suggested that a person's adulthood self-concept was largely affected by one's childhood self-concept.

Sex had the second most important influence upon 1986 self-concept (beta = .0626). The sign of the coefficient indicated that males were more likely to have higher self-concept (.063 standard deviation higher). Of the total zero-order correlation coefficient (r = .072) between sex and self-concept, almost 87 percent was due to direct causal effects and 4.6 percent was due to indirect effects (beta = .0033) through other intervening variables, indicating that most of the total association was due to the direct effect of sex on 1986 self-concept.

The third most influential variable on self-concept was respondent's prestige of occupation (beta = .0552). The path coefficient of .0552 indicated that each standard deviation change in the unit of the prestige of occupation increased 1986

self-concept by .055 standard deviation. Of the total association (r = .100) between 1986 self-concept and prestige of occupation, 55.2 percent was the direct causal effect upon 1986 self-concept, and 44.8 percent was the effect of correlation of prestige of occupation with other unanalyzed causes of 1986 self-concept. Like the results of Sewell's (1963) and Kohn and Schooler's (1983), the present study indicated that the direct effect of occupational status upon one's self-concept was substantial. Higher social conditions probably lead a person to have a greater self-concept. The noncausal association between prestige of occupation and self-concept was a spurious association mainly due to correlated exogenous variables (including aptitude, education, and an earlier measure of self-concept), which affected both prestige of occupation and self-concept.

Race had the fourth most important influence on 1986 self-concept (beta = -.0457). The indirect effect of race on 1986 self-concept was -.0086, which was significant at the .01 level of probability. The negative direct effect was implausible; however, it was negligibly small and interpreted as not meaningful.

The direct influence of aptitude on 1986 self-concept was .0372, which was significant at the .05 level of probability. The indirect effects through other intervening variables were almost the same as the direct effect and significant at the .01 level of probability. The greatest indirect effect was through educational attainment (.4426 x .0347 = .0154), suggesting that the effect of aptitude was largely through education and its subsequent effect on self-concept. The direct causal effect (beta = .0372) and the indirect effect (beta = .0312) were over 96 percent of the total association (r = .071) between aptitude and 1986 self-concept.

This result suggested that the higher the student's aptitude, the greater the adult's self-concept, directly and indirectly through the intervening variables. However, since the path coefficient less than .05 was considered as not meaningful, the direct effect was interpreted as not meaningful.

The estimated direct influence of education on 1986 self-concept was .0347, which was significant at the .05 level of probability. The indirect effect through prestige of occupation was (.4206 x .0552 = .0232) over two-thirds of the direct effect. The sum of the direct and the indirect effects (.0347 + .4206 x .0552 = .0579) was about 56 percent of the zero-order correlation coefficient (r = .103). About 54 percent of the zero-order association was a spurious association due to correlated exogenous variables, such as aptitude and an earlier expression of self-concept, which directly and indirectly affected both education and 1986 self-concept. Different from a majority of previous studies, this study showed that with a longer-term perspective including the prior measures of self-concept and aptitude, the effect of school attendance on psychological attitude of self-concept was negligibly small. This result suggested that the enduring effects of school learning and school environments, that provided students to improve self-concept were not substantial, while controlling for earlier measures of self-concept and aptitude.

The direct effect of father's education on 1986 self-concept was .03, which was not significant at the .05 level of probability. The indirect effect of father's education on self-concept through other intervening variables was .0076, which was significant at the .01 level of probability. The indirect effect of father's edu-

cation on self-concept through education (.1452 x .0347 = .005) was the greatest. This result indicated that the indirect influence of father's education occurred largely through the respondent's education and its subsequent influence on the psychological attitude of self-concept. Of the total association (r = .052) between father's education and 1986 self-concept, 58 percent was direct effect, 15 percent was indirect effect (beta = .0076), and about 25 percent was joint associations.

The direct effect of father's socioeconomic status on 1986 self-concept was not significant (beta = -.0112) at the .05 level of probability. The negative direct effect was implausible; however, it was negligibly small and interpreted as not meaningful. The indirect effect of father's socioeconomic status through the intervening variables was .0059, which was significant at the .01 level of probability. The indirect effect through prestige of occupation was the greatest (.0622 x .0552 = .0034), indicating that the indirect influence of father's socioeconomic status occurred largely through respondent's own prestige of occupation and its subsequent influence on psychological attitude of self-concept.

The direct effect of high school sector on self-concept in 1986 (beta = -.0094) was not significant at the .05 level of probability. The indirect effect through other intervening variables of education and prestige of occupation, however, was positive (beta = .0029) and significant at the .05 level of probability. This result suggested that whether persons attended public schools or Catholic schools did not greatly affect self-concept 14 years after finishing high school.

