Center for Demography and Ecology

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Does Family Background Affect Educational Attainment Differently According to Family Structure, Birth Order, and Sex?

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Abstract

This study of sibling resemblance in educational attainment seeks to determine whether the effect of family background on educational attainment differs according to family structure, birth order, and sex.

In order to address these research problems, I analyze sibling data from both waves of the National Survey of Families and Households and use a form of the multiple indicator, multiple cause (MIMIC) model proposed by Hauser and Goldberger (1971). The MIMIC model includes a latent common family background variable which takes into account family influences common to pairs of siblings but not captured by the set of measured family background variables.

In the first part of the analysis, I consider the educational attainment and social background of sibling pairs coming from two-parent dual-earner families, two-parent single-earner families, and single-parent single-earner families. I did find the effects of family background on educational attainment to differ among these three family groups. However, I also found family background effects to be more similar among the two-parent families than among the single-parent families. Single-parenthood seems to alter the effects that family background has on children's educational attainment much more than does mother's employment.

In the second part of the analysis, I attempt to determine whether family background affects educational attainment differently according to the birth order and sex of children. I limit my analysis to two-parent families and consider the educational attainment and social background of four types of sibling pairs (older-brother younger-brother, older-brother younger-sister, older-sister younger-sister, and older sister-younger brother). For the most part, I found family background effects to be similar among all children, regardless of birth order and sex. However, I did find sibling pairs with an older brother to exhibit a greater degree of resemblance in educational attainment; a resemblance not explained by the measured background factors. This finding lends support to Benin and Johnson's (1984) facilitation hypothesis and leads me to conclude that family background does affect children's educational attainment differently according to birth order and sex.

This study of sibling resemblance in educational attainment consists of two parts. In the first part, I will analyze the effects of family background on siblings' education among two-parent dual-earner families, two-parent single-earner families, and single-parent single-earner families in order to uncover any differences in the process of educational attainment found among these different family structures.

In the second part of the analysis, I will investigate the effects of family background on educational attainment among four different sibling-pair types in an effort to uncover any differences in the process of educational attainment according to birth order and sex.

I will analyze data from the two waves of the National Survey of Families and Households in an attempt to address the research problems mentioned above. The NSFH is a nationwide survey which provides detailed information on many dimensions of family life. Since the family is an important agent in the stratification process, such a survey should be quite useful for stratification research. Specifically, I will be looking at the relation between the educational attainment of pairs of siblings aged 25-34 and the socioeconomic background from which they emerged.

PREVIOUS RESEARCH

Family Structure

Much attention has been given to single-parent families and the consequences that single-parenthood has for children. Some attention, although much less, has also been given to the consequences that maternal employment has for children. Although the majority of mothers with school-aged children work, a substantial percentage do not. In 1987, the figures were 65% and 35%, respectively (U.S. Dept. of Labor, 1988.)

In his analysis of two-parent families in the NSFH, Kalmijn (1994) found that the occupational

status of mothers who work has a strong positive effect on children's schooling, independent of both father's occupational status and father's education. However, Kalmijn found that the benefits of a working mother depend on what type of job she holds. For instance, he found that children of non-working mothers and children of mothers with high-status jobs were more likely to complete high school, were more likely to enter college, and were more likely to graduate from college than were children of mothers with average or low-status jobs.

Haveman and Wolfe (1994) analyzed data from the Panel Study of Income Dynamics accumulated over the years 1968-1988 and found that mother's employment during one's adolescent years (age 12-15) has a significant positive effect on the likelihood of high school graduation, but no effect on completed years of schooling. These mixed findings make intuitive sense considering high school graduation is not as far removed from age 15 as is the completion of one's schooling.

However, other studies have found mother's employment to have no effect on children's educational attainment (Sewell, Hauser, and Wolf, 1980; D'Amico, Haurin, and Mott, 1983; Alwin and Thorton, 1984) regardless of whether employment during childhood or adolescence was considered.

Educational outcomes may differ between children of working mothers and children of non-working mothers for two reasons. One is that the overall effect mother's employment has on educational attainment consists of competing positive and negative effects, which may end up canceling each other out. Specifically, the positive effects of maternal employment may be the added income and the role-modeling function (especially for girls), whereas the negative effects may be the time taken away from the children which results in less interaction and less supervision.

Another explanation, somewhat related to that just mentioned, is that it is not maternal

employment per se, but the nature of the job which may have significant positive or negative effects on children's education. Kalmijn (1994) shows that maternal employment does have negative effects on certain schooling transitions, but that the negative effect may be offset by having a mother hold a high-status job. Obviously, a low-status job would not be able to offset the negative effects of maternal employment. Thus, when both factors are considered over a large range of occupations, one may expect to see maternal employment having little or no effect on the educational attainment of children, as seems to be the case in past studies.

Being raised in a single-parent family has been associated with negative outcomes for children; negative educational outcomes being one of them. Even after controlling for social background and race, children raised in single-parent families have been shown to drop out of high school at a higher rate and to complete fewer years of schooling than children living with both biological parents (Hauser and Featherman, 1976; Astone and McLanahan, 1991; Hauser and Phang, 1993; McLanahan and Sandefur, 1994). Inasmuch as family background affects the educational attainment of children, the socioeconomic disadvantages faced by single-parent families can reasonably be expected to result in disadvantages in the educational attainment of children living in such families.

Smaller incomes represent one of the major disadvantages among single-parent families. Among both blacks and whites, median income among two-parent families has been shown to be at least twice that of single-parent families (Garfinkel and McLanahan, 1986; McLanahan and Sandefur, 1994). Computing the anti-log of the income figures presented in Table 1 would reveal similar differences.[1]

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[1]For the sake of convenience, the corresponding figures are: $49,020 for two-parent dual-earner families, $36,316 for two-parent single-earner families, and $22,026 for single-parent single-earner families.

McLanahan and Sandefur point out that low income not only implies obvious and direct economic disadvantages, but that low income might entail indirect disadvantages as well, such as living in a poor neighborhood which is served by a lower-quality school.

However, the disadvantages of living in a single-parent family are not limited to economic resources. McLanahan and Sandefur found evidence that family disruption itself seems to confer additional educational disadvantages upon children. After controlling for income and number of parents in the household, they found that step-children are still more likely to drop out of high school than are children living with both biological parents. This suggests that there is something about disrupted families in addition to income discrepancies which has detrimental effects on children's schooling, whether it is the disruption

itself or the factors which lead to the disruption.

Among single-parent families, there is evidence that single parents exercise less control and supervision of their children and are less likely to monitor the educational progress of their children than are their two-parent counterparts. However, Astone and McLanahan (1991) found that these differences do little to explain the differences in educational outcomes. In their analysis of students in the High School and Beyond sophomore cohort, they found that living in a single-parent family reduces the likelihood of high school completion, even after controlling for the effects of parental practices.

Hsueh (1992) and Kuo and Hauser (1995) recently compared models of educational attainment among children raised by both

biological parents and those not raised by both biological parents. Using data on pairs of brothers from the 1973 Occupational Changes in a Generation survey (OCG), Kuo and Hauser examined

differences in sibling resemblance among intact families and non-intact families using essentially the same multi-group one factor MIMIC model that I will employ. Among blacks, they found that the process of educational attainment does not differ according to family structure. However, among whites, they do seem to find differences between intact families and non-intact families. Using the same MIMIC model, Hsueh also turned up differences between two-parent families and mother-only families in his analysis of pairs of siblings from the National Longitudinal Survey of Youth.

In the first part of my analysis, I will test the hypothesis that differences in the process of educational attainment exist among single-parent families and two-parent families. Furthermore, I will disaggregate the latter group into dual-earner families and single-earner families.

Birth Order, Sex, and the Interaction Between Birth Order and Sex

The idea that family of origin may affect children's educational attainment differentially according to birth order and sex has received a considerable amount of attention. I will address the issues of birth order and sex separately, and then follow with a brief discussion of the interaction between birth order and sex.

Lindert (1977) has suggested that educational attainment is affected by birth order and introduces a hypothesis similar to the resource dilution hypothesis (to be discussed shortly). He argues that early in life, first born children do not have to compete with other children for time and attention from their parents. Likewise, during late adolescence, last born children have to compete for parental time. Middle born children are never afforded this luxury -- they always feel a squeeze in at least one direction and are disadvantaged with respect to the amount of parental inputs afforded them. This argument lends itself well to Blau and Duncan's (1967) finding that first born and last born children fare better than do middle children in terms of years of schooling completed.

However, others have found no evidence of differences in the educational attainment of children according to birth order. Among pairs of brothers from Kalamazoo, Michigan, Olneck and Bills (1979) found that birth order has no independent effect on educational attainment after sibship size and age are controlled for. Similarly, after controlling for sex, socioeconomic background, age, and sibship size, Hauser and Sewell (1985) found ordinal position of birth to have no effect on completed years of schooling among a sample of the Wisconsin high school class of 1957. Powell and Steelman (1993) arrived at similar findings in their study of sophomores and seniors in the High School and Beyond survey.

Studies of sibling resemblance have also sought to determine whether or not family background differentially affects educational attainment according to childrens' birth order. Several studies have found no differences in the effect of family background on educational attainment according to birth order. For instance, De Graaf and Huinink (1992) found no birth order effects among their sample of West German sibling pairs. Similarly, in his study of Dutch sibling pairs, Dronkers (1993) did not find family background to differentially affect educational attainment according to birth order and neither did Kuo and Hauser (1993) in their study of Wisconsin sibling pairs.

However, others have found the effects of family background on educational attainment to be smaller among younger siblings than among older siblings. For instance, Hauser and Wong (1989) uncovered this pattern in their reanalysis of two samples of sibling pairs from Nebraska. Likewise, Hsueh (1992) found the effect of family background on educational attainment to be smaller among younger siblings than older siblings among his sample of NLSY sibling pairs living with both parents, and Kuo and Hauser (1995) uncovered the same finding in their sample of brothers from the 1973

OCG survey.

The finding that family background does not affect children differently according to birth order seems to be more consistent with other findings that children are not educationally advantaged by their birth order. However, given the existence of contrary findings which have turned up in studies of sibling pairs, testing the hypothesis that family background does not differentially affect educational attainment according to birth order seems to be an interesting task to undertake.

In addition to studying differences in educational attainment according to birth order, several attempts have been made to address differences according to sex and to the interaction between birth order and sex.

