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A Sibling Analysis of the Effect of Maternal Age on Children's Schooling

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Many studies have found that children born to young mothers face handicaps in their educational career. Considerable debate exists as to whether these effects are real age effects , or whether they are due to measured and unmeasured family background effects that are correlated with having children at a young age. In this study, we examine this problem by comparing siblings who were born at different ages of their mother. When effects of maternal age remain in sibling comparisons, they can be attributed to characteristics that change with the age of the parents and hence, they are more directly supportive of a possible causal effect of parental age. We also analyze the effect of mother's age in combination with the possible confounding influence of birth order: Children born at *late* ages on average are born *later* in the sibling row. Using data on 11,742 siblings in the Netherlands born between 1918 and 1974, our multilevel regression models show that there is a significant positive effect of maternal age on children's schooling and a small negative effect of birth order.

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The effects of parental age on children, and in particular the effects of a very young maternal age, have been studied frequently. Consequences have been studied for a range of outcomes, such as birth weight and mortality (Reichman and Pagnini, 1997), behavioral problems in children (Orlebeke et al., 1998; Wakschlag et al., 2000), demographic behavior of children at a later age (Barber, 2001; Furstenberg et al., 1990), and educational and cognitive outcomes (Berryman and Windridge, 2000; Conley, 2001; Fergusson and Woodward, 1999; Geronimus, Korenman, and Hillemeier, 1994; Hoffman et al., 1993; Ketterlinus et al., 1991). Most studies compare the children of teenage mothers to the children of older mothers, although there are also studies examining the entire age range (Wakschlag et al., 2000). In addition, most studies examine effects of maternal age; only a few look at father's age (Mare and Tzeng, 1989) or at the age of the head of the household (Conley, 2001).

In general, the research findings suggest that a young parental age at birth is associated with negative outcomes in children. When looking at effects on educational and cognitive outcomes, however, the findings appear mixed. On the one hand, there are studies suggesting that the children of young mothers do poorer on cognitive tests and have lower levels of educational attainment than children of older mothers (Berryman and Windridge, 2000; Conley, 2001; Fergusson and Woodward, 1999; Hoffman et al., 1993). On the other hand, studies have showed that such negative effects are to a large extent due to underlying and correlated negative family background factors, such as mother's education, mother's intelligence, and family structure (Geronimus et al., 1994; Ketterlinus et al., 1991; Mare and Tzeng, 1989).

The literature suggests several reasons why maternal age may affect children's outcomes (Fergusson and Woodward, 1999; Furstenberg et al., 1987; Mare and Tzeng, 1989). The main argument is socioeconomic in nature. Older parents are better off financially and may thereby be better able to pay the costs of education for their children (Mare and Tzeng, 1989). In a similar way, it can be argued that parents are more settled in their career so that the role models they provide to their children are more clear. The parents themselves may also be oriented more strongly toward occupational achievement when they are older and they may transmit this orientation to their children. Next to socioeconomic reasons, there are arguments focusing on the social and psychological correlates of age. When parents are very young, they can be less mature which can lead to a lower quality of parenting (Fergusson and Woodward, 1999). A related argument suggests that role demands are too intense when parents are young. Combining schooling or the beginning of a career with child rearing is difficult and lifestyles at a young age are often more outgoing, which may result in less time and attention for the children.[1]

Most earlier work that studied the effects of maternal age has relied on individual data. A drawback of these studies is that unmeasured family effects may bias the effects (Geronimus et al., 1994). Demographic behavior of parents is caused by and correlated with social, economic, and cultural characteristics of these parents. This is particularly true for the timing of births, which is the main factor causing variation in maternal age. Demographic research shows that people who become parents at an early age are different in many respects from other parents (e.g., Blossfeld, 1993; Rindfuss and St. John, 1993). Although some of these effects can be controlled for, such as mother's education and father's occupation (Mare and Tzeng, 1989), it is not possible to control for all relevant correlates. Hence, effects of maternal demographic characteristics may be biased in several unknown ways.