Enduring Effects of Education on Locus of Control

Table 29 presents means, standard deviations, and correlations used in the analyses of enduring effects of education on locus of control, with listwise deletion of missing data. The genders of participants used in Model 5 were given (in Table 29), with males comprising 47.7 percent (n = 2,287) and females 52.3 percent (n = 2,509), for a sample total of 4,796. Table 29 also presents data related to racial identity of participants in this sample. Whites comprised 91.3 percent (n = 4,379), and blacks comprised 8.7 percent (n = 417). Examination of the means revealed that the average score on locus of control increased about .104 points between 1972 and 1986. The correlations between independent variables and locus of control showed that those respondents from families of higher socioeconomic status and those with higher education tended to have greater internal locus of control. The negative correlations between sex and locus of control indicated that females tended to have greater internal locus of control than males. The positive correlations between race and locus of control indicated that whites tended to have greater internal locus of control than blacks. The best zero-order predictor of the locus of control in 1986 was the earlier expression of locus of control measured in 1972 (r = .304) followed by prestige of occupation (r = .158) and education (r = .154).

Table 30 presents the results of the regression of the 1986 locus of control on race, aptitude, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and an earlier measure of locus of control, with

listwise and pairwise deletion of missing data. These results clearly indicated that the best predictor of the 1986 locus of control was the scores of locus of control measured in 1972; those respondents who had a greater internal locus of control in 1972 tended to have a greater internal locus of control in 1986.

With listwise deletion of missing data, among the independent variables, aptitude, occupational status, and 1972 locus of control had significant effects at the .01 level of probability, while controlling for the other variables in the equation. The variable of race had a significant effect at the .05 level of probability. The variables of educational attainment, high school sector, father's socioeconomic status, father's educational level, and sex did not have significant effects on 1986 locus of control.

To test whether females, blacks, and students who attended public schools, respectively, received the same increments in the locus of control in return for the level of schooling as did males, whites, and students who attended Catholic schools, respectively, three interaction terms (between educational attainment, and sex, race, and school type, respectively) were added to the regression equation. These interactions were not significant. The coefficient of determination for the 1986 locus of control increased from .12143 to .12219 with the addition of interaction terms. Thus, females, blacks, and students who attended public schools, respectively, received the same increments in locus of control as a result of increases in years of schooling as did males, whites, and Catholic school students, respectively.

Table 29. The means, standard deviations, & correlations used in Model 5

	Loc	Race	Apt	Sex	FaEd	FaSE	Sch	Ed86	SEI	Loc86
Loc	1.0									
Race	.107	1.0								
Apt	.300	.406	1.0							
Sex	-.084	.084	.022	1.0						
FaEd	.095	.222	.314	.025	1.0					
FaSE	.078	.240	.270	.024	.613	1.0				
Sch	.017	.080	.102	.041	.020	.034	1.0			
Ed86	.197	.094	.455	.072	.286	.225	.080	1.0		
SEI	.129	.082	.311	.030	.175	.175	.060	.482	1.0	
Loc86	.304	.106	.204	-.021	.092	.081	.031	.154	.158	1.0
Means	3.124	.913	217.720	.477	2.650	46.749	.084	4.603	55.805	3.228
S.D.	.493	.282	29.151	.500	1.312	23.628	.278	1.084	20.236	.437

Table 30. Metric regression coefficients for Model 5

	Listwise		Pairwise	
Variable	b	SE	b	SE
Intercept	2.072*	.052	1.946*	.041
Race	.058	.024	.073*	.017
Apt	.001*	.0002	.002*	.0002
Sex	-.008	.012	.0007	.011
FaEd	.004	.006	.014	.006
FaSE	.0001	.0003	.0001	.0003
Sch	.015	.022	-.001	.024
Ed86	.009	.007	.0009	.006
SEI	.002*	.0003	.002*	.0003
Locus	.232*	.013	.218*	.011
R square	.116		.156	
n	4,796		6,097	

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Tables 31, 32, and 33 show the direct, indirect, and total path coefficients of independent variables on locus of control. Figure 11 shows the direct path coefficients in the model for locus of control. Locus of control measured in 1972 had the strongest direct effect on 1986 locus of control. The positive effect (beta = .2619) indicated that the higher one's locus of control in 1972, the higher it was likely to be in 1986. Most of the total association between the 1972 and 1986 measures of locus of control (r = .304) was due to the direct effect (86 percent) and about 1.6 percent was due to indirect effects (.005) through the intervening variables. This result suggested that a person's adulthood locus of control was largely affected by one's childhood locus of control.

Prestige of occupation had the second most important influence upon 1986 locus of control (beta = .0863). For each additional standard deviation in prestige of occupation, the standard deviation of locus of control increased by .0863. Of the total zero-order correlation coefficient (r = .158) between prestige of occupation and locus of control, about 55 percent was due to the direct causal effect and 45 percent was the effects of correlation of prestige of occupation with other unanalyzed causes of 1986 locus of control. This result suggested that the higher the occupational status, the greater internal the respondent's locus of control. A higher occupational status may supply a strong reinforcement which causes a move to an internal locus of control. A higher occupation may have more responsibility, more practice in decision-making and problem-solving, and more opportunities to observe the results of their decisions. The feeling of personal

