# The Family Is Not a Safe Haven:

# Estimating and Explaining Differences Between Siblings in Educational Outcomes

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This version: April 13, 2014

Word count: 7,780

## Abstract

This paper analyses within-family inequality in educational outcomes in Germany. I provide estimates of the proportion of inequality which is produced within as compared to between families. Furthermore, I test which mechanisms bring about inequality between siblings using family fixed effects models. These mechanisms include birth order, gender, birth spacing, maternal age, and parental separation. Finally, I look at the interaction between these factors and social origin. I find that differences in educational outcomes between siblings exist in lower and higher SES families to a similar degree. However, the effects of some of the mechanisms analyzed on track attendance are more pronounced among lower SES families. This leads to the conclusion that the mechanisms which bring about inequalities between siblings do not differ between social classes but they are more consequential with respect to final educational attainment for lower SES families.

## Keywords

family; siblings; education; compensatory effect

## INTRODUCTION

Research on inequalities in educational outcomes has mainly concentrated on differences between families. Less attention is paid to inequalities which arise within families. Some research has indirectly contributed to the latter by analyzing the effects of specific family characteristics such as family size (Blake 1981, 1989; Downey 1995; Guo and VanWey 1999), sibship sex composition (Butcher and Case 1994; Hauser and Kuo 1998; Kaestner 1997; Conley 2000), birth spacing (Powell and Steelman 1990, 1993), birth order (Black, Devereux, and Salvanes 2005; Booth and Kee 2009; Härkönen 2013), maternal age (Kalmijn and Kraaykamp 2005), and parental separation (Sandefur and Wells 1999; Ermisch and Francesconi 2001; Björklund and Sundström 2006; Francesconi, Jenkins, and Siedler 2010) on educational and occupational outcomes. Furthermore, there are some studies which provide descriptive measures of the importance of within- and between-family inequality by reporting sibling correlations in educational outcomes (Benin and Johnson 1984, Hauser and Mossel 1985, Hauser and Wong 1989, De Graaf and Huinink 1992; Kuo and Hauser 1995; Toka and Dronkers 1996; Sieben, Huinink, and de Graaf 2001).

However, there are only two studies which look at how sibling correlations vary with social background and both are limited to the US (Conley and Glauber 2008; Conley, Pfeiffer, and Velez 2007). Furthermore, research which tries systematically to explain how differences between siblings are brought about and how this process differs between lower and higher SES families is nearly missing.

This paper aims to contribute to these two questions. I use data on siblings who have grown up in the same household from the German Socio-Economic Panel Study (GSOEP). In the analysis I proceed in two steps. First, I provide descriptive estimates of the importance of between- and within-family characteristics in bringing about inequalities in educational outcomes in Germany. This is done by looking at sibling correlations in measures of

educational performance and attainment. In addition, I test whether the role of between- and within-family factors differs with social origin. For that purpose, I compare sibling correlations between different social groups. Second, using family fixed effects models I test which mechanisms bring about educational inequalities between siblings and how the impact of these mechanisms differs with social origin. The mechanisms I look at include birth order, gender, birth spacing, maternal age, and parental separation.

To anticipate the results, I find that within-family differences play an important role in bringing about educational inequalities. Especially inequalities in performance are largely brought about within families. There are no systematic differences in the amount of inequality produced within families between social classes.

With respect to the mechanisms which increase inequalities between siblings I find effects in the anticipated directions, with the exception of maternal age for which I cannot reproduce results of earlier research. Birth order exceeds a strong influence with later born children achieving lower outcomes. Gender inequalities play a crucial role in bringing about differences in families with boys being disadvantaged. Having a close spaced sibling leads to lower educational outcomes. Being still in school when the parents separate has a negative impact on track attendance.

Furthermore, I find the effects of having a closed space sibling and parental separation to vary across social groups. In general, the negative effects of these factors are equal between higher and lower SES families or stronger among higher SES families with respect to school grades. However, with respect to track attendance the relationship between social origin and negative family characteristics reverses. Having a close spaced sibling and having experienced parental separation has a stronger negative effect on children from a lower social origin. I interpret this last finding as in line with a view that higher SES families can compensate for negative life events in order to avoid detrimental consequences on the life courses of their children (Bernardi 2014; Conley 2004).

