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Birth Order and Educational Attainment in Full Sibships

ROBERT M. HAUSER and WILLIAM H. SEWELL
The University of Wisconsin-Madison

The idea that birth order influences intellectual development and social success has recently been revived, despite the accumulated evidence that birth order effects are often negligible or artifactual. In this paper, the association of birth order with educational attainment (as measured by years of schooling completed) is examined among 9,000 Wisconsin high school graduates of 1957 and among their full sibships, including more than 30,000 men and women. Whether we look at selection into the sample of high school graduates, postsecondary educational attainments of those graduates, or educational attainments within full sibships, there are no significant or systematic effects of birth order on schooling when other relevant variables have been controlled. Years of education appear to increase with birth order when family size is controlled, but this happens because secular increases in schooling have occurred within as well as across families.

Information on the family and socioeconomic characteristics, ability, and achievement of members of the same sibship may be used to address two distinct questions: (1) How and why are siblings different from one another?, and (2) How and why are siblings more like one another than

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unrelated persons? The answers to these questions tell us about the origins of social inequality within and between families and about the relative importance of families, schools, and other social contexts, including membership in a specific birth cohort, in generating social inequality.

In attempting to answer the first question, it is convenient to remove the effects of shared environment and heredity and to look at the influence of variables on which siblings do not have common values: birth order, birth year, and birth interval. These variables are logically related to the size of the sibship and may interact with it, so size of the completed sibship must be taken into account in an adequate research strategy. Also, siblings may be of the same or of opposite sex, and this, too, will affect the differentiation of life chances among family members.

In addressing the second question it is convenient to ignore the factors tending to diversify the achievements of siblings, while attempting to measure and interpret their shared background. Siblings have a partly overlapping genetic heritage. Excepting the possibility of temporal change within the family of orientation, siblings share a set of parents (and other relatives) with whom they each interact in ways that reflect psychological, social, and cultural differentiation in the larger society. Some of the relevant factors include the cognitive characteristics, education, occupation, and income of the parents, and the family's religion, ethnicity, and size. There are other aspects of the social environment, too, which do not involve the functioning of families in a narrow sense, but whose nature and influence vary from family to family. For example, the neighborhood and community in which the family resides and the schools attended by its children are of this character.

Ultimately, the division between the purposes of studying the similarity of siblings and of studying differences among them is strained and artificial. We have already noted that family size enters both analyses, as will sex. Moreover, family composition and many characteristics of family members do change over time. Ideally, one would hope to construct a comprehensive model of family influences on achievement that would render the distinction unnecessary. For the moment we think the distinction is a useful heuristic device; it breaks the research problem into two parts, neither of which is especially simple when taken by itself.

Although we have addressed both of these questions in our research (Hauser, 1984a, 1984b; Hauser & Mossel, forthcoming; Hauser, Sewell, & Clarridge, 1982; Sewell & Hauser, 1977), the present analysis is limited to the effects of family structure on educational attainment as measured by years of completed schooling in relation to size of sibship, birth order, birth year, and sex. Our analysis of family effects on schooling is in five parts. First, we review research on the effects of families and of family structure on socioeconomic attainment. Second, we briefly describe a unique body of data on family structure and educational attainment that

we have obtained for a large and heterogeneous panel of Wisconsin high school graduates. Third, we look for birth order effects on the length of schooling among respondents in the Wisconsin Longitudinal Study. Fourth, we analyze completed schooling by size of sibship, birth order, birth year, and sex in the full sibships of our respondents. Fifth, for each sibship size category, after controlling birth year, we examine the possible influence of differences in socioeconomic origins on the relationship between birth order and years of education.

FAMILY STRUCTURE AND ACHIEVEMENT

At least since the time of Galton (1874), scholars have studied the effects of birth order on intelligence, eminence, educational attainment, occupational achievement, aspirations and motivation, various aspects of deviance—including mental illness, delinquent behavior, and alcoholism—and selected personality characteristics, such as anxiety, dependency, affiliation, achievement orientation, and conformity. This massive literature has been competently reviewed by a number of scholars, including Sampson (1965), Altus (1965), Warren (1966), Bayer and Folger (1967), Bradley (1968), Sutton-Smith and Rosenberg (1970), Adams (1972), Schooler (1972), and Cicirelli (1978).

These reviews indicate that several post hoc theories have been used as explanations of birth order effects, including physiological, psychological, developmental, social structural, and economic explanations. Reviewers agree that the findings to date are seriously flawed by inadequate samples, selection biases, and failure to control for variables known to be related both to sibling position and to the outcomes under study. Moreover, none of the past studies has had adequate information to examine the influence of family structure in a sufficiently comprehensive and systematic way to permit definitive conclusions regarding the influence of sex, age, sibling position, sibship size, and spacing on career achievements.

The influences of family structure on achievement may be studied in samples of persons, as in the research of Blau and Duncan (1967), where structural variation between families is correlated with achievement variables. Also, family influences may be studied in samples of families (minimally, in at least one sib-pair from each family), as in the research of Lindert (1974, 1977, 1978) or Olneck and Bills (1979), where structural variation within families was correlated with achievement variables. The first design risks the confounding of family structural characteristics with other characteristics of the family of orientation, as in the correlations of completed family size with social class or religion. The second design implicitly controls all of the global characteristics of the family of orientation, whether or not we happen to know what they are, but variations in ordinal position, family size, and child spacing are inherently confounded with temporal changes in the larger society.

