The Relationship of Age to Education Across Time

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Introduction

Developmental psychologists and educational researchers know that age and education are positively related. Political scientists, sociologists, and public opinion researchers know that age and education are negatively related. They are both right given a) their particular perspectives and populations of interest (respectively children and adults) and b) contemporary and recent historical conditions.

In this paper we examine how the relationship between age and education depends on a) the population of interest, b) the separation of age into chronological age and cohort, c) historical changes in education and resulting cohort effects, d) how the

changing relation of age and education affects social science analysis, and e) how other factors such as school quality and the accumulation of knowledge affect the age-education relationship.

Age, Education, and the Population of Interest

In the first place the relationship of age to education depends on the population of interest. Both the direction and magnitude of the relationship depends on the age of the population being studied. In general, chronological age (i.e. years lived) is positively related to education among children and largely unrelated among adults.

As with any variable that can accumulate over time, there should be a direct relationship between age and education. The older one is the more years of education one can have acquired. This natural relationship prevails among children. From about ages 5 to 18 each increase in age is generally associated with an increase in years of schooling. But since mandatory schooling ends in the mid-teens and most people finish their post secondary education by their early twenties, there is little basis for a positive association between age and education among adults (18+). If one further censures the adult age range to start after most schooling is completed (e.g. 25+), the natural, positive association between age and education is virtually eliminated. Only the resumption of education after some period out of school would still contribute to a positive relationship between age and education.

Chronological Age and Cohort

Age measures both the chronological accumulation of time (i.e. aging or years lived) and what cohort one is a member of. At any one time point (and thus in any single cross-sectional survey) age and cohort are identical. For example, in 1990 someone who is 45 years old has both lived 45 years and is a member of the 1945 birth cohort. Chronological age and cohort are distinct, but confounded measures. Chronological age measures years lived and may be thought of as related to such matters as biological aging, life cycle, and age conditional rights and benefits. It is related to why the 45 year old mentioned above is going grey, has a teenage son, and is beginning to save for retirement. Cohort refers to the historical period at which one was born and during which one grew up. It relates to why our 45 year old thinks the Vietnam War was the most important event in recent American history, listens to "golden oldies" on the radio, and remembers who Roger Maris was.

The problem is that in one survey it is impossible to separate the two components of age. We can logically infer that greying hair is a function of chronological age and not of being born in 1945, but we can not statistically demonstrate this (at least not with data from a single time point).

Overall, changes across time impact differentially on succeeding cohorts to create a relationship between age and the phenomenon undergoing the change.

If the prevalence of an activity is declining over time, then each succeeding generation will be less exposed to the experience and this will show up among adults as a positive relation to age. For example, farming has been declining as an employment sector over the last century. As a result, the % raised on a farm has fallen over time. This currently shows up as a positive association between age and % raised on a farm. For example, 8.8% of those 20-29 were raised on a farm, 14.6% of those 40-49, and 29.4% of those 60-69.

Conversely, if a condition is increasing over time, then each succeeding generation will be more exposed to it and this will appear as a negative relation to age. For example, suburbs have been attracting a growing portion of the population over the last century. As a result, the % raised in a suburb has risen over time. This currently creates a negative association between age and % raised in a suburb. For example, 15.7% of those 20-29 were raised in a suburb of a large city, 10.1% of those 40-49, and 4.4% of those 60-69.

Of course, if a condition is not changing over time, then each succeeding generation will be equally exposed to it and there will be no relationship to age. For example, while farm and suburban residence changed notably during this century, the % living in small towns has held steady. As a result, there is currently no relationship between age and having been raised in a small town. For those 20-29 31.9% were raised in a small town, for those 40-49 it was 33.1% and for those 60-69 30.7%.

In addition, the historical change needs not be monotonic. An increase may cease and either level off or even reverse course. Such a switch in the rate or even direction of change will in turn create a complex relation between age and the phenomenon in question. In the example above, the % growing up in suburbs of large cities more than doubled between those 60-69 and 40-49 (from 4.4% to 10.1%), but only rose by about half between those 40-49 and 20-29 (from 10.1% to 15.7%). Since suburbanization has stabilized in recent decades, if we looked at the residence of origin of the next "generation" (i.e. those now in the 0-9 age group), we would expect to find little further increase. A more extreme example

involving a reversal of condition would be the % of Russians born under a Communist government. It would currently be 0% for those over 75 (i.e. born before the Fall of 1917), 100% for those 1-75, and 0% for those under 1.