## FAMILY BACKGROUND AND DIFFERENCES BETWEEN SIBLINGS IN EDUCATIONAL OUTCOMES

### *Sibling Correlations in Educational and Occupational Outcomes*

Both in Sociology and in Economics, there is a robust literature which uses sibling correlations in education, occupation, and earnings as a measure of how much family background influences these outcomes. Jencks et al. (1972) were the first to analyze sibling correlations in education. This one and following studies on the US usually demonstrated that around half of the variance in education can be explained between families and the other half varies within families (Hauser and Mossel 1985; Hauser and Wong 1989; Kuo and Hauser 1995). Some papers have also applied this approach to Europe with similar estimates on the importance of between- and within-family inequality (De Graaf and Huinink 1992; Sieben, Huinink, and de Graaf 2001; Toka and Dronkers 1996).

Following Solon et al. (1991) several studies in Economics report sibling correlations in earnings for the US (Mazumder 2008), several Scandinavian countries (Björklund et al. 2002), and Germany (Schnitzlein 2014). All these studies have in common that they treat sibling correlations as a measure of the complete effects of family background on these outcomes. Overall, they find sibling correlations in earnings to be of similar size than sibling correlations in education.

### *Variation of Sibling Correlations by Social Origin and the Compensatory Class Effect*

None of the studies mentioned above analyzed how these sibling correlations vary across social groups. This has only be done by two more recent papers using data on the US (Conley, Pfeiffer, and Velez 2007; Conley and Glauber 2008). There are, however, good

reasons to expect sibling differences to vary by social background based on earlier research on educational inequalities.

Economists widely apply Becker and Tomes (1976, 1986) economic theory of the family to explain differences within families and discuss whether parents invest similarly in all children or whether they invest in order to maximize their returns. In the latter case, parents invest more in those children who demonstrated earlier a higher level of abilities.

But also Boudon's Inequality, Education, and Opportunity (IEO) theory can be taken as a starting point in order to analyze the role differences within families play in bringing about the amount of overall inequality (Boudon 1973, 1998). The prediction derived from Boudon's theory is that parents' behavior is a function of social status. Boudon argues that the impact of early performance on educational transitions is stronger in lower SES families. Applied to the setting within families, the hypothesis is that lower SES families reinforce differences between siblings whilst higher SES families equal them more out. As a result, we would expect that educational outcomes are more similar for siblings from higher SES than for siblings from lower SES families.

*Compensatory Class Effect:* Siblings from higher SES families resemble each other in their educational outcomes more than siblings from lower SES families.

As stated above, research which tests this hypothesis is scarce. Qualitative evidence supporting this hypothesis was offered by Conley (2004). Conley and Glauber (2008), using data from the US Panel Study of Income Dynamics (PSID), find lower sibling similarity in years of education for families with a lower income and larger family size which they interpret in line with this hypothesis. However, they do not find statistical significant differences between families with a low and with a high level of parental education.

### *Factors which Influence Educational Inequalities Between Siblings*

There has been some interest in studying if and how family characteristics influence educational outcomes. More often the influence of single factors has been studied in isolation instead that it has been analyzed how certain factors contribute to overall within-family inequality in educational outcomes. As one such a single family characteristic, in particular family size has received a lot of attention in research on educational inequalities (Blake 1981, 1989; Downey 1995).

This paper concentrates on five factors which explain inequalities within families and which have been discussed in previous research: birth order, gender, birth spacing, maternal age, and parental separation. Family size is not included in this analysis because it does not vary within families and can, hence, not explain differences between siblings. Furthermore, more recent research suggests that family size has no causal effect on educational outcomes (Black, Devereux, and Salvanes 2005; Guo and VanWey 1999).

Birth order effects were analyzed in research for a long time. There are now several studies which demonstrate that birth order influences cognitive abilities as well as educational outcomes (Bjerkedal et al. 2007; Black, Devereux, and Salvanes 2005; Booth and Kee 2008; Härkönen 2013; Kristensen and Bjerkedal 2007). Black, Devereux, and Salvanes (2005) report that birth order effects dominate family size effects in Norway. Other studies find similar results for the US (Booth and Kee 2009). There is evidence from family fixed effects models that birth order has a significant impact on educational transitions in Germany (Härkönen 2013).

The second factor I look at is gender. Gender effects on educational outcomes have received a lot of attention in sociology of education. However, it might be that they are brought about within families and not in schools as research on sibship sex composition suggests (Butcher and Case 1994; Conley 2000; Hauser and Kuo 1998; Kaestner 1997).[1]

Similarly to the issue family size, the problem of including sibship sex composition as a factor to explain inequalities between siblings is that it does not vary within families. Hence it cannot explain differences in educational outcomes between siblings. However, I include gender in the analysis in order to see how gender effects vary between families of different social origin.