Our interests in this paper are limited to family structure and educational attainment, and we have made no attempt to review the extensive literature on the effects of birth order and family size on cognitive skills that has been stimulated by the Zajonc-Markus confluence models (Zajonc, 1975, 1976; Zajonc & Markus, 1975). Briefly, the confluence model says that the effects of birth order and family size on cognitive development result from changes in the cognitive environment of the family as children are born and mature. At any time, the quality of the environment of a given child is a complex function of the ages of siblings and consequent opportunities to learn from them or teach them. The theory was initially proposed to account for the data of Belmont and Marolla (1973) on IQs of 400,000 Dutch men born during 1944 to 1947. A decline in IQ with birth order was explained by dilution of the cognitive environment, while additional deficits of last born children and the relatively poor performance of only children were explained by the absence of an opportunity to tutor younger siblings. Blake (1981) argued that these patterns in the Dutch data were more likely a result of selective factors under wartime conditions. Zajonc, Markus, and Markus (1979) elaborated the confluence model to account for altogether different findings in several other studies, and it is no longer clear that the model yields distinctive predictions in aggregate data.

As discussed below, studies that have attempted to assess the theory in its original form in relation to socioeconomic achievements have without exception been unable to confirm any distinctive propositions derived from it (Blake, 1981; Lindert, 1978; Olneck & Bills, 1979; Wright, 1977). For that matter, the results of recent studies using adequate samples have failed to confirm the theory in relation to cognitive abilities (Belmont, Stein, & Zybert, 1978; Melican & Feldt, 1980; Mercy & Steelman, 1982; Page & Grandon, 1979; Steelman & Doby, 1983; Steelman & Mercy, 1980, 1981; Velandia, Grandon, & Page, 1978; Wolfe, 1982), and the earlier studies have produced mixed results at best. (For a review of the earlier literature see Cicirelli, 1978.) However, Zajonc (1983) has responded that others' tests of the confluence model have been methodologically flawed and that the available data do support the predictions of the theory.[1]

The best example of an extensive study of between-family variations in socioeconomic achievements is that of Blau and Duncan (1967), based on the 1962 Occupational Changes in a Generation (OCG) survey. They showed that both the size of the parental family and the sibling position of the son exerted an important influence on the son's subsequent occupational career. The attainments of first-born and last-born sons were superior

[1] Obviously, the effects of birth order on intellectual development are relevant to educational attainment, but we have chosen to look first at schooling alone. In later analyses, we will look at effects of family structure on ability among our respondents and a subsample of their siblings.

to those of children in the intermediate positions, but this advantage or disadvantage depended to some extent on family size. Sibling position and number of siblings interacted in such a way that there was little difference in the achievements of oldest and youngest children in small families. Older sons in large families may make sacrifices and take on responsibilities for younger ones so that the resulting benefits accruing to younger sons compensate for the more limited resources, both psychological and economic, available for any child if there are many children in the family. Almost all of the influence of family structure and climate on occupational achievement was transmitted through education. Blau and Duncan (1967) concluded that "the family into which a man is born exerts a profound influence on his career, because his occupational life is conditioned by his education and his education depends to a considerable extent on his family" (p. 330).

Although this study was superior to any previous research on family structure and careers, both in its large and representative sample of males in the U. S. labor force and the sophistication with which the data were analyzed, its conclusions were limited by the fact that no data were available on the achievements of siblings other than the oldest brother, and information was available only on the number of years he attended school. Moreover, nothing was known about family structure other than the size of the sibship and the sibling position of the respondent. For example, neither the 1962 OCG survey, nor its 1973 replicate (Featherman & Hauser, 1978), contained a roster of siblings by age and sex. Further, women were not included in either OCG survey; they neither appear as respondents nor as members of sibling pairs.

Another important study by Lindert (1974, 1977, 1978) covered a wider range of family structure characteristics, including sex, age, sibling position, family size, birth order, and spacing. It was based on a sample of 1,087 siblings collected in 1963 by a Cornell Medical School team that interviewed 312 higher level male employees of a New Jersey utility company in search of information about the incidence of heart disease. The respondents, aged 55–61, gave information about their siblings' age, sex, education, and most recent occupation (see Hermalin, 1969). Lindert proposed a simple explanation of the way in which family size and birth order should influence a child's subsequent attainments by governing the time and inputs the child received from his parents (based on a Cornell University time-use survey of 1967–68, which indicated the effect of family size on the time parents spent with young children), and he tested the link between sibling position and achievement within as well as between families. Lindert's theory led to predictions that middle children would do less well than first- or last-born children, and these differences would be larger as birth intervals increased. Further, competition from a younger sibling

would be stronger than that from an older sibling because younger siblings required more care. Lindert's findings supported his theory and thus conflicted with the conclusions of Blau and Duncan about the relative advantages of first- and last-born children. However, Lindert's findings were consonant with Blau and Duncan's in that family background and structural variables were found to explain schooling levels better than they explained occupational achievements.

The major weaknesses of the Lindert study were its relatively small and highly selective sample and its lack of information on such important characteristics as family background, siblings' histories, and siblings' incomes. Nonetheless, Lindert's sophisticated theoretical ideas and analytic techniques formed a solid basis for additional research on the effects of family structure on career achievements.

In their study of a sample of Kalamazoo, Michigan, brothers, Olneck and Bills (1979) assessed the effects of birth order among individuals and within families on ability test scores, education, occupation, and earnings. Their regression analysis indicated that birth order effects were small, derived mainly from sibship size, and were reduced to insignificance when brothers were compared with one another. Because of their relatively small sample (692 brothers in 346 pairs), Olneck and Bills pooled birth order effects across sibships of all sizes using linear and quadratic terms plus dummy variables for first- and last-born brothers; consequently, they were unable to examine schooling by birth order within sibships of each size. Sibship size effects persisted, however, even when family background was controlled. Finally, for men with similar backgrounds, test scores, and education, there were no significant effects of sibship size on any of the later achievement variables. Their results offered no support for either the Zajonc or Lindert theories. Although the Olneck and Bills research was a major step in the right direction, it was necessarily limited by their small and restricted sample, lack of information on the sex and age composition of the respondent's sibships, and the exclusion of only children.