A possible solution to these problems is to compare children within rather than across families. Within a family, children are born at different ages of the parents and this variation may be used to estimate the causal effect of parent's age more conclusively. Siblings in the same family share many characteristics of the parents so that many confounding influences

[1] There may also be advantages of being born to a younger parent (e.g., younger parents may be more flexible and the generation gap may be smaller).

are taken into account (Curtis et al., 1993; De Graaf and Huinink, 1992; Hauser, 1988; Kuo and Hauser, 1995; Sieben, 2001). Obviously, there are also changes in socioeconomic or cultural characteristics that occur *within* a family, but these are connected to the explanation of why a maternal age effect occurs in the first place. In other words, they serve as intermediating rather than as confounding variables and do not need to be taken into account. Note that the maternal age range in a small family is not large, but it can be substantial in somewhat larger families. Moreover, if a sibling approach is used in combination with a large number of cases, there will be enough statistical power to estimate the implications of even small variations in maternal age.

In studying the role of parental age, it is important to take into account the possible effect of birth order on educational attainment. This factor has been studied often in the past and for various outcomes, such as personality characteristics, intellectual ability, and educational attainment (for a review, Steelman et al., 2002). Originally, research found evidence that first borns did better on academic tests and educational outcome variables than later born children (Zajonc and Markus, 1975). Over time, however, consensus has grown that there are no systematic and universal effects of birth order position (Blake, 1989; Harris, 1998; Hauser and Sewell, 1985; Retherford and Sewell, 1991; Rodgers et al., 2000; Steelman and Powell, 1985; Steelman et al., 2002; Van Eijck, 1996; Van Eijck and De Graaf, 1995). Despite this consensus, there are still exceptions which find the originally expected negative birth order effect on academic outcome variables (Guo and VanWey, 1999). In addition, there is evidence that the amount of energy invested in children is higher for first-borns (Powell and Steelman, 1990, 1993).

The main reason to study birth order in combination with maternal age, is that these two aspects of family structure are correlated. Within families, those who are born later have older parents than those who are born earlier, although the extent to which this is true depends on child spacing. This also implies a positive correlation between birth order and parent's age in a cross-sectional survey. Given this correlation, the two factors tend to work as each other's suppressors, as the causal diagram in Figure 1 illustrates. The hypotheses are that mother's age has a positive effect on educational attainment, whereas birth order position has a negative effect: Being born late is an asset, but being born later is a handicap. If these hypotheses are valid, a true positive effect of parent's age is suppressed by the negative effect of birth order position (and the positive correlation between parent's age and birth order position). Similarly, the true negative effect of birth order position is suppressed by the positive effect of parent's age.

*** Figure 1 about here ***

The present paper contributes to the literature in three ways. First, we analyze the effect of maternal age in a novel way, i.e., by analyzing the consequences of differences in maternal ages *within* families in a multilevel sibling design. Second, we examine the effect of maternal age in combination with the effect of birth order, thereby obtaining better estimates of both maternal age effects *and* birth order effects. Interesting to note is that previous work on family configuration has already applied sibling models to estimate effects on academic outcomes. Retherford and Sewell (1991), for example, compared siblings of different birth orders within a family, while Guo and VanWey (1999) treated sibsize as something that is different for different siblings within a family (at a given point in time). None of these sibling analyses, however, have looked at father's or mother's age, which is a factor that within a family is different for different siblings.[2]

[2] It is not clear if Guo and VanWey (1999) include mother's age as a time-varying or time-constant variable.

We analyze the influence of maternal age on children's completed level of education by using recent data that were collected in the Netherlands. In comparison to other western countries, the Netherlands provides a 'normal' case for analyzing these influences. The Netherlands has a highly developed educational system with a hierarchical structure that corresponds with the general primary, secondary and tertiary division. In comparison to the American system, the Dutch system is different in that students are separated into different schools with different levels at an early age. In the last half of the 20th century, the Netherlands experienced a rapid educational expansion. In conjunction with this process, the effects of family background on schooling have declined over time, showing that the educational system has become more meritocratic (De Graaf and Ganzeboom, 1993; Dronkers, 1993). In demographic terms, the Netherlands has a relatively late maternal age at first birth (over 29 in the late 1990s), a total fertility rate of 1.6, and a relatively small percentage of large families—about 20 percent of Dutch women have three or more children (Statistics Netherlands, 1999). Small sibsizes and late fertility timing imply that the variance in parental age will be somewhat smaller than elsewhere, which probably makes it more difficult to find a parental age effect. Nevertheless, there are no clear theoretical reasons to expect the effects of parental age and birth order to be different in the Dutch context.

