
Schooling, Intelligence, and Income

Stephen J. Ceci and Wendy M. Williams
Cornell University

In this article, the authors examined the evidence for linkages among 3 variables: schooling, intelligence, and income. They concluded that intelligence and schooling have a bidirectional relationship, with each variable influencing variations in the other. Moreover, changes in both schooling and intelligence influence variations in economic outcomes. Although any single study of the interdependency of these 3 variables can be criticized on the grounds that the data are correlational—and consequently are open to alternative interpretations—when viewed together, the evidence for their linked causality is quite convincing: Each increment in school attendance appears to convey significant increases not only in economic and social returns but also in psychometric intelligence. Thus, the value of schooling appears to extend beyond simply schooling's direct effect on income.

The word is out: The benefits of staying in school are pervasive. School attendance is associated with lower rates of teen pregnancy, welfare dependency, and criminality proneness, to name only a few of the myriad advantages of staying in school (Bronfenbrenner, McClelland, Wethington, Moen, & Ceci, 1996). High school graduates will earn \$212,000 more than nongraduates over their lifetimes, and each additional year of school attainment is associated with increasing income. For example, college graduates will earn \$812,000 more than high school dropouts, and graduate students with professional degrees will earn nearly \$1,600,000 more than college graduates (Bronfenbrenner et al., 1996).

These economic benefits of school attendance are clear and unambiguous. What is less clear, however, is the reason for them. Why, exactly, does schooling increase income? To some, staying in school is related to later earnings because it is primarily a marker for intelligence. According to this view, the reason more schooling leads to higher income is primarily because people who complete more schooling were more intelligent before they even entered school and because intelligence both directly and indirectly conveys tangible economic benefits. It is well documented that those who drop out of high school tend to score lower on intelligence tests than do those who graduate, and it is also known that they earn less income (Bronfenbrenner et al., 1996). Because of these facts, the correlation between school attendance and earnings could be due to a combination of two effects: (a) the indirect effect that intelligence exerts on economic

outcomes (because intelligent workers are rewarded for the skills they display in training and in doing their jobs) and (b) the direct effect that schooling has as a result of minimum entry-level educational standards required for getting certain jobs (e.g., Scarr, 1992).

Although all serious scholars agree that no single factor accounts for the entire advantage that schooling contributes to economic success, several researchers have suggested that the indirect route through which general intelligence mediates school performance, and consequently employment success, is prepotent (see, e.g., Gottfredson, in press; Rushton, 1997). When intelligence is statistically controlled, very little of the variance in job success is accounted for by schooling: "Average validity coefficients for educational level (0.0 to 0.2) are inconsequential relative to those for general intelligence" (Gottfredson, in press; also see F. Schmidt, 1996).

Recently, in *The Wall Street Journal*, there was a heated exchange of letters and editorials regarding a new personnel test for the selection of police officers. F. Schmidt (1996) argued that general intelligence reigns supreme in accounting for occupational success in a wide range of settings, even among applicants possessing a minimum of two years of college: "Eighty years of research shows that general intelligence is the best predictor of both performance in training and performance later on the job" (p. A23). And in perhaps the best documented validity study to date, Hunter (1983) reported that differences in intelligence accounted for 29% of the variance in job-performance ratings when the ratings were corrected for unreliability. Thus, intelligence was far more powerful as a predictor of job success than any other variable Hunter considered.

The high predictive validity of intelligence for job success suggests that the association between schooling and job success may be due to the mediating role that intelligence plays in schooling, with more intelligent students being reinforced for staying in school longer. This account is consistent with the high correlations generally found between measures of intelligence and the amount of schooling one receives—.60 for White males in the data set used by Herrnstein and Murray (1994), .55 in a recent report by a task force established by the American

Correspondence concerning this article should be addressed to Stephen J. Ceci or Wendy M. Williams, Department of Human Development, Cornell University, MVR Hall, Ithaca, NY 14853. Electronic mail may be sent to sjc9@cornell.edu or wmw5@cornell.edu.

Psychological Association (Neisser et al., 1996), and between .50 and .90 in Ceci's (1991) review of 16 studies.

