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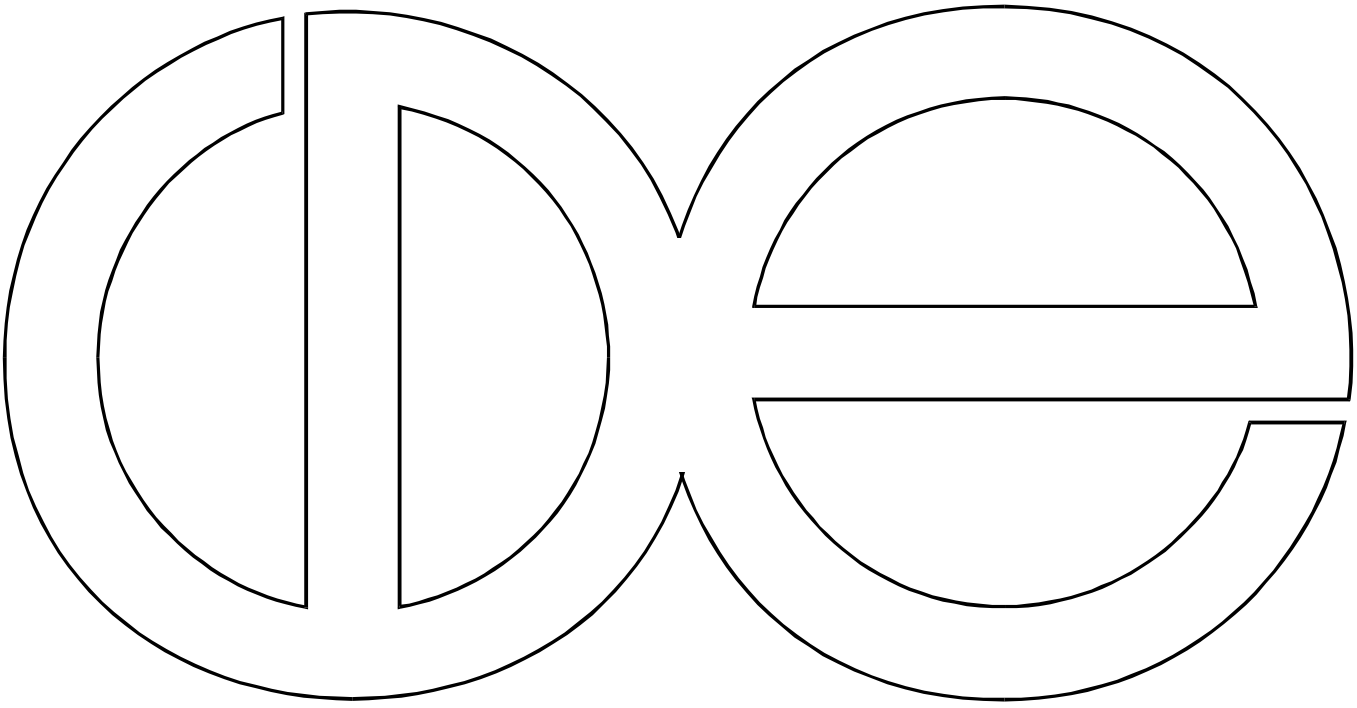

Socioeconomic Achievements of Siblings in the Life Course:

New Findings from the Wisconsin Longitudinal Study[1]

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ABSTRACT

About 8500 graduates of Wisconsin high schools and a randomly selected brother or sister have been followed from 1957 through the early 1990s. Data include multiple measures of social background, cognitive ability, schooling, and occupations held from career entry to midlife. We have analyzed occupational standing across the life course, based on complementary measures of occupational education and of occupational income. Women's and men's careers follow similar upward trajectories in occupational education, but they diverge sharply in occupational income. Women's occupational income trajectories are lower and show less growth than those of men. After correcting for response error, we estimate between-family components of variance in ability (31 to 57 percent), schooling (33 to 55 percent), and occupational standing (11 to 48 percent) -- depending on stage of the occupational career. These estimates are based on structural equation models of sibling resemblance, which yield estimates of the effects of social background, cognitive ability, and schooling -- both within- and between-families -- across the life course of women and men. Across families, educational attainment levels are determined largely by cognitive ability and to a lesser degree by social background; family levels of occupational attainment are determined largely by family education levels. Within families, cognitive ability also affects occupational standing primarily through schooling. Occupational inequalities and the effects of educational attainment on those inequalities both tend to decline across the life course.

The family is a key agent in the process of stratification, that is, the transmission of social and economic inequalities from generation to generation, but the evolution of family effects across the life course has been neglected. Influences of the family of orientation are often cited, but rarely treated explicitly, in social and economic studies of health and psychological outcomes (Smith and Kington 1997). Researchers typically represent family characteristics through a handful of variables -- race, education, occupation, income, female headship, size of sibship, region, size of place, and in some cases, neighborhood or community variables -- that do not represent the full variety or influence of family circumstances (Blau and Duncan 1967; Jencks, et al. 1972; Duncan, et al. 1972; Sewell and Hauser 1975; Jencks, et al. 1979; Halsey, et al. 1980; Corcoran, et al. 1992a; Korenman and Winship 1995). Blau and Duncan's (1967) discussions of "family climate" and the possibility of cross-sibling influences on achievement initiated modern studies of family effects. Nonetheless, most subsequent research has emphasized between-family differences in measured social and economic characteristics of individuals, rather than differences within and between families in resources or social support, typical patterns of activity or interaction, mutual influences among family members, or the link between stratification and family formation.

Some researchers have studied sibling resemblance in an effort to resolve the continuing debate about 'nature' versus 'nurture' as sources of social inequality (Behrman and Taubman 1976; Taubman 1976; Behrman, et al. 1977). In contrast, our goal is more modest, to estimate the contributions of measured and unmeasured variables to variation in the life course within and between families (Hauser and Mossel 1985; Hauser and Mossel 1987; Kuo and Hauser 1995). Thus, in previous work with adult sibling pairs in the Wisconsin Longitudinal Study (WLS), we have studied family resemblance and intra-family differences in education, occupation, earnings,

and fertility (Clarridge 1983; Hauser 1984; Hauser and Sewell 1985; Hauser and Sewell 1986; Hauser and Wong 1989; Mare 1993; Kuo and Hauser 1996; Kuo and Hauser 1997).

Many questions remain about the size and mechanisms of family influence. Some believe that the family, together with other social institutions, mainly reflects and embodies class reproduction (Bourdieu and Passeron 1977; Bowles and Gintis 1976). Others see family effects fundamentally as reflecting genetic potential (Plomin, et al. 1990; Herrnstein and Murray 1994; Murray 1996). Yet others suggest that the family is a potential equalizer because parents may compensate for differences among offspring in order to equalize their outcomes (Griliches 1979). That is, in smaller families, parents may be more effective in equalizing outcomes, thus accounting for supposedly greater heterogeneity among socioeconomic outcomes in larger sibships. However, in the case of educational attainment, Kuo and Hauser (1997) have found that within-family heterogeneity in outcomes does not vary with number of children, while between-family differences are larger in smaller families. In either case, as fertility declines, between-family differences could become a relatively larger component of inequality (Blake 1981; Blake 1989; Heer 1985, 11).

Although effects of measured social background on the occupational standing of adults have declined in recent U.S. cohorts (Featherman and Hauser 1978; Hout 1988), the family remains an important stratifying agent. There is ample evidence that siblings resemble one another to a much greater degree than individuals randomly selected from the population. For example, among 30,000 U.S. men born between 1907 and 1951, who were interviewed in the 1973 Occupational Changes in a Generation (OCG) survey, about two-thirds of the variance in

years of schooling can be explained by a common family factor,[2] and about half the variance in the common family factor can be explained by measured background variables (Hauser and Featherman 1976; Kuo and Hauser 1995). Among the WLS brother pairs, about 40% of the variance in occupational status at age 36 can be explained by family resemblance (Hauser and Sewell 1986:S109). Using data for brothers in the Panel Study of Income Dynamics (PSID), Solon, et al. (1991) estimate that about 45% of the variance in men's permanent incomes can be explained by common family background.

Sibling-based research designs provide several analytic advantages (Corcoran 1992b): (1) Measurements of the resemblance between siblings provide a global indication of the strength of familial (and related) influences on initial conditions and outcomes. Global family effects are underestimated when measured socioeconomic characteristics alone are used to specify the influence of family background, especially when measurement is retrospective. (2) The resemblance between siblings' socioeconomic outcomes across the life course is a useful criterion for proposed explanations of familial and individual differences in achievement. For example, the finding that half the fraternal correlation in schooling is explained by measured family background implies that half is explained by other, unmeasured common variables. This raises the obvious question: What accounts for the other half of sibling resemblance? (3) A central issue in assessments of the effects of schooling is the degree to which associations between measures of schooling and later outcomes are artifacts of the influence of family background. By controlling global effects of family background, sibling-based research designs provide better estimates of the

[2] The correlation (corrected for measurement error) between brothers' years of completed schooling is 0.67 in the OCG data, so a single common factor affecting each brother's schooling equally would explain 67% of the variance in each brother's educational attainment.

effects of schooling and other of variables, e.g., ability and aspiration, that vary both between and within families. (4) Sibling data provide insights into the way that family upbringing enters the process of social stratification. When used along with measured family and individual characteristics, we can identify sources of homogeneity or heterogeneity in the family and the ways in which family membership may compound or offset other sources or mechanisms of stratification.

Previous research on the resemblance of siblings in social and economic standing has often been based on very small and, often, highly selected samples (Griliches 1979; Solon, et al. 1991:514-15; Jencks, et al. 1979:6-7). For example, a recent longitudinal analysis of brothers' earnings in the Panel Study of Income Dynamics (PSID) uses many cases to estimate the temporal stability of earnings. However, a key estimate of family resemblance is based on only 178 brother pairs. Olneck's (1977) pioneering work on the resemblance of brothers is based on 346 pairs from Kalamazoo, Michigan. Also, unlike the WLS, most sibling studies define sibship by co-residence within a specific age range, rather than by kinship alone, as in the case of the 14 to 21-year old participants in the 1979 National Longitudinal Survey of Youth (NLSY) and the siblings who were drawn from a common set of retired CPS households in the earlier National Longitudinal Surveys of Labor Market Experience (NLS). The NLSY provides a large national sample, but studies of NLSY siblings are limited to socioeconomic outcomes in the early career (Korenman and Winship 1995; Murray 1996). Few studies have focused on the resemblance of sisters and brothers, or of sisters and sisters. A valuable exception is sibling pairs from the several original samples in the NLS, which were begun in the late 1960s (Altonji and Dunn 1990a:38). We

calculate that Altonji and Dunn's analysis of cumulated cross-sections is based upon 408 brother pairs, 371 sister pairs, and 1012 mixed-gender pairs.[3]

Sibling Samples in the Wisconsin Longitudinal Study

The WLS is based on a random sample of 10,317 women and men who graduated from Wisconsin high schools in 1957. Survey data were collected from the graduates or their parents in 1957, 1964, and 1975. Those data provide a full record of social background, youthful aspirations, schooling, military service, family formation, labor market experiences, and social participation. Early survey data were supplemented by earnings of parents from state tax records, mental ability tests and rank in class from high schools, and characteristics of communities of residence, schools and colleges, employers, and industries. In 1977 the study design was expanded with the collection of parallel interview data for a highly stratified, random subsample of 2000 siblings of the graduates. In 1992-94, we carried out four major surveys: Telephone and mail surveys of WLS graduates and parallel telephone and mail surveys of a selectively expanded random sample of brothers and sisters of the graduates. The sample design has become increasingly complex over time. Briefly, we now have active samples of 8500 WLS graduates out of 9750 survivors and of 5300 of their siblings, and sample retention is high in both components of the design.