The third mechanism which I include is birth spacing. In two papers, Powell and Steelman (1990, 1993) argue that having closely spaced siblings is detrimental to educational outcomes. This evidence is based on cross-sectional evidence and it is to be seen whether it holds up in the family fixed effects setting.

As a fourth factor I include maternal age in the analysis. Kalmijn and Kraaykamp (2005) demonstrate substantial positive effects of maternal age on educational outcomes in the Netherlands, even using family fixed effects models. They find small positive effects of maternal age on years of education in the Netherlands. However, they do net test whether these effects vary with social origin.

Finally, I include parental separation into the analysis. Experience of parental separation often differ between siblings and for that reason family fixed effects models have been used in order to analyze the effects of parental separation on educational outcomes (Sandefur and Wells 1999; Ermisch and Francesoni 2001; Björklund and Sundström 2006; Francesconi, Jenkins, and Siedler 2010). It might be that these effects differ across social groups, although none of the studies which applied family fixed effect models to the study of parental separation tested this possibility.

## THE GERMAN EDUCATION SYSTEM

This paper analyzes educational outcomes in Germany. Although the German school system differs between its 16 states, some features are shared among the states. They all have

a tracked school system although the duration children spend in primary school before they are sent to different tracks in secondary schools as well as the number of tracks differ between states. However, in all states there is an upper track (*Gymnasium*) and successful completion of this upper track (*Abitur*) is a precondition for universal access to university. Some states have two lower tracks, others only one. Some states also have comprehensive schools. However, only a small percentage of a school cohort attends a comprehensive school.

Research has argued that this tracking which happens when the children are aged 10 to 12 is the main reason for high inequality of educational opportunity in Germany (Hilmert and Jacob 2010). Attendance of the upper track can be used as a proxy for final educational attainment as this is done in the following analysis.

## DATA AND METHODS

### *Methods*

In order to achieve the two aims of this paper I employ two techniques. Both methods are applied to a sample of siblings who were born between 1982 and 1995 which is derived from the German Socio-Economic Panel Study (GSOEP) and described in more detail in the next section.

First, I provide descriptive estimates of the role within-family inequality plays in bringing about educational inequalities. For this purpose I estimate maximum likelihood multilevel models and report the intra-class correlation coefficients of these models. This approach is comparable to the one taken by Conley and Glauber (2008) following the work of economists who look at sibling correlations in income (e.g. Solon et al. 1991; Mazumder 2008; Schnitzlein 2014). The analysis of multilevel models restricted to the upper and the lower class allows testing the compensatory class hypothesis (Conley and Glauber 2008).

In these models I only control for year of birth dummies. Hence, these multilevel models can be written as:

$$E_{i,j} = \mathbf{X}_{i,j}\, ß + \alpha_j + \delta_{i,j} \qquad (1)$$

with $E_{i,j}$ being the educational outcome of interest, $\mathbf{X}_{i,j}$ being a vector of the year of birth control variables and $\alpha_j$ being the family specific and $\delta_{i,j}$ being the individual specific component.

From these models I report and compare the intra-class correlation coefficients:

$$\rho = \sigma_\alpha^2 / (\sigma_\alpha^2 + \sigma_\delta^2) \qquad (2)$$

Second, I test the influence of certain individual-level mechanisms on differences between siblings. For this purpose I employ family fixed effects models. In addition, I report results including interaction effects with social origin in order to see whether the influence of the mediating factors (birth order, gender, maternal age, spacing of siblings, and parental separation) varies with family background.

School grades are estimated using OLS regression models with robust standard errors. The other two outcomes are coded as dichotomous variables and estimates are calculated using Linear Probability Models with robust standard errors. The use of Linear Probability Models allows an easy interpretation of regression coefficients, in particular of the interaction effects I am interested in, and the possibility to compare coefficients across models without them being biased through unobserved heterogeneity (Angrist and Pischke 2008, Mood 2010). In the models which I estimated there is virtually no out-of-sample prediction (between 0 and 0.3 percent) so this should not be a reason to turn to logit and probit models which are based on stronger assumptions and more difficult to interpret.

All models are estimated using the xtreg command in STATA 13.0.