Thus, the high correlation between general intelligence and years of schooling is consistent with the position some have taken that achievement in school is driven by native intelligence rather than by background variables that are external to the organism:

Being poor has a small effect on dropping out (of high school) independent of IQ . . . [and] youngsters from poor backgrounds with high IQs are likely to get through college these days, but those with low IQs even if they come from well-to-do backgrounds are not. (Herrnstein & Murray, 1994, p. 143)

The high correlation between general intelligence and years of schooling also implies that if higher IQ students did not attend school, they would, on average, nevertheless earn more than their lower IQ peers—even if the latter stayed in school longer. Put simply, this view says it is intelligence that is mainly responsible for students staying in school and for people achieving higher earnings, a position in accord with Herrnstein and Murray's analysis of the drastic reduction in predicting poverty that resulted when they controlled for general intelligence—by as much as 80% (p. 334). Thus, the fact that years of schooling and IQ are correlated is seen by proponents of this view as evidence that teachers and parents recognize and reward students who possess high IQs. This attention to high-IQ students reinforces students' decisions to remain in school, where they may acquire more job-related skills and better entry-level credentials. Also, because they are more intelligent, they often will do better in future jobs than will their less intelligent peers.¹

Although the majority of serious scholars in the field of intelligence realize that intelligence does influence the decision to stay in school, some may not realize that staying in school can itself elevate one's IQ—or, more accurately, prevent it from slipping. For example, elsewhere Ceci has shown that each additional month a student remains in school may increase the student's IQ score above what would be expected if the student had dropped out (see Ceci, 1991, for a review of the historical literature). The proposition that schooling increases IQ—instead of simply IQ influencing the decision to remain in school—is surprising to anyone who views IQ as a measure of innate intelligence, associated with brain size and various other neurobiological indicators (see Rushon, 1997, for evidence that IQ is related to brain size, the latter being related to occupational status as well).

Some theories do postulate the enhancement of intelligence as a function of schooling, most notably Cattell's Gf-Gc (see Horn, 1994), but for reasons we describe later, such theories are unable to explain the data we describe here.

There are at least seven types of evidence for the proposition that staying in school elevates IQ. We review these seven types of evidence, drawing support from classic studies from the earlier half of this century. In our

review, we focus on the path that leads from school attendance to increases in intelligence test scores, not because we believe that this is the sole causal route to economic success but rather because until recently there existed a cadre of researchers who doubted that this route played any important role at all (Ceci, 1991). Following this brief historical review, we attempt to link changes in both schooling and intelligence test scores to changes in economic outcomes. Our goal is to better inform the study of economic outcomes by clarifying the interdependent nature of schooling and IQ.

Seven Types of Historical Evidence for the Effect of Schooling on IQ

How exactly does staying in school elevate IQ? Let us consider the seven types of evidence we have uncovered in our excavation of some older studies that are often overlooked by modern researchers.

First Type of Evidence: The Effect of Intermittent School Attendance

The earliest example of the influence of schooling on IQ scores was reported by Freeman (1934). At the turn of the century, the London Board of Education commissioned Hugh Gordon to study a group of children who had very low IQs. Some of these children were found in London classrooms, whereas others attended school only intermittently—either because of their physical disabilities or because of their status as sons and daughters of gypsies, canal-boat parents, and so forth. In Freeman's words,

further analysis revealed the impressive and startling fact that the intelligence quotients of children within the same family decreased from the youngest to the oldest, the rank correlation between the intelligence quotients and chronological age being $-.75$. Not only that, but the youngest group (4 to 6 years of age) had an average IQ of 90, whereas the oldest children (12 to 22) had an average IQ of only 60, a distinctly subnormal level. . . . The marked and steady decrease in intelligence with increasing age suggests that factors other than heredity are at work. . . . The younger children appear to be about "normal" in intelligence, because success in the tests of the earlier years does not depend upon the opportunity for mental stimulus and exercise such as is offered by the school. . . . The results of the investigation suggest that without the opportunity for mental activity of the kind provided by the school—though not restricted to it—intellectual development will be seriously limited or aborted. (p. 115)

¹ Obviously, there are some jobs for which school learning is important (e.g., no one wants to be operated on by someone who has not attended medical school, regardless of how high the person's IQ is). In contrast, many jobs require high school and college diplomas that do not guarantee actual job-relevant knowledge; rather, such diplomas reflect discipline, stick-to-itiveness, and sundry other forms of motivation. At the statistical (aggregate) level, the claim is that intelligence is associated with gains in earnings, net any and all such contributions due to schooling.