Sewell, Hauser, and Wolf (1980) analyzed the determinants of educational attainment among a sample of Wisconsin high school graduates (class of 1957) and uncovered several statistically significant differences among boys and girls. Kuo and Hauser (1993, 1995) found similar differences to exist among boys and girls in their study of Wisconsin sibling pairs as well as in their study of pairs of brothers in the 1973 OCG survey. Specifically, they found family background to have a much smaller effect on women than on men, regardless of sibship size and the gender configuration of the sibship. These findings seem to lend evidence to the idea that the process of educational attainment is somewhat different among boys and girls.

Benin and Johnson (1984) addressed both birth order and sex in their attempt to uncover inter-sibling effects in educational attainment. Benin and Johnson used data from two samples of sibling pairs from Nebraska and investigated four types of sibling pairs ordered by birth order and sex (older-brother younger-brother (OB-YB), older brother-younger sister (OB-YS), older sister-younger sister (OS-YS), older sister-younger brother (OS-YB)). They were particularly interested in

determining whether the direction and magnitude of influence differs among siblings arranged by relative birth order and sex.

Benin and Johnson hypothesize that older siblings may be performing the duties of facilitator ("providing contacts and resources") and role model to younger siblings. They argue that older brothers are probably better suited to fill the role of facilitator, since they are likely to have more resources at their disposal and better able to pass on advantages, thus the OB-YB pair and OB-YS pair should demonstrate a higher degree of resemblance than the others. (This hypothesis does not necessarily suggest that older brothers are educationally advantageous to younger siblings, just more influential.)

Furthermore, they argue that the role modeling function should be stronger among like-sex pairs than among cross-sex pairs, which (along with a greater similarity in socialization patterns) would allow for a greater resemblance in educational attainment among the former. Therefore, given the two hypotheses mentioned above, they speculate that the OB-YB pair should demonstrate a relatively large degree of resemblance while the OS-YB pair should show a relatively small one.

In their analysis, they did find a greater degree of resemblance in educational attainment among the OB-YB pair and a remarkably low degree of educational resemblance among the OS-YB pair. They argue that these findings provide evidence of the facilitation and role modeling hypotheses, but by focusing on differences in residual covariances, their study only directly addresses the degree of similarity in educational attainment among these four groups, and not inter-sibling effects.

Using Olneck's data on brother pairs from Kalamazoo and a non-recursive MIMIC model, Hauser and Wong (1989) were able to investigate the existence of inter-sibling effects among

brothers. They found the effect the older brother has on the younger brother's attainment to be no larger than the inter-sibling effect in the opposite direction. Thus, they do not find evidence of Benin and Johnson's facilitation hypothesis.

Following Benin and Johnson's lead, several other studies have investigated the four sibling-pair combinations in an effort to compare degrees of educational resemblance among siblings and to uncover differences in the educational attainment process according to birth order and sex.

Hauser and Wong (1989) reanalyzed the Nebraska sibling pair data used originally used by Benin and Johnson. As mentioned earlier, they found family background to have a larger effect on the educational attainment of older siblings relative to that of younger siblings. However, they were not able to uncover any differences in effects according to sex. Similarly, Hsueh (1992) found family background to have a larger effect on older siblings and to have equal effects on boys and girls.

However, De Graaf and Huinink (1992) and Dronkers (1993) were not able to find any such differences according to birth order or sex. That is to say, they found the effect of family background on educational attainment to be equal among all children, regardless of their birth order or sex.

Using the same research strategy as in the studies just mentioned, the second part of the analysis will consist of testing the hypothesis that differences in the process of educational attainment exist according to birth order and sex.

VARIABLES

Educational Attainment

The socioeconomic importance of educational attainment cannot be overstated. Educational attainment is important in itself as it is one basis of social status. However, educational attainment is also important as it has large and direct effects on one's placement in the occupational structure

and on one's earnings (Featherman and Hauser, 1978). Furthermore, as discussed earlier, one's educational attainment has large and direct effects on the educational attainment of one's children (Blau and Duncan, 1967; Featherman and Hauser, 1978).

Father's Occupational Status, Father's Educational Attainment, Mother's Educational Attainment

The significant effects that father's occupational status and father's educational attainment has on children's education have been clearly established in the research on intergenerational mobility and educational attainment (Blau and Duncan, 1967; Hauser and Featherman, 1976; Featherman and Hauser, 1978). Despite high levels of marital homogamy over the last fifty years (Mare, 1991), subsequent studies have shown mother's educational attainment to have significant effects on children's education independent of the effect of father's educational attainment (D'Amico, Haurin, and Mott; 1983; Kalmijn, 1994).

Studies of sibling resemblance have shown these three social background factors to have significant effects on the common family factor, which in turn, has a significant effect on children's educational attainment (Hauser and Wong, 1989; De Graaf and Huinink, 1992; Hsueh, 1992; Kuo and Hauser, 1993, 1994, 1995). Furthermore, several of these studies have shown the effect of mother's education on the common family factor to be equal to the effect of father's education (Hauser and Wong, 1989; Hsueh, 1992; Kuo and Hauser, 1993, 1995). I will try to replicate each of these findings in my analysis.

Mother's Occupational Status

As mentioned earlier, Kalmijn (1994) sought to uncover the effect of mother's occupational status on children's schooling transitions. He found mother's occupational status to have a significant

positive effect on the likelihood of the three schooling transitions he studied (high school graduation, college entrance, college graduation). In fact, among dual-earner families, he found the effect of mother's occupational status to be larger than that of father's occupational status for the first two transitions. In my analysis, I will test the hypothesis that the effect of mother's occupational status on the common family factor is equal to that of father's occupational status.

Family Income

As McLanahan and Sandefur (1994) have argued, income has important direct and indirect consequences for children's educational outcomes. Although family income is correlated with parents' education and occupational status, income has been shown to have significant independent effects on educational outcomes (Hauser and Phang, 1993; Hauser, 1993; Powell and Steelman, 1993). Past studies of sibling resemblance, have also found income to have a significant positive effect on the common family factor (Kuo and Hauser, 1993, 1994).

Race

In several cases, the educational attainments of blacks and whites have been found to be differentially affected by similar determinants (Hauser and Phang, 1993; Hauser, 1993; Kuo and Hauser, 1995). Thus, there is evidence that the educational attainment process is different among the two groups.

However, Gottfredson (1981) estimated a latent variable model of educational attainment among blacks and one among whites and found no statistically significant differences in the structural coefficients among blacks and whites.

Furthermore, McLanahan and Sandefur (1994) and Hauser and Featherman (1976) found that among more recent birth cohorts, the independent effect that race has on educational attainment

disappears after other social background factors have been controlled. Thus, there seems to be some conflicting evidence as to whether family background effects educational attainment differently among blacks and whites.

Unfortunately, the small number of blacks included in my sample does not allow me to conduct separate analyses for blacks and whites. I am left with no option but to pool together blacks and whites and include race as a dummy variable. I will be unable to analyze separately the processes of educational attainment among blacks and whites as Gottfredson (1981) and Kuo and Hauser (1995) were able to.

Home Ownership

Hauser and Phang (1993) and Hauser (1993) found home ownership to have independent and significant effects on reducing the likelihood of dropping out of high school and on increasing the likelihood of college entry. Home ownership is used in these analyses as "a crude measure of wealth", however, they state that owning a home may also reflect other values or practices which are conducive to having children make schooling transitions. Richard Green (1994) also found home ownership to have an independent and significant effect on high school graduation, but he found no evidence of omitted variable bias (omitted variables in the high school graduation decision were not found to be correlated with omitted variables in the tenure-choice decision).

Southern Residence

Featherman and Hauser (1978) have shown differences in educational attainment to exist between those raised in the South and those raised elsewhere. Independent of other factors, Southern origins have been shown to have a negative effect on educational attainment, although over time, the disadvantage has been decreasing in magnitude (Hauser and Featherman, 1976; Kuo and Hauser,

1995). These two studies use data from the 1973 OCG survey, which includes men born between 1907 and 1951. If the disadvantages of Southern origin have continued to decline, disadvantages in educational attainment may have actually disappeared among more recent birth cohorts (such as those in my sample).

Using data from the Current Population Survey and focusing on a sample of youth at risk of high school dropout and born roughly between 1950 and 1975, Hauser and Phang (1993) found that Southern origins are only detrimental to whites in regards to the likelihood of dropping out of high school. Among a sample of high school graduates born roughly between 1950 and 1965 and also included in the Current Population Survey, Hauser (1993) found that Southern origins do not have any effect on college entry.

Number of Children

Blake (1989) has argued that every additional child introduced into a family dilutes the amount of parental resources that can be devoted to each child. Parental resources consist not only of time and individual attention, but also include income, emotional and physical energy, and space (such as having one's own room or a quiet place to do homework).

The negative consequences that large sibships have on children's educational attainment have been well documented (Featherman and Hauser, 1978; Olneck and Bills, 1979; Powell and Steelman, 1993; Kalmijn, 1994). Sibling resemblance studies have consistently presented similar results (De Graaf and Huinink, 1992; Hsueh, 1992; Kuo and Hauser, 1995).

Finally, I should mention that besides having a common family factor, my model does not include any intervening variables which have previously been shown to mediate the effect of family background on educational attainment (such as significant others' influence, academic performance,

or educational aspirations), as the NSFH does not include this information for more than one child in a family. Furthermore, no measure of mental ability is provided. As a consequence, the amount of explained variance in the latent variable and in the measures of educational attainment will be lower than would have been the case if the aforementioned variables had been included in the analysis.

DATA

As mentioned earlier, the data come from the two waves of the National Survey of Families and Households. The first wave of interviews was conducted during 1987 and 1988 and included 13,017 main respondents. The second wave was conducted between 1992 and 1994 and successfully re-interviewed 10,007 of the original main respondents. In this study, main respondents serve as the parents of the adult children whose educational outcomes are being considered. The main respondents are supplying the information on their children's behalf and on the family's behalf.

