THE ENDURING EFFECTS OF EDUCATION ON VERBAL SKILLS*

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While there is abundant evidence to indicate that students make significant gains in verbal skills within school, surprisingly little is known about cognitive outcomes once individuals are separated from educational institutions. This paper develops a working causal model of the enduring effects of education which extends and elaborates Hyman, Wright and Reed's (1975) analysis. Unlike previous studies, the model developed here includes the estimated effects of intelligence measures. The data necessarily consist of a correlation matrix combined from several difference sources, primarily cross-sectional, which confound age with cohort differences. The results indicate that previous studies have seriously overestimated the enduring effects of education.

Educators hope that their efforts produce individuals with the ability to comprehend language and to use it correctly and effectively in the presentation of ideas (Bowen, 1977:55). There are a host of studies to indicate that these verbal skills increase during primary and secondary school years (e.g., Coleman, 1966a; Shaycoft, 1967). There is also abundant evidence to indicate that students make significant gains in verbal skills during college (e.g., Feldman and Newcomb, 1969; Bowen, 1977). Yet surprisingly little is known about cognitive outcomes once the individual is separated from educational institutions. As Bowen has succinctly pointed out, "Everyone knows that the half life of memorized details from academic learning is short unless the information is used frequently. What we do not know, and should investigate, is the residue left over from academic learning when the details have been lost" (1977:64). Härnqvist (1977) noted the difficulties posed by studies designed to measure the long-term effects of education, yet he too thought such research to be worthwhile.

While research on long-term effects (particularly cognitive effects) of education has been neglected, some evidence is available. What has been learned may be summarized under three headings: self-reported effects by alumni, socioeconomic effects, and social surveys of public knowledge stratified by level of education.

One approach to the question of effects of education is to ask alumni to assess the impact of college upon them. In 1968 Spaeth and Greeley (1970) surveyed 4868 persons who graduated in June 1961 from 135 accredited or large colleges and universities. The respondents were asked to rate the extent to which college affected their abilities to think and express themselves. Eighty-seven percent responded that college developed their abilities "greatly" or "somewhat" (Spaeth and Greeley, 1970:40). Pace (1974) surveyed another 8254 persons who graduated in 1950 from 74 colleges and universities. Of these, 79 percent reported that they had benefited "very much" or "quite a bit" from college with respect to vocabulary, terminology, and facts in various fields of knowledge. In 1974 Solmon, Bisconti and Ochsner (1977) surveyed a panel of 5536 white B.A. recipients. These people were asked to indicate the extent to which their college education had been useful to them in increasing their general knowledge and their ability to think clearly. Seventy-three percent said that their education was "very" useful in increasing knowledge. For increasing ability to think clearly, 42 percent responded "very" and 53 percent answered "somewhat" useful (Solmon, et

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al., 1977:58). All of these and similar studies are based upon what respondents think about their educational experience. There are obvious attendant faults with the research design, but the results at least suggest that college graduates themselves feel as if the benefits derived from their education have persisted.

Another approach to the question of the enduring effects of education is to assess the importance of education on subsequent socioeconomic achievements. In 1962, the U.S. Bureau of the Census surveyed about 20,700 men 20 to 64 years of age in order to secure data on social mobility. Analysis of these data by Blau and Duncan (1967) revealed that the single most important causal determinant of occupational status in 1962, regardless of age, was educational attainment (1967:181). Sewell and Hauser (1975) have analyzed a longitudinal study of the 1957 Wisconsin high school graduating class. They also found education to be the most important determinant of occupational status in 1964 (Sewell and Hauser, 1975:100). Unlike most mobility studies, the Wisconsin data included an IQ measure obtained prior to the time of educational differentiation; the direct influence of intelligence upon occupational achievement was small compared to the effect of education, but intelligence also affected other intervening causes of occupational achievement. In its total effect (in path analytic terms, this is the sum of all direct and indirect effects [see Alwin and Hauser, 1975]), intelligence was second only to education in its importance as a predictor of occupational status. While these and similar studies definitely deal with long-term effects of education, the outcome variables do not directly measure cognitive skills. However, Spaeth (1976) has recently interpreted occupational prestige as an indicator of cognitive complexity of occupations, and concluded that exposure to educational complexity enabled one to enter occupations that were cognitively complex; and Duncan, Featherman and Duncan (1972) have reported a correlation of .81 between socioeconomic status of occupations and a scale of intelligence which occupations were believed to demand. Once again, the evidence, while meager, suggests that education has long-term effects upon the distribution of cognitive skills.