Freeman's (1934) conclusion was bolstered by data from the children of gypsies, who also attended school intermittently. There was a high negative correlation between IQ and chronological age, as was the case for physically handicapped youngsters. Note that this is in the opposite direction of the often-reported fact that first-born children possess higher IQs than their younger siblings (Zajonc & Bargh, 1980). Thus, the longer youngsters stayed out of school, the lower were their IQs.

The next study of the influence of intermittent schooling on IQ was carried out in 1932 by Sherman and Key. They studied children reared 100 miles west of Washington, DC, in "hollows" that rimmed the Blue Ridge Mountains. Some of the hollows were more remote than others. The ancestors of these "hollow children" were Scottish-Irish and English immigrants who retreated into remote regions of the mountains when their land was deeded to German immigrants in the 19th century. They remained in these hollows for several generations.

Sherman and Key (1932) assumed that the original genetic pool of the people in the different hollows was very similar. They selected four of the hollows for study on the basis of their differing levels of isolation from modern communities. They also studied a fifth hollow, Briarsville, that had been settled by the same Scottish-Irish stock as the others but that was situated at the foot of the mountains rather than in an isolated area and had schools in session nine months of the year. Thus, Briarsville represented a sort of baseline against which the effects of isolation associated with the more remote hollows could be evaluated.

Colvin, the most remotely situated of the hollows, had no movies or newspapers and virtually no access roads to the outside world. There was a single school, but it was in session intermittently, a total of only 16 months out of 127 months between 1918 and 1930. Only three of Colvin's adults were literate, and physical contact with the outside world appears to have been nonexistent. The other three hollows were progressively more modern. They had varying levels of contact with the outside world (Sherman & Key, 1932).

Sherman and Key (1932) observed that the IQ scores of the hollow children fluctuated systematically with the level of schooling available in their hollows. Advantages of 10–30 points were found for the children who received the most schooling. Also, there was a dramatic age-related trend in IQ levels: the older the child, the lower was his or her IQ. Six-year-olds' IQs were not much below the national average, but by age 14, the children's IQs had plummeted into the mentally retarded range. In a later study, Tyler (1965) reached a similar conclusion. She reported that the IQs of children born in 1940 in a mountainous area of Tennessee were, on average, 11 points higher than the IQs of their siblings born in 1930. She rejected a genetic explanation for this improvement in favor of one that emphasized the increased educational

and economic opportunities that developed during the decade in question.

Similar "cumulative deficits" in IQ with age have been reported among African Americans and British working-class youths (Jensen, 1980; Vernon, 1969; Wiseman, 1966). Also, Douglas (1964) showed that the average difference between the IQs of differing social classes became larger with age. All of these studies share a focus on the systematic changes in IQ scores with the amount of schooling that a child receives. All show that the average child started out with an IQ in the average range but became progressively lower in IQ as a function of the cumulative effects of intermittent schooling. Thus, studies of intermittent schooling provide evidence for a causal link between schooling and IQ.

Second Type of Evidence: The Effects of Delayed School Start-Up

In an investigation carried out in South Africa, Ramphal (as cited in Vernon, 1969) studied the intellectual functioning of children of Indian ancestry whose schooling was delayed for up to four years because of the unavailability of teachers in their village. Compared with children from nearby villages inhabited by Indian settlers of similar genetic stock who were fortunate enough to have teachers, children whose schooling was delayed experienced a decrement of five IQ points for every year that their schooling was delayed.

Other studies also have documented the deficit in IQ scores that accompanies delayed school start-up. For example, in The Netherlands during World War II, many schools were closed as a result of the Nazi occupation, and many children entered school several years late. These children's IQs dropped approximately seven points, probably as a result of their delayed entry into school (DeGroot, 1951). Fortunately, much of this decrement was ultimately recovered by those who remained in school.