### *Data and Sample Selection*

The analysis in this paper uses a sample of siblings derived from the German Socio-Economic Panel Study (GSOEP). The GSOEP is a long-running panel study which samples household units (Wagner, Frick, and Schupp 2007). The study started in 1984 with a sample of West Germans and includes a sample of East Germans since 1991. Since all household members are sampled and followed after they leave their initial household, a sample of siblings born in the same household can be constructed.

The sample is restricted to respondents who filled out a special questionnaire in the year they turned 17 which provides information on educational outcomes in the year preceding the survey, i.e. when the respondents were 16. The sample includes all respondents who have been born in GSOEP households between 1982 and 1995. Finally, those respondents without any sibling with valid information are dropped from the analysis.

I exclude children born outside Germany from the analysis. However, all children who were born in Germany were included in the analysis no matter where their parents were born. In one part of the analysis, I analyze sibling correlations separately by migration background. Someone is defined as having a migration background if both parents were born outside Germany.

Using both the sample on East and West Germany, I conduct the analysis for children from both parts of Germany together. They have experienced most of their childhood in reunified Germany and all school results were obtained after reunification. However, I report sibling correlations separately for East and West Germany in one part of the analysis. Similarly to the definition of migration background, someone is defined as being East German if he or both of his parents lived in the German Democratic Republic (GDR) before 1989.

### *Variables*

I measure four educational outcomes: school grades in Mathematics and German at age 16 which are the two main subjects in the German educational system, the probability of attending the highest track in secondary school which leads to *Abitur* (high school degree) and is called *Gymnasium* and the probability of having retaken a grade at any stage of the educational career up to age 16. As detailed in the section on the German education system, track attendance is arguably the most important predictor of final educational attainment.

In German schools grades ranges from 1 to 6. For better performances lower grades are given. I recode that variable so that a higher grade signifies a better performance. In that case, a positive effect of an intervening variable can be understood as an effect which increases educational performance. Since these grades are achieved in different school tracks I control for track attendance.

I include several variables in the family fixed effects models in order to test for influencing mechanisms. These variables include, as discussed in the theoretical section above, birth order, gender, birth spacing, maternal age, and parental separation. Birth order is a continuous variable which gives the rank within the siblings group. I also tested a dummy variable for being first born. The results do not change. I find the biggest effects of birth order between first and second born. However, overall the effects seem pretty close to being linear (Härkönen 2013).[2] Male is a dummy variable. Birth spacing is coded as a dummy variable which is one if the respondent has any sibling born one year before or after him. Maternal age is entered as a continuous variable into the models. Parental separation is a dummy variable which is coded one if someone has not lived with his two parents in the same household all the time before age 16.[3] I use the age threshold of 10 in the models which estimate track attendance since allocation to tracks is made after that age. As the only control in the fixed

effects models, I control for year of birth dummies in all models. Furthermore, in the models which estimate school grades and retaking of a grade as an outcome variable I control for track attendance using dummy variables for each track.

I measure social origin via three indicators, the first one being parental education. Parental education is measured by the highest level of education achieved by either parent. I employ a dummy variable which is coded one if one or both parents have received *Abitur* (high school degree) and zero otherwise. In robustness checks I have employed parental EGP class and parental ISEI as alternative measures of social origin (see analysis and the online appendix). High parental class is defined as a dummy variable if one of the parents belongs to one of the service classes or is self-employed. Parental ISEI is a continuous variable but in order to compare two groups I assign those who have a value on parental ISEI higher than the mean as being of a high parental ISEI origin and those with a lower value as being of a low parental ISEI origin.

[TABLE 1 ABOUT HERE]

Summary statistics on the final analysis sample are reported in Table 1. The overall sample size is 1,895 siblings from 891 families. Since there are only few missing values on the outcome variables and virtually no missing values on the independent variables, I do not impute missing values.[4] The sample size for the track attendance variable is lower since pupils attending comprehensive schools (*Gemeinschaftsschulen*) are dropped from the analysis of this outcome variable. The table also reports the decomposition of the variance of the variables into a between- and a within-family part. This demonstrates that, although most of the variation of the variables is between families, there is also considerable variation within families which should be sufficient to detect effects.

## RESULTS

### *The Importance of Between- and Within-Family Inequalities*

Table 2 reports intra-class correlation coefficients from multilevel regression models. The models are estimated separately for the four outcomes. Results are reported for the overall sample and then for samples restricted to subgroups of interest. The main aim of this exercise is to give a picture of how the relation between between- and within-family inequalities varies between social groups.