DATA AND METHOD

We use three waves of the *Family Survey of the Dutch Population* (FSDP), conducted in 1992, 1998, and 2000 (De Graaf et al., 1998, 2000; Ultee and Ganzeboom, 1992). The FSDP investigates various aspects of the life course of the Dutch-speaking population of the Netherlands between the ages of 18 and 70. Face-to-face interviews were held with a primary respondent and, if married or cohabiting, their partners were interviewed as well. The number of households in the three surveys was 1000 in 1992, 1140 in 1998, and 850 in 2000, yielding a total of almost three-thousand households. For each survey, a sample of primary respondents was drawn randomly from population registers of a stratified sample of Dutch municipalities (stratified with respect to region and urbanization). Contact rates were (contacted households compared to the total sample) 90% in 1992, 91% in 1998, and 86% in 2000. The cooperation rate (responding households to contacted households) was 47% in 1992, 54% in 1998, and 47% in 2000. Unfortunately, response rates under 50% are rather common in the Netherlands. The relatively low response rate here is mainly due to the fact that both partners had to be interviewed for a successful response.

In the FSDP 2000 survey, both the primary and secondary respondent answered questions about all of their siblings. In 1998, educational data are only available for a random subset of three siblings. Fortunately, birth years in this survey are available for all siblings so that we construct control variables pertaining to siblings in similar ways as in the other surveys. In 1992, information on siblings was only collected from the primary respondent.

We selected respondents, partners, and siblings 24 years of age and older in order to ensure that persons completed their schooling. We also tried to ensure that we are only considering full biological siblings in our analyses. To accomplish this, we selected the respondents whose own parents were still together at age 15. As a result of this selection procedure, we cannot address problems associated with single parent families and our results apply only to intact families. Because information on intact families was obtained from the primary respondent, the family structure may have been different for the other siblings (e.g., the mother may have divorced and remarried at a later age and had new children from that marriage). As a result, not all half- or step-siblings will have been excluded. In the 1998 dataset we are able to check how well this selection procedure works because a specific question was asked about the status of the sibling. Before making the intact family selection, 6% of the siblings of the primary respondent are half- or step-siblings. After making the selection, the percentage is 4. Hence, this indirect procedure probably removes about a third of the half- or step-siblings. We further excluded cases with missing values on any of the variables.

Using this information, we constructed a hierarchical data-file that includes all respondents and their siblings, as well as all partners and their siblings. In the text and tables, we refer to these individuals as 'respondents' and these constitute the lowest level in our data-file (*N* = 11,316). The higher level in our analysis consists of the families-of-origin of the primary or secondary respondents (*N* = 3,190). We do not expect dependencies between primary and secondary respondents because the information we use refers to the period when they were growing up (i.e., long before marriage).

Dependent variable and statistical model

The dependent variable is the completed educational attainment of the respondent, classified in ten categories. To obtain a scale that is comparable to the practice in American research we applied a standard recoding procedure into the minimum number of years that is needed to complete the given level: 5 = primary education not finished; 6 = completed primary education ('LO'); 9 = junior vocational training ('LBO'); 10 = junior general secondary education ('MAVO'); 11 = senior general secondary education ('HAVO'); 12 = senior vocational training ('MBO'); 13 = pre-university education ('VWO'); 15 = vocational colleges ('HBO'); 17 = university degree; 21 = Ph.D. In doing this, we follow earlier work on educational stratification in the Netherlands (De Graaf and Ganzeboom, 1993).