A third source of evidence about long-term effects of education is provided by surveys of public knowledge among populations stratified by level of education. Härnqvist (1977:5) summarized one such survey, the National Assessment of Educational Progress (1976). The sample was drawn from a national population of people age 26 to 35 in 1973. The skills tested were of the type one would be expected to learn in elementary grades. Härnqvist reported that, "The frequency of correct answers was strongly related to amount of schooling" (1977:5).

Hyman, Wright and Reed (1975) presented a remarkable secondary analysis of responses to knowledge questions in public opinion surveys. Their data were obtained from 72 national samples conducted by the Gallup organization, the National Opinion Research Center, and the Institute for Social Research, between 1947 and 1974. In these surveys, people of different ages and educational attainment were polled on their knowledge of a wide variety of facts. Respondents were asked to identify prominent public figures, and to respond to questions on vocabulary, history, government, science, popular culture, and the like. On almost all questions and regardless of age, the higher the respondents' level of educational attainment the more often correct responses were given. The authors concluded that "education produces large, pervasive, and enduring effects on knowledge and receptivity to knowledge" (Hyman, et al., 1975:109).

A major analytic problem exists with analyses based on self-reported effects and public surveys of knowledge. The people who attain higher levels of education are self-selected, and the effects of education are difficult to distinguish from the bases by which people select themselves to continue their schooling. However, Hyman, et al. (1975) were able to buttress their conclusions on the effects of education by statistically controlling for variables thought to affect knowledge independent of education. The introduction of controls, one or two at a time, for sex, religion, ethnicity, geographical origin, age, socioeconomic background, and current occupational status, had little effect on the relationship between education and knowledge.

There were, however, other variables for which Hyman, et al. (1975) were unable to control. Indeed, the study's principal weakness was the authors' inability to control for early intelligence or propensity to learn (Astin, 1976; Withey, 1976). Hyman, et al. (1975:23) were not unaware of the specification problem (Duncan, 1975), and claimed correctly that the specification error was reduced to the extent that intelligence was associated with other variables for which statistical controls were possible. Nonetheless, doubts remain. A number of researchers have demonstrated that intelligence has a strong effect upon socioeconomic achievements (Duncan, 1968; Griliches and Mason, 1972; Jencks, 1972; Taubman and Wales, 1972; Sewell and Hauser, 1975; Scarr and Weinberg, 1978), and it is possible, indeed likely, that analyses of educational effects which do not include IQ variables suffer severe, but unknown, specification errors. Hyman, et al. (1975) have probably attributed effects to education that correctly belong to intelligence.

The purpose of this paper is to develop a working causal model of the enduring effects of education which includes measures of intelligence. Inclusion of IQ measures helps to eliminate specification errors which have plagued previous analyses. Unfortunately, there is no single longitudinal data source which contains all the information required, and the model described below has been estimated from correlations combined from several different sources. Thus, empirical estimates of causal effects are provided only to the extent feasible at the present time.