Wright (1977) used the 1962 OCG data to test predictions about sibling effects on achievement drawn from the Zajonc-Markus and Lindert models. Her regression analysis offered no support for either theory in terms of the specific achievements of first-born, middle- and last-born children. In fact, she found that birth order was significant only in relation to educational achievement and that its effects were slight. Size of sibship had a small but significant effect on education, occupation, and earnings. The educational attainments of later born children in large sibships (six through eight) had a discernible tendency to increase.

Blake (1981) reanalyzed data from several national fertility surveys to determine the effect of sibship size and birth order on educational attainment. After adjusting for age, socioeconomic background, religion, community size, southern origin, and intact family, she found that sibship size

TABLE I

Numbers of Respondents and Siblings in the Wisconsin Longitudinal Study

Number	Description of sample
10,317	High school seniors in 1957
9,138	Interviewed in 1975 follow-up survey
9,115	Provided any information about siblings (including 614 only children, 68 with no surviving siblings, and 34 who did not complete sibling roster)
8,987	Reported size of sibship and own birth order and educational attainment
8,399	Completed roster of living siblings
34,808	Respondents and siblings in roster
30,774	Respondents and siblings with all data present in sibships aged 20 to 65 in 1975

had an important negative effect on educational attainment, but she did not find important birth order effects. Using a modified version of the Wisconsin model she also found that number of siblings had a negative influence on the intervening social psychological variables affecting college plans.

THE WISCONSIN DATA

Data from our longitudinal sample of Wisconsin high school seniors are free of many of the limitations of past studies, and these provide the basis for our examination of the influence of family structure on educational attainment. Briefly, our longitudinal data have been accumulated over the years on a random sample of over 10,000 male and female students who were seniors in Wisconsin public, private, and parochial high schools in 1957. (For more detail, see Sewell & Hauser, 1980.) We have information collected in 1957 on the social origins, academic ability and performance, and the educational aspirations of these students. In addition, we have made two successful follow-up surveys (with approximately 90% response rates) in 1964 and 1975. From these surveys we have obtained additional information on background characteristics and the structure of the family of origin, including a roster of siblings by age, sex, and years of completed education. The analysis in the present paper is based on these data.[2]

Table I shows the numbers of respondents and siblings used in our analysis. Of 10, 317 respondents in 1957, 9,138 were interviewed in 1975.

[2] We have additional information, gathered in 1977, but not used in this paper, for a randomly selected sibling, which includes current residence, mental ability, formal and informal educational attainments, first and current occupation, marital and fertility history, and social participation (see Clarridge, 1983; Hauser, 1984a, 1984b; Hauser & Mossel, forthcoming; Hauser et al., 1982).

Of these, 9,115 provided minimal information about their sibships, including 614 only children, 68 with no surviving siblings, and 34 who did not give complete information on the sibling roster. Our initial examination of the data for respondents pertains to 8,987 persons who reported the size of their sibship and their own birth order and years of education. Our initial examination of the data for full sibships is based on a roster of age, sex, and educational attainment of 34,808 living respondents and siblings, obtained from 614 only children and 8,399 respondents with living siblings. The latter part of the analysis is restricted to 30,771 respondents and siblings with all data present from sibships in which all persons were aged 20 to 65 in 1975. We imposed the lower age restriction because many persons under age 20 would not have completed their schooling. We imposed the upper age restriction because few biological families exhibit a 30-year span of childbearing, and we were not able to distinguish biological from social sibships.

EFFECTS OF FAMILY STRUCTURE ON EDUCATIONAL ATTAINMENT

In most past research, the effects of sex, sibling position, child spacing, and sibship size on the educational attainments and other achievements of siblings have been studied using population cross-sections or cohorts. We think there are advantages in studying pairs of members of the same family. The great advantage is in being able to ascertain the effects of sibship characteristics both across families within a cohort and across cohorts within families. The latter possibility is foreclosed in studies that merely compare individuals in a cross-sectional sample or in some school or college class. We have attempted to avoid the problems of selectivity and sample size as well as those posed by lack of complete information on full rosters of siblings.

In looking at variations in educational attainment with structural variables across families within our original sample, we have effectively held history constant, except insofar as particular historical factors led to a birth in 1939-40 and resulted in survival to high school graduation in 1957. In this cohort, however, structural variables are confounded with other relevant social characteristics of families that are difficult to control. The most obvious problem is the correlation of social class with family size and the rate of childbearing and, thereby, with sibling position and spacing. The analysis of full sibships solves this problem, but it also adds a historical dimension to the analysis, for the siblings of our original sample were born over a wide span of years. To analyze the data on family members, then, we control both family structural variables and birth year, thereby generating measures of the effect of membership in particular birth cohorts that are free of the confounding of year of birth with family structure. Of

course, historical interpretations of our results must be tempered by the fact that everyone covered in the study was drawn into the sample because he or she or a sibling was born in 1939-40. In the last section of the paper, we show that the introduction of birth year as an explanatory variable requires us also to enter socioeconomic background variables in analyses of educational attainment within categories of sibship size, even though birth order is uncorrelated with socioeconomic background.

Postsecondary Schooling Among Respondents and Their Siblings

Before proceeding with our examination of the effects of family structure on educational attainment, we conducted an extensive analysis of the possibility that birth order may have affected selection into the Wisconsin sample. That is, birth order may have affected the likelihood of completing 12 years of school. We concluded that it did not. To save space, this analysis is not reported here, but it is reported by Hauser et al. (1982, pp. 12–15).