We analyze this dependent variable using multilevel models, i.e., a fixed effects regression model (Greene, 1990). This model takes into account that the individual errors are correlated within families. More importantly, the model essentially regresses 'changes' in the dependent variable on 'changes' in the independent variables. Translated to the sibling data, this means that variables that vary across siblings are included as difference scores. The regression model uses differences in educational level with respect to the average sibling as a dependent variable. The models are estimated using the XTREG routine in the STATA program. To assess whether our novel approach yields more reliable results, we compared the outcomes of the fixed effects models to the parameters of more conventional OLS models for the sibling data set. The OLS estimates of the standard errors are corrected for dependencies between siblings in the data (using the cluster-option in STATA).

Independent variables

The central independent variable is the age of the mother when the respondent or sibling was born. We initially look at maternal age as a linear variable but we will also present evidence on possible deviations from linearity. The means in Table 1 show that the average age of the mother when the respondent or sibling is born is 30. Table 2 shows the distribution of mother's age. About 4% of the children were born to teenage mothers and about 4% of the mothers is older than forty. We look primarily at mother's age, although we also present supplementary analyses using father's age.

*** Table 1 and 2 about here ***

Because we make comparisons within families, it is important to assess how much the age of mothers actually varies across siblings. Figure 2 shows the maternal age range between the oldest and youngest sibling for each sibsize category. The range is substantial. For small families (e.g., 2 children), the average range is about 3 years. For large families (e.g., 5 children), the average range is more than 10 years.

*** Figure 2 about here ***

Note that the age of the mother at the birth of the respondent (or the birth of the sibling) is a somewhat arbitrary point. If maternal age matters for schooling, it not only matters at birth, but also at later ages of the respondent, and hence, at later ages of the mother. A more appropriate way to conceptualize maternal age is to regard it as an indicator of how long a person has been exposed to a younger parent when growing up. This is also the way in which differences between siblings need to be conceptualized. A person born when his or her mother was 20, for example, was exposed to a young mother for a longer period of time than a person who was born when his or her mother was 25.

Next to birth order, we include two other aspects of family structure that have often been considered important in the literature: the number of siblings (Blake, 1989) and a measure of close birth spacing (Powell and Steelman, 1993). Spacing is measured as the number of siblings who are born within one calendar year range of the respondent (i.e., the same calendar year or one year later or earlier). This definition implies that the maximum range is 23 months and the natural minimum range is 9 months. Hence, the average interval will be about 16 months. Our data show that about 21% of the respondents have at least one sibling closely spaced. Our definition of spacing closely follows earlier work (Powell and Steelman 1993). We further note that unlike sibsize, spacing is a variable that can be different for different siblings. In earlier research, sibsize has sometimes been treated as varying across siblings (Guo and VanWey, 1999), but this is only feasible when the dependent variable is time-varying (e.g., as it is for annually measured test scores). Our dependent variable—educational attainment—is measured at age 24, long after this point, and hence we treat sibsize as fixed (i.e., the same for each sibling).

Different aspects of family structure are linked, as the correlations in the appendix show. The correlation between maternal age and birth order is $r = .63$, reflecting the obvious fact that older born respondents are born to older parents. This correlation is high, but since the number of cases is substantial, we have enough statistical power to estimate the two effects simultaneously. The reason why the correlation is far from perfect lies in the timing of births. Both between families and between birth orders within families, there is variation in the spacing of births. This variation results in differences in the parent's ages that are independent of birth order.

We include several other control variables: (a) sex of the respondent, (b) father's completed education, (c) mother's completed education. Means and standard deviations are presented in Table 1. Although there is more information on family background in the dataset (e.g., financial and social resources), we do not use this information because these characteristics may vary within families (for different siblings), and hence, are potentially intermediating rather than confounding variables. This problem does not exist for parental education, which precedes the birth of the children and hence can be assumed to be the same for each sibling within a family.[3]

It is important to control for the fact that educational attainment has expanded over time (De Graaf and Ganzeboom, 1993). Due to educational expansion, later-born respondents have better opportunities of achieving high levels of schooling than early-born respondents. Omitting such period effects would lead to an underestimation of the effects of maternal age (within families). Children born when the mother was younger have a disadvantage because they were born in times when educational opportunities were more limited. The measure is defined as the percentage of the population that has achieved higher vocational or university

[3] A pragmatic reason not to include intermediating variables is that the survey only includes these measures referring to one point in time, i.e., the age at which the primary or secondary respondent was 15.

training in the respondent's (single-year) birth cohort. The measure ranges from 8% for persons born in 1918 to 28% for persons born in 1974.