Table 31. The matrix of standardized direct effects for Model 5

To:	Loc86	SEI	Ed86	Sch
From:				
Loc86	.0000	.0000	.0000	.0000
SEI	.0863*	.0000	.0000	.0000
Ed86	.0216	.4211*	.0000	.0000
Sch	.0097	.0145	.0389*	.0000
FaSE	.0053	.0632*	.0452*	.0161
FaEd	.0132	-.0162	.1459*	-.0280
Sex	-.0086	-.0022	.0741*	.0348
Apt	.0672*	.1090*	.4263*	.0912*
Race	.0373	-.0156	-.1394*	.0435*
Locus	.2619*	.0112	.0722*	-.0107

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 32. The matrix of standardized indirect effects for Model 5

To:	Loc86	SEI	Ed86	Sch
From:				
Loc86	.0000	.0000	.0000	.0000
SEI	.0000	.0000	.0000	.0000
Ed86	.0363*	.0000	.0000	.0000
Sch	.0035	.0164*	.0000	.0000
FaSE	.0083*	.0195*	.0006	.0000
FaEd	.0067	.0606*	-.0011	.0000
Sex	.0046	.0323*	.0014	.0000
Apt	.0353*	.1823*	.0036*	.0000
Race	-.0088*	-.0573*	.0017	.0000
Loc	.0050*	.0301*	-.0004	.0000

*Indicates absolute size of coefficient equals or exceeds 2.57 times its standard error.

Table 33. The matrix of standardized total causal effects for Model 5

To:	Loc86	SEI	Ed86	Sch
From:				
Loc86	.0000	.0000	.0000	.0000
SEI	.0863	.0000	.0000	.0000
Ed86	.0579	.4211	.0000	.0000
Sch	.0132	.0309	.0389	.0000
FaSE	.0135	.0827	.0458	.0161
FaEd	.0199	.0443	.1448	-.0280
Sex	-.0041	.0301	.0754	.0348
Apt	.1025	.2913	.4299	.0912
Race	.0285	-.0729	-.1377	.0435
Loc	.2669	.0413	.0718	-.0107