[TABLE 2 ABOUT HERE]

The overall results, reported in the first row of Table 2, suggest an important role of within-family inequalities. These results already underline the primary proposition of this paper, that there is considerable variation between siblings which has to be explained. Most variance is explained within rather than between families. This is demonstrated by low intra-class correlations. This conclusion particularly holds for measures of performance. The intra-class correlation for track attendance is higher. Hence, differences are stronger between than within families for track attendance. This means that educational attainment is more unequal distributed between families than educational performance.

With respect to the compensatory class hypothesis, the results do not reveal a clear pattern. Three indicators are used which can be interpreted as proxies for social origin: parental education, parental ISEI, and parental class. Whatever the variable used to define social origin, the coefficients and, hence, the relation between the variation within and between families is very similar across both social origin groups. Since there are no systematic higher sibling correlations for families with a higher SES, there is no support for

the hypothesis that children from lower class families show a higher variation in educational outcomes.

One further difference might arise between families with and without a migrant background. Comparing these two groups, sibling correlations are higher in non-migrant families. This finding can be interpreted as in line with the compensatory hypothesis with respect to migrants.

Finally, the last two rows compare the outcomes between families which lived before 1989 in the Federal Republic of Germany, called West German families, and families which originated from the German Democratic Republic, called East German families. There are no major differences in the role within compared to between family differences play by origin country. This suggests that processes of intergenerational transmission of education are similar across both countries.[5]

To sum up, this analysis has only demonstrated slight differences in sibling correlations between social groups. Sibling correlations seem to be higher in West German, non-migrant families with a higher parental ISEI, in particular, with respect to upper track attendance which is arguable the most important outcome in the German education system. These results are in line with the compensatory class hypothesis which was outlined in the theoretical considerations. However, sibling correlations are not higher among higher educated and higher class families. Hence, there does not seem to be one universal mechanism operating along one dividing line and results have to be interpreted in detail.

### *Explaining Differences between Siblings in Educational Outcomes*

Sibling correlations are informative. But if inequality between siblings is largely brought about by locating one social group at the upper end of an outcome and another group at the lower end, the sibling correlations within these groups can be similar but the meaning of

similar sibling correlations can be very different across social groups. For instance, the above results demonstrate that sibling correlations in upper track attendance are of similar order for higher and lower SES families. However, this similarity takes place at different levels. Most of the children with parents with a high level of education attend the upper track in high school (*Gymnasium*) whilst most of the children from families with low parental education attend one of the lower tracks. The meaning of the sibling correlations is totally different between lower and higher SES families.

The question which arises is whether the role of factors which influence educational outcomes varies between higher and lower SES families. It might be that upper class children attend the upper track in any case but lower class children need favorable circumstances to do so. In that case, the influence of factors which influences success within families should be stronger among lower class children.

In order to test this revised compensatory class hypothesis, I run family fixed effects models which include interaction effects between all influencing factors and social origin. In the paper, I present results using parental education as an indicator of social origin. In the online appendix, I report results using parental class to define social origin. The estimates do only differ slightly between the different measures of social origin and the results lead to the same conclusions.

Table 3 and 4 report these family fixed effects regression results on the four educational outcomes which I distinguish. Table 3 starts with the effects on educational performance measured by school grades. One intriguing finding is the difference in influence of the factors and the interactions with social origin on educational performance and on the educational outcomes reported in Table 4.[6]

[TABLE 3 ABOUT HERE]

The baseline models, which do not include the interaction effects with social origin, reveal a negative effect of birth order, being male, birth spacing, and parental separation during childhood on educational performance. These results are expected and in line with previous research demonstrating the effects of these factors on educational outcomes. However, I cannot find any clear effects of maternal age on educational outcomes. The effects of maternal age on school grades go in opposite directions for German and Mathematics.[7] In conclusion, birth order, gender, birth spacing, and parental separation all contribute to inequality between siblings and explain partially why siblings differ in educational outcomes.

Separating the sample by social origin suggests that the penalties which are associated with being male, being of a higher birth order, and having experienced parental separation do not differ substantially between social classes when it comes to grades. If at all, it is higher class children who are more affected by these factors, in particular in performance in Mathematics. Having a close spaced sibling, however, has mainly detrimental effects on educational outcomes for children from families with a high level of parental education. This finding holds for both outcome variables. The effects of maternal age within families with a high level of parental age are inconclusive since the German grades model predicts positive maternal age effects and the Mathematics grades model predicts negative effects of a higher maternal age on performance.