We now turn to a prospective look at the way in which birth order and sibship size affect postsecondary educational attainment. Figure 1 graphi-

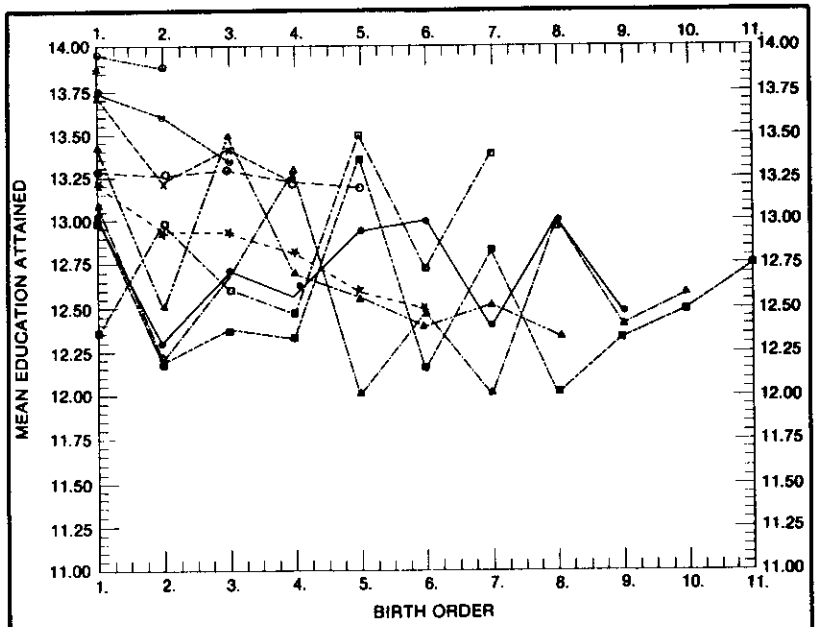

FIGURE 1. Mean educational attainment by size of sibship and birth order: Wisconsin primary respondents

cally presents mean educational attainment by size of sibship and birth order among respondents. Clearly, these are not a strong set of results, and little more is visible in them beyond a modest effect of total sibship size, a tendency for first-borns to complete more schooling than second-borns, and a vaguely downward drift in attainment with increasing birth order beyond the third.

Among respondents, only children obtained an average of 13.86 years of schooling, which is roughly midway between the attainments of first-born children in two-child families (13.94 years) and in three- or four-child families (13.73 and 13.71 years, respectively). We see no evidence in this that only children are either disadvantaged or advantaged in the schooling process.

A clearer pattern of birth order differentials emerges when we look at educational attainments for our combined sample of respondents and their siblings, as shown in Figure 2. The data are far more orderly than in the cross-section sample, composed only of respondents; one cannot attribute this merely to the increase in sample size, for the sample of respondents is itself quite large.[3] A main effect of family size dominates the data. Further, and quite surprisingly to us, there is an interaction effect between birth order and sibship size, such that the effect of birth order is negative in small families and positive in large families.

The interpretation of the data in Figure 2 is by no means self-evident. For example, do the positive effects of birth order in large families reflect the opportunities to be taught and encouraged by knowledgeable older siblings, as in the Zajonc-Markus confluence model? Or do they merely reflect the passage of the Wisconsin families through a historic period during which educational attainment was generally on the rise? Respondents in the Wisconsin sample were concentrated in low birth orders because of the prevalence of low order births in their cohorts (Hauser et al., 1982, pp. 12–15). Thus, it seems likely that many of their siblings, and especially those in large families, are substantially younger than the respondents. For example, Table II gives the distribution of age differences between respondents and their siblings, and it is obvious that most siblings are younger. Having located our data firmly within the family, we become challenged to disengage the effects of history from the dynamics of the family environment.

[3] Indeed, because of the clustering of siblings within families, our use of the data for full sibships leads to a lesser reduction in sampling variability than is suggested by the increasing numbers of observations. We have made no correction for the clustering of observations within families here or in the later regression analyses, and consequently we have tended to overestimate the statistical reliability of birth order effects. Because we find no effects of birth order, this is not a methodological problem; it would be a problem only if we found nominally significant effects, but were uncertain of their statistical reliability.

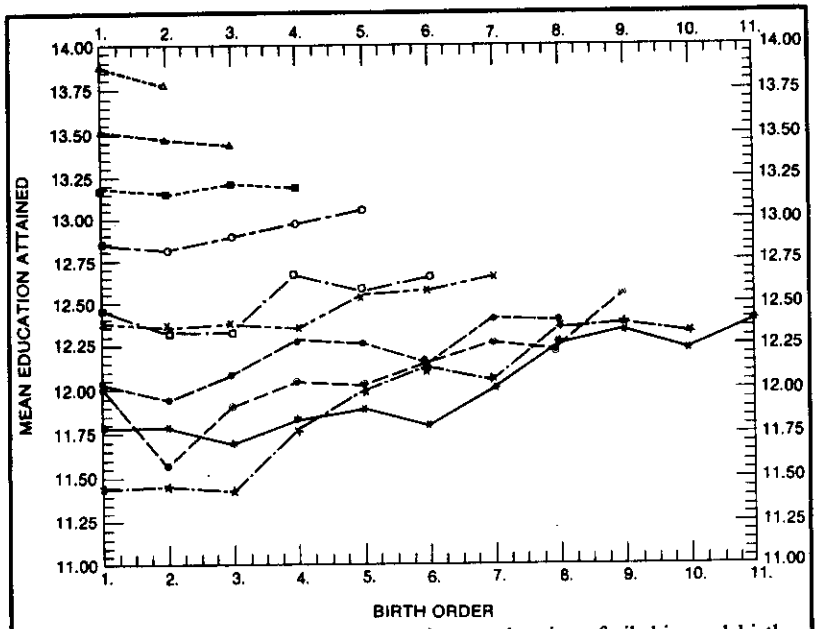

FIGURE 2. Mean educational attainment by size of sibship and birth order: Total Wisconsin sibships

The combination of the facts that respondents tend to appear in low birth orders and are all high school graduates further confounds the interpretation of birth order effects on mean levels of schooling. We have established this in a detailed examination of mean schooling levels by birth order within family size and respondent status categories. For example, Figure 3 shows mean educational attainment by ordinal position in three-child families. Among our respondents (solid line) the regression is steeply negative, but among their siblings it is weakly positive. For the combined samples of respondents and their siblings—dominated by a relatively large number of respondents in the first and second parity—the regression is weakly negative. In the sibling sample, the observed regression confounds birth order with date of birth. First-born siblings were all born before 1939, and third-born siblings were all born after 1939, while second-born siblings are more heterogeneous in age than either the first- or third-born siblings.