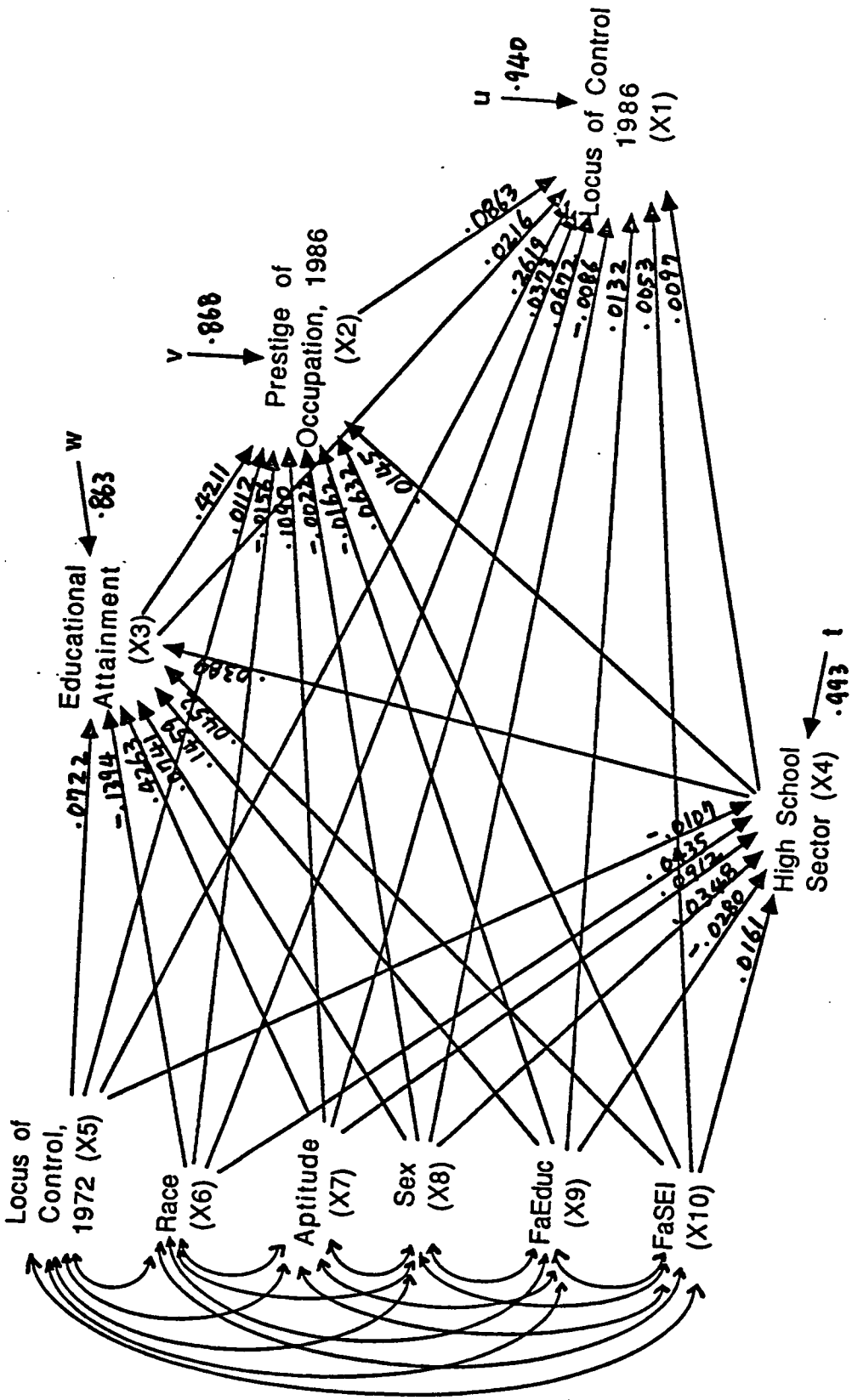

Figure 11. Recursive Path Model of Locus of Control, National Longitudinal Study of the High School Class of 1972

importance may be derived from those responsibility, experience, or respect from others.

The third most influential variable on locus of control was aptitude (beta = .0672). The path coefficient of .0672 indicated that each standard deviation change in aptitude increased the standard deviation of the 1986 locus of control by .0672. The direct causal effect of aptitude upon 1986 locus of control (beta = .0672) was about 33 percent of the total association (r = .204) between 1986 locus of control and aptitude. This result suggested that the higher the students' aptitude, the greater internal the adults' locus of control directly and indirectly through the intervening variables. The indirect effects of aptitude through other intervening variables (beta = .0353) were about 17.3 percent of the total association, which was significant at the .01 level of probability. The greatest indirect effect was through educational attainment and prestige of occupation (.4263 x .4211 x .0863 = .0155), suggesting that long-term indirect influence of one's aptitude on adulthood's locus of control was through one's education and its subsequent effect on occupational achievement, which, in turn, affected one's adulthood locus of control.

The direct effect of race (beta = .0373) on 1986 locus of control was significant at the .05 level of probability. The indirect effect of race (beta = -.0088) on 1986 locus of control was significant at the .01 level of probability. The sign of the path coefficient indicated that whites were more likely to have greater internal locus of control. However, since direct path coefficient less than .05 is

considered as not meaningful, this result may be interpreted as the effect of race on locus of control is negligible.

The direct influence of education upon 1986 locus of control was .0216, which was, unexpectedly, not significant at the .05 level of probability. The indirect effect of education through the prestige of occupation (beta = .0363) was much greater than the direct effect, and significant at the .01 level of probability. Of the total association (r = .154) between education and 1986 locus of control, 14 percent was direct causal effect and almost 24 percent was indirect effect, suggesting that long-term effect of education on locus of control was mainly through one's occupational achievement and its subsequent effect on locus of control. About 62 percent of the total association between education and locus of control was spurious, mainly due to mutual dependence of education and locus of control on the pre-existing locus of control and ability. This result suggested that when long-term effects were considered and when an earlier expression of locus of control and aptitude were controlled, school attendance did not greatly increase one's psychological attitude of locus of control.

The estimated direct effect of father's socioeconomic status on locus of control (beta = .0053) was not significant at the .05 level of probability. The indirect effect of father's socioeconomic status through the intervening variables (beta = .0083), which was significant at the .01 level of probability, was greater than the direct effect. The indirect effect through prestige of occupation was the greatest (.0632 x .0863 = .0055), suggesting that the effect of father's socioeconomic status on locus of control was through one's occupational status, which subsequently

affected one's psychological behavior of locus of control. Of the total associaiton (r = .081) between father's socioeconomic status and locus of control in 1986, 7 percent was direct effect, 10 percent was indirect effect, and about 83 percent was a joint association. The joint association was due to the fact that father's socioeconomic status was correlated with the other exogenous variables, particularly with father's educational level, for reasons unanalyzed in this model.

The direct effect of father's education on locus of control in 1986 was .0132, which was not significant at the .05 level of probability. The indirect effect of father's education on locus of control through prestige of occupation, education, and high school sector was .0067, which was significant at the .05 level of probability. The indirect effect through education and prestige of occupation was the greatest (.1459 x .4211 x .0863 = .0053). This result suggested that the indirect effect of father's education on locus of control was through one's education and its subsequent occupational achievement, which in turn affected one's psychological behavior of locus of control. Of the total association (r = .092) between father's education and 1986 locus of control, about 14 percent was direct effect, 7.3 percent was indirect effect, and about three-quarters of the total association was a joint association. Most of the portion of the joint association was due to the fact that father's educational level was correlated with the other exogenous variables, particularly with father's socioeconomic status, for reasons unanalyzed in this model.

The estimated effect of high school sector on locus of control in 1986 (beta = .0097) was not significant at the .05 level of probability. The indirect effect

through other intervening variables, education and prestige of occupation, however, was (beta = .0035) significant at the .05 level of probability. The indirect effect through prestige of occupation was the greatest (.0145 x .0863 = .00125). Of the total association (r = .031) between high school sector and 1986 locus of control, about 31.3 percent was direct effect, 11.3 percent was indirect effect, and about 57 percent of the total association was a spurious association. This result suggested that whether persons attended public schools or Catholic schools did not greatly affect one's psychological attitude of internality or externality.