The NSFH includes a string of variables which helps to indicate the socioeconomic background from which these children emerge. The measured background factors reported at NSFH1 include: father's education, mother's education (reported in terms of years of schooling completed), family income (transformed into the natural log of income[2]), father's occupational status, mother's occupational status (measured by the socioeconomic index constructed by Stevens and Cho [1985], which I rescaled to cover a range from roughly 1 to 9 [1.18 to 8.87]), number of children in the family (including biological children, step-children, adopted children, foster children, adult children living outside the household, and children away at college), and dummy variables for race (1=black, 0=white), Southern

[2]Family income is expressed as a natural logarithm, but its effect on children's education is still expressed in terms of years of schooling completed. For example, a coefficient of .3 would lead me to conclude that a 1% increase in income is associated with an increase of .3 years of completed schooling.

residence (1=residing in South, 0=residing elsewhere), and home ownership (1=homeowner, 0=non-homeowner). In addition, I constructed a dummy variable for each case in which a report of family income was missing.[3]

For two-parent dual-earner families, all of these variables are applicable. For two-parent single-earner families, all of the previous variables apply with the exception of one of the occupational status variables. No distinction was made with regard to the sex of the working parent, although 74% of the earners in the sample were fathers. For single-parent single-earner families, all of the previously

mentioned variables apply except one of the occupational status variables and one of the educational attainment variables. Once again, no distinction was made with regard to the sex of the earner although it should be noted that 72% of the single parents in the sample were single mothers.[4]

SAMPLE

For my sample, I included one pair of siblings from each of the families meeting the selection criteria. I first limited my sample to white and black families, and to those in which at least one

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[3]Non-responses and refusals were obviously classified as missing, but so were income reports of less than $5,000. Inspecting the data, I found that reports of less than $5,000 were problematic: many respondents used $0 as a refusal and many others reported annual incomes which were not consistent with the number of hours worked and the wage rates they reported. These income reports were considered missing.

a predicted value for income was assigned to the cases with reports considered missing. The value was calculated as follows: among cases with valid reports, I regressed the natural log of earnings on parental education, occupational status, race, and region. I used the regression coefficients and the data from the cases with missing reports in order to arrive at a predicted value for the natural log of income for the cases with missing data.

[4]This percentage is quite low according to national figures. In 1985, 87% of all single-parent families were headed by women (U.S. House of Representatives, 1993). The smaller percentage may due to the small sample size as well as to the process of sample selection. For example, it's likely that single fathers are more likely to work than are single mothers.

income-earning parent (not merely a relative) was present. I further limited my sample to those families with at least two children aged 25-34 and not currently enrolled in school at NSFH2. From each of these families, I selected two children from the list of all children meeting the age and enrollment-status criteria. Where more than two eligible children existed in the same sibship (as occurred in about 30% of the cases), I randomly selected two siblings for the analysis. Therefore, my sample consists of 875 families and 875 sibling pairs: 425 pairs belonging to two-parent dual-earner families, 284 pairs belonging to two-parent single-earner families, and 166 pairs belonging to single-parent single-earner families.

I should point out that single parents who work are undoubtedly different from single parents who do not work. Given that my sample of single parents consists entirely of single parents who work, my findings should not be generalized to all single parents. (McLanahan and Sandefur [1994] report that 70% of single mothers work and that 25% work full time.) Table 2 shows that, indeed, single parents who work differ from single parents who do not work across the variables used in the analysis.[5] These findings should be taken with some caution since the sample sizes are very small. However, the differences are sizable and thus the exclusion of non-working single parents serves to explain why some of the single-parent background variables displayed in Table 1 may seem relatively high compared to those of two-parent families. a major drawback in using the NSFH data for this particular research problem is that the small lapse of time between interviews does not allow it to depict both social origins during the maturation process and social outcomes once they have been allowed to sufficiently run their course. The two waves of the survey were only separated by five years, and at each wave, current (not retrospective) reports of the family background variables were

[5]The non-working single-parent families were selected using the same criteria to select the 166 single-parent single-earner families, the sole exception being the requirement of employment.

recorded. Taken together, these considerations present a few methodological problems.

First, consider that a certain age must be attained by children in order to allow their education to be completed. Hauser and Featherman (1976) found that the youngest cohorts in both OCG surveys (those aged 21-25 in the 1962 OCG survey and those aged 22-26 in the 1973 OCG survey) do not constitute good populations for studying educational attainment due to the fact that many in these cohorts may not have completed their education. According to the Digest of Education Statistics (U. S. Dept. of Education, 1993), in 1992, the percent of the population enrolled in school (any type of school other than trade schools, business colleges, and correspondence schools) was 31.6% for those aged 20-24, 9.8% for those aged 25-29, and 6.1% for those aged 30-34 (p. 15). Although it might be a good idea to allow people to reach age 30 in order to complete their schooling, not much is lost by considering those aged 25-34.

Second, problems may arise if the social background measures have changed since the children have left the household. Ideally, not much time should be allowed to elapse between the children's period of residence in the household and the reporting of the measures of family background (which serve to measure the environment in which the children were raised). The more time allowed between the two, the greater the likelihood of an intermittent event occurring (such as a job promotion, a divorce or remarriage, step-children joining the family, or a parent's withdrawal from the labor force) which could result in the mismeasurement of effects or the misclassification of families in this particular analysis. Given the above considerations and constraints, the age range 25-34 seems to be the best alternative for the analysis at hand.

Including step-children in my analysis presents a few theoretical issues which deserve attention. Step-children have much less in common with one another than do full siblings. The most

obvious lack of commonality is genetic. Whereas full-siblings share half their genes, step-siblings do not share any. Not far removed from this issue is the fact that step-siblings may not have an environment in common to the same extent that full-siblings have. Theoretically, the degree of similarity among step-siblings will depend on how long they have actually been living in the same home. By including step-children in my sample, the degree of sibling resemblance in educational attainment may be somewhat attenuated, owing to smaller degrees of a common origin and a common family background found among step-children. However, including step-children is somewhat important. Although in 1985, only 11% of all children under age 18 belonged to step-families (U.S. House of Representatives, 1993), they are a part of American families and there is no reason they should necessarily be excluded from analyses of the family.

METHODS AND MODEL

For the purpose of studying resemblance in educational attainment among sibling pairs, I will be using a form of the multiple indicator, multiple cause (MIMIC) model proposed by Hauser and Goldberger (1971). The notation for the specific model I will be using is:

$$\eta = \Gamma x + \zeta \qquad (1)$$

$$y = \Lambda_y \eta + \varepsilon \qquad (2)$$

Equation 1 is the structural equation model in which x is a vector of measured background factors having variance-covariance matrix ϕ. Γ is a matrix (in this case, a vector) of the effects of x on η. ζ is a vector of structural disturbances, independent of x, having variance-covariance matrix ψ. η is the common family factor, a latent variable, which is affected by x, the measured background factors, and ζ, the structural disturbances.

Equation 2 is the measurement model for the latent variable in which y is a vector of the

measured educational attainments of children, which serve as indicators of η. Λ_y is a vector of the loadings of η on y. ε is a vector of disturbances in y, whose elements are contained in the variance-covariance matrix θ_ε. In the first part of the analysis, this model will apply to each family type; during the second part, each of the sibling pair combinations will be represented by such a model.

The unmeasured common family background variable included in the MIMIC model is very useful in that it takes into account common family influences that are not captured by the set of measured family background variables. Such influences include common genes, common socialization practices, common environment, etc. As pointed out by Kuo and Hauser (1993) and Mare (1993), no matter how many observed social background variables are introduced, certain family background variables which affect educational attainment are sure to be omitted. In the first part of my analysis, I will be analyzing three different family groups, thus a 3-group MIMIC model is proposed (see Figure 1). However, since these family groups have slightly different structures in terms of exogenous variables and path coefficients, pseudo-values must be introduced in order that between-group comparisons can be made. This technique is discussed by Allison (1987) and Allison and Hauser (1991) and is illustrated through example by Joreskog and Sorbom (1989) and Hauser and Kuo (1994). Basically, it entails the inclusion of values into the inapplicable variables in order to produce models which have the same structure. However, the values introduced must be ones that will not change the parameter estimates of the model. For the missing occupational status variable in the two-parent single-earner family and the missing occupational status and parental education variables in the single-parent single-earner family, I introduced values of 1 for their variances (in Φ), values of 0 for their covariances with other observable variables (in Φ), and values of 0 for their effect on the common family factor (in Γ). However, the number of degrees of freedom

reported in LISREL is incorrect since it treats the pseudo values as if they were observed data. For each of the three inapplicable variables, LISREL reports two extra degrees of freedom. This was taken into account when making between-group comparisons.

In the second part of my analysis, I will attempt to uncover differences among the four sibling pair combinations, thus a 4-group MIMIC model will be used (see Figure 2). As will be discussed later, the structures of exogenous variables will be similar in each group, therefore pseudo-values will not be needed.

RESULTS

Model Selection

Goodness-of-fit tests among alternative models will be carried out in order to test hypotheses concerning similarities and differences in the process of educational attainment according to family structure and then according to sex and birth order. The models introduced will be hierarchically ordered, each model building on the results of a previously accepted one. Attention will be given to the change in fit between ordered models in determining which models are selected.

The likelihood ratio test statistic (L^2) will be used as the criterion for goodness-of-fit. The test statistic follows the χ^2 distribution in large samples under the assumption of multivariate normality. The difference between test statistics of two nested models will be distributed as χ^2 with the number of degrees of freedom being equal to the difference in degrees of freedom between the two models (Hauser and Wong, 1989). When adding constraints, a statistically significant deterioration in fit will lead me to reject the model at hand. When releasing constraints, a statistically significant improvement in fit will lead me to accept the new model in favor of a previously accepted one.

Inspection of initial parameter estimates shows that the two-parent family groups resemble each other much more than either resemble the single-parent family group. My series of hypothesis tests will follow a consistent pattern in which, at each step, I first try to impose an equality constraint across all three groups, and if this fails, I will confine the restriction of equality to the two-parent family groups.

I start with a baseline MIMIC model, in which the only constraints imposed are the normalizations of factor loadings on younger sibling's education among each group.[6] This is done in order to identify the latent variable and to introduce a scale for it (the effect of the common family factor on the older sibling's education will be expressed as a proportion of the effect on the common family factor on the younger sibling's education). As shown in Table 3, the baseline model fits the data very well: L^2=19.99 with 24 degrees of freedom.

First, I will test the hypothesis that the corresponding elements in the variance-covariance matrices of family background variables are equal across family groups. Accepting this model would lead me to conclude that family background characteristics are essentially the same among each of the three family types. a quick glance at the correlation matrices in Appendix a would lead one to suspect that this equality constraint will not be accepted. Indeed, Model B entails a statistically significant deterioration in fit: L^2 increases 314.79 with an additional 81 degrees of freedom. Thus, I reject Model B.