To sum up, the influences the five analyzed mechanisms have on educational performance are similar for families with different family backgrounds and rather slightly stronger for higher SES families.

Grades in school are, however, not as important as a predictor of final educational attainment as track attendance. Table 4 analyzes with track attendance and retaking of a grade arguably the more important educational outcomes. In particular, track attendance has the most important influence on future educational success.

[TABLE 4 ABOUT HERE]

The analysis of track attendance reveals that the interaction effects return their sign. Hence, the performance differences in the effects between social groups are not translated in differences in track attendance between those groups in the same way. Rather the opposite seems to be the case. With respect to track attendance, the impact of having a closed spaced sibling and parental separation are stronger among lower class children. This suggests that even though the same mechanisms operate, the consequences which they have for final educational attainment vary with family background. It is in that way in which this paper provides support to the compensatory class hypothesis.

However, again, this finding is not universal since with respect to the other two mechanisms (birth order and gender), no evidence is found that the effects of these variables vary with family background. With respect to birth order, this finding is in line with previous research on birth order effects in Germany (Härkönen 2013). The analysis of retaking a grade does neither reveal any differences between social groups in the effects of influencing mechanisms.

## ROBUSTNESS CHECKS

As a robustness check, I have estimated all models using social class as an indicator of social origin. These results are reported in the online appendix. Generally, the results with respect to differences between families of different social origin do not change compared to the models which proxy social origin via parental education. This holds true for the negative effects of having a close spaced sibling on performance being concentrated among the higher SES children as well as for the finding that the negative effects of having a closed spaced

sibling and parental separation are concentrated among the lower class children. Hence, the results are robust to different specifications of social origin.

A concern may also been that my results are influenced by including children from East Germany. This would be the case if sibling effects differ between West German and East German families. I have tested this possibility by re-estimating all models without East Germans. This does, however, not change the direction of any of the estimates although the sizes of the effects are generally bigger in this reduced. I conclude that sibling effects are similar across these two groups, maybe slightly more pronounced among West Germans. Results are reported in the online appendix as well.

## DISCUSSION

This paper has both provided descriptive figures of the importance of between- and within-family inequality across social groups and analyzed which factors bring about differences between siblings in educational outcomes. There is a substantial part of inequality which exists between siblings. The analysis revealed that the amount of similarity between siblings can vary between social groups. However, it is not varying in a systematic way as predicted by the compensatory class hypothesis making sibling similarity generally higher among higher SES than among lower SES families.

However, what differs between different social groups is the long-term impact of some of the influencing mechanisms. The effects of these factors also vary depending on whether educational performance or educational attainment is the outcome. The effects of the five analyzed mechanisms on school grades are equally strong between social classes or stronger among children from higher SES families. To the contrary, the effects of having a close spaced sibling and parental separation on track attendance are concentrated among lower class families.

Arguably it is track attendance which has the biggest impact on final educational attainment (Hilmert and Jacob 2010). It then seems that the effect of influencing factors in strongly conditioned by social origin. This finding can be brought in line with a modified version of the compensatory class hypothesis. According to this version of the compensatory class hypothesis, the influence of negative life events on educational outcomes is substantially weaker among higher SES families.

There is some support on this hypothesis by other research which analyses the effects of early health conditions (Almond, Edlund, and Palme 2009), birth weight (Torche and Echevarria 2010), and school entry age (Bernardi 2014) on educational outcomes. The results of this paper go into the same direction although several mechanisms are possible which bring about the observed interaction Between social origin and influencing factors on educational outcomes. Besides a compensatory behavior among upper class families, these results can also be brought about through a reinforcing behavior among lower class families.[8]

The results presented here have significance for research on educational inequalities in general. They have shown that what happens within families has to be taken into account for the explanation of social mobility processes and educational attainment. Similarities between siblings are lower than theories of social stratification would predict. The integration of differences within families in theories of educational and social mobility is still an open challenge. It is not an easy but a necessary one in particular because between- and within-family effects do not simply add up in an additional manner.

This conclusion also implies that sibling correlations have to be interpreted with caution. They do not take into account differences in the way within-family inequalities are brought about between social groups. If, as I have shown, the effects of factors which influence educational attainment within families vary between social groups, sibling correlations report biased estimates of the effects of family background on outcomes.