The estimated effect of sex on locus of control in 1986 (beta = -.0086) was negative and was not significant at the .05 level of probability. However, the indirect effect (beta = .0046) was positive and significant at the .05 level of probability, indicating that the effect of sex was mainly indirect through the intervening variables.

Chapter 5. Conclusions and Recommendations

This study investigated the enduring effects of education on vocabulary and mathematics achievements, its subsequent effect on occupational achievement, and affective behaviors of self-concept and locus of control, after the students left high school and as they engaged in higher education and entered the working world. Unlike previous studies on the impact of education, this study was able to assess the effects of education upon cognitive and occupational achievements, self-concept, and locus of control, while controlling for the earlier measures of intelligence, self-concept, and locus of control. Using national longitudinal data, it was possible to examine the cause-effect relationship of the long-term outcomes of education by estimating several causal models. Findings of this study were discussed as they related to the research questions and to earlier studies.

Vocabulary and Mathematics Achievements

Research questions one, two, and three addressed the effects of independent variables, i.e. race, aptitude, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and prestige of occupation upon vocabulary and mathematics achievements.

The best zero-order predictor of the vocabulary achievement was, not surprisingly, the aptitude score measured in 1972. The findings of path analysis showed that aptitude had the highest significant direct effect on vocabulary achievement followed by educational attainment, father's education, and race, in order of importance. The direct effects of sex, high school sector, prestige of occupation, father's socioeconomic status were not statistically significant. However, the indirect effect of father's socioeconomic status on vocabulary achievement was significant at the .01 level of probability.

Educational attainment was expected to have a positive effect on vocabulary. The path coefficient of .11 confirmed this expectation. People who had higher level of education had higher vocabulary achievement. The direct effect of education on vocabulary (.11) was significant. However, the indirect effect of education on vocabulary achievement through occupation (.0049) was not statistically significant. In other words, the causal effect of education on vocabulary achievement occurred largely directly. The sum of direct and indirect effects was about one-quarter of the zero-order correlation coefficient (.451) between education and vocabulary achievement.

Hyman, et al. (1975), found a zero-order coefficient of .31 between education and vocabulary test administered by NORC in 1966. Their partial correlation coefficient (.25) controlling for social origin was 80 percent of their zero-order correlation. However, their causal models were misspecified by failing to include an earlier measure of intelligence. Including an earlier measure of intelligence in the path model, Wolfle (1980a) found that a zero-order association between education and vocabulary achievement was .511, and the sum (.182) of direct and indirect effect of education on vocabulary achievement was about one-third of the total association.

The present study confirmed Wolfle's (1980a) results of the enduring effects of education on vocabulary achievement. However, using longitudinal data, instead of cross-sectional data as in Wolfle's (1980a) study, while controlling for an earlier measure of intelligence, this study found a smaller total association between education and vocabulary achievement ($r = .451$), and a smaller standardized total effect of education on vocabulary achievement (.1149). The present study indicated that nearly three-quarters of the zero-order association between education and vocabulary achievement was a spurious association, due to correlated exogenous variables (including aptitude) which directly and indirectly affected both education and vocabulary achievement.

High school sector was expected to have a positive effect on vocabulary achievement. The zero-order association between high school sector and vocabulary achievement was .110, but the standardized partial regression coefficient was only .0093, which was not significant at the .05 level of probability. The in-

direct effect of high school sector through education and prestige of occupation (beta = .0024) was only 2.2 percent of the total zero-order association between high school sector and vocabulary achievement. Unlike the previous study (Coleman, Hoffer, & Kilgore, 1981), these results indicated that the effect of high school sector on vocabulary achievement was nearly nonexistent from a long-term perspective, while an earlier intelligence was controlled.

The best zero-order predictor of the mathematics achievement was, not surprisingly, the aptitude score measured in 1972. The path coefficient indicated that aptitude had the highest significant direct effect on mathematics achievement followed by sex, educational attainment, high school sector, and prestige of occupation, in order of importance. The direct effects of race, father's education, father's socioeconomic status were not statistically significant. However, all of the indirect effects of race, father's education, and father's socioeconomic status on mathematics achievement were significant at the .01 level of probability. The indirect effects of race, father's education, and father's socioeconomic status on mathematics achievement through education were the greatest. The indirect effect of father's education on mathematics achievement was about 1.3 times its direct effect. The indirect effect of father's education through education was greater than its direct effect. This result indicated that the influence of father's education on mathematics achievement occurred mainly through the respondent's own education and its subsequent influence on his mathematics achievement.

Unlike the results for vocabulary achievement, the direct effect of high school sector upon mathematics achievement was significant at the .01 level of proba-

bility. The negative direct effect indicated that students who attended public schools were more likely to obtain higher mathematics achievement. Different from the findings of the Coleman, Hoffer, and Kilgore (1981) study, which concluded that cognitive achievement was greater in Catholic schools than in public schools, the present study, which included the aptitude variable, indicated that Catholic school students did worse than public school students when the long-term enduring effects were considered.