A half decade later, W. H. O. Schmidt (1967) reported results similar to those of Ramphal (as cited in Vernon, 1969) in his analysis of a different South African community of East Indian settlers. W. H. O. Schmidt measured the impact of schooling on both IQ and achievement, holding constant age, socioeconomic status (SES), and parental motivation. With age held constant and SES and motivation partialled out, the correlation between the number of years of school attended and IQ was .49 for a measure of nonverbal intelligence and .68 for a measure of verbal intelligence. In addition, W. H. O. Schmidt reported a correlation of .51 between schooling and scores on the Raven's Progressive Matrices. (Raven's Progressive Matrices are considered to be an excellent measure of general intelligence, or *g*.)

W. H. O. Schmidt (1967) also found that even after children had been in school for several years, those who began school late had substantially lower IQs than those who began school early—another instance of a cumulative deficit. Finally, W. H. O. Schmidt reported that the

correlation between the number of years of schooling completed and achievement test scores (vocabulary and arithmetic) was no higher than that observed between schooling and IQ. This equality of correlations seems to suggest that IQ scores are just as influenced by schooling as is something that is assumed to be explicitly taught in school, namely, academic achievement (Howe, 1972). These results, viewed together with others that we mention shortly, strongly suggest that schooling exerts a substantial effect on IQ that is independent of parental motivation or SES (see also Kemp, 1955; Wiseman, 1966). Moreover, none of the findings support the proposition that the IQ-schooling relationship can be attributed to intelligent children beginning school earlier or staying in school longer or to any form of increased outbreeding. Thus, studies of the effects of delayed school start-up also suggest a causal relationship between schooling and IQ.

Third Type of Evidence: The Effect of Remaining in School Longer

There is no a priori reason for thinking that people born on a given day of the year are smarter than people born on any other day. What systematic variable could be responsible for men born on, say, July 9, 1951, being more intelligent than men born on, say, July 7, 1951? No ready explanation comes to mind. Consider, though, that toward the end of the Vietnam War, a draft priority score was established by lottery. For a given birth cohort, each day of the year was assigned a number from 1 to 365. If a man's number was low, his chance of being drafted was heightened if he did not have a student deferment or a medical exemption. For those with very low numbers, staying in school was a sure way to avoid being drafted. It is well established that men born on July 9, 1951, stayed in school longer, on average, than their peers born on July 7, 1951. July 9th happened to be the Number 1 draft date for men born in 1951, whereas July 7th happened to be the Number 365 draft date.

As a result of extra schooling to avoid military service, men born on July 9th earned approximately a 7% rate of return on their extra years of schooling (Angrist & Krueger, 1991). This figure of 7% was very close to the estimate of the return on an extra year of schooling derived from studies of being born early or late in a given year (see Neal & Johnson, as cited in Heckman, 1995). Because of the nature of such experiments, it is possible to be fairly confident that the wage-schooling gap was not due to differences in native intelligence between men born on these two days. Instead, the differences in the amount of schooling of men with comparable intellectual potential led to significant differences in economic outcome. Thus, studies of the effects of remaining in school on subsequent earnings, although not demonstrating a direct causal effect of schooling on IQ, do imply such a link, because IQ, which is associated with variance in earnings, was presumably the same for both groups prior to their divergence in schooling. Of course, this is sur-

mise; the relevant IQ data to test this hypothesis are nonexistent.

Fourth Type of Evidence: The Effect of Discontinued Schooling

Researchers have demonstrated the detrimental effect of dropping out of school before graduating (DeGroot, 1951; Husen, 1951; Lörge, 1945). In Harnqvist's (1968) study of Swedish male adolescents, he selected a 10% random sample of the Swedish school population born in 1948 who at the age of 13 were given IQ tests. When they reached the age of 18 (in 1966), 4,616 of these Swedish men were retested as part of their country's national military registration. Thus, this study was not vulnerable to the usual sampling criticisms.

Harnqvist (1968) compared adolescents who were similar on IQ, SES, and school grades at age 13 and determined the impact of dropping out of school. He found that for each year of high school (gymnasium) not completed, there was a loss of 1.8 IQ points, up to a maximum difference of nearly 8 IQ points between two adolescents who were similar in IQ, SES, and grades at age 13 but who subsequently differed in the amount of schooling completed by up to 4 years of high school. (Similar findings were reported by both DeGroot [1951] and Husen [1951], using different samples and analytical procedures. In Husen's study, a comparison of 613 Swedish boys who had been tested in the third grade in 1938 and again at the time of military registration in 1948 indicated that completing junior high school was associated with a 3-point advantage whereas completing secondary school yielded an 8-point advantage.) Thus, studying the effects of discontinued schooling also provides evidence for the effect of schooling on IQ.