THE MODEL

The independent variables included in the causal model of educational effects were measures of childhood intelligence, age, sex, father's educational attainment, father's socioeconomic status, respondent's educational attainment, and adult intelligence. The dependent variable was a ten-item word test developed by the National Opinion Research Center (1976) from the Gallup-Thorndike verbal intelligence test. This classic vocabulary test of verbal intelligence (Thorndike and Gallup, 1944), of course, measures only one aspect of educational effects, but Bowen's (1977:55) inventory of educational goals gives primary importance to language skills, and the same vocabulary test comprised a part of Hyman, et al.'s (1975) analysis. Inclusion of these variables in a model of educational effects makes it possible to interpret the important social psychological processes by which people of different backgrounds are led to achieve different levels of education, and to develop adult cognitive abilities. Thus, the model presented here extends and elaborates the basic Hyman, Wright and Reed causal analysis of educational effects.

One may wonder about the propriety of including a measure of adult intelligence as a predictor of the vocabulary test score. Most intelligence tests include vocabulary subscales; intelligence and vocabulary are therefore conceptually linked. However, the criterion measure used by Hyman, et al. (1975) to which this analysis addresses itself was exactly the same vocabulary test as used in the present analysis. The question then became whether another measure of adult intelligence belonged on the right hand side of the equation. The answer is "yes." Because it is the association between educational attainment and the vocabulary test score which is of primary interest, and because adults of higher intelligence may be expected to possess a larger vocabulary independent of education, it is the effect of education on vocabulary net of intelligence which is of importance. Indeed, it was the omission of intelligence from Hyman, et al.'s (1975) analysis which led them to attribute effects to education which probably belonged to intelligence.

The model is described by a path diagram in Figure 1. The curved, double-headed arrows represent unanalyzed relationships, while the straight, unidirectional arrows represent direct paths of causal influence found to be statistically significant. In this model, educational at-

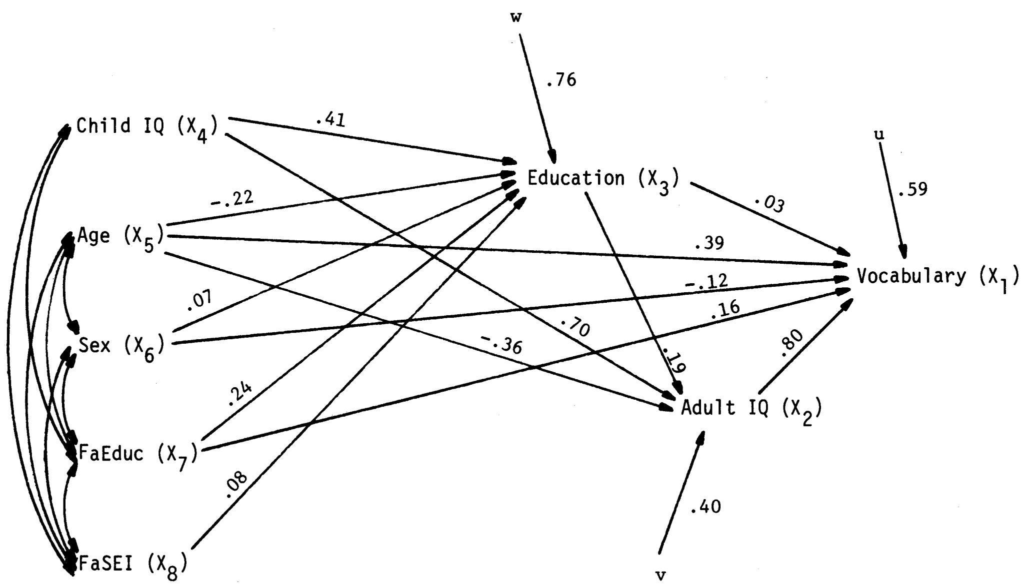

Figure 1. Recursive Path Model of Vocabulary Recognition, U.S. White Civilian Population, Age 25 to 72