We thought at first that family socioeconomic characteristics could be ignored in the analysis of full sibships, if we controlled size of sibship. Because there is one respondent or sibling in each birth order in a family, and because there is one respondent in each family, there is no correlation between global family characteristics and either birth order or respondent

TABLE II

Age Differences Between Respondents and Siblings

Sibling's age less respondent's age	Percentage
−10 to −17	10.5
−7 to −9	9.3
−5 to −6	11.2
−3 to −4	12.5
−1 to −2	10.8
0	1.9
1 to 2	9.4
3 to 4	11.7
5 to 6	6.8
7 to 9	6.6
10 to 17	8.4
18 or more	1.0
Total	100.0
	(8216)

status (being a respondent rather than a sibling). Moreover, as an empirical matter, there is virtually no relationship between sex and birth order. Such a relationship could exist if there were a strong preference for the sex of children, resulting, for example, in a disproportionate number of male last-born children; however, we found no such pattern.

If global family characteristics were uncorrelated with any of the explanatory variables within families of each size, there would be no need to introduce such family characteristics into the regressions, except to increase statistical power by reducing the unexplained variance in schooling. However, global family characteristics are correlated with age within sibships. Births of siblings may have occurred earlier or later than that of the respondent, and the timing of the remaining births may have been confounded with other family or parental characteristics. In particular, sibships in which the parents were well educated tended to be completed more recently than sibships in which parents were poorly educated. Controlling size of sibship, the correlation between birth year and the educational attainment of either parent is approximately .2. Since the length of parental schooling affects that of the children, this correlation could account for part of the positive correlation between birth year and schooling among offspring. We assume that the correlation between birth year and parental schooling occurred because more educated parents were drawn from more recent cohorts or because their prolonged schooling had delayed childbearing. We will show that this correlation not only affects our estimates of the effect of birth year on schooling, but also that of birth order. To demonstrate these effects, we first analyze the family educational rosters

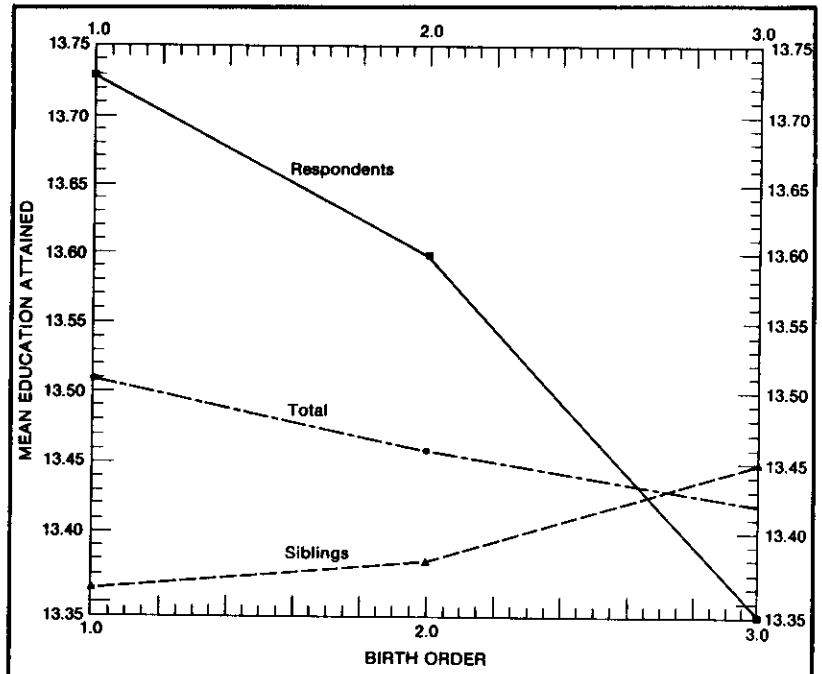

FIGURE 3. Mean educational attainment by birth order and respondent status: Three-child sibships of Wisconsin respondents

without introducing parental socioeconomic characteristics and then introduce these characteristics at a later stage of the analysis.[4]

Schooling and Family Structure in Full Sibships

To separate the effects of family size, birth order, and age, we have carried out regression analyses of years of completed schooling within sibships numbering from 2 to 10 or more. For each size of sibship, we have also entered a dummy variable indicating whether the observation pertained to a respondent (1 = respondent, 0 = sibling) and variables for sex (1 = male, 2 = female) and the interaction of sex with respondent status (R × S). We introduced these three variables to show the effect of sex on schooling within families and to take account of the fact that all

[4] Robert Retherford (personal communication, January 1984) has pointed out to us that an analysis of differences between siblings in adjacent birth orders would eliminate the main effects of families. However, we have not pursued the analysis in that way here.

respondents were at least high school graduates. Given our coding of the variables, the difference in the mean schooling of male and female siblings is the regression coefficient of sex. For example, in Table III male siblings in three-child families obtained .481 more years of schooling than female siblings. The difference in the mean schooling of male and female respondents is the sum of the coefficients of sex and that of the sex by respondent status interaction variable. In three-child families, male respondents obtained .481 + .464 = .945 more years of schooling than female respondents. The difference in the mean schooling of male respondents and male siblings is the sum of the coefficients of response status and the respondent status by sex interaction variable. In three-child families, male respondents obtained .889 − .464 = .425 more years of schooling than male siblings. The difference in the mean schooling of female respondents and female siblings is the sum of the coefficients of respondent status and twice the coefficient of the respondent status by sex interaction variable. In three-child families, the schooling of female respondents differed by .889 − 2(.464) = −.039 years of schooling from that of female siblings.