RESULTS

We estimate both OLS regression models and fixed effects models with educational attainment as the dependent variable. The OLS regression models refer to the across family comparisons, whereas the fixed effects models refer to the within family comparisons. Because we want to assess to what extent mother's age and birth order are suppressing each other's effects, we estimate three models: one with only mother's age (Model I), one with only birth order (Model II), and one with both (Model III, Table 3). All models contain control variables. We concentrate in our discussion on the fixed effects results and note that the effects of father's and mother's education, as well as the effects of the number of siblings in the OLS models are consistent with earlier research (De Graaf and Ganzeboom, 1993; Kuo and Hauser, 1997).

We start with an empty fixed effects model to assess the family and individual variance (not presented in Table 3). This model shows that 44% of the variance in educational attainment is due to differences among families. In other words, almost half of the educational differences can be explained by the influence of measured and unmeasured family background variables. This is about equal to what sibling models in the United States, the Netherlands, and Germany have found (De Graaf and Huinink, 1992; Kuo and Hauser, 1995; Sieben, 2001; Van Eijck, 1996).

*** Table 3 about here ***

In Model I, mother's age appears to have a significant and positive effect on educational attainment. The older the mother, the more successful the child is in his or her educational career. Because we are using fixed effects models, this effect is not biased by other (measured or unmeasured) family background factors. However, we also see that the effect of mother's age is somewhat stronger in the OLS model than it is in the fixed effects model. Hence, if there are unmeasured background factors associated with the timing of births, omitting them will lead to a small overstatement of the maternal age effects. The effect of close spacing turns out to be negative, as expected, but the coefficient is not statistically significant.

In Model II, we include birth order in the model and drop maternal age. Birth order appears to have no significant effect on educational attainment, neither in the OLS specification, nor in the fixed effects specification. When we add both maternal age and birth order in Model III, we see a different picture. We first observe that the effect of mother's age almost doubles from Model I to Model III. In addition, we see that the effect of birth order now becomes statistically significant. The effect turns out to be negative, showing that later born children have a disadvantage, consistent with early theoretical work on the issue. This also implies that mother's age and birth order both work as a suppressor variable for each other, as was illustrated in Figure 1.

Are the effects large or small? The effect of mother's age in Model III is .06, which amounts to a 1.22 years difference in schooling between a mother aged 20 and a mother aged 40. This is about 40% of a standard deviation in educational attainment (Table 1). To assess the magnitude of this effect in a different way, we can calculate the standardized coefficient. The standardized coefficient is .11, which is modest. We can also compare this effect to the effects of other stratification variables. For that end, we compare the effect of mother's age to the effect of father's education (while leaving out mother's education), and to the effect of mother's education (while leaving out father's education). The standardized effect of father's education is .38, the effect of mother's education is .32, and the effects of mother's age are .12 and .13 respectively. Hence, for explaining differences in educational outcomes, parental education is about three times more important than mother's age.

The effects of the sibling-specific control variables are as expected. Brothers have a .72 year educational advantage over their sisters. Close birth spacing has no significant effect. Our cohort measure of educational attainment does not affect educational attainment differences within families. In the OLS equation we do find a significant effect, but when we look at differences within families, the effect is no longer significant.

Is it mother's or father's age that is relevant? Most studies have looked at mother's age only, with the exception of Mare and Tzeng (1989) who look at father's age (only). Including both parental ages is difficult since the two variables are highly correlated. In our data, this correlation is r = .81. If there are enough cases, it is still possible to estimate the two effects separately. Because our dataset is large, we estimated an additional model III which includes both mother's and father's age. Note that this was done in the OLS model, not in the fixed effects model. Because the two ages change in tandem, the fixed effects models cannot include both. The results show that the effect of mother's age is stronger than the effect of father's age (.04 versus .03, Model III). Both effects are significant. Although the difference appears large, a statistical test showed that the coefficients are not significantly different from each other ($F = .28$, $p > .60$). This is probably due to the high correlation between mother's and father's age, which tends to produce a negative correlation between the estimates of their effects (Kmenta, 1986, p. 414). A negative correlation between estimates leads to a greater difference in the estimates of father's and mother's age than is true in reality. Hence, we conclude that it is in fact parental age and not mother's or father's age that is important for explaining educational outcomes in children.