tainment was considered dependent upon the respondent's intelligence as a child, the age-cohort of which the respondent was a member, the respondent's sex, and two measures of socioeconomic background—the father's educational attainment and father's socioeconomic status. In addition to the five exogenous variables, education was assumed to depend on unspecified residual factors uncorrelated with the independent variables. These five independent variables have causes exogenous to the model, and are consequently correlated for unknown, or at least unanalyzed, reasons. Two exogenous correlations, however, have been specified *a priori* to be zero, namely those between childhood intelligence and age, and childhood intelligence and sex. To entertain a nonzero correlation between childhood IQ and age would imply that intelligence of U.S. children has been changing with time, an argument of little substantive weight for which I can find no empirical support. The association between childhood IQ and sex was also assumed to be zero. Sexual differences in IQ among children have been reported, but they depend largely upon the ambiguity involved in composite scores. Boys are favored in some component tests, and girls in others. Thus, while a given test may favor one sex or the other, the differences depend upon the component parts, and in any case are usually small. If one assumes that the childhood IQ measure included in this model was a balanced, standard intelligence scale, the best guess as to the correlation between sex and IQ would have to be zero (Guilford, 1967:403).

Adult intelligence was assumed to depend directly upon education, age, childhood intelligence, and unspecified residual causes uncorrelated with these and other exogenous variables. This is equivalent to assuming that the socioeconomic statuses of the family of orientation influence adult intelligence only indirectly through their correlation with age and childhood intelligence and, along with the respondent's sex, indirectly through their influence on educational attainment. The omission of paths from father's education and socioeconomic status to adult IQ is therefore a theoretical postulate, and not an empirical finding.

The vocabulary score was seen as a function of adult intelligence, education, the respondent's age and sex, and the father's education. The model specifies that there is no direct effect of childhood intelligence on the respondent's vocabulary. The model does, however, permit childhood IQ to influence vocabulary indirectly through its influence on education and adult intelligence. This postulate is not testable with the data at hand, but seems reasonable. It is equivalent to arguing, in part, that one's vocabulary score depends on current intelligence, not earlier intelligence, except as it influences current intelligence. The omission from Figure 1 of direct effects from sex to adult intelligence and from father's socioeconomic status to vocabulary does not rest on any theoretical assumption, but reflects the empirical result that these effects were determined to be numerically negligible and statistically insignificant.

THE DATA

The model represented in Figure 1 merely represents a set of three recursive regression equations:

$$x_3 = p_{34}x_4 + p_{35}x_5 + p_{36}x_6 + p_{37}x_7 + p_{38}x_8 + w,$$
$$x_2 = p_{23}x_3 + p_{24}x_4 + p_{25}x_5 + v,$$
$$x_1 = p_{12}x_2 + p_{13}x_3 + p_{15}x_5 + p_{16}x_6 + p_{17}x_7 + u,$$

where the p_{ij} are standardized partial regression coefficients, often called path coefficients; the x_j variables represent standardized variables as labeled in Figure 1; and u, v, and w are residual factors assumed to be randomly distributed, and uncorrelated with each other and with explicitly measured variables that precede them in the model.

Direct regression routines which are usually used to estimate equations such as those above require the input or calculation of a matrix of zero-order correlations. Such matrices are usually based upon computations derived from a single sample. However, there are no longitudinal studies in which intelligence scores have been obtained for a representative sample of children, and their subsequent levels of educational, intellectual, and verbal achievements measured. It is possible, however, to complete a matrix of zero-order correlations by combining pieces of evidence from several different sources. Such procedures have been previously and successfully employed by Duncan (1968) and Jencks (1972) in models of socioeconomic achievement. Pending the completion of representative, longitudinal studies in this neglected area of educational research (Härnqvist, 1977), piecing together the correlation matrix is the only way in which to estimate the model.