The strength of the WLS as a resource for studies of midlife and of future aging lie in its longitudinal scope, the quality of survey coverage and data, and in its relational design: the fact

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[3] Altonji and Dunn (1990b:20) report that there are potentially 621 brother pairs, 646 sister pairs, and 1921 brother-sister pairs in the NLS samples. The scope of their analyses is limited both by the termination of the NLS young men's sample after 1981 and by the initial selection of the NLS panels from co-resident household members.

that it has followed a large and diverse sample from high school graduation to midlife and that it has followed a number of social and economic relationships between the WLS graduates and significant others. While the WLS data center on the graduates of 1957, we now find it more useful to think of the graduates as focal points in sets of relationships with aging parents, young adult children, and brothers and sisters, as shown in Figure 1, as well as with the social structures through which they have passed -- high schools, colleges, employers, and localities. WLS files include full survey and administrative data records for graduates, linked with those of friends and siblings. Parents were the initial post-high school informants about graduates, but a great deal of our information about parents has come from administrative record data or from siblings, as well as from graduates.

In the 1992-94 WLS surveys, we updated our measurements of marital status, child-rearing, education, labor force participation, jobs and occupations, social participation, and future aspirations and plans among graduates and siblings (Hauser, et al. 1992; Hauser, et al. 1994). In addition, we expanded the content of earlier follow-ups to include psychological well-being, mental and physical health, wealth, household economic transfers, and social comparison and exchange relationships with parents, siblings, and children. We weighed our previous concepts and methods, which resemble those of the Current Population Survey (CPS) and the 1973 Occupational Changes in a Generation Survey (OCG), against comparability with other well-designed surveys, e.g., the Health and Retirement Survey (HRS), the National Survey of Families and Households (NSFH), NIH surveys of work and psychological functioning, and the NORC General Social Survey (GSS). We also coordinated our design with members of the MacArthur Foundation Research Network on Successful Midlife Development, with the Whitehall II study

(Marmot, et al. 1991), and with M.E.J. Wadsworth's (1991) longitudinal study of persons born in Great Britain in 1946.

Among Americans aged 50 to 54 in 1990 and 1991, approximately 66 percent are non-Hispanic white women and men who completed at least 12 years of schooling (Kominski and Adams 1992) and thus resemble the WLS cohort. The WLS cohort, mainly born in 1939, precedes by about a decade the bulk of the baby boom generation that continues to tax social institutions and resources at each stage of life. For this reason, the study can provide early indications of trends and problems that will become important as the larger group passes through its fifties. In addition, the WLS is the first of the large, longitudinal studies of American adolescents, and it thus provides the first large-scale opportunity to study the life course from late adolescence through the mid-50s in the context of a full record of ability, aspiration, and achievement.[4] The WLS overlaps the youngest cohorts in the HRS, and this provides opportunities to check the scope of our findings (and those of the HRS). Unlike the WLS, the HRS is nationally representative, but it does not cover the lives of respondents from adolescence forward to midlife, nor does it provide first-person data from siblings.

The WLS data also have obvious limitations. Some strata of American society are not represented. Everyone in the primary sample graduated from high school. Sewell and Hauser (1975:207-15) estimated that about 75 percent of Wisconsin youth graduated from high schools in the late 1950s; about 7 percent of siblings in the WLS did not graduate. There are only a handful of African American, Hispanic, or Asian persons in the WLS. Given the minuscule share

[4] There have, of course, been important and influential longer-term studies of the life-course in the U.S. These reflect careful and insightful work, but they are based on small, local, or highly selected samples (Oden 1968; Elder 1974; Clausen 1993).

of minorities in Wisconsin when the WLS began, there is no way to remedy this omission. About 19 percent of the WLS sample is of farm origin; this is consistent with national estimates in cohorts of the late 1930s. In 1964, in 1975, and again in 1992, 70 percent of the sample lived in Wisconsin, but 30 percent lived elsewhere in the U.S. or abroad. The WLS graduates are homogeneous in age, but their siblings are not, and their ages cover a broad range, mainly within 8 to 10 years of the age of graduates.

The present analysis is limited to approximately 4662 graduate-sibling pairs in which the graduate was interviewed both in 1975 and in 1992-93, and the sibling was interviewed in 1993-94 and, possibly, in 1977.[5] Most of the analysis has been carried out within subgroups defined by the gender combination of sibling pairs and by response status of the sibling in 1977, which determines the collection of some variables. That is, more data have been obtained for pairs in which the sibling was selected into in the 1977 survey than for pairs in which the sibling was not selected into the 1977 survey. The gender pairs are designated by F-F, F-M, M-F, and M-M, where we use the first initial in each pair to indicate the gender of the graduate and the second to indicate the gender of the randomly selected sibling. Thus, in F-M pairs, the graduate is a woman and the sibling is her brother. Within each type of pair, there are two, distinct random subsamples of sibling data, defined by response status in 1977. The number of cases in each of the eight subsamples is shown in Table 1. It is obvious from the table that there is a differential allocation of cases by type of gender pair to status in the 1977 survey. This occurs because the initial, random selection of cases into the 1977 survey was stratified by type of gender pair. That is, the

[5] This excludes a 20 percent random subsample of potential sibling pairs in which, as a cost-saving measure, the 1993-94 survey operations for siblings were limited in content and were conducted entirely by mail.

selection rate was substantially higher for same-gender than for opposite-gender pairs. Aside from this initial stratification, selection into the 1977 sample was strictly random. Thus, within pairs defined by gender, we have pooled the data for the complete data and incomplete data samples, using methods for estimation with data that are missing completely at random (Allison 1987; Allison and Hauser 1991).

Variables and Measurement

Tables 2, 3, and 4 provide descriptive statistics for variables used in the analysis by gender of graduate and of sibling, including the sources of multiple measures of almost all variables.[6] Table 2 describes the social background of the sample. We use eight distinct social background constructs: Head's occupational education, head's occupational income, father's education, mother's education, parental income, non-intact family, farm background, and number of siblings.

In all but two cases, we have specified a factor model of measurement. That is, each observed variable is described by a linear equation in a corresponding, but unobserved construct, plus an error term. The properties of the constructs are identified because there are multiple, independent measures of them (Hauser, et al. 1983). In a few cases, where there is only one measure of a construct, we have "borrowed" plausible estimates of error variance from another similar variable for which the error variance is identified (Hauser and Sewell 1986). For example, we apply the estimated error variance in junior year test scores of graduates, for whom there is a second, freshman year test score, to the test scores of siblings, for whom there is no second measure. Similarly, whenever an error variance is identified in a complete data sample, but not in

[6] In these tables, we have ignored the pair structure of the sibling data. For example, the estimates for women graduates pool the data for women with sisters in the sample and women with brothers in the sample.

the corresponding sample with incomplete data, we have applied estimates of the error variance from the complete data sample to the sample with incomplete data (Allison 1987; Allison and Hauser 1991).

In two cases, non-intact family and farm origin, where the observed measures are dichotomous, we have simply constructed a linear composite of the available measures, rather than applying a standard linear model whose assumptions cannot be justified at that level of measurement.

Throughout, we use two distinct indexes for each occupational variable: Occupational education and occupational income. Occupation, industry, and class of worker were coded into detailed, seven digit codes from the 1970 Census of Population. These codes were then mapped into characteristics of occupational incumbents in the 1970 Census, based on a special tabulation of all Census records (Featherman and Stevens 1982). Occupational education is based on the percentage of incumbents in each detailed occupation or combination of occupation, industry, and class of worker who completed one or more years of college. Occupational income is based on the percentage of incumbents in each detailed occupation or combination of occupation, industry, and class of worker who earned more than $10,000 in 1969. Each of these percentages was transformed into a started logit of the form $\log[(p + .01)/(1 - p + .01)]$, where p is the proportion of the population above the threshold. This transformation reduces heteroscedasticity in the transformed variable without creating extreme outliers. Hauser and Warren (1997) and Warren, Sheridan, and Hauser (forthcoming) show that these two indexes are preferable to a standard, composite index of occupational socioeconomic status, such as the Duncan SEI. The problems with the SEI and other composite measures are that occupational income typically has lower

construct validity than occupational education and that women and men differ systematically in those two occupational characteristics. Women tend to work in occupations with slightly higher levels of education than men, but they work in occupations with much lower levels of income.

The background measure of occupational standing is based on the job of the head of the household, who was typically the father, but also may have been the mother or a surrogate parent. Head's occupation was ascertained both in the 1975 survey of graduates and in the 1977 survey of siblings. Father's and mother's educational attainments are expressed in years of schooling, truncated at 18 years. Both those variables were ascertained in the 1957 school survey and in the 1975 graduate survey; father's education was also remeasured in the 1977 sibling survey. Parental income data were collected in the early 1960s from Wisconsin state income tax records for the period 1957 to 1960, the years in which the graduates were most likely to have entered and attended college. For this analysis, we have created two income variables: Income in the first available year and the average of incomes in all other years. A small constant was added to each variable, and they were re-expressed in natural logs. Non-intact family is a dummy variable, indicating that the graduate or sibling did not live with both parents.[7] Note that the incidence of non-intact family is much lower than among children today; moreover, about half of the non-intact families in the WLS were disrupted by widowhood. Farm background is a dummy variable, based upon occupation of the head of household. It was ascertained in the 1975 graduate survey, the 1977 sibling survey, and from Wisconsin tax records. Only in the case of number of siblings have

[7] This variable shows a systematic difference between graduates and siblings. Graduates were asked about family structure up to their senior year in high school, while siblings were asked about "most of the time before they were 16 years old." Thus, the two questions do not refer either to the same calendar period or to the same period in the life course of graduates and siblings.

we relied upon a single indicator, obtained from the 1975 graduate survey. However, this variable is based upon four separate questions about the numbers of older and younger brothers and sisters of the graduate, and it has also been checked against a roster of living siblings in the 1975 graduate survey.

Table 3 shows descriptive statistics for educational attainment and cognitive ability. Educational attainments of graduates and siblings were each measured twice. For graduates, schooling was ascertained from the 1964 parent survey as well as in the 1975 graduate survey. To be sure, some graduates completed additional schooling between 1964 and 1975, but we have ignored those changes here. For siblings, schooling was ascertained from the graduate in the 1975 survey and from the sibling in the 1977 or 1993-94 surveys.

Cognitive ability has been ascertained from records of the Wisconsin State Testing Service, a unit of the University of Wisconsin Madison which began to test and record the scores of Wisconsin students in the early 1930s as part of a cooperative program of state high schools and colleges to identify academically talented youth. After the early 1970s, its functions were eclipsed by those of the major national college testing organizations. Through most of this period, the State Testing Service administered a single test, the Henmon-Nelson Test of Mental Ability, to Wisconsin high school students. However, the grade level at which the test was administered varied from time to time. Early in the period, it was administered only to high school seniors, then to sophomores and seniors. After about 1950, it was administered to high school freshman and juniors. Originally, WLS project files included only junior-level data for the class of 1957. Data for siblings in the 1977 sample were added in the late 1970s. During the past year, we have added freshman test scores for the 1957 graduates whenever they were available.

This second measurement exists for about two thirds of the graduates.[8] Finally, we have just completed a search for test scores for all remaining siblings, and coverage is approximately 80 percent. Using national norms by grade level for the Henmon-Nelson test as well as a renorming of raw scores for graduates for whom there were test scores in both the freshman and junior year, we have estimated junior year raw scores on the Henmon-Nelson test for all of the graduates and siblings for whom any test score has been obtained. Finally, we renormed the raw scores to a set of IQ equivalents, based on the percentile distribution of scores that were observed among all Wisconsin high school juniors in 1951. Thus, our norming of the Henmon-Nelson test scores does not depend on the obsolete concept of mental age used in the construction of Henmon-Nelson IQ scores.