In general, the findings of this study underscore the need for future research on siblings. The increasing availability of data sources with information on siblings will make this also a feasible enterprise. What we can hope for using this data is a more complete picture of how educational inequalities are brought about.

NOTES

1. All of these studies rely on data covering rather old cohorts. To my knowledge, there is no study which analyzes how the effects of sibship sex composition have changed with the increasing female advantage in educational outcomes. However, it is difficult to test these arguments in a family fixed effects approach because of insufficient variation of sibship sex composition within families.

2. There is a small number of children who experienced death of a parent during childhood. These children were dropped from the analyzed sample.

3. One difference between this study and the birth order study by Härkönen (2013) is that I use data on a far more recent cohort. The youngest cohort in his analysis was born in 1964, the oldest children in this paper were born in 1982. For instance, gender effects have completely reversed between those cohorts and the effects of other variables could have changed as well.

4. The only variable where there is a worrisome large number of missing values is parental ISEI. However, this variable is not used in the second part of the analysis.

5. A thorough analysis of this hypothesis cannot be provided in this paper. Although there is some literature on social mobility in East Germany, comparative literature on social mobility in East and West Germany is nearly missing.

6. One concern with adding all interactions between parental education and the mechanisms in one model may be that this introduces collinearity between the interaction terms into the models. For that reason I estimated models in which I add only one interaction term per model. These results are reported in the online appendix. The results show no difference between the estimates whilst the standard errors are smaller in the models which include only a single interaction term each.

7. There are certainly several explanations, which I am not able to test, possible why the results I find for maternal age differ from those reported by Kalmijn and Kraaykamp (2005). I do not think that there are cross-national differences at work. However, future research might want to test a hypothesis that the effects of maternal age on education vary over time. I, then, might not find any effects since my analysis is based on a very recent cohort.

8. With respect to birth weight, Hsin (2012) and Restrepo (2012) both show that SES influences parental responses to birth weight differences. However, since they do not include educational outcomes into analysis, both studies cannot show that these diverging parental investment behaviors explain observed differences by SES in education.

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**TABLES**

**Table 1.** Descriptive statistics

| Variable | Mean | Std. Dev. | Std. Dev. Between Families | Std. Dev. Within Families | Min. | Max. | N |
|---|---|---|---|---|---|---|---|
| Age in 2012 | 23.28 | 3.36 | 2.78 | 1.97 | 17 | 29 | 1895 |
| German grade | 4.09 | 0.84 | 0.65 | 0.56 | 1 | 6 | 1869 |
| Mathematics grade | 4.05 | 1.03 | 0.80 | 0.66 | 1 | 6 | 1866 |
| Retaken a grade | 0.22 | 0.41 | 0.32 | 0.27 | 0 | 1 | 1891 |
| Upper track attendance (*Gymnasium*) | 0.41 | 0.49 | 0.44 | 0.24 | 0 | 1 | 1727 |
| High parental education | 0.36 | 0.48 | 0.48 | - | 0 | 1 | 1895 |
| High parental class | 0.48 | 0.50 | 0.50 | - | 0 | 1 | 1856 |
| Parental ISEI | 50.18 | 17.71 | 17.71 | - | 16 | 90 | 1791 |
| Migration background | 0.18 | 0.39 | 0.39 | - | 0 | 1 | 1895 |
| East Germany (GDR origin) | 0.24 | 0.43 | 0.43 | - | 0 | 1 | 1879 |
| Birth order | 1.91 | 0.99 | 0.73 | 0.64 | 1 | 10 | 1895 |
| Male | 0.50 | 0.50 | 0.35 | 0.36 | 0 | 1 | 1895 |
| Closed space sibling | 0.21 | 0.41 | 0.37 | 0.17 | 0 | 1 | 1895 |
| Maternal age at birth | 33.61 | 4.68 | 4.71 | 0.39 | 18 | 52 | 1895 |
| Parental separation before age 11 | 0.15 | 0.36 | 0.33 | 0.15 | 0 | 1 | 1892 |
| Parental separation before age 16 | 0.20 | 0.40 | 0.37 | 0.15 | 0 | 1 | 1892 |

Source: German Socio-Economic Panel Study (GSOEP), v29.