Fifteen of the 28 zero-order correlations needed to complete the matrix were obtained from the National Opinion Research Center's general social surveys of 1974 and 1976. These data were collected by probability and block quota sampling techniques to represent English-speaking persons 18 years of age or over, living in noninstitutional living arrangements within the United States. The NORC general social surveys have been conducted every spring since 1972, and include a standard but changing set of questions. In 1974 and 1976 the survey included a ten-item modified version of the Gallup-Thorndike test. Responses from the two surveys were combined, and the zero-order correlations were calculated on a subset of respondents who were members of the population for which estimates were desired. The population was defined exactly as used by Hyman, et al. (1975). It included white, native-born, noninstitutionalized persons, 25 years of age or over but not over age 72; people with post-collegiate graduate degrees were excluded. There were 1240 respondents who were included in the population and who gave complete answers to the questions used in the analysis. Computation of father's socioeconomic status was accomplished by recoding the father's detailed occupation code to the Duncan (1961) socioeconomic index reported in Hauser and Featherman (1977:319). The 15 correlations derived from the NORC surveys are reported in Table 1; the key to the source of each correlation is given in the lower left corner of the matrix.

The remaining 13 correlations in Table 1 are correlations with the two measures of intelligence—variables that were not included in the NORC surveys. The correlations between childhood intelligence and age, and childhood intelligence and sex, were assumed to be equal to zero for the

Table 1. Estimated Correlations for Variables in a Model of Enduring Effects of Education for White, Native-Born People 25 to 72 Years Old in the Contemporary United States *

	Variables							
	Child IQ	Age	Sex	FaEduc	FaSEI	Educ	Adult IQ	Vocabulary
Child IQ (x_4)	—	0	0	.31	.30	.51	.80	—
Age (x_5)	b	—	.026	−.304	−.130	−.304	−.42	−.005
Sex (x_6)	b	a	—	−.054	−.058	.050	0	−.121
FaEduc (x_7)	d	a	a	—	.488	.469	.30	.302
FaSEI (x_8)	e	a	a	a	—	.347	.31	.285
Educ (x_3)	f	a	a	a	a	—	.66	.511
Adult IQ (x_2)	f	g	c	e	e	g	—	.71
Vocabulary (x_1)	—	a	a	a	a	a	h	—
Mean	—	43.60	0.44	8.92	32.65	12.29	—	6.38
Std. Dev.	—	13.51	0.50	4.04	22.30	2.66	—	2.15

* Sources: (a) National Opinion Research Center (1974, 1976).
(b) By assumption, see text.
(c) Miner (1957:85 –6).
(d) Coleman (1966b:359).
(e) Jencks (1972:322).
(f) Duncan (1968), Jencks (1972), and McCall (1977).
(g) Wechsler (1958:251).
(h) Thorndike (1967).

reasons stated above. The correlation between sex and adult intelligence was also set to zero; Miner (1957) reviewed a number of studies of sex differences in intelligence and could find no indication that intelligence consistently favored one group or the other. The correlation between father's education and childhood intelligence was taken from Coleman (1966b). He reported correlations between verbal test scores and a composite index of parental educational attainment for whites of .326 in twelfth grade, .352 in ninth grade, .312 in sixth grade, and .244 in first grade. These correlations compare to the values .27 conjectured by Duncan (1968) and .30 employed by Jencks (1972:322), but these were selected for a population of males. In this study the estimated value of .31 was used, which is both the simple average of the four values reported by Coleman, and also the value reported for sixth graders. The correlation of .30 between childhood intelligence and father's socioeconomic index was taken directly from Jencks (1972:323); despite the fact that Jencks estimated the correlation for a sample of males, no better nor more representative estimate apparently exists.

The evidence is also sparse on the association between childhood intelligence and educational attainment. Duncan (1968) re-estimated data provided by Bensen (1942), and used a correlation of .54 for his study of white males. Jencks (1972:322) examined several more local studies, and settled on a value of .55. More recent evidence from the Fels Longitudinal Study has been provided by McCall (1977). He reports correlations between IQ measured at age 11 and attained adult education to be .50 for males, and .46 for females. In light of adding women to the data set, and McCall's (1977) more recent contribution to the set of studies considered by Duncan (1968) and Jencks (1972), an estimated value of .51 was accepted as the correlation between childhood IQ and educational attainment for a national sample of white men and women.