Fifth Type of Evidence: The Effect of Summer Vacations

A special case of the disadvantages of early school leaving can be seen in the lives of every American child during summer vacation. Two independent studies have documented, with large samples, the systematic declines in scores that occur during the summer months (Hayes & Grether, 1982; Heyns, 1978). These declines are not large, but they are undeniable: With each passing month away from school, children lose ground from their end-of-year scores on both intellectual and academic tests. The declines are especially pronounced for those children whose summers are least academically oriented. Thus, by looking at children's performance as a function of time away from school for vacations, evidence is found once again for a causal relationship between schooling and IQ.

Sixth Type of Evidence: The Effect of Early-Year Birth Dates

Consider the effect on intelligence of being born early versus late in the year. A naturalistic experiment again sheds light on the intellectual benefit of attending school.

Most states have restrictions on the age at which students can enter schools as well as policies mandating compulsory attendance until age 16 or 17. Neal and Johnson (as cited in Heckman, 1995) examined the relationship between IQ and the number of years of schooling completed. Within a given birth year, the number of years of schooling completed are the same for those born during the first nine months of the year, but the amount of school attendance drops off for those born during the final three months of the year. This is because these individuals are statistically more likely to enter school a year later as a result of having been born too late in the year for entry with the rest of their birth-year cohort. Eventually, these individuals come of age at a point when they have been in school one less year than the rest of their birth-year cohort. After coming of age, some individuals leave school. Hence, students with late-year births are more likely to stay in school one year less than students with early-year births because students with late-year births reach the age for school leaving (16 or 17 years) after one less year of school attendance.

Viewed from this perspective, a child born during the last three months of the year can be seen as belonging to a different cohort than a child born during the first nine months of the year. Neal and Johnson (as cited in Heckman, 1995) showed that for each year of schooling that is completed, there is an IQ gain of approximately one-quarter standard deviation (i.e., 3.5 points). Students with late-year births, as a group, show this effect because their group IQ score is lower.

Given the random processes involved in being born early versus late within a given year, one can assume that the genetic potential for intelligence is the same in these groups. The cause of lower IQs among students with late-year births is entirely a function of their being more likely to attend school one less year than their peers born during the first nine months of the year. In addition, Angrist and Krueger (1991) found that those who spent an extra year in school earned between 7% and 10% more than their peers who dropped out a year earlier but at the same chronological age. Thus, by looking at children born at different times in the year, one finds more evidence supporting a causal relationship between schooling and IQ.

Seventh Type of Evidence: Cross-Sequential Trends

One of the best documented studies of the effect of schooling was actually intended as a methodological demonstration of cohort-sequential analysis rather than as a study of the effect of schooling per se. Baltes and Reinert (1969) randomly sampled 630 children from 48 elementary schools in Saarbrücken, Germany. Three cross-sections of 8–10-year-olds who were separated in age by 4-month intervals were administered a German version of the Primary Mental Abilities Test (Thurstone & Thurstone, 1962). Because the German school system at that time required entering children to be 6 years of age by April 1, it was possible to compare same-aged children

who had received up to a year difference in schooling. For example, a child born in March who was 8 years and 2 months old in May could be compared with a child born in April who was 8 years and 2 months old in June. The former child would have received an additional year of schooling by the time he or she was 8 years old. Baltes and Reinert found a substantial correlation between the length of schooling completed and intellectual performance among same-aged, same-SES children. In fact, highly schooled 8-year-olds were actually closer in mental abilities to the least schooled 10-year-olds than they were to the least schooled 8-year-olds! Thus, this seventh type of evidence provides additional support for the influence of schooling on IQ.