Coleman, et al. (1981), by examining data in the High School and Beyond Study of 1980 (Jones et al., 1986) for high school sophomores and seniors, while controlling for socioeconomic backgrounds of students in different types of high schools, concluded that private schools were more effective than public schools on the cognitive achievement. Page and Keith (1981), using a measure of general ability as a control, reanalyzed the 1980 HSB data. They concluded that when ability was controlled, the effect of private school on achievement was nearly disappeared. Page and Keith (1981) analysis of the 1980 HSB data yielded results consistent with the results of the current study. Unlike Coleman, et al. (1981), Noell (1982) added the four additional background variables of sex, handicap status, region of residence, and eighth grade college attendance expectations, that could be associated with self-selection into Catholic schools. Noell (1982) concluded that except for a small advantage on sophomore reading tests, Catholic school students did no better or worse than public school students on cognitive outcomes.

Willms (1985), using the 1982 follow-up HSB data, analyzed the effect of attending Catholic schools. Willms (1985) obtained considerably smaller differences between Catholic and public school students, and concluded that there were no Catholic school advantages in terms of academic achievement. The effects of attending Catholic schools that were estimated by Coleman, et al. (1981), Page and Keith (1981), Noell (1982), and Willms (1985) were short-term ones. Wolfle (1987) included the variables of number of semesters of mathematics taken, highest level of college education, and prior vocabulary and mathematics tests, using the NLS data. Wolfle concluded that effect of school sector on vocabulary achievement was nearly nonexistent, and that the effect on mathematics achievement favored public school students.

In sum, in this study, aptitude was the most important predictor of cognitive skills. The indirect effect of aptitude via education was also high. The effect of education on cognitive skills was relatively high. Additional education did result in an increase in adults' cognitive skills. However, the direct enduring effect of education on cognitive skills was not as strong as reported by Hyman et al (1975), with about two-thirds to three-quarters of the correlation between education and cognitive skills being spurious associations. The spurious associations were largely due to the common prior causal variable of aptitude score, which directly and indirectly affected both education and cognitive skills greatly.

Prestige of Occupation

Research questions four and five addressed the effects of independent variables, i.e. race, aptitude, sex, father's education, father's socioeconomic status, high school sector, and educational attainment upon prestige of occupation. A significant interaction between sex and education on prestige of occupation was found, which indicated that females received less increment than males in prestige of occupation as a result of increases in schooling.

Blau and Duncan's (1967) study indicated that education played a crucial role in the process of socioeconomic achievement. They added that the influence of socioeconomic background on the respondent's occupational achievement was mainly through education. Sewell and Hauser's (1975) model, which included education, ability, mother's education, parent's income, father's occupation, and father's education, affirmed that education was the chief direct access to prestige of occupation. Their study indicated that ability was second in importance for predicting socioeconomic status. The results of this present study were consistent with Blau and Duncan's (1967) study as well as Sewell and Hauser's (1975) study.

In the present study, the largest zero-order association with prestige of occupation in 1986 was educational attainment: $r = .541$ for males, and $r = .410$ for females. The metric regression coefficient indicated that males received much greater advantages on prestige of occupation than females as a result of increases in education. Most of the total association between education and prestige of

occupation was due to the direct causal effect of edcuation upon prestige of occupation: 90 percent for males, and 85 percent for females. This result suggested that occupational handicap of birth into a low social stratum might be overcome by education.

The second most important predictor of prestige of occupation for both sexes was aptitude. The direct path coefficients indicated that about one-third of the total zero-order association with prestige of occupation was due to the direct effect for males; about 43 percent was due to the direct effect for females. For males, the indirect effect of aptitude through education was over twice its direct effect of aptitude on prestige of occupation. For females, the indirect effect of aptitude through education was about 1.4 times its direct effect of aptitude on prestige of occupation. These results suggested that the influence of aptitude occurred largely through education, and its subsequent influence on prestige of occupation.

Different from females, the predicted direct effects of father's education and father's socioeconomic status upon prestige of occupation were statistically significant for males. The path coefficient of father's socioeconomic status (.0996) upon prestige of occupation indicated that the higher the father's socioeconomic status, the higher the son's prestige of occupation. This result suggested that a benefit of a high socioeconomic background to a son's occupational achievement was great. The indirect effects of father's socioeconomic status and father's education upon prestige of occupation were, like earlier studies, mainly through education. Both of the indirect effects were positive and statistically significant.

These results suggested that the influence of a high socioeconomic background occurred largely through son's education, which subsequently affected son's occupational achievement.

For females, the predicted direct effects of father's education and father's socioeconomic status upon occupational achievement were not significant. However, the indirect effect of father's education upon prestige of occupation was significant. The indirect effect of father's education through education was over 1.5 times its direct effect. This result suggested that the influence of father's education upon occupational achievement occurred largely through daughter's education, and its subsequent influence on prestige of occupation. In addition, this result indicated that for females, the benefit of a higher socioeconomic background to prestige of occupation was negligible.