The effects of sex and respondent status differ by family size. Among siblings, the sex differential in schooling appears to be less in large sibships. Among respondents, the sex differential is relatively stable at .6 to .8 years in sibships of 3 to 9, but it is close to a year in sibships of 1, 2, and 10 or more. Among men, the effect of being a respondent varies positively with size of sibship from about .4 years in sibships of 2 or 3 to .9 years or more in sibships of 7 or more. This is consistent with the idea that the positive selectivity into the sample is greater in large families where the average level of completed schooling is lower. Among women, the pattern of selectivity is similar to that among men, but it is less severe. There is virtually no difference in the complete schooling of female respondents and their siblings in sibships of 4 or fewer; there is a larger, but somewhat irregular effect of selectivity among women in larger sibships.

The overall pattern of sex and selection effects appears to be consistent with a main effect of size of sibship on schooling, combined with a large sex differential in postsecondary schooling. Thus, the sex differential is large and relatively invariant to size of sibship among respondents, all of whom have completed high school. The sex differential is less among their siblings, who are not positively selected on schooling, and it is even less among siblings from large sibships, where completed schooling is relatively low. Obversely, the selectivity of respondents is greater in large sibships.

Because of the great variability in birth year and the continuous upward trend in completed schooling among cohorts born in the mid-20th century, we have entered a linear term for age as a proxy for birth cohort. While this term may not fully represent cohort effects on schooling, it is clear that age has a significant negative effect on schooling within sibships of

TABLE III

Dummy Variable Regression Analysis of Educational Attainment on Sibling Position, Sex, and Respondent Status by Size of Sibship

Size of sibship	Age	Sex	Respondent	R × S	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	SP11	Constant	R^2	SEE	N
2	−.0245	−.659	.808	−.386	−.143										15.65	.032	2.50	3938
	(.0118)	(.113)	(.257)	(.160)	(.099)													
3	−.0333	−.481	.889	−.464	−.156	−.356									15.47	.024	2.40	5739
	(.0075)	(.078)	(.213)	(.134)	(.082)	(.101)												
4	−.0456	−.408	.857	−.349	−.114	−.229	−.419								15.47	.026	2.32	5285
	(.0064)	(.074)	(.234)	(.147)	(.092)	(.100)	(.116)											
5	−.0598	−.252	1.218	−.518	−.184	−.237	−.268	−.494							15.56	.039	2.17	4425
	(.0062)	(.073)	(.260)	(.163)	(.104)	(.109)	(.117)	(.131)										
6	−.0610	−.299	.883	−.309	−.247	−.275	−.164	−.436	−.581						15.32	.048	1.99	3246
	(.0063)	(.077)	(.300)	(.188)	(.122)	(.125)	(.131)	(.139)	(.152)									
7	−.0481	−.099	1.675	−.635	−.024	−.165	−.348	−.192	−.203	−.358					14.34	.038	2.16	2226
	(.0081)	(.099)	(.434)	(.265)	(.172)	(.175)	(.180)	(.187)	(.197)	(.214)								
8	−.0862	.254	1.970	−.903	−.251	−.253	−.149	−.420	−.697	−.604	−.922				15.27	.087	2.02	1760
	(.0082)	(.103)	(.477)	(.293)	(.194)	(.196)	(.200)	(.207)	(.214)	(.225)	(.239)							
9	−.0862	−.157	1.305	−.427	−.527	−.270	−.338	−.450	−.404	−.447	−.892	−.831			15.89	.085	2.22	1107
	(.0108)	(.142)	(.674)	(.425)	(.284)	(.286)	(.290)	(.297)	(.304)	(.314)	(.327)	(.345)						
10 or more	−.0783	.062	2.303	−1.088	−.133	−.348	−.229	−.221	−.425	−.406	−.209	−.263	−.576	−.680	14.98	.097	1.99	2454
	(.0065)	(.085)	(.454)	(.278)	(.185)	(.187)	(.189)	(.191)	(.195)	(.199)	(.204)	(.211)	(.218)	(.251)				

Note. See text for definitions of sex, respondent status, and sex-by-respondent status interaction variables (R × S). SP2, . . . , SP11 are effects of birth orders 2, . . . , 11, respectively, relative to first borns. Parenthetic entries are estimated standard errors.

every size. The effect of a 10-year difference in birth dates within a family ranges from .245 years in sibships of two to .862 years in sibships of eight or nine. There is some tendency for the cohort effects to increase with size of sibship. This may reflect nonlinearities in cohort effects, combined with the different ranges of birth year surrounding 1939 for larger and smaller sibships. However, we find that effects of birth year are virtually linear in the total sample, and for that reason we suspect that larger families may be more subject to the exogenous social forces that effect educational change across cohorts. We have tested the linearity of age effects by entering dummy variables for ages of respondents and siblings at the survey date in a regression equation that pools the effects of age, sex, birth order, and respondent status across all sizes of sibships. Educational attainment is excessively low among very young siblings (aged 20 to 22), many of whom have not completed their schooling. Otherwise, the relationship between schooling and age is very nearly linear.

The triangular array of sibling position (SP) coefficients in Table III shows the effects of birth order on educational attainment within sibships of each size. Each coefficient is the deviation of mean schooling from that in the first ordinal position in sibships of the given size. Because sex, respondent status, and age have been controlled, the pattern of these effects is altogether different from those on mean educational attainment in Figure 2. First, without exception, children in the first ordinal position obtain more schooling than second- or later-born children, regardless of the size of the sibship; all of the effects of sibling position are negative. Second, with few exceptions there is an inverse relationship between birth order and educational attainment in sibships of every size. For example, in sibships of three, first-born children obtain .156 more years of schooling than second-born children, and second-born children obtain .200 more years of schooling than third-born children. In sibships of four, the advantage of first-born children relative to the second-born is .116 years; that of second- relative to third-born is .113 years; and that of third- relative to fourth-born is .190 years. These effects are less regular in larger sibships, where there are fewer observations at each birth order, but the general pattern of results seems clear.