Table 4 gives descriptive statistics for occupational education and occupational income of the graduates and siblings. The measures correspond to four distinct times in the occupational career at which we have observed the occupations of both members of the pairs. We have one measure each of the first, full-time civilian occupation held after leaving school and of the occupation held in 1970. We have two measures each of occupations held by the graduate and sibling in 1975 or in 1977. Graduates described those jobs contemporaneously and retrospectively, during the 1992-93 surveys. For siblings, the first report was given by the graduate in the 1975 survey, and the second report was either given contemporaneously in 1977 or retrospectively in 1993-94. Finally we have two measures of occupation in the early 1990s for siblings, but only one measure for graduates. That is, graduates were asked about the jobs held

[8] In a very small number of cases, only the freshman score is available.

by their siblings during the 1992-93 surveys, but siblings were not asked about the jobs held by the graduates.

Figure 2 shows the trajectories of occupational education of graduates and siblings by gender from family of origin to the early 1990s.[9] Regardless of gender, mean occupational education of graduates and siblings was substantially higher than that of their parents. This reflects selection of the sample for relatively high levels of schooling and effects of differential fertility, as well as secular economic development. That is, the selection of high school graduates in itself tends to raise the status of graduates and their siblings relative to their parents. Also, lower status parents had more children than higher status parents, and all children shared in secular occupational change. Even after entry to the labor market -- excepting the 1975 observation for women graduates -- there was continued growth in occupational education over the life course. With the same exception, graduates of each gender were slightly more successful than their siblings, and women were at least as successful as men. The major exception to all of these generalizations appears to be the unusually low occupational standing of women graduates in 1975. However, we think the more unusual observation may actually be the high level of occupational education among women graduates in 1970; that data point reflects the highly selected subgroup of women who were in the labor market when many of their cohort were fully engaged in child-rearing. The same pattern does not appear among female siblings because they vary widely in age at each observation point, so the effects of family responsibilities are distributed across time.

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[9] Figure 2 and Figure 3 are drawn to the same scale in logarithms, so it is fair to compare the trajectories of occupational education and occupational income. However, divisions on the horizontal axis do not correspond to elapsed time between occupational measurements.

Figure 3 is a corresponding display of trajectories of occupational income across the life course. Here, trends and differentials in occupational standing are far different from those in occupational education. Both male graduates (and siblings) and female graduates (and siblings) experience a sharp drop in occupational income between their families of origin and their first, full-time civilian jobs. However, the drop is much larger among women than among men. While women as well as men experience lifetime growth in occupational income, that growth appears to be less steep among women than among men between first jobs and jobs in 1970. Women never approach parity with their fathers, with their male peers, or with their brothers. Again, there is some evidence that the occupational income of women graduates is relatively high in 1970 and relatively low in 1975, but this pattern is weaker here than in the case of occupational education. Finally, male graduates enjoy higher levels of occupational income than male siblings through most of their careers.

Models of Sibling Resemblance

In this paper, our aim is to improve and extend earlier models of attainment within and between families. Some of that earlier work also focuses on occupational outcomes, but most of it is limited to brother pairs and to achievements up through age 36 (Hauser 1984; Hauser and Mossel 1987; Hauser and Sewell 1986). Other work with WLS sibling data focuses on educational attainment in full sibships, but it fails to take advantage of our most recent enhancements of the WLS data (Kuo and Hauser 1996; Kuo and Hauser 1997). Here, we have worked with full data for many more sibling pairs, extended the period of observation from school-leaving to the early 1990s, used new measurements of siblings' cognitive ability in

adolescence, and added new measures of socioeconomic attainment, beginning with revised measures of occupational standing.

Suppose we have observations of the ability (A_G and A_S), schooling (X_G and X_S), and earnings or occupational status (Y_G and Y_S) of a graduate (G) and his or her sibling (S). The naive regressions,

$$Y_G = \alpha_G + \beta_{GA}A + \beta_{GX}X + \epsilon_G$$

and

$$Y_S = \alpha_S + \beta_{SA}A + \beta_{SX}X + \epsilon_S \qquad (1)$$

may be misleading with respect to the effects of ability and of schooling on earnings because G and S have unmeasured common characteristics that affect both ability and schooling, e.g., shared home, neighborhood, or community environments and common genetic heritage. We can eliminate these biases by regressing sibling differences in earnings or status on sibling differences in ability and schooling. If $\triangle A = A_G - A_S$, $\triangle X = X_G - X_S$, and $\triangle Y = Y_G - Y_S$, then we can estimate $\triangle Y = \beta_A \triangle A + \beta_X \triangle X + \epsilon$. This is a simple fixed-effect model.

Since we observe several variables both for graduates and their sisters and brothers, we could use the fixed-effect model to analyze differences between siblings. This would have serious limitations. First, it would tell us nothing about differences between families; at best, it simply eliminates common family effects, as if they were nuisance variables, rather than of intrinsic theoretical interest. To overcome this, one could imagine analyzing family means in parallel with sibling differences, but this would not be quite right. We observe only two siblings per family, so the observed family mean does not reliably describe the family. Second, the difference regressions are far more vulnerable to biases associated with measurement error than are the naive regressions. This occurs, much as in the case of regressions of change scores, because the

difference variables include all of the unreliability in the original variables, but less of the true variance. Third, the measurement structure is often more complex than the simple observation of each variable in each member of a sibling pair. For example, we have two measurements of mental ability for many of the graduates, but only one for the siblings, and we might want to "borrow" an estimated error variance from one part of the model, where it is identified, and use it in another part of the model, where the corresponding parameter would not be identified. Also, in some cases the variable pertaining to the sibling was reported by the graduate (or vice versa), thus raising the possibility of correlation between reporting errors. For these reasons, we have developed a structural equation model of sibling resemblance that combines "within" and "between" family regressions and that provides great flexibility in the specification of measurement error.

Two examples of the model are shown schematically by path diagrams in Figure 4 and Figure 5.[10] Figure 4 is a random effect model of the regression of occupational status on educational attainment among WLS men and their brothers (Hauser and Mossel 1987). There are nine measured variables: two measures of graduate's schooling (EDEQYR and EDAT64), two measures of brother's schooling (XEDEQYR and SSBED), two measures of respondent's occupational status (OCSXCR and OCSX70), and three measures of brother's status (XOCSXCR, OCCSIB, XOCSX70). Each observable is determined by its construct, η_2, ... η_5,

[10] We ignore means and intercepts throughout this discussion. However, we have actually equated the means of complete and incomplete data samples from each subgroup of sibling pairs throughout our analysis, in conformity with our assumption that data are missing completely at random.

and by a random error, ϵ_1, ... ϵ_9.[11] In turn, there is a common family factor, ξ_1 in the two education constructs, η_2 and η_3, and a common family factor, η_1, in the two occupational status constructs, η_4 and η_5. Each of the four constructs is completely determined by one of the common family factors and by a unique individual (within-family) component (ξ_2, ξ_3, η_6, η_7), that is, $\eta_2 = \xi_1 + \xi_2$, $\eta_3 = \gamma_{31}\xi_1 + \xi_3$, $\eta_4 = \eta_1 + \eta_6$, and $\eta_5 = \beta_{51}\eta_1 + \eta_7$. Finally, there are three regressions, a between-family regression of occupational status on educational attainment, $\eta_1 = \gamma_{11}\xi_1 + \zeta_1$ and two within-family regressions pertaining to graduate, $\eta_6 = \gamma_{62}\xi_2 + \zeta_6$ and brother, $\eta_7 = \gamma_{73}\xi_3 + \zeta_7$. The model is "simple" in that it represents only a single regression, that of occupational status on schooling, but it is powerful and flexible in permitting us to test hypotheses about structure and measurement, for example, about equality in the slopes between graduates and their brothers and within and between families (γ_{11}, γ_{62}, γ_{73}). Similarly, we can test for equality in the several variance components, e.g., the variances of schooling of graduates and brothers (ϕ_2 = var (ξ_2) and ϕ_3 = var (ξ_3)), the disturbances in occupational status of graduates and their brothers (ψ_6 = var (ζ_6) and ψ_7 = var (ζ_7)), and the error variances in the observables (θ^{ϵ} = var (ϵ)). This level of disaggregation in the parameters of the model permits us to examine one aspect of the selectivity of the WLS sample. That is, the sibling sample is less selective (with respect to high school graduation) than is the original sample of graduates, but structural parameters need not be equal between graduates and their siblings.[12]

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[11] The model permits correlations among the errors (ϵ_i) of variables that were reported by the same person or on the same occasion, but these are not shown (Hauser and Mossel 1987:122-25).

[12] Models like this can be estimated by maximum likelihood and various specifications tested using standard statistical software, e.g., LISREL, EQS, AMOS, and LISCOMP. All of our models have been estimated using LISREL 8.14 on a Pentium PC.

Figure 5, from Hauser and Sewell (1986), specifies the within- and between-family regressions pertaining to three characteristics of the graduate and sibling (ability, schooling, and occupational status or earnings). It incorporates three measured background characteristics of the siblings (father's education, father's occupational status, and number of siblings), each of which is permitted to affect the common family factors of ability, schooling, and earnings. Also, it illustrates the possibility of "borrowing" parameters; there is only one measure of mental ability for the brother in this analysis, and we have used the estimated error variance from the graduate to specify the measurement error in brother's ability.

We have applied this scheme to estimation and testing of more elaborate models that incorporate our larger samples and new data. These models provide an analytic framework within which it is possible to address many questions about the socioeconomic life course. Specifically, (1) we have added social, economic, and family structure variables, as described above; (2) we have estimated models for all of the siblings interviewed in 1977 or in 1994 and for all types of sibling pairs; and (3) we have estimated reduced-form models for each occupational status construct at each of four dates: First job, 1970 job, 1975-77 job, and 1992-94 job.

Family Effects on Ability, Schooling, and Occupational Standing

Table 5 shows estimates of between- and within-family components of variance in test scores, schooling, and occupational standing. Each set of statistics was estimated separately within the complete and incomplete data samples for each type of sibling pair.[13] For example, the first two lines of the table show variance components for test scores in adolescence. The first line

[13] Thus, estimates from one type of sibling pair sometimes cross-validate estimates from another type of sibling pair. Also, all of the variance component estimates are corrected for effects of random response error using a LISREL model.

gives absolute estimates of variance components. The between-family component of variance among sister pairs is 101.82. The within-family variances in test scores are 76.67 for women graduates and 115.97 for women siblings in sister pairs. Thus, the within-family variance in test scores for women graduates is 43.0 percent [100 X 76.67/(76.67 + 101.82)] of their total variance, and the within-family variance in test scores for sisters of women graduates is 53.2 percent [100 X 115.97/(115.97 + 101.82)] of their total variance. One can think of the percentages as inverse measures of the correlation between hypothetical siblings who are like graduates or like their sisters or brothers. For example, in the case of graduate women in sister pairs, the estimate of 43.0 percent of variance within families implies that 57.0 percent of the variance in test scores lies between families, and this corresponds to a correlation of 0.57 between the test scores of two graduate women from the same family. Similarly, the 53.2 percent of sisters' test score variance within families implies a correlation of 0.468 between the test scores of two (non-graduate) sisters from the same family. Finally, the model estimates imply a correlation of $(0.57 \text{ X } 0.468)^{½} = 0.516$ between the test scores of a woman graduate and her sister. In Table 5, the within-family variance components of test scores range from 43 percent to 69 percent of total variance, and the mean is 57 percent. As we might expect from the educational selection of graduates, the within-family variances are usually smaller among graduates than among their siblings; one exception is the pairs of male graduates and their sisters.