Model C limits the above equality constraint to the first two groups. However, Model C also yields a statistically significant deterioration in fit: L^2 increases 165.27 while the number of degrees

[6]In sibling resemblance studies, normalizing is usually undertaken on the factor loading for the education of the older sibling. However, the data on younger brothers appears to be more consistent across groups than is the case with older siblings, thus I chose to normalize the loading on younger sibling's education.

of freedom increases by 45. Model C is also rejected.

Next, I will test the hypothesis that the effect of the common family factor on the older sibling's educational attainment is invariant across groups. Acceptance of Model D would imply that each family type is similar with regard to its influence on the educational attainment of older siblings. Adding this constraint involves an increase of two degrees of freedom and an increase in L^2 of 3.88. Compared to the baseline model, the deterioration in fit is not shown to be statistically significant, and thus I accept Model D.

Next, I will test the hypothesis that the effects the measured background factors have on the common family factor are equivalent across groups. Owing to the different patterns of exogenous variables among the three groups, a few within-group constraints are imposed along with the between-group constraints in order to facilitate the comparison. Specifically, all five of the effects of parental education on the common factor will be set equal to one another as will all four of the effects of occupational status on the common factor. The pseudo-values for γ_{214}, γ_{312}, and γ_{314} remain set equal to zero, and obviously, will not be included in the cross-group test. Model E imposes the equality constraint across all three family groups, and does not show a statistically significant deterioration in fit: with an additional 19 degrees of freedom, L^2 only increases 24.93. Thus, I accept Model E.

Next, I test the hypothesis that within-family variances in educational attainment are invariant across family groups. Accepting Model F would imply that the amount of variance in educational attainment which cannot be traced to shared family characteristics is equal across all three family types. Model F imposes the constraint of equality among all three groups but shows a statistically significant deterioration in fit: with an addition 4 degrees of freedom, L^2 increases 10.82. Model

F is rejected.

Model G limits the aforementioned equality constraint to two-parent families. Compared to Model E, Model G also demonstrates a statistically significant deterioration in fit: L^2 increases 8.16 alongside an increase of 2 degrees of freedom. Thus, I also reject Model G.

Next, I test the hypothesis that the unmeasured between-family variances are equal across groups. Accepting Model H would imply that the amount of variance in the common family factor that is not attributable to the measured background factors is equal across all three groups. Model H displays a statistically significant deterioration in fit: along with an increase of 2 degrees of freedom, L^2 increases 9.12. Thus, I reject Model H.

Model I limits the equality constraint in the between-family variances to the two-parent family groups. Compared to Model G, the deterioration in fit associated with accepting this model is statistically insignificant: L^2 increases 1.39 with one added degree of freedom. Model I is accepted and becomes my preferred model. Model I is shown to fit the data very well ($L^2 = 50.19$ with 46 degrees of freedom).

Parameter Estimates

Parameter estimates for Model I are presented in Table 4. The data show the extent to which family background affects educational attainment differently according to our three family types.

Holding birth order constant, the effect of the common family factor on children's educational attainment is shown to be equal across all three family types. However, the effect of the common family factor is shown to be uniformly smaller on older siblings' education than it is on younger siblings' education. The coefficient of .77 implies that family background has an effect on the educational attainment of older siblings only .77 times as large as the corresponding effect on the

educational attainment of younger siblings. With regard to previous studies of sibling resemblance, this finding is quite unique. As discussed earlier, past studies have either found family background to affect older and younger siblings equally or to affect the older sibling more than the younger sibling.

Subsequent analyses, not presented here, show that this finding can be attributed to the inclusion of single-parent families. When tested individually, the estimates of $\lambda_{11}^{(1)}$ and $\lambda_{11}^{(2)}$ are not found to be statistically different from 1. This is consistent with past findings showing no difference in the effect of family background on educational attainment according to birth order.

However, when tested individually, the coefficient for $\lambda_{11}^{(3)}$ is found to be much smaller than 1, demonstrating that family background has a larger effect on the educational attainment of younger siblings (relative to older siblings) growing up in a single-parent family. This seems sensible given that younger siblings are likely to spend more of their years growing up in a single-parent family than are older siblings.

When the invariance restriction on Λ_y is applied to all three groups, the presence of single-parent families reduces the magnitude of the estimate of λ_{11}. Thus, the inclusion of single-parent families accounts for the unique finding that the effect of family background on the educational attainment of older siblings is significantly smaller than the effect on younger siblings.

Several of the exogenous variables are shown to have significant effects on the common family factor. The effects of parental education prove to be significant, as do the effects of occupational status. Furthermore, these effects do not differ by the sex of parent. That is to say, mother's education has an effect on the common family factor equivalent to that of father's education and mother's occupational status has an effect on the common family factor equivalent to that of

father's occupational status. Every additional year of schooling completed by a father or mother entails an increase of .14 years of schooling among children. Every ten point increase in the occupational status of a parent (either father or mother) entails an increase of .15 years of schooling among children. The first finding of equality has also been uncovered by Hauser and Wong (1989), Hsueh (1992), and Kuo and Hauser (1993, 1995), while the second resonates with Kalmijn's (1994) finding of equal effects across schooling transitions.

The effects of family income and home ownership also prove to be significant. Every 1% increase in family income entails an increase of .47 years of completed schooling. The significance of income supports McLanahan and Sandefur's assertion that money does have important consequences for a child's educational success. Owning a home entails an advantage of .65 years of completed schooling among children. Indeed, the effect of home ownership on educational attainment is found to be quite large, but this is consistent with previous findings (Hauser, 1993; Hauser and Phang, 1993; Green, 1994).

The effects of race and Southern residence are found not to be statistically different from zero, thus race and Southern residence do not entail any independent disadvantages to educational attainment. These findings are consistent with previous studies that focus on more recent birth cohorts (Hauser and Featherman, 1976; Hauser, 1993; McLanahan and Sandefur, 1994).

The finding that number of children has no effect on the common family factor comes as a surprise. As mentioned earlier, the negative impact of additional children has consistently been found in studies of educational attainment and, more specifically, in studies of sibling resemblance (De Graaf and Huinink, 1992; Hsueh, 1992; Kuo and Hauser, 1995). I can think of no ready explanation as to why I was unable to replicate this finding.

Finally, the dummy variable for missing income is found not to be significant. This simply means that a parent's missing report of income is not associated with children's educational attainment to a statistically significant degree.

The unmeasured between-family variances are found to be equal among the two-parent families and to be much larger than that of single-parent families. This pattern is consistent with the pattern for total between-family variance. Therefore, the proportions of variance in the common family factor explained by measured background variables are shown to be quite similar across the three family groups. As shown in Table 5, each vector of measured background factors explains about 30% of the variance in η, 70% of the variance being produced by other, unmeasured factors. With regards to previous studies of sibling resemblance in educational attainment, my figures for the proportion of explained variance in the common family factor are quite low. Hauser and Featherman (1976) found their vector of measured family background factors to explain about 54% of the variance in the common family factor. Subsequent studies have produced $_{\text{percentages of explained variance}}$ in the neighborhood of 50%, although there is a fair amount of variation in estimates.[7]

As is the case with unmeasured between-family variances, within-family variances are also shown not to be invariant across family groups. However, in each of the three groups, the within-family variance for older siblings is consistently found to be about twice as large as the within-family variance for younger siblings. That is to say, the variance in educational attainment among older siblings is more influenced by individual factors (factors which are not common to both siblings) than

[7]Hauser and Sewell (1986): 57%; Dronkers (1993): 58%; De Graaf and Huinink (1992): 52-62%; Hauser and Wong (1989): 36% for the NASIS sample, 53% for the Lincoln sample; Hsueh (1992): 47% for two-parent families, 32% for mother-only families; Kuo and Hauser (1994): 28-49% for men, 34-49% for women; Kuo and Hauser (1995): 45-56% for whites, 30-60% for blacks.

is the variance in educational attainment among younger siblings. Indeed, as shown in Table 5, the proportions of variance in educational attainment explained by the common family factor are found to be much smaller among older siblings than among younger siblings, regardless of family type.

Table 5 also shows that the proportions of explained variance in educational attainment are somewhat similar among two-parent families and are quite low among single-parent families. Thus, holding birth order constant, individual factors appear to make larger contributions to the variance in educational attainment among single-parent families and somewhat similar contributions to the variance in educational attainment among two-parent families.

The above discussion leads me to conclude that the effects of family background on educational attainment differ according to family structure. Important differences and similarities among the three family groups have been uncovered and discussed. Many of the across-group differences can be attributed to the inclusion of single-parent families. Recall that the invariance restriction on ψ was not able to be extended to single-parent families and neither was the restriction $\lambda_{11}^{(3)} = 1$ (when tested individually). Furthermore, as shown in Table 5, the proportions of explained variance also point out that the two-parent family groups resemble each other much more than either resemble the single-parent family group. These findings are consistent with the idea that maternal occupation does not fundamentally alter the effects of family background on educational attainment and consistent with the finding that family background affects educational attainment differently among two-parent families and single-parent families (Hsueh, 1992; Kuo and Hauser, 1995).

In the second part of the analysis, attention will be turned to four specific sibling-pair combinations in order to determine whether family background affects educational attainment differently according to the birth order and the sex of children.

a few studies of sibling resemblance in educational attainment have done the double duty of attempting to uncover differential family effects among groups (such as successive birth cohorts or different family structures) as well as among the four sibling pair combinations (De Graaf and Huinink, 1992; Hsueh, 1992; Dronkers, 1993).

De Graaf and Huinink's sample of sibling pairs was large enough that one data set could be used for both research problems. Within each of their three birth cohorts, they had sufficiently sized samples of each of the four sibling pair combinations. In other words, they had twelve sub-samples of adequate size, which allowed them to make comparisons among the four types of sibling pairs and then to make comparisons among the three birth cohorts. Reconfiguring the data set between the two parts of the analysis was unnecessary. Such an approach is ideal, however, it is not always possible.

Dronkers (1993) and Hsueh (1992) encountered problems with small sub-sample sizes. In order to carry out both stages of their analyses, they first arranged the data along the lines of the four sibling pair combinations and then rearranged the data along the lines of the different groups being studied.