Moreover, we see no evidence that first-born or last-born children are either advantaged or disadvantaged relative to the linear effects of birth order. For each size of sibship Table IV gives estimates of the same regression model as Table III, except sibling position is entered as a linear variable. There are negligible differences in fit between the linear and nonlinear versions of each equation, as indicated by comparisons of R^2 or standard errors of estimate (SEE). As expected, the linear effect of sibling position is negative in sibships of each size. Moreover, the linear effects do appear to vary inversely with size of sibship. This appears to be consistent

TABLE IV

Regression Analysis of Educational Attainment on Sibling Position, Sex, and Respondent Status by Size of Sibship

Size of sibship	Age	Sex	Respondent	R × S	Sib position	Constant	R^2	SEE	N
2	−.0245	−.659	.808	−.386	−.143	15.79	.032	2.50	3938
	(.0118)	(.113)	(.257)	(.160)	(.099)				
3	−.0331	−.481	.890	−.463	−.177	15.64	.024	2.40	5739
	(.0075)	(.078)	(.213)	(.134)	(.050)				
4	−.0453	−.408	.859	−.351	−.136	15.62	.026	2.32	5285
	(.0064)	(.074)	(.233)	(.147)	(.037)				
5	−.0596	−.252	1.206	−.511	−.107	15.64	.038	2.17	4425
	(.0061)	(.073)	(.260)	(.163)	(.030)				
6	−.0606	−.304	.879	−.312	−.095	15.36	.046	1.99	3246
	(.0063)	(.077)	(.300)	(.188)	(.027)				
7	−.0483	−.093	1.689	−.646	−.053	14.37	.036	2.16	2226
	(.0081)	(.099)	(.433)	(.264)	(.031)				
8	−.0857	.254	1.993	−.912	−.116	15.36	.084	2.02	1760
	(.0082)	(.103)	(.476)	(.293)	(.029)				
9	−.0855	−.173	1.280	−.423	−.079	15.82	.081	2.21	1107
	(.0108)	(.142)	(.673)	(.424)	(.035)				
10 or more	−.0783	.064	2.286	−1.088	−.043	14.93	.094	1.99	2454
	(.0065)	(.085)	(.454)	(.277)	(.018)				

Note. See text for definitions of sex, respondent status, and sex-by-respondent status interaction variables (R × S). Parenthetic entries are estimated standard errors.

with the argument that birth order and family size affect schooling and other achievement variables by diluting family resources; the relative loss from an additional child is less in larger families. However, it would be premature to draw this conclusion without first controlling the possible effects of socioeconomic origins.

Table V summarizes the effects of age and birth order in regression analyses that introduce to the above equations six parental background variables: mother's educational attainment, father's educational attainment, father's occupational status (Duncan SEI), family income, rural origin, and intact family. Family income is a 4-year average of adjusted gross income, ascertained from Wisconsin tax records for 1957 to 1960. The other variables were each ascertained from the respondents in 1975, referring back to the circumstances of the family when he or she was a senior in high school. Missing data were filled in with reports obtained at other times from the respondent or parent.

Two important changes in the findings occur when these variables are added to the regression models. First, the effects of birth order virtually disappear. The first panel of Table V (Model 1) introduces a linear birth order effect (SP). While the effect is negative in 7 of the 9 family size

TABLE V

Regression Analyses of Educational Attainment on Family Structural Variables and Socioeconomic Background by Size of Sibship

Size of sibship	Model 1			Model 2				Model 3											
	Age	SP	R^2	Age	SP1	SPL	R^2	Age	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	SP11	R^2
2	−.0077	−.061	.209	—	—	—	—	−.0077	−.061										.209
	(.0110)	(.091)						(.0110)	(.091)										
3	−.0007	−.047	.187	−.0006	.061	−.032	.187	−.0006	−.061	−.093									.187
	(.0071)	(.048)		(.0072)	(.077)	(.081)		(.0072)	(.077)	(.095)									
4	−.0085	.004	.171	−.0094	−.013	−.022	.171	−.0086	−.003	.036	−.001								.171
	(.0063)	(.036)		(.0061)	(.080)	(.084)		(.0063)	(.088)	(.096)	(.112)								
5	−.0283	−.003	.157	−.0311	.039	−.075	.158	−.0285	−.085	−.024	.035	−.081							.158
	(.0062)	(.030)		(.0058)	(.087)	(.092)		(.0062)	(.101)	(.105)	(.114)	(.128)							
6	−.0347	−.022	.110	−.0362	.108	−.109	.111	−.0351	−.157	−.135	.041	−.151	−.199						.112
	(.0065)	(.028)		(.0059)	(.103)	(.107)		(.0066)	(.121)	(.125)	(.130)	(.140)	(.154)						
7	−.0209	.019	.099	−.0233	−.009	.046	.100	−.0205	.056	.006	−.129	.039	.170	.099					.100
	(.0087)	(.032)		(.0076)	(.144)	(.150)		(.0088)	(.173)	(.177)	(.182)	(.190)	(.202)	(.221)					
8	−.0467	−.014	.166	−.0479	.047	−.173	.166	−.0473	−.130	−.074	.140	−.008	−.185	.008	−.208				.168
	(.0091)	(.030)		(.0075)	(.157)	(.161)		(.0091)	(.190)	(.194)	(.199)	(.207)	(.216)	(.230)	(.247)				
9	−.0625	−.022	.121	−.0640	.256	−.162	.122	−.0635	−.503	−.141	−.201	−.202	−.127	−.115	−.482	−.411			.126
	(.0127)	(.039)		(.0104)	(.237)	(.244)		(.0128)	(.294)	(.297)	(.302)	(.310)	(.321)	(.334)	(.351)	(.374)			
10 or more	−.0552	−.000	.179	−.0589	.182	−.196	.180	−.0552	−.020	−.157	−.107	−.022	−.185	−.111	.126	.086	−.106	−.225	.182
	(.0070)	(.019)		(.0056)	(.146)	(.148)		(.0070)	(.183)	(.185)	(.187)	(.190)	(.194)	(.199)	(.205)	(.212)	(.220)	(.253)	