For both sexes, the positive direct effect of high school sector on prestige of occupation indicated that Catholic school students were more likely to obtain higher occupational prestige than public school students. However, the standardized path coefficients were negligibly small and were not statistically significant. On the other hand, for males, the indirect effect through education was about twice its direct effect and was significant. Catholic school students were more likely to obtain higher occupational prestige than public school students through educational attainment, suggesting that the influence of high school sector upon prestige of occupation occurred largely through education, and its subsequent influence on prestige of occupation for males. Unlike for males, for

females, the indirect effect of high school sector upon prestige of occupation was much less than the direct effect and was not significant.

As in previous studies, this study indicated that education played a crucial and the most important role in the process of occupational achievement. The long-term enduring effect of education on prestige of occupation was substantial.

Self-concept

Research questions six, seven, and eight addressed the effects of the independent variables of an earlier measure of self-concept, race, aptitude, sex, father's education, father's socioeconomic status, high school sector, educational attainment, and prestige of occupation upon self-concept. The findings of path analysis showed that self-concept measured in 1972 had the largest significant direct effect on 1986 self-concept, followed by sex, prestige of occupation, race, aptitude, and educational attainment, in order of importance. The direct effects of father's education, father's socioeconomic status, and high school sector were not statistically significant. However, the indirect effects of father's socioeconomic status and father's education were significant at the .01 level of probability.

The best zero-order predictor of self-concept was, not surprisingly, an earlier expression of self-concept measured in 1972. Most of the total association between the two measures of 1972 and 1986 self-concept was due to the direct effect. A relatively small amount of the association was due to the indirect effects

through the intervening variables of prestige of occupation, educational attainment, and high school sector upon self-concept. This result suggested that a person's adulthood self-concept was largely affected by one's childhood self-concept.

The direct effect of education on self-concept (.0347) was statistically significant at the .05 level of probability, but, of course, is negligibly small. The indirect effect of education through prestige of occupation on self-concept was over two-thirds its direct effect of education on self-concept. The sum (.103) of direct and indirect effects was about 56 percent of the total zero-order association between education and self-concept. About 54 percent of the total zero-order association between education and self-concept was a spurious association, due to correlated exogenous variables, which directly and indirectly affected education and self-concept.

Wolfle's (1988) model introduced ability and socioeconomic status of family of origin to predict self-concept. Wolfle concluded that the zero-order correlation coefficient between postsecondary educational attainment and self-esteem was .14. He added that about half of the zero-order correlation coefficient was a direct causal effect (.074) and the rest of it was a spurious effect.

In this present study, which examined longer-term effects of education on self-concept than Wolfle's (1988), the results showed a lower zero-order correlation coefficient and a smaller direct effect of education on self-concept. The smaller zero-order association was due to the differences in time: this study looked at longer-term effects. The smaller direct effect was because of differences

in time, and also because of differences in the models. The present model included the new variable of prestige of occupation between education and self-concept, which was strongly influenced by education and which strongly affected self-concept. This study suggested that education increased an affective behavior of self-concept, however, about 54 percent of the total association was a spurious association, due to correlated exogenous variables, particularly earlier measures of self-concept and aptitude, which directly and indirectly affected education and self-concept.

This study also suggested that a higher occupation increased a psychological attitude of self-concept. Like the results of Sewell's (1963) and Kohn and Schooler's (1983), the present study indicated that the direct effect of prestige of occupation upon one's psychological aptitude of self-concept was significant. However, with a long-term perspective, while controlling for earlier measures of self-concept and aptitude, the effect of prestige of occupation on self-concept was relatively smaller than the results of the previous studies. This study indicated that about one-half of the total association between occupational achievement and self-concept was a spurious association, due to common prior causal variables of education and an earlier measure of self-concept, which affected both prestige of occupation and self-concept.

Different from previous studies, this study included aptitude variable in the equation. The result showed that the higher the student's aptitude in 1972, the greater the adult's self-concept in 1986.

The direct effects of father's education, father's socioeconomic status, and high school sector were not statistically significant. However, the indirect effects of father's education and father's socioeconomic status on self-concept were significant at the .01 level of probability. Among the indirect effects of father's education, the indirect effect of father's education on self-concept through education was the greatest. This result suggested that the influence of father's education occurred largely through the respondent's education and its subsequent influence on self-concept. Among the indirect effects of father's socioeconomic status, the indirect effect of father's socioeconomic status through prestige of occupation was the greatest. This result suggested that the influence of father's socioeconomic status occurred largely through the respondent's prestige of occupation and its subsequent influence on self-concept.

The present study confirmed the results of the previous studies of Bachman et al.'s (1978) and Wolfle's (1988) on the effect of education on self-concept. As the results of Bachman, et al.'s (1978) and Wolfle's (1988), the current results indicated that the long-term effect of education on self-concept was negligible, while controlling for earlier measures of self-concept and aptitude.