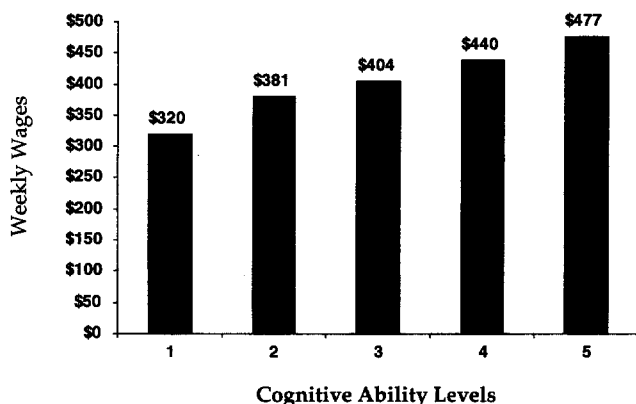
Contrasting the Roles of Schooling and IQ in Economic Outcomes

Now that we have provided seven forms of evidence supporting the effects of schooling on IQ, we return to an observation we made at the beginning of this article. It is well documented that IQ influences earnings and that schooling also influences earnings. But are these two effects independent? Consider an empirical example of IQ's effect on schooling and schooling's effect on IQ. How does the relationship between schooling and IQ inform the analysis of why some people earn more than others?

At the outset of this article, we described the hypothesis that schooling is a marker for IQ and, therefore, that the reason school attainment is associated with economic outcomes is because of the "long reach" of IQ, because workers who score higher on IQ tests get more valued positions and get promoted in them faster than their lower IQ peers. None of the seven types of evidence we reviewed disconfirm this hypothesis (i.e., that IQ influences job performance and advancement). In addition, it is easy to find evidence that differences in intelligence are responsible, in part, for the length of time someone remains in school. As seen below, intelligence test scores differ among students at any given level of schooling.

At each level of schooling completed—graduating from high school, junior college, four-year college, and so on—there are pronounced differences in intellectual ability among students at the same level. Some high school students function at higher levels of verbal and mathematical ability than do others, and the same is true for college graduates. So, regardless of the intellectual advantage conveyed by staying in school, the across-the-board IQ boost cannot account for the fact that smarter students may stay in school longer, on average. Nor can this school-induced increase in IQ explain the substantial differences in intelligence that exist among students at the same level of education. There will always be individual differences in intelligence. So, we are left wondering whether the differences in earnings associated with staying in school are due to inborn differences in intelligence rather than to variations in schooling. Below, we suggest that the picture is more complicated than this simple assertion, and we conclude

Figure 1
Weekly Wages by Level of Cognitive Ability



that both schooling and intelligence make independent contributions to lifetime earnings.

Consider the data on IQ, schooling, and earnings represented in Figure 1. As can be seen in Figure 1, even among those with comparable levels of schooling, the higher a person's level of intellectual ability, the higher will be that person's weekly earnings. As shown in this figure, there is a linear trend for a rise in earnings to be associated with increasing cognitive ability. Workers with the lowest level of intellectual ability earn only two thirds of what workers at the highest level earn. Because differences in schooling are statistically controlled in Figure 1, the source of the rise in earnings must be due to some other factors, such as variations in intellectual ability.

Differences in intellectual ability level do not entirely explain who earns more income. In Figure 2, we disaggregated the data from Figure 1 according to the verbal aptitude scores of students. It can now be seen that higher levels of school attainment are associated with higher weekly earnings, regardless of differences in level of intellectual ability. For example, high school graduates who possess the same level of verbal ability as college graduates nevertheless earn approximately 31% less income. And the same is true for every other ability level we have studied. Schooling appears to provide a credential that is needed for entry into certain high-paying jobs. But success in these jobs may have little to do with the intellectual ability level per se of job applicants. In short, two people may reason equally well and may possess similar knowledge, but the person who went to college will earn substantially more than the person who did not go to college. College graduates get better jobs than nongraduates, independent of their ability levels.