Cohort and Education

The relation between age and education follows a complex pattern similar to that shown by suburbanization in the example above. Educational opportunities began expanding early in this century with notable decreases in the % illiterate (Table 1.A2) and gains in median level of schooling (Table 1.B). However, over the last several decades first the high school and then the college graduation rates have stabilized.

Looking first at the changes in illiteracy by age groups from 1890 to 1969 shows that the secular decline in illiteracy is associated with a positive relation between age and illiteracy. This is clearly a cohort effect, each succeeding generation was more likely to be taught to read and write so illiteracy is higher among the earlier generations (i.e. older adults). Illiteracy, unlike residence of origin, is however not a completely fixed attribute and some adults who never learn to read as youths do acquire the skill later in life. There is thus the possibility of an accumulation effect since a person who has lived longer has had additional years in which to acquire literacy. This is shown in the diagonals in Table 1.A2. By moving along the diagonals we are following a cohort as it ages. For example, those who are 15-24 in 1890, are 25-34 in 1900, 35-44 in 1910, etc. There are 24 diagonal inter-censusal comparisons of the same cohorts. In 20 of these the percent illiterate declines as the cohort ages. This decrease is most likely due to adults learning to read, although differential mortality (i.e. lower life expectancy among the illiterate) also probably contributes to the decline in illiteracy. The intra-cohort decline is generally rather modest. For the cohort born between 1876 and 1885 illiteracy declines from 8.1% in 1900 (when they are 15-24) to 5.3% in 1940 (when they are 55-64) for a drop of 2.8 percentage points. This is much less than the inter-age group differences between those 15-24 and 55-64. For example, in 1900 the change across these age groups is +8.4 percentage points.

While illiteracy continues to decline across the entire 1890-1969 period, the decline generally slows as nearly universal literacy approaches. As a result, the positive relation of age to illiteracy declines over time. Using the percentage difference between those 15-24 and those 65+ as our measure of the age difference in illiteracy, the difference narrows as follows:

1890: 11.8
1900: 11.7
1910: 8.6
1920: 8.4
1930: 7.4
1940: 6.4
1947: 5.7
1952: 5.7
1959: 5.9
1969: 3.2

The pattern for median years of schooling is similar (Table 1.B). Schooling expands over time, but at an uneven rate. The gains accelerated from +0.7 years of school between 1940 and 1950 to +1.3 years between 1950 and 1960 and then to +1.6 years between 1960 and 1970. Then the gains slowed sharply to only +0.2 years between 1970 and 1980 and +0.3 years from 1980 to 1989. This historical pattern of educational expansion led to first a widening and then a narrowing in the educational difference across age groups (25-29 vs. 75+): 1940: -2.3 years, 1950: -4.0 years, 1960: -4.1 years, 1970: -4.1 years, 1980: -3.9, and 1989: -2.0 years.

Moreover a perusal to Table 1.B shows that the association with age in 1940 was largely between those under 35 and those 35 and older and in 1989 was mostly between those under 75 and those 75 and older. The educational differences across age groups can thus be seen as largely a cohort effect centering around the educational gains of the cohorts from around 1906-1910 to about 1916-1920. Before 1940 the association between age and education was probably even weaker than in 1940 and simple projections indicate that the association will continue to weaken in the near future.

There is very little intra-cohort gains in years of schooling as a cohort ages. This means that at least when examining the adult population 25+, years of schooling can be in effect treated as a fixed variable and that differences across age groups will be almost entirely a cohort phenomenon.

The Shifting Age-Education Relationship and Social Science

Age and education are the two most frequently used variables in sociological analysis. Social scientists studying adults use these variables in a host of analyses. They routinely assume (and find) that there is a negative association between education and age and that because of this interrelationship one should be

controlled for whenever the other is used in an analysis (Davis, 1979).

Few researchers however have carefully considered the historical/cohort sources of the relationship between age and education. Most seem unaware that the relationship is based on a transitory cohort effect and, as a result, that the relation has varied systematically over time and will continue to change in the future. Instead, they often treat the age-education relationship as fixed and enduring.

Tables 1.C and 1.D show the correlation of age and education on the American National Election Studies (ANES) from 1952 to 1990 and on the GSS from 1972 to 1991. There is considerable sampling variability in the correlations from year-to-year, but the overall pattern is regular and clear. Averaging across surveys we see that the correlation grew from the early 1950s to the 1970s (the peak years were 1972 on the GSS and 1976 on ANES) and then declined:

	ANES	GSS
1952-1959	-.275	---
1960-1967	-.318	---
1968-1975	-.370	-.336
1976-1983	-.360	-.295
1984-1991	-.295	-.250

Moreover the continued decline of the correlations even within the last group of years (1984-1991) and the reduction in educational differences across age groups that can be projected from Table 1.B both indicate that correlations in future years will be even lower.