Locus of Control

Research questions nine, ten, and eleven addressed the effects of the independent variables of an earlier measure of locus of control, race, aptitude, sex, father's education, father's socioeconomic ststus, high school sector, educational

attainment, and prestige of occupation upon locus of control. The findings of path analysis showed that the earlier expression of locus of control measured in 1972 had the greatest significant direct effect on 1986 locus of control followed by prestige of occupation, aptitude, and race, in order of importance. The direct effects of educational attainment, father's education, father's socioeconomic status, sex, and high school sector were not statistically significant; however, the indirect effects of these variables were significant at the .01 or .05 level of probability.

The best zero-order predictor of the 1986 locus of control was, not surprisingly, the earlier expression of locus of control measured in 1972. Most of the total association between the two measures of 1972 and 1986 locus of control was due to the direct effect. A relatively small amount of the association was due to the indirect effects through the intervening variables of prestige of occupation, educational attainment, and high school sector.

The estimated direct effect of education on locus of control (.0216) was, surprisingly, not significant. The indirect effect of education through prestige of occupation on locus of control was, however, significant and nearly twice the size of the direct effect on locus of control. Of the total zero-order association between education and locus of control, about 14 percent was direct effect and about 24 percent was indirect effect through prestige of occupation. About 62 percent was a spurious association, mainly due to mutual dependence of education and locus of control on the pre-existing locus of control and ability.

Wolfle and Robertshaw's (1982) model, which introduced ability and socioeconomic status of family of origin into the analysis, showed the zero-order correlation coefficient between postsecondary educational attainment and locus of control was .252. They said that about 20 percent of the zero-order coefficient was a direct causal effect and 80 percent was a spurious effect. In this present study, which examined longer-term effects of education on locus of control, the results showed a lower zero-order correlation coefficient, and a smaller direct effect of education on locus of control. The smaller zero-order association was due to the differences in time: this study looked at longer-term effects. The smaller direct effect was because of differences in time, and also because of differences in the models. The present model included the new variable of prestige of occupation between education and locus of control, which was strongly influenced by education and which strongly affected locus of control.

Different from previous studies, this study included aptitude variable in the equation. The result showed that the higher the student's aptitude in 1972, the greater internal the adult's locus of control in 1986.

The estimated direct effects of father's education, father's socioeconomic status, and high school sector were not statistically significant. However, the indirect effects of father's education, father's socioeconomic status, and high school sector on locus of control were significant. The indirect effects of father's socioeconomic status and high school sector on locus of control through prestige of occupation were the greatest. For father's education, the indirect effect through education was the greatest. This result suggested that the influences of

father's education, father's socioeconomic status, and high school sector occurred largely through the respondent's education or prestige of occupation and their subsequent influences on locus of control.

This study indicated that the long-term enduring effects of education on locus of control, which included a prior measure of locus of control and aptitude, were nearly nonexistent. Like previous studies (Battle and Rotter, 1963; Stephen and Delys, 1973), this study showed that the effects of socioeconomic status upon locus of control were substantial. Accordingly, the indirect effect of education through prestige of occupation was about twice its direct effect and relatively large. Therefore, it must be said that the long-term effect of education upon locus of control was not direct, but was mainly indirect through prestige of occupation.

Suggestions for Future Research

Measuring long-term effects of education has been an obvious concern for both educators and researchers. There are a considerable body of research on effects of education on cognitive skills, prestige of occupation, self-concept, and locus of control. However, there are some limitations in previous studies, either because of short-term perspectives or because of lack of controls for earlier measures of intelligence, self-concept, or locus of control.

This study served to estimate models of the enduring effects of education on cognitive skills and its subsequent effects on prestige of occuption. In addition, the models estimated the long-term effects of education on affective behaviors of

self-concept and locus of control. Since this study was a longitudinal study, it was able to examinine enduring effects of education, while controlling for earlier measures of intelligence, self-concept, and locus of control.

In conclusion, the long-term enduring effect of education was crucial to occupational prestige. In addition, education increased cognitive skills. However, with a longer-term perspective including a prior measure of aptitude, the effect was much less than the claims of previous studies. As far as affective behaviors of self-concept and locus of control were concerned, the enduring effects of education were nearly nonexistent.

However, the limitation of this study must be taken into account. The NLS respondents were not surveyed or tested until near the end of their senior year in high school. Therefore, one limitation of this study was the lack of measures of developed ability of respondents prior to entry into high school. Because this study employed secondary analysis, there may be other variables which were not included in this study, which would help to provide better understanding of enduring effects of education.

The vocabulary and mathematics achievement scores were not provided after 1979. Future study, using further follow-up studies, can test longer-term effects of education to provide better understanding in the field. The sample size used to analyze effects of cognitive skills was relatively small. Future studies with larger sample sizes are needed. Because the models used in this study were different from those used in previous studies, the results may not be directly comparable.

Independent variables may be added to or deleted from the basic model to improve explained variances in the outcome variables. For example, school variables of numbers of mathematics, English, social education courses taken; hours spent for homework; or career objectives in high school could be added. Future research with other dependent variables, such as family satisfaction, values, or contribution to society, can provide different areas of effects of education in order to provide important information for educators, administrators, counselors, teachers, parents, and students. Research using a new sample, which provides sequential longer-term effect of education than the present study, is suggested.

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