In the case of educational attainment, the shares of variance within and between families are similar to those for ability. They range from 45 percent to 67 percent, and the mean is 56 percent. Thus, typically just under half the variance in schooling lies between families, and the between-family variances range from 33 percent to 55 percent of the total. Absolutely, the

within-family variances in educational attainment are always larger for men than for women. This is consistent with the typical pattern of schooling earlier in the century, in which women were more likely than men to complete high school, but less likely than men to obtain any further schooling.

With occasional exceptions, regardless of gender or type of gender pair, within-family variance in occupational standing is a larger component of the total variance than is within-family variance in test scores or schooling. This holds also, regardless of occupational status construct and regardless of stage of the life course.[14] Occupational standing is simply much more variable within families than are test scores or educational attainment. The average within-family variance component is 70.4 percent in occupational education and 74.2 percent in occupational income. With some exceptions, the variance in occupational standing, however measured, declines across the life course. For example, in M-M pairs, the between-family variance in occupational education is 1.14 for first jobs, 1.05 for 1970 jobs, 0.78 for 1975 jobs, and 0.64 for jobs in 1992-94. However, the within-family components of variance in occupational standing also tend to decline, both for graduates (from 1.96 to 1.53) and their brothers (from 2.39 to 1.87). Thus, there is relative constancy in the shares of variance in occupational education that occur within families, in this case, about 63 percent to 75 percent. If we merely looked at the correlation between brothers' occupational statuses, we would see little change, but the variance components tell us that the appearance of constant correlation hides a gradual decline of occupational

[14] Two notable exceptions are the within-graduate variance component for occupational education of first job among sister pairs (53.8%) and both components of within family variance in occupational income of 1970 job among female graduates and their brothers (56.1% and 52.2%).

inequality across the life course. There are several exceptions to this pattern in Table 5, but we think that it is an accurate description of overall tendencies in the data.

Effects of Social Background, Ability, and Schooling Between Families

Table 6 shows the effects of social background on family levels of test scores, educational attainment, and occupational standing by type of sibling pair. It is important to note that social background characteristics are always common to both members of each sibling pair, and, thus, can affect the outcome variables only by way of one or more common family factors. The sibling resemblance model specifies common family factors in ability, schooling, and in each occupational status construct. Moreover, each family factor can be affected by prior family factors as well as by explicit social background variables. Thus, the family level or factor in educational attainment can be affected by the family ability factor, and the family levels of each occupational status construct can be affected by the family factors in ability and schooling. We have estimated a series of reduced form models, introducing each occupational status construct in turn into a model of sibling resemblance in test scores and schooling.[15]

In Table 6, we have noted estimates that are more than three times as large as their standard errors in bold type. Standard errors are shown in parenthesis below each estimate. This might appear to reflect an unduly conservative level of statistical significance. However, given the

[15] While it is possible in principle to model all of the occupational outcomes simultaneously, estimation of such large models is impractical. For example, we estimated some models that incorporated all of the occupational education constructs or all of the occupational income constructs. The complexity of these models was reduced by treating each occupational construct as an indicator of a graduate's or sibling's general level of occupational achievement. Such models could be estimated using LISREL 8.14 on a PC with 128 Mb of RAM, but not on a PC with as "little" as 64 Mb of RAM.

relatively large sample sizes in each pair type and the large number of parameter estimates reported, we think this reflects an appropriate decision rule (Raftery 1995).

The parameter estimates in Table 6 show a clear pattern: Social background variables have modest (and nominally significant) effects on family levels of ability. These most often meet our stringent criterion of statistical significance in the case of maternal or paternal schooling and number of siblings. Also, there is a significant direct effect of father's educational attainment on the family level of schooling, which appears in three of the four pair types. Otherwise, few significant effects of social background variables on family levels of educational attainment or occupational standing are significant across pair types. One other set of fairly consistent effects, which do not always meet our standard, is that farm background typically reduces family levels of occupational standing. Head's occupational income has notably weak effects, which are often negative, rather than positive.

The most consistent and significant effects in the between-family models are those of family test scores on educational attainment and of family educational attainment on subsequent occupational status. Family background affects schooling primarily through family levels of ability. Family background and ability affect occupational standing primarily by way of family levels of educational attainment. Social background and family ability levels jointly explain about 55 percent of the between-family variance in educational attainment in same-sex pairs, and they explain about 70 percent of the between-family variance in educational attainment in opposite-sex pairs. Thus, much of the effect of family differences in educational attainment on occupational standing is independent of social background or of family ability level.

Furthermore, there is a general, though imperfect tendency for the effects of family levels of educational attainment to decline across the occupational career. This holds for occupational education and for occupational income. However, in pairs with female graduates, the effects of family schooling levels are larger in 1970 than at the beginning of the career. The general pattern of effects, like the pattern we observed earlier in respect to within- and between-family variances, shows a tendency for inequality to decline across the life course. That is, just as between-family variances in occupational standing tend to decline over time, so also do the effects on occupations of initial inequalities in schooling. One might contrast these patterns in the data with hypothesized "Matthew Effects," which propose that initial inequalities are magnified with the passage of time (O'Rand 1995).

Effects of Ability and Education within Families

Since ability, schooling, and occupational standing vary within as well as between families, we have also estimated effects of ability on schooling and of ability and schooling on occupational standing within families. In same-sex pair types, we have constrained these effects to be the same for graduates and their siblings. In opposite-sex pair types, we have permitted the within-family effects to differ between graduate and sibling. These estimates are shown in Table 7, and, again, we have highlighted effects which are at least three times as large as their standard errors (shown in parenthesis).

In general, the within-family effects of ability and schooling in Table 7 are similar to the between-family effects in Table 6.[16] Ability affects occupational standing primarily through

[16] It is straightforward to test this hypothesis explicitly in the LISREL framework, and we plan to do so in an extension of this paper.

schooling, though there is a smattering of statistically significant effects of ability on occupational standing, especially in the later career. That is, there is some tendency for ability to become more important, net of schooling, as the time between work and school-leaving increases. Put more directly, when differences between siblings in schooling are controlled, ability differences between them are more clearly reflected in occupational success as careers unfold. As in the between-family regressions, the within-family regressions tend to show declining effects of educational attainment on occupational status across the life course. Sibling differences in schooling lead to smaller occupational differences in the later career than early in the career. However, one should not make too much of either the growing importance of ability or the declining importance of schooling within families.[17] The effects of schooling on occupational standing are far larger than those of cognitive ability throughout the career.

Finally, Table 8 shows estimates of the between- and within-family disturbances in educational attainment and in occupational standing. These are the variances of the residuals from the family and within-family equations in schooling and occupational status.[18] There is no compelling reason to decompose residual variances into relative between- and within-family components, though we do note that there is much more unexplained within-family variance in occupational standing than there is unexplained between-family variance in occupational standing. Our main interest in Table 8 lies in the possibility that there may be consistent patterns of growth

[17] Recall that effects of family ability levels on family occupational standing do not appear to grow throughout the career.

[18] In a few cases, LISREL yielded statistically insignificant negative estimates of disturbance variances. Since these are inherently positive quantities, we re-estimated these models subject to the constraint that the problematic variances had to be positive.

or decline in occupational inequality across the life course, independent of the determinants of occupational standing that we have examined.

There are some patterns in the residual variances in Table 8, but they appear to be weak and inconsistent, and we have much less confidence in them than in patterns we have observed in other estimates. First, there is no clear pattern of change in the residual, between-family variances. That is, family effects on occupational education and occupational income, other than those embodied in family levels of ability and schooling, neither become more or less variable across the life course. Second, and especially among women graduates, there appears to be growing unexplained inequality in occupational outcomes across the life course. However, we are not sure whether this is a reliable finding, for it does not appear among female siblings, nor among male graduates or male siblings. In this one way, occupational inequality does become larger across the life course, but independent of family background, ability, or schooling. Thus, it would not be appropriate to characterize the growth of inequality as a "Matthew effect" or magnification of initial differences.

Summary and Conclusions

We have examined differences and similarities in cognitive ability, educational attainment, and occupational standing among large samples of pairs of sisters and brothers who have been followed from youth to mature adulthood. We have looked separately at occupational standing as indicated by typical levels of occupational education and by typical levels of occupational earnings. The main difference between those two occupational constructs appears to lie in their relationship with gender. Women are at least at parity with men in occupational education, but they fall far below men in occupational income. Women and men experience growth in

occupational education, both in the transition from their families of orientation to the labor market and throughout their careers. However, women typically enter occupations with low levels of income, early in their careers, and subsequent growth never leads to parity with their fathers, peers, or brothers.

After correcting for response error, we estimate between-family components of variance in ability (31 to 57 percent), schooling (33 to 55 percent), and occupational standing (11 to 48 percent -- but usually about 70 percent) -- depending on stage of the occupational career. These estimates are based on structural equation models of sibling resemblance, which yield estimates of the effects of social background, cognitive ability, and schooling -- both within- and between-families -- across the life course of women and men. There is some tendency for occupational inequalities to contract throughout life. This occurs both between families and within families, thus leading to a relative constancy in the correlation between occupational characteristics of siblings across the life course.

In this midwestern and largely white sample, social background affects educational attainment and occupational standing primarily through family levels of ability. Family ability levels, in turn, affect occupational standing throughout the career primarily through their influence on family educational levels. Across families, education tends to become less important in determining occupational standing as the career progresses. Ability never has substantial effects on differences in occupational success among families, once education has been controlled. When we look within families, there are again, large effects of education on occupational success and small effects of cognitive ability. However, in contrast to differences among families, there is

some tendency for ability have larger effects on differences in occupational standing within families as careers progress.

Since the publication of Herrnstein and Murray's *The Bell Curve*, there has been renewed interest in the effects of cognitive ability on adult success. Here as in a great deal of earlier research with data from the Wisconsin Longitudinal Study, we find important effects of cognitive ability, but it is by no means the central variable in the stratification process. That role is reserved for educational attainment, which is surely affected by ability, but has life-long effects on occupational success that dominate the direct effects of cognitive ability.

This is only one in a series of papers on sibling resemblance across the life course, based on new data from the Wisconsin Longitudinal Study. It holds particular interest to us because of the several, independent measurements of occupational standing obtained in the course of the study. However, occupations are by no means the only outcomes that, we think, should be analyzed in parallel fashion. Other outcomes on our agenda include detailed job characteristics, occupational aspirations, strictly economic success (earnings and assets), social participation, and social and economic characteristics of spouses.