Unfortunately, I have encountered the same problem: small sub-sample sizes prevent me from separately analyzing each of the three sets of four sibling-pair combinations (see Table 7). Given the degree of similarity found among two-parent dual-earner families and two-parent single-earner families, I have decided to pool together data from these groups in order to attain four sub-samples large enough to adequately investigate differences among them.

Pooling the data between the two-parent families basically presents the problem of there being a large number of missing cases for mother's occupational status. (Recall that approximately 74%

of the single earners in two-parent families were men.) I addressed this problem by removing mother's occupational status from the analysis and pooling the data for head's occupational status with the data for father's occupational status.

The second part of the analysis will be conducted in much the same way as was the first part. Since I will be analyzing four different types of sibling pairs, I will employ a 4-group MIMIC model, which is essentially similar to the model used earlier (see Figure 2).

Model Selection

Hypothesis testing will also be conducted much the same way as it was in the first part of the analysis. The models will be hierarchically ordered and attention will be given to the change in fit between ordered models.

I begin with a baseline MIMIC model, which has no parameters constrained except the restriction that the loadings on the educational attainment of the younger siblings are set equal to 1. As shown in Table 9, Model a fits the data very well:$L^2 = 26.50$ with 32 degrees of freedom.

First, I will test the hypothesis that the variance-covariance matrix of family background variables is invariant across all four types of sibling pairs. Given that my sibling pairs are drawn from the same population, and that children should be randomly distributed across the four sibling pair combinations, this is a reasonable assumption to make. When compared to the baseline model, Model B produces an insignificant deterioration in fit: with an additional 135 degrees of freedom, L^2 only increases 157.42. I accept Model B.

Next, I will consider the effect of family background on educational attainment according to birth order and sex. Model C sets each factor loading equal to 1. Acceptance of Model C would imply that the effect of family background on educational attainment does not differ by birth order

nor by sex. Model C does not lead to a statistically significant deterioration in fit: L^2 increases 2.23 with four added degrees of freedom. Therefore, I accept Model C.

The finding that family background affects the educational attainment of all children equally, regardless of birth order and sex, is consistent with that of Dronkers (1993) and De Graaf and Huinink (1992). On the surface, this does not seem to be consistent with my earlier finding that family background affects the educational attainment of younger siblings more so than older siblings (see Table 4). Recall however, that differential birth order effects were only found among single-parent families. Single-parent families are not included in this part of the analysis, and consequently, differential birth order effects are not to be found.

Next, I turn my attention to the effects the exogenous variables have on the common family factor. Model D constrains the effects of the corresponding exogenous variables to be equal across all four sibling pair combinations. Model D does not lead to a statistically significant deterioration in fit: with 27 additional degrees of freedom, L^2 increases only 31.03. Thus, I accept Model D.

Next, I will test the hypothesis that within-family variance in educational attainment does not differ according to birth order or sex. Model E constrains all eight within-family variance parameters to be equal to one another. Acceptance of Model E would imply that the amount of variance in educational attainment which cannot be attributed to shared family background characteristics is equal among all children regardless of birth order and sex. Model E does not lead to a statistically significant deterioration in fit: L^2 increases 10.27 with an added 7 degrees of freedom. I choose to accept Model E.

The finding that within-family variance does not differ by birth order is consistent with findings in past studies of sibling resemblance (Hauser and Wong, 1989; Hsueh, 1992; De Graaf and

Huinink, 1992; Dronkers, 1993). However, the finding that within-family variance does not differ by sex is not consistent with findings in several past studies of sibling resemblance (Hauser and Wong, 1989; De Graaf and Huinink, 1992; Kuo and Hauser, 1994). These studies have found within-family variance in educational attainment to be much larger among boys than among girls. However, this reflects the fact that their samples included older birth cohorts in which total variance in educational attainment was much larger among boys than among girls. Differences in the variance of educational attainment do exist among the boys and girls in my sample, however these differences are relatively small.

Next, I will investigate whether or not between-family variances differ among the four types of sibling pairs. Model F constrains ψ to be equal across the four sibling pair combinations. Acceptance of Model F would imply that the degree of resemblance among siblings is equal across all four groups and would argue against any facilitation and role modeling functions which vary according to sex. Model F leads to a statistically significant deterioration in fit: L^2 increases 18.22 along with the addition of 3 degrees of freedom. Thus, I reject Model F.

The finding that between-family variance is not invariant across types of sibling pairs is consistent with the findings of Hauser and Wong (1989) and Hsueh (1992). Hauser and Wong found between-family variance in the OS-YB pair to be significantly smaller than that of the other three groups. Similarly, Benin and Johnson (1984) found residual covariances in educational attainment to be smallest among this group as well. I try to replicate this finding in Model G by releasing the OS-YB pair from the cross-group equality constraint on ψ. Acceptance of Model G along with the finding that ψ is smaller among the OS-YB group would give partial support to the facilitation and role modeling hypotheses. However, Model G shows a statistically significant deterioration in fit:

with two additional degrees of freedom L^2 increases 13.58. Thus, I reject Model G.

Inspecting the data, I noticed that between-family variances for the OB-YB and OB-YS pairs seem to be similar to one another and much larger than those of the OS-YS and OS-YB pairs, which also seem to be similar to one another. Interestingly enough, such a pattern was also uncovered by Hsueh (1992).[8] I constructed Model H to constrain ψ to be invariant across pairs according to the sex of the older sibling. Acceptance of Model H along with the finding that the between-family variance is larger in pairs with an older brother would seem to support Benin and Johnson's (1984) facilitation hypothesis.[9] Compared to Model E, Model H does not entail a statistically significant deterioration in fit: with two added degrees of freedom, L^2 only increases .34. Thus, I choose to accept Model H.

Finally, in the interests of building a somewhat more parsimonious model and replicating the findings of Hauser and Wong (1989), Hsueh (1992), and Kuo and Hauser (1993, 1995), I set the effects of mother's education on the common family factor to be equal to that of father's education. Model I imposes this constraint and does not entail a statistically significant deterioration in fit: with one added degree of freedom, L^2 increases 1.23. Model I becomes my preferred model. Parameter estimates for Model I are provided in Table 10.

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[8]My estimates for ψ were 3.58, 3.92, 1.56, and 1.58, for the OB-YB, OB-YS, OS-YS, and OS-YB pairs, respectively. In the same order, Hsueh's estimates for ψ were 2.47, 2.20, 1.64, and 1.58.

[9]As shown in Hauser and Wong (1989), a direct test of the facilitation hypothesis would involve testing the magnitudes of reciprocal, causal paths between children's educational attainment. The hypothesis would be supported if the effect of older brother's educational attainment is found to be statistically significant and larger in magnitude than any of the other significant inter-sibling effects.

Parameter Estimates

As shown in Table 10, most of my findings are consistent with those found in the first part of the analysis.

The effect of the common family factor on educational attainment was found to be equal among all of the sibling pairs. That is to say, among two-parent families, the effect of the common family factor on educational attainment does not differ by sex nor by birth order. As mentioned earlier, the absence of birth order effects among two-parent families was also uncovered in the first part of the analysis.

The effects of father's education and mother's education remain significant and they remain equal to one another as well. Every additional year of schooling completed by a father or mother is associated with .17 more years of completed schooling among children. The effect of family income on the common family factor remains significant as does the effect of home ownership. Every 1% increase in family income is found to increase the number of years of completed schooling by .42 years and home ownership is found to increase children's educational attainment .52 years.

Race continues to show an insignificant effect, as does Southern residence, number of children, and the dummy variable for missing income.

Interestingly enough, the effect of head's occupational status has been rendered statistically insignificant in this part of the analysis. This change in significance is due to an increase in the estimate of the standard error and to a decrease in the magnitude of the effect. The increase in the estimate of the standard error can be attributed to a smaller sample size. The smaller effect found for head's occupational status can be explained by the changed composition of my sample. Initial parameter estimates show that the effect of occupational status on educational attainment was highest

among single-parent families. Thus, when I excluded single-parent families from this part of the analysis, the cross-group effect of head's occupational status necessarily declined.

Unmeasured between-family variance is found to be greater among the OB-YB and OB-YS pairs than among the OS-YS and OS-YB pairs. However, total between-family variance was found to be much greater among the OB-YB and OB-YS pairs than among the other two. Consequently, the vector of measured background factors does a much better job of explaining variation in the common family factor in sibling pairs with an older sister. As shown in Table 11, the nine measured variables explain almost 50% of the variance in the common family factor among the OS-YS and OS-YB pairs, while they only explain about 25% of the variance among the OB-YB and OB-YS pairs.

Across all four of the sibling pairs, the within-family variances in educational attainment were set to be invariant regardless of birth order and sex. However, due to small differences in the total variances in educational attainment among the children in the four sibling combinations, the equality restriction on θ_ε will necessarily produce different figures for the proportions of explained variance. As shown in Table 11, the common family factor seems to do a relatively good job of explaining the variance in education attainment among all children, especially among children in a pair with an older brother. Among the OB-YB and OB-YS pairs, approximately 70% of the variance in educational attainment can be traced back to common family influences, with less than a third of the variance being attributed to unmeasured, individual factors. Among the OS-YS and OS-YB pairs, the common family factor is shown to explain about 55% of the variance in educational attainment.

Tables 10 and 11 point to a greater degree of resemblance or commonality among pairs with an older brother. In Table 10, the much larger values of ψ show that there is a greater degree of sibling resemblance among pairs with an older brother. Similarly, Table 11 points out that common

factors make a larger contribution to the variance in educational attainment among children in the OB-YS and OB-YS pairs. However, Table 11 also shows that most of the common influence among these pairs cannot be traced back to social background factors. Thus, the data seem to support Benin and Johnson's (1984) hypothesis that older brothers are better able to facilitate and influence the educational attainment of younger siblings.

The estimates presented in Table 10 show that, for the most part, the effects of family background on educational attainment are invariant with regard to birth order and sex. However, as discussed above, I did find evidence of differential effects of family background, and these differential effects are shown to be rooted in the interaction between birth order and sex.

CONCLUSION

The purpose of the analysis has been to determine whether the effect of family background on educational attainment differs according to family structure, birth order, and sex.

In the first part of my analysis, I considered the educational attainment and social background of pairs of siblings coming from two-parent dual-earner families, two-parent single-earner families, and single-parent single-earner families. Among these three groups, I did find differences in the effects of family background on children's educational attainment. Specifically, unmeasured between-family variances in educational attainment were found to differ among family groups as were within-family variances in educational attainment. I also found the effects of family background to be more similar among the two-parent families than among the single-parent families.