All variables are modeled in a linear fashion in Table 3. Earlier studies have argued that the effect of parent's age is not linear (Mare and Tzeng, 1989). In addition, many studies have focused on comparisons of teenage mothers and other mothers (e.g., Fergusson and Woodward, 1999; Geronimus et al., 1994; Hoffman et al., 1993). If the effect of mother's age is due to the contrast between teenage mothers and older mothers, we may be underestimating the effect of maternal age.

To address this issue, we break down maternal age in six categories. We also break down birth order in six categories. We present results in Table 4. Table 4 shows that we have sufficient numbers of cases in each age category. The effect of mother's age turns out to be more or less linear. Each next age category has a somewhat more positive effect than the former category. The effect of birth order is nonlinear. The first born has a higher level of education than the second born (b = -.18, $p < .01$), and the second born has a higher level of education than the third born (b = -.15, $p < .05$). There is fluctuation among the later born as well, but this is not systematic. The results are virtually the same when we use father's age instead of mother's age (presented in the second column of Table 4). Note that these are small effects, they constitute about 5% of the standard deviation in educational attainment.

*** Table 4 about here ***

Because maternal age has a greater range in larger families than in smaller families, one would suspect that there is more room for within-family effects in larger families. In addition, the birth order variable is not defined the same way for each family size: Small families do not have the later birth orders. For these reasons, we estimated a model for each family size category. We replace the age dummy's by a linear maternal age effect since Table 4 showed that the effect was linear. The results are presented in Table 5 and first show that the effect of parent's age is positive and significant in each group. The four effects do vary, but not in a systematic fashion: they range between .06 and .13. In other words, the effect of mother's age is consistent: It occurs in both small and large families. The effects of birth order are similar as in the pooled model and again show that the biggest contrast is between the first child and the later children.

*** Table 5 about here ***

CONCLUSION

This study has examined the possible influence of maternal age on the level of completed education of their children. By comparing siblings within families, differences in outcomes cannot be attributed to common family background characteristics, such as the mother's intelligence, her educational attainment, or stable personality characteristics. In the literature, there has been debate as to whether the negative effects of a young maternal age are due to such underlying family background factors (Geronimus et al., 1994; Hoffman et al., 1993). By analyzing the problem with a multilevel sibling design, we have developed a new way to rule out the effect of measured and unmeasured family background effects.

Using data on more than 10,000 siblings from intact families in the Netherlands, our results generally show that there are positive effects of maternal age on children's educational level. In other words, even if the influences of measured and unmeasured family background effects are ruled out, there is a significant effect of mother's age. This remaining effect can be attributed to the number of years that children have been exposed to young parents at home. More specifically, the effect should be due to economic, social, or psychological characteristics that *change* with the age of the parents. Examples are a higher socioeconomic or income status of the household as the parents grow older, clearer occupational and educational parental role models, and a more mature and supportive child rearing style. Our sibling design has shown that such changes in parental characteristics matter, and has thereby provided more direct support for a intrinsic interpretation of the maternal age effect than has been offered before. To assess which of the three causal mechanisms is most important, panel data are needed that contain dynamic measures of these intermediating variables.

The analyses also provide additional insights. First, the effects of maternal age, although significant, are modest at best. To illustrate, the effect of parental education is almost three times more important than the effect of maternal age. Second, the effects of maternal age are linear—we find no evidence for a special effect of teenage fertility, nor do we find other deviations from linearity. Third, the effects of mother's age are more or less equal to the effects of father's age, suggesting that a combination of social and economic explanations will be most promising. In sum, we think the literature has focused too much on the special group of teenage mothers and has overlooked the more general influences that are associated with parental ageing.