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Table 1. Sibling Pairs by Gender and Response Status in 1977 Sibling Survey: Wisconsin Longitudinal Study

Gender of graduate	Gender of sibling	Sibling in 1977 sample	Sibling not in 1977 sample	Total
Female	Female	606	707	1313
Female	Male	189	966	1155
Male	Female	206	888	1094
Male	Male	526	574	1100
Total		1527	3135	4662

Table 2. Social Background of Wisconsin Graduates and Siblings

		Female Graduate			Sisters of Graduates			Male Graduates			Brothers of Graduates		
		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977	
Head's occupational education	Mean	-1.51	-1.59		-1.51	-1.55		-1.49	-1.61		-1.49	-1.65	
	SD	1.29	1.24		1.32	1.27		1.34	1.27		1.31	1.23	
	N	2421	793		2362	813		2144	725		2203	705	
		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977	
Head's occupational income	Mean	-1.05	-1.15		-1.08	-1.13		-1.04	-1.13		-1.01	-1.16	
	SD	1.12	1.17		1.14	1.17		1.11	1.10		1.09	1.10	
	N	2421	793		2362	813		2144	725		2203	705	
		Grad 1957	Grad 1975	Sib 1977	Grad 1957	Grad 1975	Sib 1977	Grad 1957	Grad 1975	Sib 1977	Grad 1957	Grad 1975	Sib 1977
Father's education	Mean	10.24	9.73	9.46	10.31	9.77	9.62	10.52	9.94	10.10	10.43	9.90	9.93
	SD	3.14	3.29	3.22	3.15	3.34	3.23	3.23	3.39	3.24	3.22	3.34	3.25
	N	2302	2360	757	2250	2322	770	2041	2111	691	2093	2149	678
		Grad 1957	Grad 1975		Grad 1957	Grad 1975		Grad 1957	Grad 1975		Grad 1957	Grad 1975	
Mother's education	Mean	10.63	10.40		10.72	10.56		10.77	10.69		10.68	10.51	
	SD	2.97	2.77		2.94	2.70		2.91	2.77		2.95	2.84	
	N	2351	2393		2271	2332		2026	2120		2106	2181	
		Tax Data	Tax Data (Ave.)		Tax Data	Tax Data (Ave.)		Tax Data	Tax Data (Ave.)		Tax Data	Tax Data (Ave.)	
Parental income	Mean	8.48	8.57		8.50	8.57		8.51	8.59		8.48	8.59	
	SD	0.70	0.66		0.69	0.67		0.69	0.67		0.70	0.65	
	N	2189	2082		2117	2013		1931	1830		2003	1899	
		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977		Grad 1975	Sib 1977	
Non-intact family	Mean	0.09	0.06		0.09	0.07		0.09	0.06		0.09	0.06	
	SD	0.28	0.25		0.28	0.25		0.28	0.24		0.28	0.24	
	N	2468	807		2406	825		2193	737		2255	719	
		Tax Data	Grad 1975	Sib 1977	Tax Data	Grad 1975	Sib 1977	Tax Data	Grad 1975	Sib 1977	Tax Data	Grad 1975	Sib 1977
Farm background	Mean	0.21	0.21	0.23	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.23
	SD	0.41	0.41	0.42	0.40	0.40	0.41	0.41	0.41	0.42	0.42	0.41	0.42
	N	2170	2421	793	2102	2362	813	1921	2144	725	1989	2203	705
		Grad 1975			Grad 1975			Grad 1975			Grad 1975		
Number of siblings	Mean	3.46			3.38			3.38			3.47		
	SD	2.48			2.48			2.51			2.51		
	N	2468			2407			2194			2255		

Table 3. Cognitive Ability and Education of Wisconsin Graduates and Siblings

		Female Graduate		Sisters of Graduates		Male Graduates		Brothers of Graduates	
		Parents 1964	Grad 1975	Grad 1975	Sib 1977/94	Parents 1964	Grad 1975	Grad 1975	Sib 1977/94
Educational Attainment	Mean	13.34	13.04	13.01	13.27	13.96	13.81	13.42	13.79
	SD	1.73	1.75	2.01	2.18	2.12	2.28	2.47	2.53
	N	2218	2468	2397	2405	2011	2194	2249	2255
		Junior	Freshman	Best		Junior	Freshman	Best	
Constructed IQ Based on	Mean	101.40	102.29	102.85		101.65	99.78	102.82	
Wisconsin Junior-Year Norms	SD	14.16	15.45	15.37		15.03	14.71	16.01	
	N	2295	1759	2028		1998	1496	1824	

Table 4: Occupational Education and Occupational Income of Wisconsin Graduates and Siblings

		Female Graduate		Sisters of Graduates		Male Graduates		Brothers of Graduates	
		Grad 1975		Sib 1977/94		Grad 1975		Sib 1977/94	
First full-time civilian occupational education	Mean	-0.77		-0.73		-0.96		-0.97	
	SD	1.56		1.65		1.91		1.88	
	N	2280		2282		2081		2214	
		Grad 1975		Sib 1977		Grad 1975		Sib 1977	
1970 occupational education	Mean	-0.49		-0.67		-0.59		-0.80	
	SD	1.65		1.64		1.79		1.72	
	N	1097		401		2090		638	
		Grad 1975	Grad 1993	Grad 1975	Sib 1977/94	Grad 1975	Grad 1993	Grad 1975	Sib 1977/94
1975-77 occupational education	Mean	-0.75	-0.69	-0.50	-0.66	-0.55	-0.54	-0.73	-0.75
	SD	1.52	1.52	1.62	1.60	1.73	1.76	1.74	1.72
	N	1779	2280	1204	1555	2177	2184	2027	2147
		Grad 1993		Grad 1993	Sib 1994	Grad 1993		Grad 1993	Sib 1994
1993-94 occupational education	Mean	-0.54		-0.54	-0.58	-0.54		-0.67	-0.70
	SD	1.50		1.56	1.54	1.68		1.71	1.69
	N	2280		2066	2363	2183		2068	2241
		Grad 1975		Sib 1977/94		Grad 1975		Sib 1977/94	
First full-time civilian occupational income	Mean	-2.70		-2.44		-1.34		-1.23	
	SD	1.01		1.24		1.39		1.36	
	N	2280		2282		2081		2214	
		Grad 1975		Sib 1977		Grad 1975		Sib 1977	
1970 occupational income	Mean	-2.25		-2.40		-0.59		-0.84	
	SD	1.20		1.20		1.14		1.22	
	N	1097		401		2090		638	
		Grad 1975	Grad 1993	Grad 1975	Sib 1977/94	Grad 1975	Grad 1993	Grad 1975	Sib 1977/94
1975-77 occupational income	Mean	-2.38	-2.27	-2.26	-2.20	-0.51	-0.55	-0.70	-0.66
	SD	1.24	1.28	1.26	1.30	1.14	1.14	1.18	1.18
	N	1779	2280	1204	1555	2177	2184	2027	2147
		Grad 1993		Grad 1993	Sib 1994	Grad 1993		Grad 1993	Sib 1994
1993-94 occupational income	Mean	-1.93		-2.01	-1.96	-0.49		-0.64	-0.63
	SD	1.39		1.35	1.39	1.17		1.17	1.22
	N	2280		2066	2363	2183		2068	2241

Table 5. Between- and Within-Family Variance Components of Selected Variables by Type of Sibling Pair

Variable	Female graduate, female sibling			Female graduate, male sibling			Male graduate, female sibling			Male graduate, male sibling		
	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling
Test score	101.82	76.67 43.0%	115.97 53.2%	75.47	103.57 57.8%	161.58 68.2%	72.44	123.20 63.0%	116.13 61.6%	89.30	69.80 43.9%	99.36 52.7%
Educational attainment	1.50	1.20 44.5%	1.96 56.6%	1.57	1.44 47.8%	3.22 67.2%	1.77	2.89 62.0%	2.11 54.4%	2.25	2.60 53.6%	3.10 58.0%
First job: occupational education	0.86	1.00 53.8%	1.48 63.3%	0.60	1.43 70.5%	2.23 78.8%	0.77	2.39 75.5%	1.73 69.1%	1.14	1.96 63.1%	2.39 67.7%
1970 job: occupational education	0.89	1.29 59.1%	1.76 66.4%	0.81	1.47 64.5%	1.31 61.7%	0.52	2.12 80.2%	2.21 80.9%	1.05	1.80 63.1%	2.05 66.1%
1975/77 job: occupational education	0.67	1.28 65.7%	1.44 68.4%	0.59	1.50 72.0%	1.61 73.3%	0.45	2.04 81.9%	1.64 78.4%	0.78	1.76 69.2%	1.79 69.6%
1992/94 job: occupational education	0.53	1.25 70.3%	1.38 72.3%	0.41	1.29 75.8%	1.73 80.8%	0.54	1.75 76.5%	1.49 73.6%	0.64	1.53 70.5%	1.87 74.5%
First job: occupational income	0.20	0.39 65.5%	0.92 82.0%	0.21	0.40 65.1%	1.07 83.5%	0.26	1.23 82.5%	1.05 80.1%	0.43	0.91 68.0%	1.20 73.6%
1970 job: occupational income	0.32	0.68 68.2%	0.85 72.9%	0.46	0.58 56.1%	0.50 52.2%	0.14	0.80 85.2%	1.12 88.9%	0.27	0.53 66.0%	0.93 77.4%
1975/77 job: occupational income	0.23	0.77 76.6%	0.54 69.7%	0.22	1.14 83.9%	0.69 75.8%	0.22	0.64 74.4%	0.60 73.3%	0.21	0.61 74.4%	0.61 74.3%
1992/94 job: occupational income	0.24	0.83 77.8%	0.82 77.7%	0.19	1.19 86.2%	0.70 78.5%	0.21	0.40 65.6%	0.87 80.4%	0.21	0.44 67.5%	0.62 74.4%

Table 6. Effects of Social Background on Family Ability, Schooling, and Occupational Standing by Type of Sibling Pair

Group and variable	Father's education	Mother's education	Head's occupational education	Head's occupational income	Parents' income	Farm background	Broken family	Number of siblings	Family test score	Family educational attainment
Female graduate, female sibling										
Test score	**0.661**	**0.731**	1.179	0.520	0.558	0.005	-1.833	-0.230		
	(0.191)	(0.169)	(0.603)	(0.645)	(0.682)	(0.310)	(0.675)	(0.135)		
Educational attainment	**0.067**	**0.089**	0.174	-0.007	0.184	**0.105**	-0.101	-0.042	**0.048**	
	(0.021)	(0.019)	(0.065)	(0.069)	(0.073)	(0.033)	(0.073)	(0.015)	(0.006)	
First job: occupational education	-0.016	0.003	-0.031	0.051	-0.035	-0.013	0.033	-0.009	0.006	**0.690**
	(0.013)	(0.012)	(0.040)	(0.041)	(0.045)	(0.021)	(0.044)	(0.009)	(0.004)	(0.047)
1970 job: occupational education	-0.044	-0.014	0.016	0.087	**-0.277**	-0.036	0.036	-0.020	-0.001	**0.836**
	(0.015)	(0.014)	(0.046)	(0.049)	(0.054)	(0.025)	(0.054)	(0.011)	(0.006)	(0.061)
1975/77 job: occupational education	0.013	-0.014	-0.067	0.099	**-0.180**	-0.040	-0.067	-0.005	0.004	**0.602**
	(0.013)	(0.012)	(0.040)	(0.042)	(0.045)	(0.021)	(0.044)	(0.009)	(0.004)	(0.047)
1992/94 job: occupational education	-0.010	0.013	-0.002	-0.019	0.036	-0.056	-0.051	0.001	0.014	**0.491**
	(0.014)	(0.013)	(0.042)	(0.044)	(0.048)	(0.022)	(0.047)	(0.010)	(0.005)	(0.049)
First job: occupational income	0.000	-0.005	-0.050	0.035	0.029	-0.019	0.034	0.005	0.008	**0.349**
	(0.010)	(0.010)	(0.032)	(0.033)	(0.036)	(0.017)	(0.036)	(0.007)	(0.004)	(0.040)
1970 job: occupational income	**-0.053**	-0.022	-0.005	0.101	0.020	-0.028	0.146	0.014	-0.017	**0.500**
	(0.016)	(0.015)	(0.049)	(0.052)	(0.056)	(0.026)	(0.057)	(0.011)	(0.006)	(0.062)
1975/77 job: occupational income	-0.002	-0.014	-0.087	0.081	-0.066	-0.055	-0.001	0.009	0.002	**0.367**
	(0.012)	(0.011)	(0.038)	(0.039)	(0.042)	(0.019)	(0.042)	(0.008)	(0.004)	(0.044)
1992/94 job: occupational income	-0.008	0.018	-0.026	0.031	0.014	-0.018	0.050	0.005	0.013	**0.249**
	(0.014)	(0.013)	(0.045)	(0.047)	(0.051)	(0.023)	(0.050)	(0.010)	(0.005)	(0.051)
Female graduate, male sibling										
Test score	0.509	**0.734**	0.866	0.003	1.210	0.183	0.759	**-0.441**		
	(0.199)	(0.177)	(0.501)	(0.717)	(0.715)	(0.323)	(0.694)	(0.143)		
Educational attainment	**0.069**	0.056	0.147	0.043	**0.265**	0.058	-0.088	**-0.088**	**0.066**	
	(0.023)	(0.021)	(0.058)	(0.083)	(0.082)	(0.036)	(0.078)	(0.017)	(0.009)	
First job: occupational education	0.007	0.026	0.045	-0.001	0.020	0.046	-0.090	-0.024	-0.001	**0.530**
	(0.015)	(0.013)	(0.036)	(0.049)	(0.054)	(0.022)	(0.048)	(0.012)	(0.009)	(0.083)
1970 job: occupational education	0.008	0.011	-0.055	-0.114	-0.001	-0.010	-0.002	0.026	-0.013	**0.837**
	(0.020)	(0.019)	(0.050)	(0.065)	(0.074)	(0.031)	(0.066)	(0.017)	(0.012)	(0.123)
1975/77 job: occupational education	-0.001	0.003	0.000	-0.016	0.076	-0.026	-0.004	-0.028	-0.001	**0.535**
	(0.015)	(0.013)	(0.036)	(0.049)	(0.053)	(0.023)	(0.048)	(0.012)	(0.009)	(0.082)
1992/94 job: occupational education	-0.012	0.020	0.025	0.009	0.048	-0.021	0.046	-0.022	0.004	**0.427**
	(0.016)	(0.014)	(0.038)	(0.052)	(0.057)	(0.024)	(0.052)	(0.013)	(0.009)	(0.086)
First job: occupational income	0.006	0.020	-0.050	0.039	0.105	0.011	-0.034	-0.024	-0.006	**0.322**
	(0.012)	(0.011)	(0.030)	(0.041)	(0.044)	(0.019)	(0.040)	(0.010)	(0.007)	(0.070)
1970 job: occupational income	-0.003	-0.011	-0.078	-0.022	0.128	-0.001	0.004	0.019	0.006	**0.359**
	(0.019)	(0.017)	(0.046)	(0.063)	(0.070)	(0.029)	(0.063)	(0.016)	(0.011)	(0.111)
1975/77 job: occupational income	-0.030	0.022	-0.030	0.091	0.109	-0.061	0.044	-0.015	0.002	**0.263**
	(0.014)	(0.013)	(0.035)	(0.050)	(0.051)	(0.022)	(0.046)	(0.012)	(0.008)	(0.078)
1992/94 job: occupational income	-0.013	0.022	-0.032	0.056	0.084	-0.062	0.075	-0.003	0.007	0.197
	(0.015)	(0.014)	(0.037)	(0.051)	(0.055)	(0.023)	(0.050)	(0.012)	(0.009)	(0.080)