I conclude that mother's employment does not fundamentally alter the effects that family background has on educational attainment, but single-parenthood does.

In the second part of my analysis, I sought to discover whether or not family background

differentially affects educational attainment according to the birth order and sex of children. I considered the educational attainment and social background of four types of sibling pairs, ordered by birth order and sex. For the most part, I found the process of educational attainment to be basically similar among older and younger siblings and among boys and girls. However, I did find the unmeasured between-family variances to be larger in pairs with an older brother. Sibling pairs with an older brother exhibit a greater degree of resemblance in educational attainment; a resemblance not explained by the measured background factors. This finding lends support to Benin and Johnson's (1984) facilitation hypothesis and leads me to conclude that the effects of family background on educational attainment differ according to the birth order and sex of children. Such a finding may be rooted in differential inter-sibling effects on educational attainment. This seems to be an interesting and suitable area for future research.

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Table 1. Descriptive Statistics for Observable Variables.

	Two-Parent Dual-Earner n=425	Two-Parent Single-Earner n=284	One-Parent Single-Earner n=166
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Father's education	13.4 (3.04)	12.1 (3.51)	
Mother's education	13.0 (2.21)	11.9 (2.40)	
Head's education			12.5 (2.70)
Father's occ. status	4.18 (1.97)		
Mother's occ. status	3.80 (1.77)		
Head's occ. status		3.56 (1.75)	3.61 (1.91)
Family income (log)	10.8 (.480)	10.5 (.653)	10.0 (.501)
Income missing	.22 (.415)	.29 (.454)	.32 (.469)
Race	.07 (.262)	.12 (.330)	.28 (.452)
Home ownership	.89 (.388)	.83 (.375)	.65 (.480)
Southern residence	.30 (.458)	.38 (.487)	.38 (.487)
Number of children	3.6 (1.56)	4.5 (2.42)	3.8 (1.86)
Older sib's education	13.9 (2.56)	12.9 (2.39)	13.3 (2.29)
Younger sib's education	13.8 (2.57)	13.4 (2.61)	13.2 (2.23)

Table 2. Proportions and Means of Selected Characteristics of Single Parents.

	Years of Schooling	Race	Home Owners	Southern Residence	Number of Children
Working Parent (n=166)	12.5	.28	.65	.38	3.8
Non-working Parent (n=67)	10.7	.36	.45	.45	5.5

Table 3. Alternative Models and Results from Goodness-of-Fit Tests.

			Difference	
Model	L^2	df	L^2	df
a. Baseline model	19.99	24	-	-
B. a + Φ invariant across all groups	334.78	105	314.79	81
C. a + Φ invariant among two-parent families	185.26	69	165.27	45
D. a + Λ_y invariant across all groups	23.87	26	3.88	2
E. D + Γ invariant across all groups	48.80	45	24.93	19
F. E + Θ_ε invariant across all groups	59.62	49	10.82	4
G. E. + Θ_ε invariant among two-parent families	56.96	47	8.16	2
H. E + Ψ invariant across all groups	57.92	47	9.12	2
I. E + Ψ invariant among two-parent families	50.19	46	1.39	1

Table 4. Parameter Estimates and Estimated Standard Errors for Preferred Model (Model I).

	Two-Parent Dual-Earner	Two-Parent Single-Earner	Single-Parent Single-Earner
Effect of Common Family Factor on:			
Older sibling	.77 (.06)	.77 (.06)	.77 (.06)
Younger sibling	1.0	1.0	1.0
Effects of Exogenous Variables (Γ)			
Father's education	.14 (.03)	.14 (.03)	
Mother's education	.14 (.03)	.14 (.03)	
Head's education			.14 (.03)
Father's occ. status	.15 (.04)		
Mother's occ. status	.15 (.04)		
Head's occ. status		.15 (.04)	.15 (.04)
Family income (log)	.47 (.17)	.47 (.17)	.47 (.17)
Income missing	-.07 (.18)	-.07 (.18)	-.07 (.18)
Race	.03 (.22)	.03 (.22)	.03 (.22)
Home ownership	.65 (.20)	.65 (.20)	.65 (.20)
Southern residence	-.18 (.17)	-.18 (.17)	-.18 (.17)
Number of children	.00 (.04)	.00 (.04)	.00 (.04)
Unmeasured Between-Family Variance (ψ)			
	3.66 (.47)	3.66 (.47)	2.12 (.43)
Within-Family Variances (θ_ε)			
Older sibling	3.35 (.39)	2.34 (.36)	3.57 (.40)
Younger sibling	1.62 (.48)	1.17 (.47)	1.70 (.41)

Table 5. Proportions of Variance Explained in Endogenous Variables (R^2)

	Two-Parent Dual-Earner	Two-Parent Single-Earner	Single-Parent Single-Earner
Common family factor	.30	.30	.26
Older sibling's education	.47	.58	.29
Younger sibling's education	.75	.82	.65

Table 6. Crosstabulation Between Family Structure and Sibling Pairs (Weighted Data).

	Family Structure			
	Two-Parent Dual-Earner	Two-Parent Single-Earner	Single-Parent Single-Earner	Total
Sibling Pair				
Older Brother-Younger Brother	130	85	41	256
Older Brother-Younger Sister	98	56	35	189
Older Sister-Younger Sister	105	83	43	231
Older Sister-Younger Brother	91	60	47	198
Total	425	284	166	875

Table 7. Crosstabulation Between Family Structure and Sibling Pairs (Unweighted Data).

	Family Structure			
	Two-Parent Dual-Earner	Two-Parent Single-Earner	Single-Parent Single-Earner	Total
Sibling Pair				
Older Brother-Younger Brother	84	57	58	199
Older Brother-Younger Sister	71	35	55	161
Older Sister-Younger Sister	74	59	69	202
Older Sister-Younger Brother	55	40	55	150
Total	284	191	237	712

Table 8. Descriptive Statistics for Observable Variables (Based on Data Pooled Among Two Parent Families).

	OB-YB n=215	OB-YS n=154	OS-YS n=188	OS-YB n=151
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Father's education	12.7 (3.47)	12.9 (3.15)	12.9 (3.62)	13.2 (2.68)
Mother's education	12.4 (2.31)	12.7 (2.57)	12.6 (2.44)	12.5 (2.01)
Head's occ. status	3.92 (2.02)	3.99 (2.01)	3.88 (1.83)	3.96 (1.75)
Family income (log)	10.6 (.588)	10.7 (.543)	10.7 (.615)	10.6 (.542)
Income missing	.31 (.466)	.24 (.427)	.19 (.396)	.23 (.424)
Race	.09 (.280)	.11 (.312)	.13 (.339)	.05 (.208)
Home ownership	.85 (.362)	.87 (.340)	.87 (.341)	.85 (.359)
Southern residence	.30 (.460)	.41 (.493)	.34 (.476)	.29 (.453)
Number of children	3.8 (1.93)	3.9 (2.09)	4.1 (1.97)	4.1 (1.80)
Older sib's education	13.3 (2.70)	13.6 (2.67)	13.7 (2.29)	13.6 (2.28)
Younger sib's education	13.4 (2.80)	13.8 (2.59)	13.6 (2.28)	13.8 (2.45)

Table 9. Alternative Models and Results from Goodness-of-Fit Tests.

			Difference	
Model	L^2	df	L^2	df
a. Baseline model	26.50	32	-	-
B. a + Φ invariant across all groups	183.92	167	157.42	135
C. B + Λ_y invariant and equal across all pairs	186.15	171	2.23	4
D. C + Γ invariant across all pairs	217.18	198	31.03	27
E. D + Θ_ε invariant and equal across all pairs	227.45	205	10.27	7
F. E + Ψ invariant across all pairs	245.67	208	18.22	3
G. E + Ψ invariant across all pairs except OS-YB pair	241.03	207	13.58	2
H. E + $\Psi_{111} = \Psi_{211}$ and $\Psi_{311} = \Psi_{411}$	227.79	207	.34	2
I. H + $\gamma_{11} = \gamma_{12}$ across all pairs	229.02	208	1.23	1

Table 10. Parameter Estimates and Estimated Standard Errors for Preferred Model (Model I).

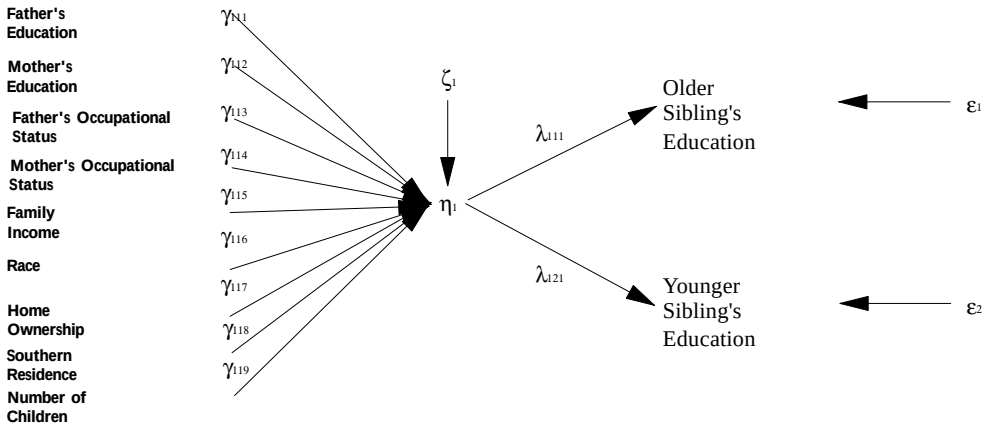
	OB-YB	OB-YS	OS-YS	OS-YB
Effect of Common Family Factor on:				
Older sibling	1.0	1.0	1.0	1.0
Younger sibling	1.0	1.0	1.0	1.0
Effects of Exogenous Variables (Γ)				
Father's education	.17 (.03)	.17 (.03)	.17 (.03)	.17 (.03)
Mother's education	.17 (.03)	.17 (.03)	.17 (.03)	.17 (.03)
Head's occ. status	.09 (.06)	.09 (.06)	.09 (.06)	.09 (.06)
Family income (log)	.42 (.20)	.42 (.20)	.42 (.20)	.42 (.20)
Income missing	.19 (.21)	.19 (.21)	.19 (.21)	.19 (.21)
Race	.26 (.32)	.26 (.32)	.26 (.32)	.26 (.32)
Home ownership	.52 (.26)	.52 (.26)	.52 (.26)	.52 (.26)
Southern residence	-.01 (.19)	-.01 (.19)	-.01 (.19)	-.01 (.19)
Number of children	.03 (.05)	.03 (.05)	.03 (.05)	.03 (.05)
Unmeasured Between-Family Variance (ψ)				
	3.80 (.46)	3.80 (.46)	1.59 (.27)	1.59 (.27)
Within-Family Variances (θ_ε)				
Older sibling	2.34 (.15)	2.34 (.15)	2.34 (.15)	2.34 (.15)
Younger sibling	2.34 (.15)	2.34 (.15)	2.34 (.15)	2.34 (.15)