To estimate the correlation between childhood and adult intelligence, Duncan (1968) used Bloom's (1964) finding of a correlation coefficient of .90. Jencks (1972:325) reviewed a handful of local studies and settled upon a value of .83. McCall (1977) reports correlations between intelligence measured at ages 11 and 40 in the Fels sample of .76 for men and .68 for women. In this study, the value of .80 was accepted as something of a compromise between the higher estimates used by Duncan (1968) and Jencks (1972), and the lower estimates recently reported by McCall (1977).

The correlation of −.42 between age

and adult intelligence was taken from Wechsler (1958:251). There is an extensive literature on life-span intelligence (e.g., Nesselroade, Schaie, and Baltes, 1972; Horn and Donaldson, 1976; Baltes and Schaie, 1976; Kohn and Schooler, 1978) which suggests that the negative correlation of age with intelligence is probably a methodological artifact caused by sampling people of different ages cross sectionally. When adults are measured longitudinally, their respective intelligence scores are fairly stable, particularly when not attenuated by measurement error (see Kohn and Schooler, 1978). However, there has never been any doubt that the correlation between age and intelligence measured cross sectionally for people now living is negative. Because the NORC data which comprise the majority of the correlations in the analysis are themselves cross sectional, it seems appropriate to estimate this correlation from cross-sectional data. Readers should be cautious, however, not to interpret this cross-sectional correlation as if it were longitudinal.

The correlations of .30 and .31 between adult intelligence and father's education, and adult IQ and father's socioeconomic index, respectively, were estimated by Jencks (1972:322) from the 1964 NORC veterans survey. Once again, the values pertain to men, but more appropriate estimates apparently do not exist. The work of Wechsler (1958:251) was again consulted in selecting an estimate of .66 between educational attainment and adult intelligence.

The correlation between adult intelligence and the vocabulary score was calculated from information kindly provided by Robert L. Thorndike (1967). He reported on two normative studies by Irving Lorge conducted among Army enlisted men who were administered the AGCT and the Vocabulary-GT. Correlations of .70 and .77 were reported for Forms 1 and 2, respectively. These two values were averaged (.74), and to this value the Spearman-Brown correction of test length was applied (because NORC used only half the items) using Thorndike's revised estimate of the test's reliability (Miner, 1957:50). These computations resulted in a revised correlation of .71 between adult intelligence and the NORC vocabulary score.

The correlation between childhood intelligence and vocabulary score is unknown. No evidence exists. Fortunately, the value of the correlation is not necessary to estimate the coefficients for the model as given. However, with knowledge of the standardized partial regression coefficients and assuming the model is correct, the fundamental theorem of path analysis (Duncan, 1966:5) may be used to estimate this value. This result will be discussed on the following pages.

RESULTS

The results are shown in Figure 1 in the form of estimated standardized partial regression coefficients. The regression of educational attainment on the five exogenous variables, and the regression of adult intelligence on education, age, and childhood IQ, produce results that for the most part replicate well-known relationships among social origins, early and adult intelligence, and schooling. Duncan (1968) and Jencks (1972), for example, each employed slightly different models than analyzed here, yet the results are comparable. Despite slightly different models, differences in results could in any case be caused by sampling fluctuations. Because these effects have been thoroughly discussed elsewhere, there is no need to emphasize them here.

The regression of vocabulary score on adult IQ, educational attainment, age, sex, and father's education confirmed our *a priori* expectations. Adult intelligence was expected to show a strong effect on the vocabulary score for obvious reasons. Adults of greater intelligence should score better on any language skills test than would those who were not so intelligent. The path coefficient of .80 confirmed this expectation. Father's education was also hypothesized to have a positive effect on vocabulary. People who were exposed to parents of greater educational attainment apparently acquired language skills early in life that years later produced higher results on the vocabulary test; the coefficient was .16.