Table 6 (Continued). Effects of Social Background on Family Ability, Schooling, and Occupational Standing by Type of Sibling Pair

Group and variable	Father's education	Mother's education	Head's occupational education	Head's occupational income	Parents' income	Farm background	Broken family	Number of siblings	Family test score	Family educational attainment
Male graduate, female sibling										
Test score	**0.758**	0.576	0.787	-0.246	**1.938**	0.132	-0.735	-0.182		
	(0.224)	(0.194)	(0.541)	(0.695)	(0.639)	(0.336)	(0.708)	(0.144)		
Educational attainment	0.045	0.062	**0.322**	-0.100	**0.368**	0.022	0.001	**-0.089**	**0.062**	
	(0.028)	(0.024)	(0.069)	(0.085)	(0.080)	(0.040)	(0.085)	(0.017)	(0.011)	
First job: occupational education	-0.010	0.005	-0.003	0.002	**-0.195**	**-0.080**	-0.061	-0.012	0.003	**0.664**
	(0.016)	(0.015)	(0.043)	(0.048)	(0.053)	(0.023)	(0.049)	(0.011)	(0.008)	(0.072)
1970 job: occupational education	0.041	-0.048	0.078	-0.043	-0.147	**-0.096**	-0.146	0.016	0.008	**0.455**
	(0.021)	(0.019)	(0.058)	(0.063)	(0.071)	(0.031)	(0.067)	(0.016)	(0.011)	(0.096)
1975/77 job: occupational education	0.023	-0.024	-0.043	0.009	**-0.172**	**-0.080**	**-0.148**	0.004	-0.005	**0.561**
	(0.015)	(0.014)	(0.042)	(0.045)	(0.049)	(0.022)	(0.045)	(0.011)	(0.008)	(0.068)
1992/94 job: occupational education	0.006	-0.019	-0.035	-0.016	-0.111	**-0.097**	-0.035	0.002	0.018	**0.453**
	(0.018)	(0.016)	(0.048)	(0.052)	(0.058)	(0.025)	(0.053)	(0.013)	(0.008)	(0.077)
First job: occupational income	0.008	0.013	-0.065	0.105	-0.006	**-0.103**	0.040	0.002	0.001	**0.333**
	(0.016)	(0.014)	(0.043)	(0.050)	(0.053)	(0.023)	(0.048)	(0.011)	(0.008)	(0.072)
1970 job: occupational income	0.043	-0.009	0.035	0.070	0.028	-0.051	0.077	-0.027	0.014	0.046
	(0.020)	(0.018)	(0.053)	(0.059)	(0.066)	(0.029)	(0.062)	(0.014)	(0.009)	(0.081)
1975/77 job: occupational income	0.017	-0.011	-0.002	0.086	-0.017	-0.059	0.020	-0.006	0.012	**0.184**
	(0.014)	(0.012)	(0.037)	(0.043)	(0.046)	(0.020)	(0.042)	(0.010)	(0.007)	(0.060)
1992/94 job: occupational income	0.008	0.004	-0.111	**0.167**	-0.001	-0.068	**0.161**	0.011	**0.026**	0.147
	(0.017)	(0.015)	(0.046)	(0.054)	(0.055)	(0.023)	(0.050)	(0.012)	(0.008)	(0.071)
Male graduate, male sibling										
Test score	**0.623**	0.554	1.491	-0.665	1.235	0.015	-0.605	-0.411		
	(0.196)	(0.190)	(0.653)	(0.883)	(0.772)	(0.331)	(0.703)	(0.138)		
Educational attainment	**0.114**	0.004	**0.337**	-0.140	0.064	0.030	-0.055	**-0.102**	**0.065**	
	(0.028)	(0.027)	(0.091)	(0.122)	(0.107)	(0.045)	(0.097)	(0.019)	(0.009)	
First job: occupational education	0.013	-0.008	-0.013	-0.036	-0.076	-0.032	-0.025	0.017	-0.003	**0.736**
	(0.015)	(0.013)	(0.049)	(0.062)	(0.054)	(0.023)	(0.049)	(0.011)	(0.006)	(0.050)
1970 job: occupational education	-0.015	-0.022	0.149	-0.143	-0.075	-0.088	-0.009	0.017	0.014	**0.591**
	(0.019)	(0.017)	(0.061)	(0.077)	(0.069)	(0.029)	(0.065)	(0.014)	(0.007)	(0.062)
1975/77 job: occupational education	0.007	-0.007	0.068	-0.106	-0.045	**-0.074**	-0.048	0.012	0.000	**0.547**
	(0.015)	(0.014)	(0.050)	(0.063)	(0.055)	(0.023)	(0.050)	(0.011)	(0.006)	(0.048)
1992/94 job: occupational education	-0.018	0.023	0.076	-0.020	-0.009	-0.066	0.008	0.003	-0.009	**0.504**
	(0.017)	(0.015)	(0.055)	(0.070)	(0.061)	(0.026)	(0.055)	(0.012)	(0.007)	(0.053)
First job: occupational income	-0.007	0.008	-0.044	0.134	0.053	**-0.067**	0.064	0.008	0.009	**0.373**
	(0.015)	(0.013)	(0.048)	(0.061)	(0.053)	(0.022)	(0.048)	(0.011)	(0.006)	(0.047)
1970 job: occupational income	-0.031	-0.016	0.146	0.011	0.116	-0.055	0.116	0.006	0.020	0.111
	(0.017)	(0.015)	(0.054)	(0.068)	(0.061)	(0.026)	(0.057)	(0.012)	(0.007)	(0.054)
1975/77 job: occupational income	-0.012	-0.005	0.030	0.104	0.057	-0.046	0.047	0.002	0.004	**0.173**
	(0.013)	(0.012)	(0.042)	(0.054)	(0.048)	(0.020)	(0.043)	(0.010)	(0.005)	(0.041)
1992/94 job: occupational income	-0.005	0.014	0.000	0.147	0.074	-0.027	0.018	0.000	0.004	**0.138**
	(0.014)	(0.013)	(0.046)	(0.059)	(0.052)	(0.022)	(0.047)	(0.010)	(0.005)	(0.043)

Table 7. Effects of Test Scores and Schooling Within Families by Type of Sibling Pair

Variable	Female graduate, female sibling		Female graduate, male sibling				Male graduate, female sibling				Male graduate, male sibling	
			Female graduate		Male sibling		Male graduate		Female sibling			
	Test score	Schooling	Test score	Schooling	Test score	Schooling	Test score	Schooling	Test score	Schooling	Test score	Schooling
Educational attainment	**0.034** (0.004)		**0.027** (0.006)		**0.065** (0.006)		**0.076** (0.006)		**0.052** (0.007)		**0.081** (0.007)	
First job: occupational education	0.005 (0.003)	**0.724** (0.025)	0.004 (0.005)	**0.867** (0.046)	0.002 (0.004)	**0.634** (0.029)	-0.007 (0.005)	**0.803** (0.032)	0.005 (0.005)	**0.642** (0.034)	-0.004 (0.005)	**0.705** (0.026)
1970 job: occupational education	**0.012** (0.004)	**0.763** (0.035)	0.011 (0.005)	**0.743** (0.051)	0.000 (0.009)	**0.461** (0.064)	0.010 (0.006)	**0.651** (0.037)	-0.003 (0.009)	**1.032** (0.066)	-0.014 (0.007)	**0.652** (0.033)
1975/77 job: occupational education	**0.012** (0.003)	**0.665** (0.026)	**0.015** (0.005)	**0.657** (0.044)	0.001 (0.004)	**0.521** (0.028)	**0.017** (0.005)	**0.559** (0.033)	0.011 (0.004)	**0.693** (0.037)	0.009 (0.005)	**0.569** (0.025)
1992/94 job: occupational education	**0.013** (0.003)	**0.516** (0.026)	**0.017** (0.005)	**0.480** (0.048)	0.007 (0.004)	**0.456** (0.028)	0.014 (0.005)	**0.515** (0.037)	0.006 (0.005)	**0.560** (0.034)	**0.020** (0.005)	**0.486** (0.027)
First job: occupational income	0.004 (0.003)	**0.384** (0.022)	0.005 (0.004)	**0.453** (0.036)	0.004 (0.004)	**0.347** (0.025)	0.007 (0.005)	**0.399** (0.032)	0.004 (0.005)	**0.370** (0.032)	0.002 (0.005)	**0.335** (0.024)
1970 job: occupational income	**0.022** (0.004)	**0.274** (0.033)	0.014 (0.005)	**0.385** (0.047)	0.008 (0.008)	**0.207** (0.056)	**0.015** (0.005)	**0.170** (0.035)	-0.006 (0.010)	**0.601** (0.071)	0.001 (0.006)	**0.195** (0.029)
1975/77 job: occupational income	**0.010** (0.003)	**0.279** (0.023)	**0.017** (0.005)	**0.399** (0.044)	0.007 (0.003)	**0.166** (0.024)	**0.021** (0.004)	**0.089** (0.027)	0.009 (0.004)	**0.314** (0.033)	**0.019** (0.004)	**0.136** (0.020)
1992/94 job: occupational income	**0.016** (0.004)	**0.197** (0.026)	**0.024** (0.005)	**0.212** (0.049)	**0.013** (0.004)	**0.137** (0.024)	**0.018** (0.005)	**0.144** (0.033)	**0.015** (0.005)	**0.223** (0.033)	**0.012** (0.004)	**0.152** (0.021)