Conclusion: The Interdependency of IQ, Schooling, and Income

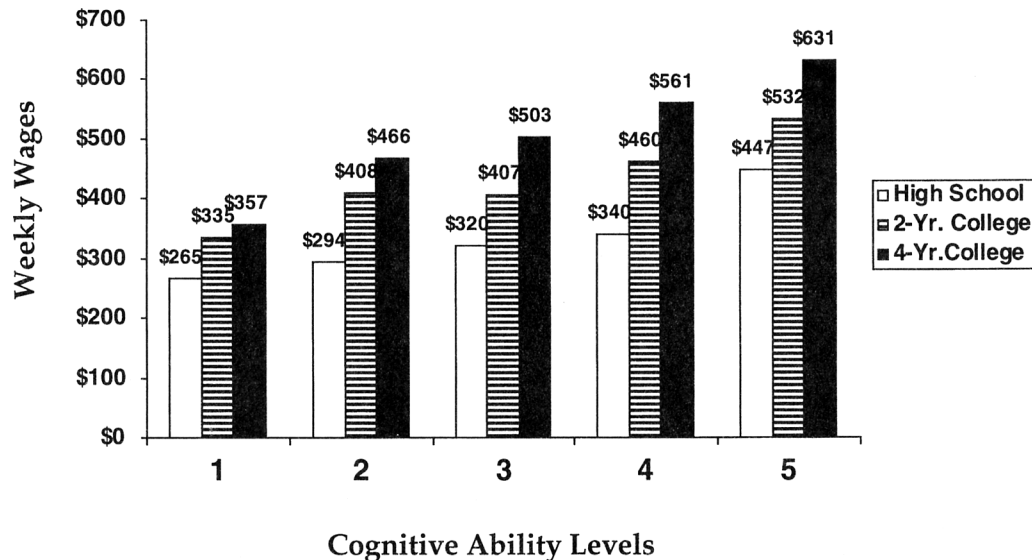
It is hardly a novel idea that both school attendance and intelligence seem to influence economic outcomes; vari-

ants of this position have been around for much of this century, although it has been difficult to disentangle their causal pathways (Ceci, 1991). In this article, we have presented some unexpected evidence that shows that variation in the amount of schooling completed is related not only to variation in intelligence test scores but also to variation in economic outcomes.² Both the relationship between schooling and earnings and the relationship between intelligence and earnings are influenced by the joint relationship between schooling and intelligence. In turn, this relationship may be the result of the action of a third variable, one having to do with temperament or personality: Consider that both school attainment (mean number of years of schooling completed) and intelligence are highly heritable, both heritability coefficients (h^2 s) between .60 and .80 (see Herrnstein & Murray, 1994, for data on the heritability of intelligence). Perhaps some variable such as hyperactivity or disposition tends to influence how long one stays in school as well as how well one does on an IQ test. It remains for future research to tease apart such variables.

In view of the data presented in Figures 1 and 2, the economic advantage associated with schooling cannot be reduced solely to the long reach of high IQ among students with more schooling, any more than the economic advantage of having a high IQ can be reduced solely to having stayed in school longer. In addition to

² Some theories of intelligence, most notably Cattell's theory of Gf-Gc (see Horn, 1994), could be invoked to account for the differential effect of schooling and IQ on economic outcomes, as suggested by one of the reviewers. Cattell envisioned crystallized intelligence (Gc) as more responsive to the environment, including schooling, than fluid intelligence (Gf), which is presumed to be relatively more influenced by neurological development. Extensive statistical evidence supports this distinction, involving the factoring of more than 40 so-called primary cognitive abilities into approximately 10 so-called family factors, which in turn can be factored into the Gf-Gc second-order distinction. (The latter can itself be factored into a single factor, although proponents suggest that Gf-Gc represents a reasonable compromise.) Hence, one could posit that the type of intellectual abilities indexed by Gf (e.g., certain types of visual and quantitative reasoning) might be linked to economic achievements that exist independently of the types of abilities that schooling fosters (e.g., semantic interpretations). The problem posed by Gf-Gc theory in the context of this article is that it is nonspecific as to actual pathways through which this differential effect on schooling and economic outcomes occurs. At the level of second-order factors themselves (i.e., Gf-Gc), there is no substantial predictive differential between Gf and Gc in predicting economic outcomes and schooling outcomes—each does so between .40 and .50. Alternatively, if the composite primary abilities that comprise Gf and Gc are disaggregated, one is left with very little data to predict either economic or schooling outcomes. Notwithstanding this problem, there is an empirical issue that remains unresolved, namely, how to reconcile the claim that Gf declines with age but Gc does not, at least not before very old age (Horn, 1994). Flynn (1987) reported longitudinal data from a Dutch sample showing that the largest gains during adult development were for Gf measures and the smallest gains were for Gc measures, in opposition to the theory of Gf-Gc. Moreover, Cahan and Cohen (1989) reported that the largest gains among Israeli school children were for Gf measures, the very ones for which schooling was postulated to have less impact. Although not ruling out the potential usefulness of Gf-Gc theory to explain the present findings, we must await resolution of these empirical and conceptual questions.