Note. Each model also includes variables for sex, respondent status, sex-by-respondent status, mother's education, father's education, father's occupation, family income, rural origin, and intact family. SP2, . . . , SP11 are effects of birth orders 2, . . . , 11, respectively, relative to first born. Parenthetic entries are estimated standard errors.

categories, it does not approach statistical significance in sibships of any size. Model 2 introduces dummy variables for siblings in the first (SP1) and last (SPL) positions, thus contrasting these positions with the aggregate of intermediate positions. The effects of being first-born are statistically insignificant, and they are not even consistently positive or negative. The effects of being last born are negative except in sibships of size 7, but again none of these effects is statistically significant. Model 3 introduces sets of dummy variables that contrast first-born children with those in each other birth order. Not one of these contrasts is statistically significant, nor does there appear to be any pattern to the variation of educational attainment with birth order. One possible exception is the consistently negative contrasts of other birth orders with the first in sibships of size 9, yet the global contrast of first-born with middle children in Model 2 is not statistically significant. Moreover, when we compare the fit of Model 3 with that of Model 1 or Model 2, we find negligible differences; note the R^2 in the last column of each panel. There is no substantial evidence either of linear or of nonlinear effects of birth order on schooling. Thus, covariation in the timing of births with the socioeconomic characteristics of parents appears to explain the appearance of negative birth order effects on educational attainment.

Second, while the effects of age on schooling are less in sibships of every size than in the preceding analyses, those effects remain statistically significant in sibships of five or more. Although the effects of birth year on completed education are partly an artifact of differences among characteristics of the parents of successive cohorts, larger families remain vulnerable to exogenous sources of intercohort change in schooling.

It may appear surprising that the introduction of a set of control variables (parental socioeconomic characteristics) that are uncorrelated with an explanatory variable of interest (birth order) should account for the effects of the latter variable. This occurs in the present case because the parental characteristics, and especially parental schooling, are correlated with birth year, while the latter variable is highly correlated with birth order. Within categories of sibship size, the correlation of birth year and birth order ranges from .55 to .70. Consequently, age (birth year) appears to suppress the effects of birth order on schooling; apparently positive effects of birth order (in Figure 2) turn negative (in Tables III and IV) when age enters the analysis. The addition of the socioeconomic variables to the model provides another mechanism by which the correlation between age and schooling can be explained; the effect of the socioeconomic variables, particularly parents' education, eliminates the suppressor effect that led to the appearance of birth order differentials in schooling.

DISCUSSION

The analysis yields three major findings. First, as in other studies, there

is a substantial, negative effect of size of sibship on schooling; however, only children are not clearly advantaged or disadvantaged relative to other children from small families. Second, intercohort changes in educational attainment occur within, as well as between, families; for cohorts born between 1930 and 1950 intercohort gains in schooling are large enough to obscure the association of ordinal position with schooling. Thus, over its own history, the family is apparently sufficiently vulnerable to societal forces that extrafamilial influences must be controlled before social differentiation within families can be observed; these effects occur mainly in large sibships. To the extent that, as many believe, the American family has become a less cohesive social unit since World War II, the present evidence of cohort effects within families is even more impressive. Third, there are virtually no effects of birth order on educational attainment within families. If we fail to control birth year, a spurious positive coefficient of birth order appears because birth order varies directly with birth year. If we control birth year but fail to control parental education, a spurious negative coefficient of birth order appears because parental education varies directly with birth year across families of each size. If we control birth year and parental education, there is no significant association between birth order and years of completed education: There is no linear effect; there are no effects of being first or last born; there are no patterned or statistically significant differences among ordinal positions. There is no need to invoke any of the more complex theories of child development or intrafamilial resource allocation to explain the effects of birth order on educational attainment because there is nothing to explain.

This does not prove that no birth order effects are to be found in our sample on cognition or on other achievements, such as occupational or economic attainments. These remain to be tested. The present analysis is the first step in our investigation of the effects of family size and structure in the Wisconsin Longitudinal Survey. For a randomly selected sibling in each sibship, as well as for the respondent, we have ascertained occupational status in 1975. In addition, for a highly stratified subsample of siblings in these pairs, we have ascertained mental ability, earnings, and several other social and psychological variables. We hope to extend the present analysis in several ways with these more complete data. First, we want to look at the effects of family structure on ability. While nothing in the present results leads us to expect that we will find substantial effects of ordinal position on ability, we think it is still important to exploit the evidence in our data on that issue. Second, we want to bring variations in ability within the family into our models of educational attainment. Whether or not ordinal position affects the intellectual development of children, the effects of ability differences within families raise interesting questions about the allocation of familial resources and about the effects of personal and family characteristics in the stratification process. Third,

we are extending these models to include postschooling outcomes of the stratification process: occupational status, earnings, and family formation.

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AUTHORS

ROBERT M. HAUSER, Hilldale Professor of Sociology, Department of Sociology, University of Wisconsin-Madison, 1180 Observatory Drive, Madison, WI 53706. *Specializations:* Social stratification, social statistics.

WILLIAM H. SEWELL, Vilas Research Professor of Sociology Emeritus, Department of Sociology, University of Wisconsin-Madison, Madison, WI 53706. *Specializations:* Social stratification, social psychology.