Sex (coded 1 for men and 0 for women) was hypothesized to have a slightly negative effect on vocabulary. The usual procedure in constructing measures of intelligence is to combine items and subtests in a way that minimizes sex differences. Indeed, it was this practice that led to the acceptance of an estimated zero correlation between sex and adult intelligence. However, data reported by Wechsler (1958:144) show that there are subtests on the WAIS that are easier (or more difficult) for one or the other of the sexes. Among the subtests reported by Wechsler (1958:147) was the vocabulary—one of three subtests in which women achieved higher mean scores. Accordingly, women were expected to score higher on the NORC vocabulary test. The standardized coefficient of $-.12$ confirmed the hypothesis; in metric terms, women scored about one-half point higher on the ten-item vocabulary test than did men, *ceteris paribus*.

Age was hypothesized to have a positive effect on vocabulary. The theory of fluid and crystallized intelligence (e.g., Horn and Cattell, 1967) is that fluid intelligence declines in adulthood, whereas crystallized intelligence increases. The tasks which define crystallized intelligence include vocabulary (Horn and Cattell, 1967:111). Therefore, older age cohorts were expected to score higher on the vocabulary test. The zero-order correlation coefficient between age and vocabulary was nearly zero, but the standardized partial regression coefficient was a postive .39. Apparently, the zero-order effect is nearly zero because age has negative effects upon education ($p_{35} = -.22$) and adult intelligence ($p_{25} = -.36$). When the indirect effects of age on vocabulary through education and adult IQ are computed according to the standard rules for disaggregating effects in path models (Finney, 1972), they sum to $-.33$. Thus, when the direct, indirect, and joint associations are summed, the result is nearly zero. In substantive terms, when the partial effect of age on vocabulary is separated from the effects of lowered educational attainments and general intelligence among older age cohorts, it is apparent that the older one gets, the greater are the vocabulary skills.

Finally, the effect of education on vocabulary was considered. All previous evidence indicated this effect would be strong and positive. Hyman, et al. (1975), for example, concluded that "education produces large, pervasive, and enduring effects on knowledge and receptivity to knowledge" (1975:109). Using correlational methods, they found a zero-order coefficient of .31 between education and a vocabulary test administered by NORC in 1966 (Hyman, et al., 1975:157). The equivalent partial correlation coefficient controlling for social origins was .25, a reduction of about 20 percent. However, the causal models they implicitly employed were seriously misspecified in that they were unable to control for the respondent's intelligence. Inclusion of such measures in the model presented in this paper was expected to result in a further reduction of the measured effect of education on vocabulary.

The estimated direct effect of education on the vocabulary test was in fact quite small. In metric terms, one additional year of schooling resulted in an increase of .02 points on the vocabulary test, *ceteris paribus*. However, the total effect of education was greater due to the indirect effect of education through adult intelligence. Indeed, this indirect effect was five times the size of the direct. The sum of these direct and indirect effects ($.03 + .19 \times .80$) was about one-third of the zero-order coefficient. In contrast to Hyman, et al. (1975) then, these results indicate that nearly two-thirds of the zero-order association between educational attainment and vocabulary skills was a spurious association due to correlated exogenous variables (including childhood IQ) which directly and indirectly affect education and vocabulary.

One may now speculate about the zero-order association of childhood intelligence and vocabulary recognition as an adult. Assuming the model represented in Figure 1 to be correct, the fundamental theorem of path analysis (Duncan, 1966:5) may be employed to estimate the correlation implied by the model and the estimated results. The implied correlation coefficient is .70.

DISCUSSION

I have tried to compare the results of this study with those of other similar studies, but without much success. None of the other studies of enduring educational effects used models incorporating measures of intelligence. Studies that have included measures of intelligence (Duncan, 1968; Jencks, 1972) were concerned with socioeconomic achievement, not cognitive development. One cannot therefore be certain that differences between previous studies and this one were due to specification errors, changes in the causal models, changes in the measurement scales, or the assumptions underlying the correlations included in Table 1. The results of this study are therefore conditional until confirmed by longitudinal studies in which intelligence scores are obtained for a representative sample of children, and their subsequent levels of educational, intellectual, and verbal achievements are measured.