For most multivariate analysis the weakening relationship between age and education will presumably have little effect since whatever interrelationship exists is controlled for regardless of its magnitude. However, it is possible that the fact that educational and age effects net of the other are almost always complementary (i.e. similar in sign and direction) (Davis, 1979) may still be related to shared cohort effects and that this complementariness may decline as the association between age and education decreases. More certainly, the power of the cohort/education turnover model for explaining social change will attenuate as the association between cohort and education diminishes.

Qualitative Aspects of Educational Level Over Time

The preceding discussion of the relationship of age and education has treated education as a measure of years of schooling or highest level of schooling. This is both a straight forward and standard operationalization of the concept. However, neither years of schooling nor level of education are uniform and invariant measures. How much "education" a student gets from a typical suburban school vs. a typical inner city school or how much is learned during a year in a Japanese vs. an American school are not equivalent. Similarly, it may be that educational quality has changed over time, so that a year of schooling at one point in time is not equivalent to a year of schooling at another point.

Table 2 explores this possibility by comparing scores on a 10-item vocabulary test asked on the GSS. It shows that within educational levels vocabulary scores have declined across cohorts. Within each educational level the newest cohort (born in 1960+) has the lowest score, while one of the earlier cohorts (born 1944 or before) has the highest score. While it is possible that the higher scores of the earlier cohorts reflect adult learning (i.e. the building up of one's vocabulary after leaving school), an analysis of intra-cohort changes in verbal ability from 1975 to 1989 shows no sign of such a process (data available from author).

Similarly, Table 3 indicates that both geographical and political knowledge has declined within educational groups from the 1940s and 1950s to the late 1980s.

This within educational level decrease may indicate that educational quality has been declining over the last several decades. However, there is an alternative interpretation that also fits the data. For the earlier cohorts in Table 2 and for the older adults interviewed in the surveys in the 1940s and 1950s there were severe structural limitations on educational attainment when they grew up. High school education was far from universal and college education was restricted to a small elite. As a result of the restricted educational opportunities, many people were not able to obtain the highest level of education they had the natural ability to complete. Many grade school graduates were high school or even college material. Similarly many who completed high school could have easily completed college, but did not have the opportunity. This meant that at each level of education there was a large group of undereducated people who obtained less education than they ideally could have.

Later on the impediments to high school education were removed and those to a college education greatly reduced. As a result, the proportion of undereducated people blocked at each educational level diminished over time.

In turn this may mean that the decline in within educational

level vocabulary scores across cohorts and the drops in geographical and political knowledge across time may not reflect a fall in educational quality, but a fall in undereducation as more people obtain a level of education commensurate with their natural abilities. It is of course possible that a combination of these two may be operating.

Summary

The relation of age and education depends on the populations under study (minors, all adults, adults above a certain age), the way age (chronological age or cohort) and education (years of schooling, etc.) are defined, and the time period under investigation. Due to the historical expansion of educational opportunities, the association between age and education notably increased during this century. But then the leveling-off of educational expansion began to attenuate this relationship. Since the 1970s, it has been declining and this decline will continue in the near future. The increase in educational opportunities may also have created a negative relationship between time and cohort, and various forms of knowledge (controlling for education). This relationship might also result from deterioration in the quality of education however. Due to both the dual nature of the variable age and to changes in educational attainment over time, the association between age and education is complex and variable across time.

Table 1

Trends in the Relationship of Age and Education

A1. US Census: Illiteracy (% Illiterate) by Age Groups

	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65+	All
1890	10.4	10.0	10.8	12.0	15.0	17.2	18.8	22.2	13.3
1900	7.1	7.8	8.5	9.1	11.2	14.7	16.0	19.8	10.7
1910	4.1	4.9	6.9	7.3	8.1	9.9	12.0	14.5	7.7
1920	2.3	3.0	4.2	5.6	7.0	8.2	9.1	12.0	6.0
1930	1.2	1.9	2.7	3.3	5.2	6.6	7.2	9.7	4.3
1940	1.0	1.1		2.2	2.7	4.2	5.3	7.5	2.9
1947	---	1.0		1.4	2.1	3.0	5.2	6.7	2.7
1952	---	1.2		1.2	1.3	2.7	4.5	6.9	2.5
1959	---	0.6		1.2		2.6		6.5	2.2