Table 8. Between- and Within-Family Disturbance Variances of Selected Variables by Type of Sibling Pair

Variable	Female graduate, female sibling			Female graduate, male sibling			Male graduate, female sibling			Male graduate, male sibling		
	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling	Between-family	Within-graduate	Within-sibling
Educational attainment	0.669 (0.072)	1.113 (0.087)	1.828 (0.121)	0.464 (0.086)	1.357 (0.113)	2.531 (0.169)	0.558 (0.093)	2.177 (0.154)	1.786 (0.141)	0.957 (0.120)	2.135 (0.166)	2.441 (0.189)
First job: occupational education	0.106 (0.028)	0.281 (0.043)	0.344 (0.049)	0.000 (0.035)	0.343 (0.060)	0.797 (0.070)	0.022 (0.035)	0.555 (0.064)	0.683 (0.063)	0.000 (0.037)	0.604 (0.062)	0.820 (0.071)
1970 job: occupational education	0.000 (0.048)	0.489 (0.063)	0.584 (0.087)	0.000 (0.094)	0.605 (0.105)	0.647 (0.154)	0.016 (0.074)	0.770 (0.089)	0.000 (0.116)	0.077 (0.062)	0.800 (0.084)	0.815 (0.105)
1975/77 job: occupational education	0.109 (0.029)	0.691 (0.054)	0.492 (0.047)	0.069 (0.034)	0.801 (0.066)	0.722 (0.061)	0.000 (0.032)	0.922 (0.063)	0.528 (0.054)	0.081 (0.036)	0.861 (0.065)	0.699 (0.062)
1992/94 job: occupational education	0.045 (0.035)	0.881 (0.073)	0.708 (0.055)	0.001 (0.040)	0.895 (0.083)	0.948 (0.069)	0.077 (0.040)	0.868 (0.084)	0.698 (0.063)	0.063 (0.045)	0.804 (0.088)	0.896 (0.072)
First job: occupational income	0.000 (0.021)	0.197 (0.033)	0.554 (0.045)	0.000 (0.025)	0.102 (0.037)	0.623 (0.054)	0.000 (0.034)	0.720 (0.061)	0.681 (0.059)	0.000 (0.036)	0.626 (0.058)	0.801 (0.064)
1970 job: occupational income	0.097 (0.051)	0.525 (0.059)	0.594 (0.075)	0.258 (0.078)	0.323 (0.085)	0.321 (0.112)	0.000 (0.075)	0.648 (0.085)	0.398 (0.127)	0.101 (0.050)	0.442 (0.062)	0.801 (0.090)
1975/77 job: occupational income	0.059 (0.026)	0.658 (0.069)	0.349 (0.045)	0.043 (0.031)	0.862 (0.086)	0.572 (0.065)	0.056 (0.025)	0.532 (0.049)	0.351 (0.053)	0.091 (0.026)	0.515 (0.051)	0.468 (0.052)
1992/94 job: occupational income	0.072 (0.039)	0.751 (0.088)	0.682 (0.059)	0.058 (0.038)	1.043 (0.089)	0.573 (0.053)	0.032 (0.035)	0.262 (0.080)	0.684 (0.062)	0.104 (0.031)	0.358 (0.066)	0.500 (0.047)

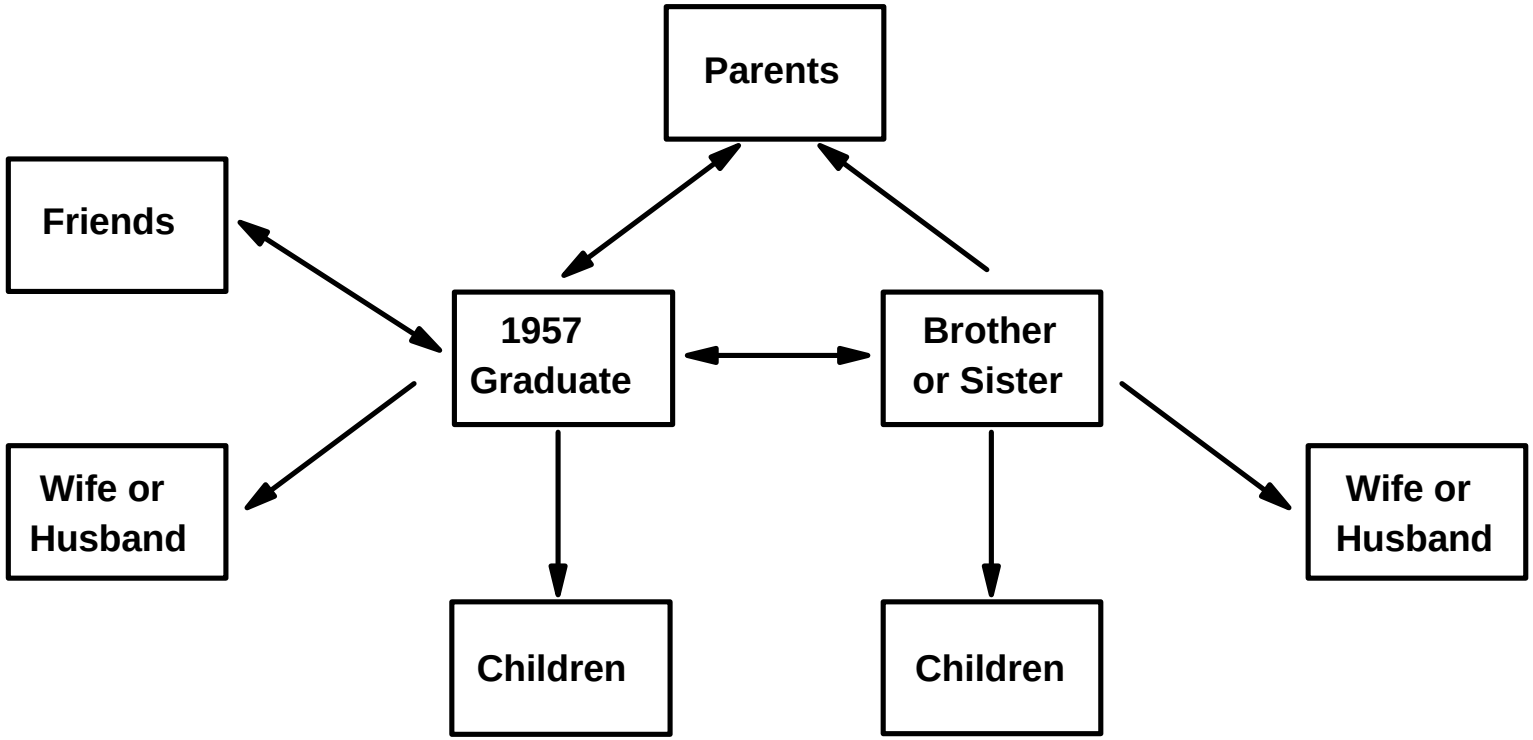
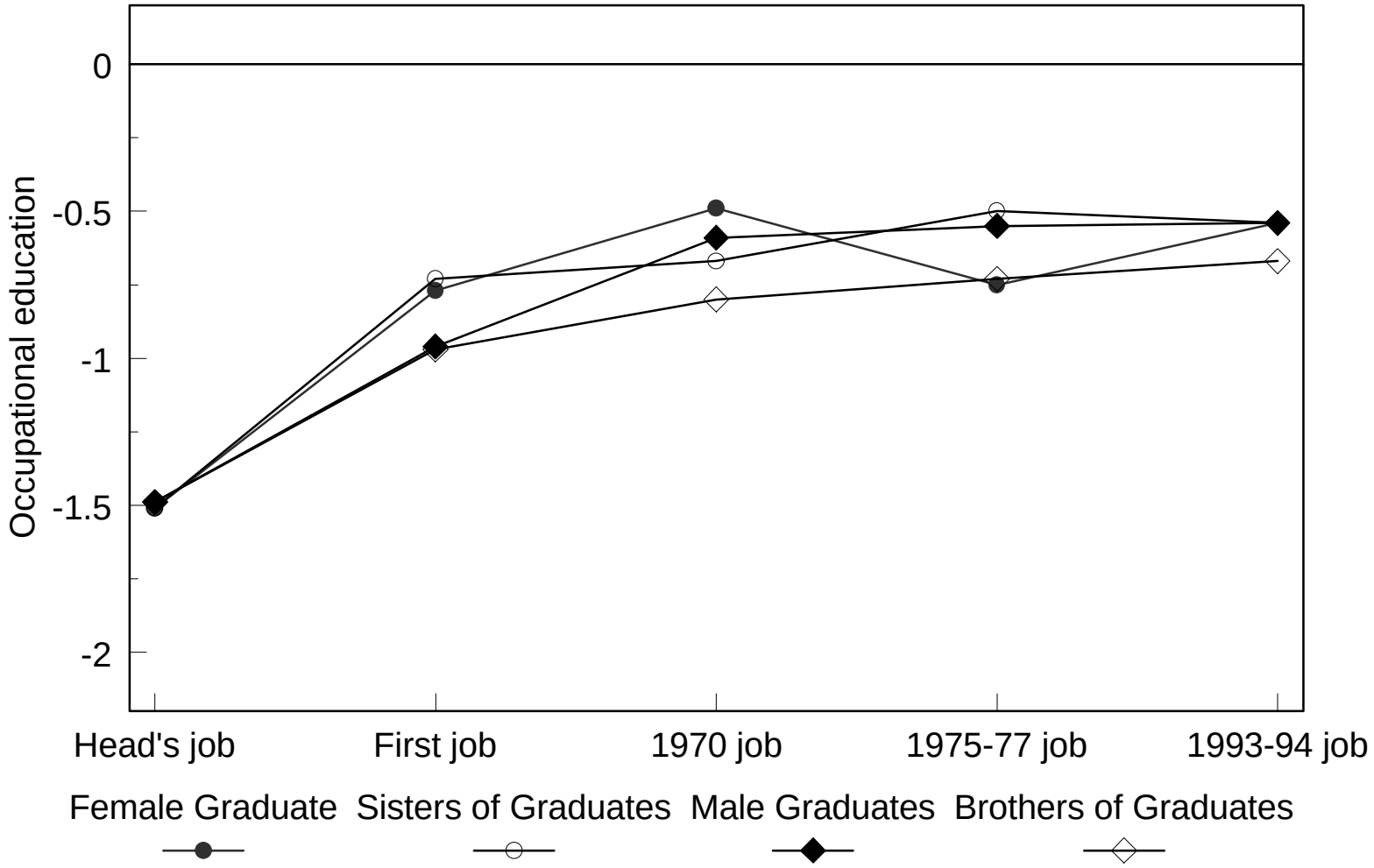