We analyzed the effects of maternal age in combination with the effect of birth order. Since these two variables are positively correlated while possibly having opposite effects on child outcomes, they may work as suppressor variables. We find evidence that both effects increase when analyzed simultaneously, suggesting the need to include both variables in regression models. In the full model, parental age has a positive effect and birth order has a small negative effect on the child's educational attainment. This leads to the conclusion that later born children have a disadvantage which is compensated by the fact that they are born at a late age of the mother. The effect of birth order is inconsistent with most earlier research, although there have been recent studies which also find a birth order effect (Guo and VanWey, 1999). We should note, however, that the birth order effect is small, which reduces the need to look for country-specific interpretations of this exception. The parental age effect on children's schooling is the more important of the two and our main point is that we have established this parental age effect in a novel and—we think—more convincing fashion than before.

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TABLE 1
Description of Variables

Variable	Mean	Standard Deviation	Minimum	Maximum	N
Male (1=male)	.508	.500	0	1	11,742
% Tertiary Educated in Birth Cohort	19.075	4.446	7.811	29.474	11,742
Educational Attainment Father	9.284	3.444	6	21	11,554
Educational Attainment Mother	8.247	2.656	6	21	11,614
Number of Siblings	3.838	2.409	0	9	11,742
Spacing between sibling	.246	.510	0	4	11,742
Birth Order	2.916	1.957	1	10	11,742
Age Mother at Birth Child	29.850	5.773	16	49	11,742
Educational Attainment	11.642	3.083	6	21	11,572

Source: Family-Survey Dutch Population (1992, 1998 and 2000: N=11316).

TABLE 2

Frequency Distribution of Maternal Age at Birth of Respondent or Sibling

	Mother	Father
Age 16-20	3.6	1.2
Age 21-25	20.6	10.3
Age 26-30	33.4	29.4
Age 31-35	24.5	29.0
Age 36-40	13.7	18.0
Age 41-45	4.0	8.6
Age 46-49	0.3	3.5
Total	100	100

Source: Family-Survey Dutch Population (1992, 1998 and 2000: N=11316).

TABLE 3

OLS-Regression and Fixed Effects Regression of Educational Attainment on Maternal Age and Birth Order Using Sibling Data Within Families (standard errors in parentheses).

	unstandardized regression coefficients					
	Model I		Model II		Model III	
Variables	Clustered OLS	Fixed Efffects	Clustered OLS	Fixed Efffects	Clustered OLS	Fixed Efffects
Background Factors						
Male (1=male)	.437***	.719***	.435***	.717***	.445***	.721***
	(.065)	(.066)	(.066)	(.066)	(.065)	(.066)
% Tertiary Educated in Birth Cohort	.073***	-.022	.079***	.031	.085***	-.024
	(.009)	(.022)	(.010)	(.018)	(.009)	(.022)
Educational Attainment Father	.266***	invariant	.268***	invariant	.264***	invariant
	(.014)		(.014)		(.014)	
Educational Attainment Mother	.187***	invariant	.184***	invariant	.183***	invariant
	(.018)		(.018)		(.018)	
Family Characteristics						
Number of Siblings	-.120***	invariant	-.090***	invariant	-.048*	invariant
	(.018)		(.020)		(.020)	
Spacing between sibling	.061	-.088	.007	-.107	.044	-.089
	(.065)	(.059)	(.066)	(.059)	(.064)	(.059)
Birth Order			-.007	.019	-.161***	-.080**
			(.017)	(.020)	(.026)	(.030)
Age Mother at Birth Child	.037***	.033***			.064***	.061***
	(.006)	(.009)			(.008)	(.014)
Constant	5.334***	10.711***	6.269***	10.658***	4.545***	10.169***
	(.249)	(.252)	(.222)	(.305)	(.307)	(.324)
R-squared (adjusted)	.242		.237		.246	
Sigma U		2.545		2.479		2.537
Sigma E		2.210		2.212		2.209

Source: Family-Survey Dutch Population (1992, 1998 and 2000: N(individual)=11316; N(family)=3190).

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 4
Fixed Effects Regression of Educational Attainment on Parental Age and Birth Order using Sibling Data within Families (standard errors in parentheses).