1969	---	0.3	0.5	1.1	3.5	1.0

A2. US Census: Illiteracy (% Illiterate) by Age Groups

	15-24	25-34	35-44	45-54	55-64	65+
1890	10.4	12.0	15.0	17.2	18.8	22.2
1900	8.1	9.1	11.2	14.7	16.0	19.8
1910	5.9	7.3	8.1	9.9	12.0	14.5
1920	3.6	5.6	7.0	8.2	9.1	12.0
1930	2.3	3.3	5.2	6.6	7.2	9.7
1940	1.1	2.2	2.7	4.2	5.3	7.5
1950	1.1	1.3	1.7	2.8	4.9	6.9
1959	0.6	1.2		2.6		6.5
1969	0.3	0.5		1.1		3.5

B. US Census: Median Years of School by Age Groups

	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	All
1940	10.3	9.5	8.8	8.6	8.4	8.4	8.3	8.3	8.2	8.1	8.0	8.6
1950	12.1	11.6	10.7	9.8	8.9	8.7	8.5	8.4	8.2	8.2	8.1	9.3
1960	12.3	12.2	12.1	11.8	10.6	9.7	8.8	8.6	8.4	8.3	8.2	10.6
1970	12.6	12.5	12.4		12.2		10.7		8.8		8.5	12.2
1980	12.9	12.9	12.7	12.6	12.5	12.4	12.4	12.2	11.3	10.5	8.9	12.4
1989	12.9	12.9	13.1	12.9	12.8	12.6	12.5	12.4	12.3	12.2	10.9	12.7

C. National Election Studies: Association of Age and Education

	Pearson's r
1952	-.258
1956	-.282
1958	-.279
1960	-.280
1962	-.358
1964	-.278
1966	-.357
1968	-.360
1970	-.343
1972	-.397

1974	-.379
1976	-.402
1978	-.353
1980	-.354
1982	-.329
1984	-.374
1986	-.276
1988	-.268
1990	-.260

D. General Social Surveys: Association of Age and Education

1972	-.357
1973	-.319
1974	-.329
1975	-.339
1976	-.346
1977	-.312
1978	-.287
1980	-.294
1982	-.294
1983	-.239
1984	-.242
1985	-.287
1986	-.310
1987	-.286
1988	-.258
1989	-.228
1990	-.166
1991	-.220

Table 2

Mean Vocabulary Scores by Cohort and Educational Level

Less Than High School Education

Born before 1900	4.8	(118)
1900-1914	4.8	(616)
1915-1929	4.8	(849)
1930-1944	4.4	(674)
1945-1959	4.1	(574)
1960+	4.1	(314)

High School Graduate		
Born before 1900	6.4	(34)
1900-1914	6.6	(382)
1915-1929	6.5	(1162)
1930-1944	6.2	(1540)
1945-1959	5.8	(2427)
1960+	5.5	(1072)
Junior College Degree		
Born before 1900	---	(3)
1900-1914	---	(15)
1915-1929	7.7	(45)
1930-1944	6.4	(85)
1945-1959	6.2	(245)
1960+	6.0	(74)
Bachelor's Degree		
Born before 1900	---	(9)
1900-1914	7.7	(64)
1915-1929	7.9	(179)
1930-1944	8.0	(347)
1945-1959	7.6	(665)
1960+	7.0	(178)
Graduate Degree		
Born before 1900	---	(7)
1900-1914	8.4	(45)
1915-1929	8.2	(114)
1930-1944	8.3	(200)
1945-1959	8.2	(223)
1960+	7.1	(22)

Source: GSS, 1974-1991

Table 3

Knowledge Over Time within Educational Groups

A. Average % Correctly Identifying Geographic Areas-a

	1947	1988	Change (1988-1947)
Grade School			
Europe	24	18	- 6
South America	20	18	- 2
United States	41	41	0
High School			
Europe	43	28	-15
South America	37	24	-13
United States	63	55	- 8
College			
Europe	59	46	-13
South America	54	45	- 9
United States	80	69	-11

B. % Correctly Answering 12 Factual Political Questions-b

	1947-1957	1989	Change (1989-Early)
Less than High School	48.1	43.3	- 4.8
High School	67.2	58.8	- 8.4
Some College	75.7	65.3	-10.4
College	84.4	76.4	- 8.0

a People try to locate on maps 11 European countries, 8 South American countries, and 10 Unites States states (Gallup, 1988).

b Response to 12 political knowledge questions asked on surveys in 1947, 1952, 1954, and 1957 and again in 1989 (Delli Carpini and Keeter, 1991).

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