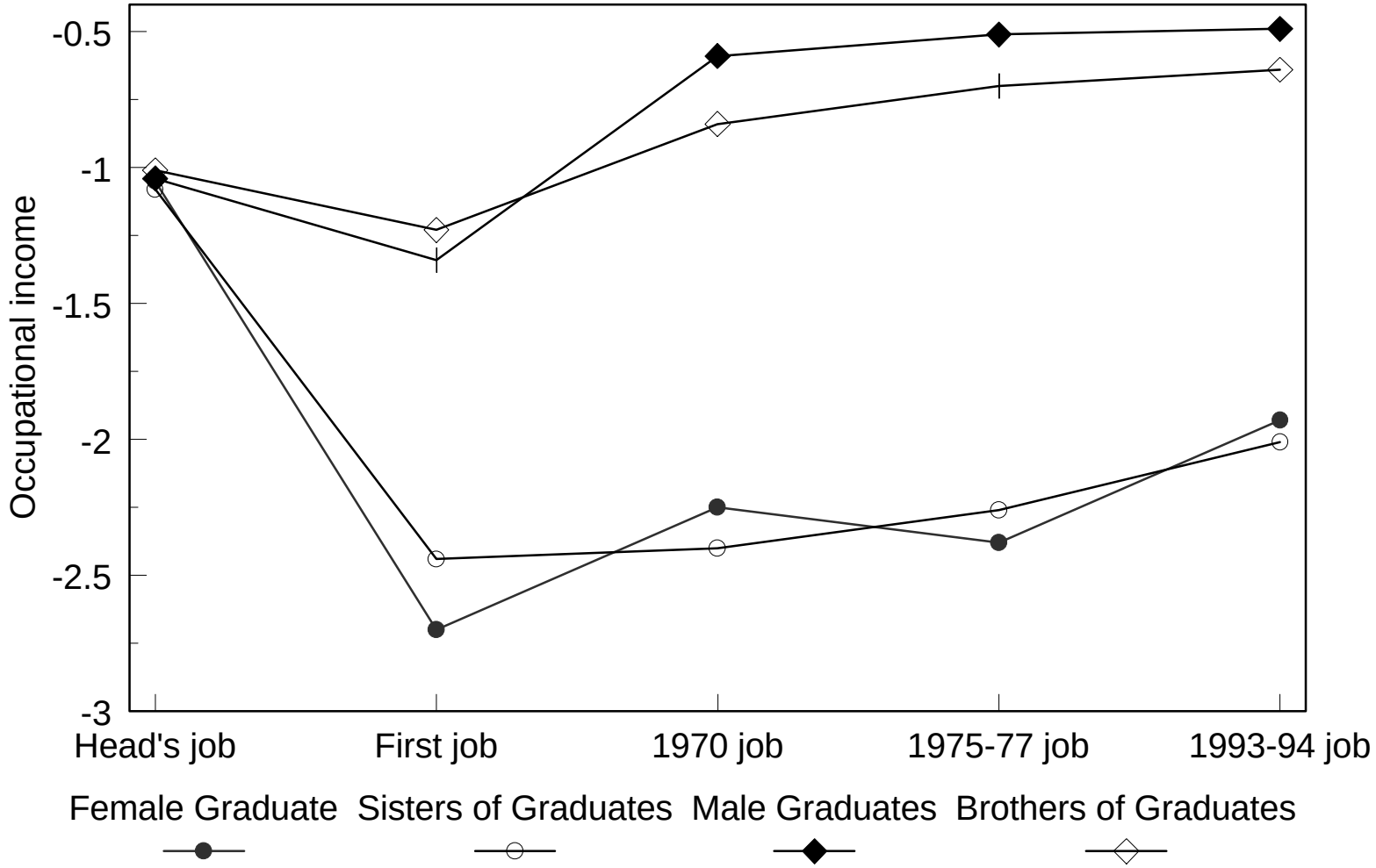
Figure 1. Some social links in the Wisconsin Longitudinal Study (Note: Arrows show sources of reports about each node in the network.)

Figure 2. Mean Occupational Education across the Life Course: Wisconsin Women and Men and their Siblings, 1957 to 1994



Note: Distances between occupational observations are not proportional to elapsed time.

Figure 3. Mean Occupational Income across the Life Course: Wisconsin Women and Men and their Siblings, 1957 to 1994



Note: Distances between occupational observations are not proportional to elapsed time.

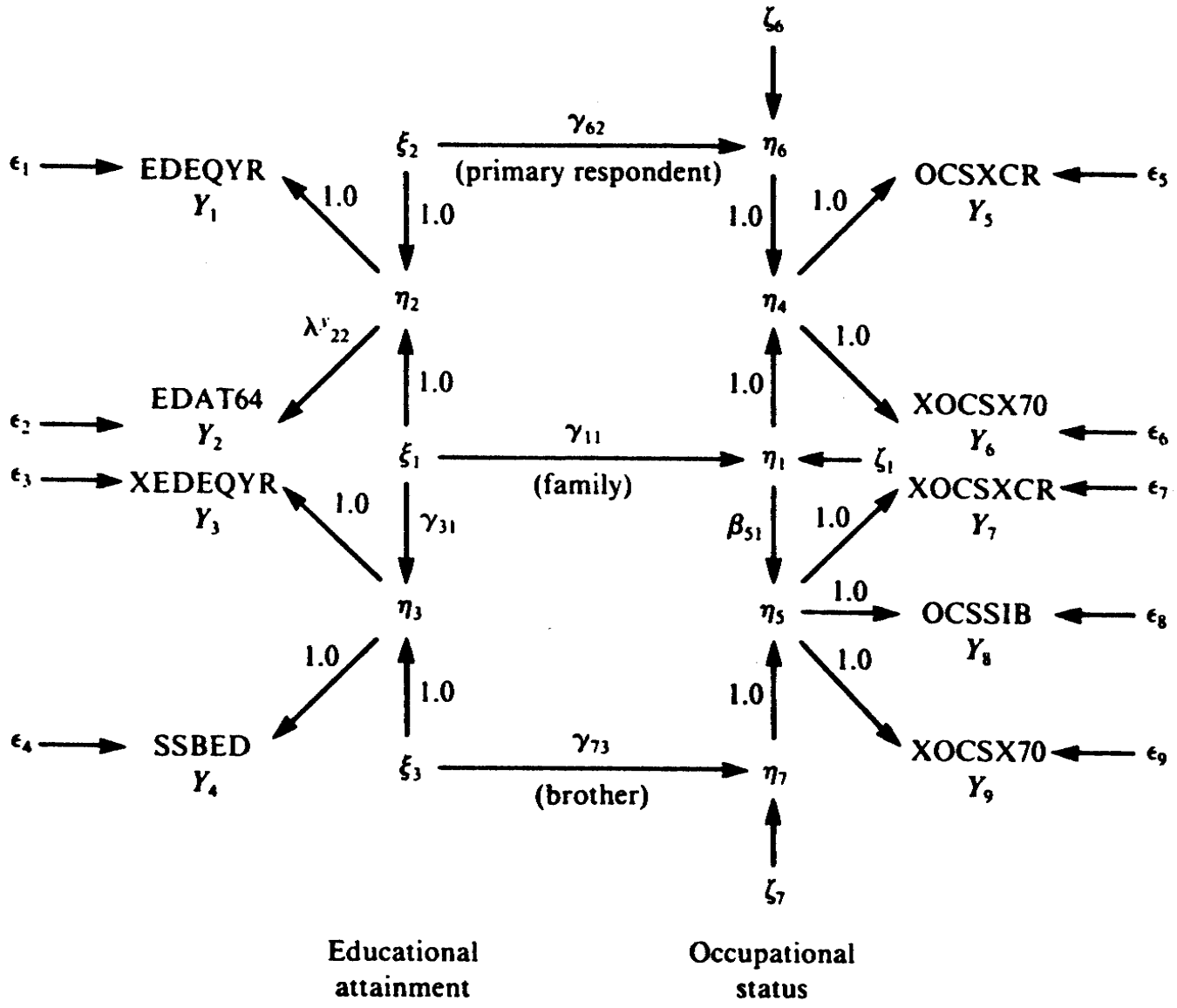


Figure 4. Structural equation model of sibling resemblance in educational attainment and occupational status with errors in variables and latent family factors (Hauser and Mossell 1987: 128)

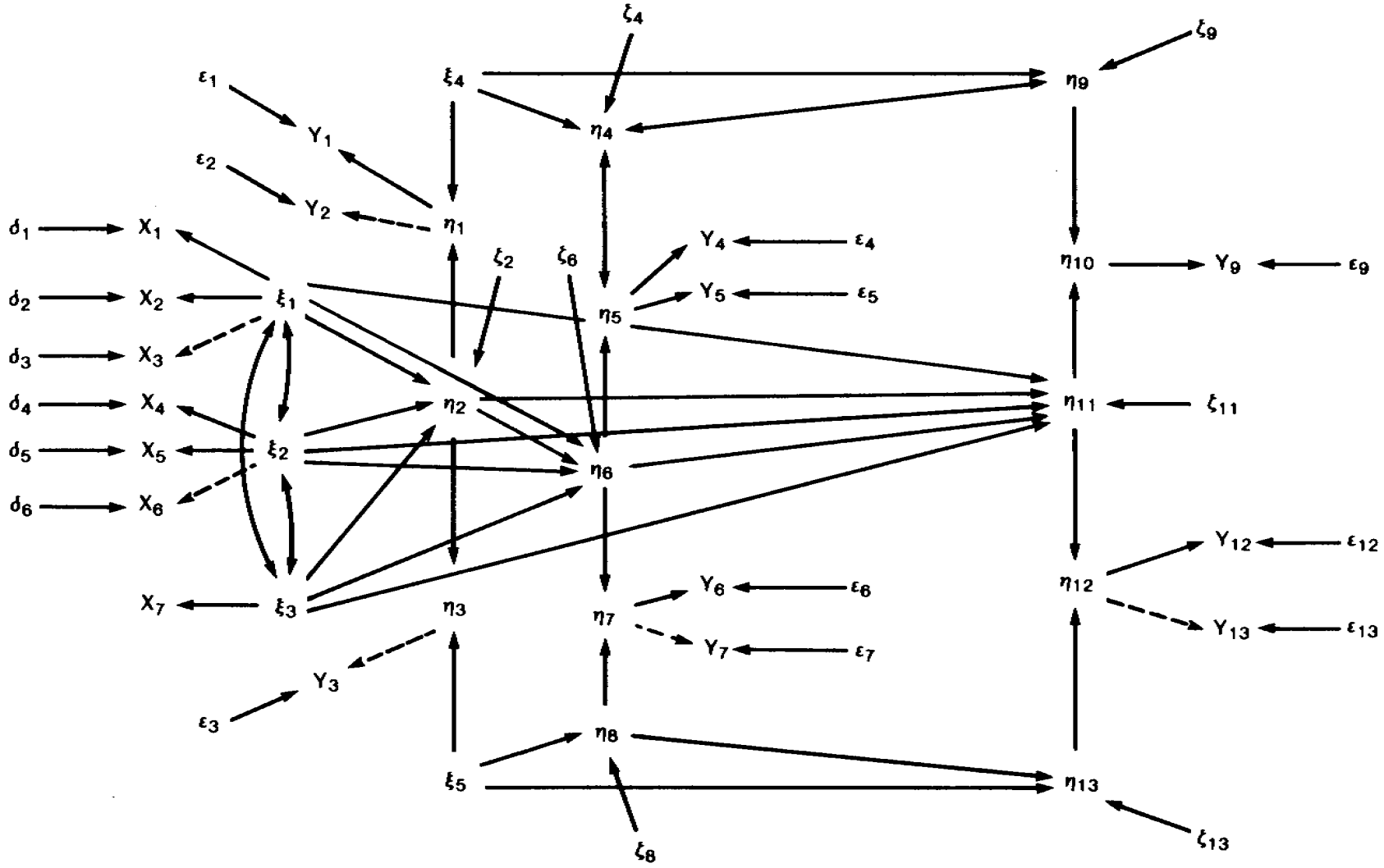


Figure 5. Structural model of sibling resemblance in occupational status with measured family background variables, measurement error, and common family factors (Hauser and Sewell 1986: S101)

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