Hyman, Wright and Reed (1975) based their study on the same population as employed in this one, but they were unable to control for respondent's intelligence. They were able to compute the partial correlation of education and vocabulary controlling for social background. The partial coefficient was reduced by only 20 percent, misleading them to conclude education had large effects upon vocabulary knowledge. If one assumes the model employed in this paper is correct, and accepts the model's implied correlation of 70 between childhood intelligence and adult vocabulary, then the partial correlation coefficient may be calculated between education and vocabulary controlling for social background *plus* childhood intelligence. The calculation yields a partial coefficient of .26, a reduction of nearly 50 percent. When these results are compared to Hyman, et al (1975) one is led to believe that omitting measures of intelligence prior to schooling yields models that are seriously misspecified. This problem was not unrecognized by Hyman, et al., but the specification problem led them to attribute effects to education that were spuriously caused primarily by childhood intelligence, and other effects that should probably be considered to occur indirectly through adult intelligence. The zero-order correlation coefficient of education and the vocabulary test was .51. Of this value, 65 percent may be considered a spurious effect of correlated prior background variables. Another 29 percent occurred indirectly through adult intelligence. A mere 6 percent of the zero-order association was found to be a direct, long-term effect of education.

The model analyzed here included a measure of adult intelligence, and its influence may help to understand the mechanism by which long-term educational effects were manifested. Yet the interpretation of effects of education on vocabulary directly, and indirectly through adult intelligence, poses a major puzzle. The variable adult intelligence was not explicitly measured. Instead, it was included by estimating its correlations with other variables in the model. If one assumes the measure of adult intelligence was obtained contemporaneously with the measure of vocabulary, then the causal determinacy between the two variables is uncertain because verbal skills are part of what is meant by intelligence. Thus, the relatively high correlation of education and adult IQ compared to the correlation of education and vocabulary may result from the vocabulary measure being an attenuated version of adult IQ, and no causal interpretations are warranted. On the other hand, if one assumes adult IQ was measured sometime between the completion of education and the measurement of vocabulary, then a substantive interpretation is possible. The direct influence of education on vocabulary was small. Whatever one learns in one additional year of schooling, it has little direct bearing upon one's knowledge of vocabulary some years later. However, education does increase one's general intelligence, and the indirect effect of education on vocabulary through adult IQ was important—five times the size of the direct effect. This is the interpretation I would like to draw—that education's primary effect is a generalized development of adult cognitive skills, not necessarily the retention of specific bits of knowledge. However, the constructed data employed here do not allow this particular conclusion to be made unambiguously.

The effects of childhood IQ posed no ambiguities. In comparison to the work of Hyman, Wright and Reed (1975), we have seen that childhood IQ is a useful variable to employ in the explanation of cognitive abilities at some later time. Indeed, it is crucial, for its exclusion will lead to serious overestimates of the effects of other variables, particularly educational attainment.

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THE OPEN CLASSROOM IN CROSS-CULTURAL PERSPECTIVE: A RESEARCH NOTE*

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The present study explores some of the differences in open classrooms as they are being implemented in the U.S., Great Britain, and Israel. Data from classroom observations carried out in these countries are compared in order to highlight dimensions that are common across all the countries, as well as features that are unique to a specific national setting. The comparison is discussed in light of psychological, social, and ideological variations, and how the implementation of an innovation, such as the open classroom, may reflect these differences.

The subject of open classroom education has gained increasing recognition from both theorists and researchers over the last decade (for example, Weber, 1971; Walberg and Thomas, 1972; Wilson, Stuckey, and Langevin, 1972; Silberman, 1973; Traub, Weiss, and Fisher, 1974; Sullivan, 1974; McPartland and Epstein, 1977). Many of these studies reflect a general consensus that open classrooms share a common set of characteristics distinctly setting them off from what are called conventional school settings. Hill (1975), however, presents a different approach which focuses on the heterogeneity to be found in open classroom programs.

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