Table 11. Proportions of Variance Explained in Endogenous Variables (R^2)

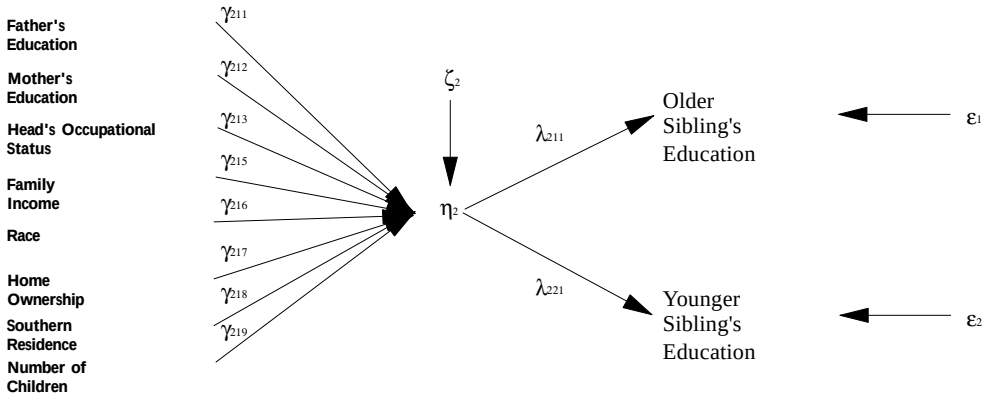
	OB-YB	OB-YS	OS-YS	OS-YB
Common family factor	.26	.26	.46	.46
Older sibling's education	.68	.67	.56	.55
Younger sibling's education	.70	.65	.55	.61

Figure 1.
Three-Group MIMIC Model of Sibling Resemblance

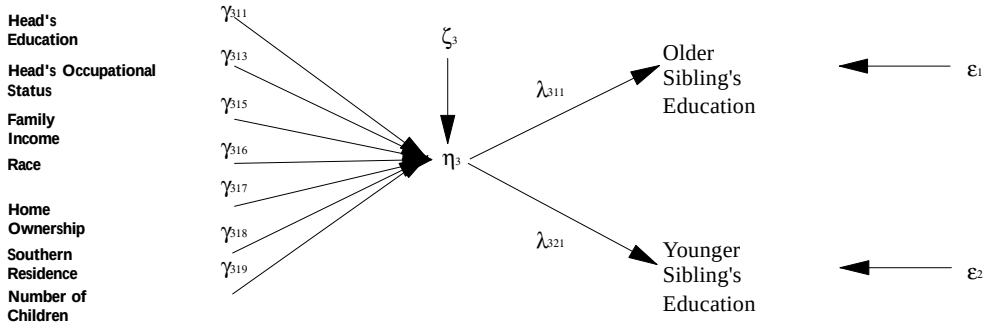
Two-Parent Dual-Earner Family



Two-Parent Single-Earner Family

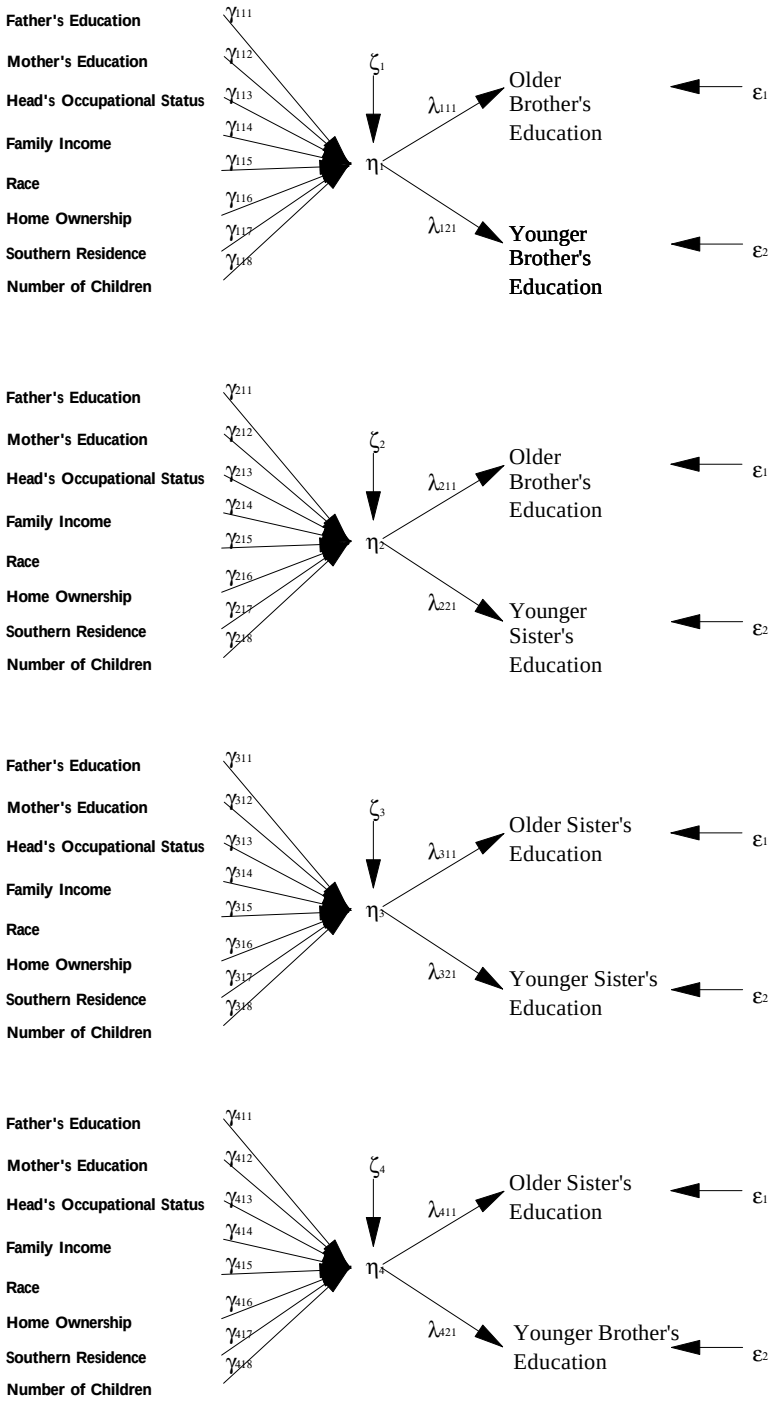


Single-Parent Single-Earner Family



Note: Correlations exist between exogenous variables (within groups) although not depicted in diagram. Although not shown, dummy variable was included for missing family income as well.

Figure 2.
Four-Group MIMIC Model of Sibling Resemblance



Note: Correlations exist between exogenous variables (within groups) although not depicted in diagram. Although not shown, dummy variable was included for missing family income as well.

Appendix A. Correlation Matrices Used in Analysis of Family Structure

2 PARENT DUAL EARNER FAMILIES (WEIGHTED N=425)

	FED	MED	FOCC	MOCC	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.6312	.6222	.4476	.5248	-.1110	-.2463	.0361	-.1568	-.1152	.4031	.4585
MED	.6312	1.000	.4987	.5822	.4050	.0634	-.1612	.2108	-.1732	-.1030	.3410	.3444
FOCC	.6222	.4987	1.000	.3840	.4368	.0338	-.1933	.0976	-.1252	-.0464	.3206	.3986
MOCC	.4476	.5822	.3840	1.000	.3031	-.0307	-.1989	.0758	-.0893	-.1629	.2231	.2311
INC	.5248	.4050	.4368	.3031	1.000	-.0331	-.0322	.1852	-.0295	-.1361	.2471	.3020
MISS	-.1110	.0634	.0338	-.0307	-.0331	1.000	-.0088	-.0341	-.0096	.0035	.0339	-.0011
RACE	-.2463	-.1612	-.1933	-.1989	-.0322	-.0088	1.000	-.0114	.1423	.1097	-.0649	-.0759
OWN	.0361	.2108	.0976	.0758	.1852	-.0341	-.0114	1.000	-.1177	-.1294	.1148	.1249
REGN	-.1568	-.1732	-.1252	-.0893	-.0295	-.0096	.1423	-.1177	1.000	-.0089	-.1368	-.1344
KIDS	-.1152	-.1030	-.0464	-.1629	-.1361	.0035	.1097	-.1294	-.0089	1.000	-.0665	-.0547
OSIB	.4031	.3410	.3206	.2231	.2471	.0039	-.0649	.1148	-.1368	-.0665	1.000	.5889
YSIB	.4585	.3444	.3986	.2311	.3020	-.0011	-.0759	.1249	-.1344	-.0547	.5889	1.000
Mean	13.4	13.0	4.18	3.80	10.7	.22	.07	.87	.30	3.64	13.9	13.8
S.D.	3.034	2.208	1.968	1.774	.480	.415	.263	.332	.458	1.522	2.520	2.543