Figure 2
Weekly Wages in 1992 by Levels of Schooling and Cognitive Ability



Note. The data are from Bronfenbrenner et al. (1996). Yr. = year.

schooling and intelligence contributing independent additive variance to the prediction of earnings, each appears to contribute interactive variance. However, the econometric analyses that have established that each additional IQ point may lead to a decision by a student to stay in school a little longer (e.g., see Heckman, 1995) have heretofore not considered the indirect effect that staying in school has on IQ.

Consider what would happen to earnings if IQ were all that mattered. If income was distributed solely according to differences in IQ, then a far less asymmetric distribution of income would be expected than we now have. Many more people would earn close to the national mean, and far fewer would earn at either of the extremes. In a recent econometric analysis, Dickens, Kane, and Schultze (1995) showed that if IQ were equated among all people and only nonintellectual variables were allowed to vary (e.g., parental SES and motivation), then the resultant income distribution would resemble the one we now have. Conversely, if all nonintellectual differences were equated and income was distributed solely in accordance with differences in IQ scores, then a far more egalitarian income distribution would be observed than the one we now have.

Another way to think about this is to compare the incomes of those who possess the top 10% of IQs with the incomes of those who possess the top 10% of wages. The incomes of those with the top 10% of IQs in Herrnstein and Murray's (1994) National Longitudinal Survey of Youth sample earned 55% more than average-IQ persons earned. In contrast, the top 10% of wage

earners in this same sample earned 200% more than the average person earned! Hence, the proportion of the variation in income that can be explained on the basis of variation in IQ is actually rather small. In fact, income varies much more because of non-IQ differences than because of IQ differences, leading one team of economists to remark, "If all that mattered was [IQ] scores, U.S. society would clearly be very egalitarian. Eliminating differences due to IQ would have little effect on the overall level of inequality" (Dickens et al., 1995, p. 20).

So, in conclusion, what can we say about the value of schooling? We have attempted to show that staying in school matters both for the maintenance of IQ and for future earning power. For each additional month or year of schooling, a worker will reap substantial economic benefits throughout his or her lifetime. Some of these benefits may derive from exposure to school-taught skills that have economic advantages, such as becoming comfortable dealing with hypotheticals and having the ability to learn specific job-related knowledge on the spot (e.g., an applicant for the position of shipping clerk may be given preferential hiring if he or she understands how to convert pounds and tons to their metric counterparts). But we have argued that some of the benefits that result from staying in school probably derive from its indirect effect on intelligence, just as some of the contribution that intelligence makes to earnings probably derives from its synergy with school-related variables.

Finally, of necessity, we have had to make short shrift of many variables that might complicate our argument, such as the hyperactivity example mentioned ear-

lier. Path models would be necessary to quantify the magnitude of school and IQ contributions to earnings, but because of the unavailability of the necessary data, we were unable to report such analyses (i.e., it would be necessary to estimate in a path-analytic framework the net effect of IQ on schooling—after the influence of schooling on IQ was assessed). As another example, it could be argued that the effect of schooling varies with age and historical cohort. Perhaps schooling variations among young adults are considerably smaller than among older adults as a result of nearly universal school attendance laws enacted during the second half of this century. If this is true, then the contribution of schooling differences to variations in earnings among younger adults would be smaller after taking into account the contribution of intelligence. Finally, schooling itself may not be static.³ It may be the case that as IQ changes over the life course, it influences decisions to stay in school. Hence, what looks like a schooling effect on IQ may in actuality be an influence of changes in IQ on the decision to remain in school (e.g., individuals who experience an elevation in IQ may decide to remain in school longer than individuals who experience a decline in IQ). These issues await future data that will enable further evaluation of the interrelationship of IQ and schooling.

³ This comment was made by a reviewer of this article.

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