Variables	Model IV (maternal age)	Model IV (paternal age)
Background Factors		
Male (1=male)	.718***	.717***
	(.066)	(.066)
% Tertiary Educated in Birth Cohort	.004	.008
	(.020)	(.020)
Educational Attainment Father	invariant	invariant
Educational Attainment Mother	invariant	invariant
Family Characteristics		
Number of Siblings	invariant	invariant
Spacing between sibling	-.062	-.063
	(.060)	(.060)
Birth Order		
First (ref.)	ref.	ref.
Second	-.179***	-.154*
	(.068)	(.068)
Third	-.332***	-.293***
	(.091)	(.090)
Fourth	-.281*	-.252*
	(.115)	(.115)
Fifth	-.494***	-.464***
	(.145)	(.142)
> Fifth	-.270	-.278
	(.162)	(.159)
Age Parent at Birth Child		
16-20 year (ref.)	ref.	ref.
21-25 year	.265	.265
	(.160)	(.266)
26-30 year	.390*	.375
	(.185)	(.281)
31-35 year	.650***	.466
	(.218)	(.304)
36-40 year	.774***	.791*
	(.252)	(.330)
41-45 year	1.124***	1.030***
	(.269)	(.359)
> 45 year		1.317***
		(.405)
Constant	10.835***	10.847***
	(.354)	(.410)
Sigma U	2.489	2.505
Sigma E	2.208	2.208

Source: Family-Survey Dutch Population (1992, 1998 and 2000: N(individual)=11316; N(family)=3190).
* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 5
Fixed Effects Regression of Educational Attainment on Maternal Age and Birth Order using Sibling Data for Five Different Family Sizes (standard errors in parentheses).

Variables	family size 2 siblings	family size 3 siblings	family size 4 siblings	family size ≥ 5 siblings
Background Factors				
Male (1=male)	.760***	.538***	.722***	.783***
	(.213)	(.138)	(.126)	(.101)
% Tertiary Educated in Birth Cohort	-.149*	-.068	-.031	.031
	(.081)	(.051)	(.048)	(.029)
Educational Attainment Father	invariant	invariant	invariant	invariant
Educational Attainment Mother	invariant	invariant	invariant	invariant
Family Characteristics				
Number of Siblings	invariant	invariant	invariant	invariant
Spacing between sibling	-1.697	-.040	-.052	-.065
	(1.050)	(.194)	(.135)	(.070)
Age Mother at Birth Child	.127*	.068*	.118***	.058***
	(.050)	(.032)	(.031)	(.018)
Birth Order				
First (ref.)	ref.	ref.	ref.	ref.
Second	-.289	-.256	-.460***	-.373**
	(.205)	(.136)	(.145)	(.129)
Third		-.457*	-.530***	-.386**
		(.227)	(.194)	(.144)
Fourth or higher			-.801***	-.559**
			(.283)	(.179)
Constant	11.924***	11.543***	9.204***	8.557***
	(1.494)	(.849)	(.862)	(.404)
Sigma U	2.909	2.532	2.389	2.234
Sigma E	2.224	2.244	2.204	2.181

Source: Survey Dutch Population (1992, 1998 and 2000: N(individual)=11316; N(family)=3190).
* $p < .05$; ** $p < .01$; *** $p < .001$.

APPENDIX 1
Correlation Matrix.

	A.	B.	C.	D.	E.	F.	G.	H.
A. Male (1=male)	1.000	-.030	-.005	.007	.011	.001	.011	-.005
B. % Tertiary Educated in Birth Cohort		1.000	.214	.300	-.320	-.016	-.008	.018
C. Educational Attainment Father			1.000	.587	-.216	.001	-.143	-.033
D. Educational Attainment Mother				1.000	-.225	.010	-.147	-.052
E. Number of Siblings					1.000	.174	.623	.239
F. Spacing between sibling						1.000	.032	-.071
G. Birth Order							1.000	.634
H. Age Mother at Birth Child								1.000

Source: Family-Survey Dutch Population (1992, 1998 and 2000: N=11.742).