2 PARENT SINGLE EARNER FAMILIES (WEIGHTED N=284)

	FED	MED	FOCC	***	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.5655	.6137	0	.3385	-.2881	-.4393	.2579	-.2829	-.1334	.3200	.4037
MED	.5655	1.000	.5134	0	.2591	-.3039	-.2704	.2063	-.1677	-.0396	.2566	.3463
FOCC	.6137	.5134	1.000	0	.3152	-.1994	-.2387	.2660	-.0512	-.1405	.2879	.3262
***	0	0	0	1	0	0	0	0	0	0	0	0
INC	.5282	.4267	.4508	0	1.000	-.1683	-.3149	.2212	-.1646	-.3025	.3620	.3624
MISS	-.2881	-.3039	-.1994	0	-.1683	1.000	.2278	-.3154	.1087	.0888	-.1267	-.1832
RACE	-.4393	-.2704	-.2387	0	-.1286	.2278	1.000	-.0564	.2216	.0505	-.1327	-.1375
OWN	.2579	.2063	.2660	0	.2011	-.3154	-.0564	1.000	.0246	-.2007	.2153	.2534
REGN	-.2829	-.1677	.0512	0	-.0147	.1087	.2216	.0246	1.000	-.0457	.0043	-.0321
KIDS	-.1334	-.0396	-.1405	0	-.2194	.0888	.0505	-.2007	-.0457	1.000	-.0959	.0043
OSIB	.3200	.2566	.2879	0	.3344	-.1267	-.1327	.2153	.0043	-.0959	1.000	.6972
YSIB	.4037	.3463	.3262	0	.3179	-.1832	-.1375	.2534	-.0321	.0043	.6972	1.000
Mean	12.1	11.9	3.56	0	10.5	.29	.12	.83	.38	4.50	12.9	13.4
S.D.	3.509	2.390	1.753	1.0	.653	.454	.331	.375	.487	2.372	2.370	2.555

1 PARENT SINGLE EARNER FAMILIES (WEIGHTED N=166)

	HED	***	HOCC	***	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
HED	1.000	0	.5967	0	.4287	-.1769	-.2843	.1781	-.1960	-.2834	.1458	.3828
***	0	1	0	0	0	0	0	0	0	0	0	0
HOCC	.5967	0	1.000	0	.4008	-.0977	-.1636	.0517	-.1608	-.1792	.1732	.3889
***	0	0	0	1	0	0	0	0	0	0	0	0
INC	.4287	0	.4008	0	1.000	-.0694	-.2010	.1554	-.1738	-.0853	.1843	.2639
MISS	-.1769	0	-.0977	0	-.0694	1.000	.0716	-.1138	.0012	.1630	-.1689	-.0857
RACE	-.2843	0	-.1636	0	-.2010	.0716	1.000	-.1658	.2150	.2270	-.1106	-.1669
OWN	.1781	0	.0517	0	.1554	-.1138	-.1658	1.000	-.0706	.0635	.1097	.2170
REGN	-.1960	0	-.1608	0	-.1738	.0012	.2150	-.0706	1.000	.0724	-.1238	-.1754
KIDS	-.2834	0	-.1792	0	-.0853	.1630	.2270	.0635	.0724	1.000	-.1614	-.1551
OSIB	.1458	0	.1732	0	.1843	-.1689	-.1106	.1097	-.1238	-.1614	1.000	.4399
YSIB	.3828	0	.3889	0	.2639	-.0857	-.1669	.2170	-.1754	-.1551	.4399	1.000
Mean	12.5	0	3.61	0	10..0	.32	.28	.65	.38	3.85	13.2	13.2
S.D.	2.701	1.0	1.906	1.0	.501	.469	.452	.480	.487	1.785	2.249	2.199

Appendix B. Correlation Matrices Used in Analysis of Four Types of Sibling Pairs

2 PARENT FAMILIES -- OLDER BROTHER-YOUNGER BROTHER (WEIGHTED N=215)

	FED	MED	HOCC	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.6138	.6921	.4949	-.1829	-.3954	.1247	-.2842	-.0467	.4214	.4230
MED	.6138	1.000	.5350	.3591	-.1604	-.3087	.2296	-.2629	-.0374	.3443	.3083
HOCC	.6921	.5350	1.000	.4778	-.1065	-.2377	.1864	-.1196	-.0945	.4672	.4710
INC	.4949	.3591	.4778	1.000	-.0663	-.1924	.2236	-.0192	-.2891	.3101	.2830
MISS	-.1829	-.1604	-.1065	-.0663	1.000	.1666	-.1237	.0907	-.0075	-.0334	-.1457
RACE	-.3954	-.3087	-.2377	-.1924	.1666	1.000	-.1160	.1874	.0409	-.1483	-.1007
OWN	.1247	.2296	.1864	.2236	-.1230	-.1160	1.000	-.0436	-.2134	.2331	.2690
REGN	-.2842	-.2629	-.1196	-.0192	.0907	.1874	-.0436	1.000	-.0948	-.1989	-.1193
KIDS	-.0467	-.0374	-.0945	-.2891	-.0075	.0409	-.2134	-.0948	1.000	-.0938	-.0065
OSIB	.4214	.3443	.4672	.3101	-.0334	-.1483	.2331	-.1989	-.0938	1.000	.7067
YSIB	.4230	.3083	.4710	.2830	-.1457	-.1007	.2690	-.1193	-.0065	.7067	1.000
Mean	12.7	12.4	3.92	10.6	.31	.09	.85	.30	3.84	13.3	13.4
S.D.	3.470	2.307	2.016	.548	.466	.280	.362	.460	1.931	2.697	2.801

2 PARENT FAMILIES -- OLDER BROTHER-YOUNGER SISTER (WEIGHTED N=154)

	FED	MED	HOCC	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.7248	.6591	.5511	-.1305	-.3483	.0656	-.0727	-.2655	.2851	.3055
MED	.7248	1.000	.5846	.4690	-.0083	-.3144	.2802	-.0865	-.1720	.2040	.2671
HOCC	.6591	.5846	1.000	.3859	-.0010	-.2833	.2279	-.0338	-.1820	.3252	.3425
INC	.5511	.4690	.3859	1.000	-.0908	-.2323	.1847	-.0190	-.2826	.2599	.3134
MISS	-.1305	-.0083	-.0010	-.0908	1.000	.1495	-.1966	.1372	.2743	-.0923	.0014
RACE	-.3483	-.3144	-.2833	-.2323	.1495	1.000	-.0495	.1578	.2560	-.0752	-.1427
OWN	.0656	.2802	.2279	.1847	-.1966	-.0495	1.000	-.1036	-.2548	.1244	.1170
REGN	-.0727	-.0865	-.0338	-.0190	.1372	.1578	-.1036	1.000	.0338	.0442	.0313
KIDS	-.2655	-.1720	-.1820	-.2826	.2743	.2560	-.2548	.0338	1.000	-.1623	-.1085
OSIB	.2851	.2040	.3252	.2599	-.0923	-.0752	.1244	.0442	-.1623	1.000	.7032
YSIB	.3055	.2671	.3425	.3134	.0014	-.1427	.1170	.0313	-.1085	.7032	1.000
Mean	12.9	12.7	3.99	10.7	.24	.11	.87	.41	3.94	13.6	13.8
S.D.	3.147	2.572	2.007	.517	.427	.312	.340	.493	2.086	2.674	2.591

2 PARENT FAMILIES -- OLDER SISTER-YOUNGER SISTER (WEIGHTED N=188)

	FED	MED	HOCC	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.5658	.6365	.5100	-.2819	-.3929	.2344	-.3314	-.2172	.4339	.5211
MED	.5658	1.000	.5128	.4611	-.2179	-.2196	.1092	-.2370	-.0872	.4179	.4956
HOCC	.6365	.5128	1.000	.4952	-.1581	-.2434	.1708	-.2238	-.1135	.3525	.3927
INC	.5100	.4611	.4952	1.000	-.0677	-.1469	.1486	-.1959	-.2651	.3708	.3526
MISS	-.2819	-.2179	-.1581	-.0677	1.000	.1182	-.2213	.1127	.0070	-.0325	-.0884
RACE	-.3929	-.2196	-.2434	-.1469	.1182	1.000	-.0287	.2673	.0911	-.1481	-.1174
OWN	.2344	.1092	.1708	.1486	-.2213	-.0287	1.000	-.0057	-.0405	.0717	.1871
REGN	-.3314	-.2370	-.2238	-.1959	.1127	.2673	-.0057	1.000	.0337	-.0958	-.1634
KIDS	-.2172	-.0872	-.1135	-.2651	.0070	.0911	-.0405	.0337	1.000	-.1184	-.0995
OSIB	.4339	.4179	.3525	.3708	-.0325	-.1481	.0717	-.0958	-.1184	1.000	.6120
YSIB	.5211	.4956	.3927	.3526	-.0884	-.1174	.1871	-.1634	-.0995	.6120	1.000
Mean	12.9	12.6	3.88	10.7	.19	.13	.87	.34	4.12	13.7	13.6
S.D.	3.616	2.437	1.833	.583	.396	.339	.341	.476	1.970	2.293	2.280

2 PARENT FAMILIES -- OLDER SISTER-YOUNGER BROTHER (WEIGHTED N=151)

	FED	MED	HOCC	INC	MISS	RACE	OWN	REGN	KIDS	OSIB	YSIB
FED	1.000	.5761	.4377	.4158	-.1974	-.1312	.1457	-.1368	-.1185	.3854	.5119
MED	.5761	1.000	.4041	.3984	-.0002	.0977	.2623	-.1471	-.1981	.3876	.3400
HOCC	.4377	.4041	1.000	.4198	.0219	-.0365	.0857	-.0360	-.0654	.0444	.2194
INC	.4158	.3984	.4198	1.000	.0254	-.0349	.2905	-.1658	-.1488	.2591	.2985
MISS	-.1974	-.0002	.0219	.0254	1.000	-.0319	-.1307	-.1735	.0451	.0143	-.0346
RACE	-.1312	.0977	-.0365	-.0349	-.0319	1.000	.0912	.0297	-.1019	-.0371	-.0589
OWN	.1457	.2623	.0857	.2905	-.1307	.0912	1.000	.1162	-.2033	.2109	.1085
REGN	-.1368	-.1471	-.0360	-.1658	-.1735	.0297	-.1162	1.000	.0122	-.1110	-.1520
KIDS	-.1185	-.1981	-.0654	-.1488	.0451	-.1019	-.2033	.0122	1.000	-.0894	.0761
OSIB	.3854	.3876	.0444	.2591	.0143	-.0371	.2109	-.1110	-.0894	1.000	.4160
YSIB	.5119	.3400	.2194	.2985	-.0346	-.0589	.1085	-.1520	.0761	.4160	1.000
Mean	13.2	12.5	3.96	10.6	.23	.05	.85	.29	4.07	13.6	13.8
S.D.	2.679	2.011	1.749	.515	.424	.208	.359	.453	1.803	2.276	2.451

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