**Table 2.** Sibling correlations in educational outcomes

| | German grade | Mathematics grade | Retaken a grade | Upper track attendance |
|---|---|---|---|---|
| Overall sample | 0.16 | 0.23 | 0.24 | 0.53 |
| (N= 1869) | (0.03) | (0.03) | (0.03) | (0.03) |
| High parental education | 0.15 | 0.29 | 0.25 | 0.40 |
| (N = 674) | (0.05) | (0.05) | (0.06) | (0.05) |
| Low parental education | 0.15 | 0.18 | 0.21 | 0.43 |
| (N = 1195) | (0.04) | (0.04) | (0.04) | (0.04) |
| High parental ISEI | 0.15 | 0.25 | 0.28 | 0.48 |
| (N= 996) | (0.04) | (0.04) | (0.04) | (0.05) |
| Low parental ISEI | 0.13 | 0.19 | 0.17 | 0.41 |
| (N = 873) | (0.05) | (0.04) | (0.04) | (0.04) |
| High parental class | 0.12 | 0.24 | 0.24 | 0.41 |
| (N = 880) | (0.05) | (0.04) | (0.04) | (0.04) |
| Low parental class | 0.18 | 0.21 | 0.18 | 0.47 |
| (N = 952) | (0.04) | (0.04) | (0.04) | (0.04) |
| No migrant background | 0.15 | 0.21 | 0.23 | 0.54 |
| (N = 1527) | (0.03) | (0.03) | (0.03) | (0.03) |
| Migrant background | 0.12 | 0.28 | 0.21 | 0.40 |
| (N = 342) | (0.08) | (0.07) | (0.07) | (0.07) |
| West Germany | 0.13 | 0.22 | 0.23 | 0.54 |
| (N= 1403) | (0.04) | (0.03) | (0.03) | (0.03) |
| East Germany | 0.18 | 0.24 | 0.22 | 0.45 |
| (N= 451) | (0.05) | (0.06) | (0.06) | (0.06) |

Source: German Socio-Economic Panel Study (GSOEP), v29.

Note: Tables report intra-class correlation coefficients of multilevel models estimated with maximum likelihood. Robust standard errors in parentheses.

**Table 3.** Family fixed effects models of school grades

| | German grade | | Mathematics grade | |
|---|---|---|---|---|
| | M1 | M2 | M1 | M2 |
| Birth order | -0.05 | -0.06 | -0.16* | -0.16† |
| | (0.05) | (0.06) | (0.07) | (0.08) |
| High parental education X Birth | | 0.03 | | -0.02 |
| order | | (0.06) | | (0.07) |
| Male | -0.42** | -0.48** | 0.05 | 0.04 |
| | (0.05) | (0.06) | (0.06) | (0.07) |
| High parental education X Male | | 0.16 | | 0.05 |
| | | (0.10) | | (0.12) |
| Maternal age | 0.01 | -0.00 | -0.03 | -0.00 |
| | (0.02) | (0.02) | (0.04) | (0.02) |
| High parental education X Maternal | | 0.12* | | -0.31** |
| age | | (0.05) | | (0.09) |
| Close spaced sibling | -0.19† | -0.02 | 0.06 | 0.12 |
| | (0.10) | (0.13) | (0.14) | (0.18) |
| High parental education X | | -0.40* | | -0.18 |
| Close spaced sibling | | (0.20) | | (0.28) |
| Parental separation | -0.00 | -0.07 | -0.05 | -0.05 |
| | (0.10) | (0.14) | (0.14) | (0.17) |
| High parental education X Parental | | 0.24 | | -0.01 |
| separation | | (0.21) | | (0.29) |
| Controls for year of birth | Yes | Yes | Yes | Yes |
| Controls for track attendance | Yes | Yes | Yes | Yes |
| Constant | | | | |
| N | 1820 | 1820 | 1817 | 1817 |

Source: German Socio-Economic Panel Study (GSOEP), v29.

Note: All models are family fixed effects OLS regression models. Robust standard errors in parentheses.

†: p ‹ .10; *: p ‹ .05; **: p ‹ .01

**Table 4.** Family fixed effects models of educational outcomes

| | Retaken a grade | | Upper track attendance[1] | |
|---|---|---|---|---|
| | M1 | M2 | M1 | M2 |
| Birth order | -0.00 | -0.01 | -0.07* | -0.06* |
| | (0.03) | (0.03) | (0.03) | (0.03) |
| High parental education X Birth | | 0.01 | | -0.02 |
| order | | (0.03) | | (0.03) |
| Male | 0.11** | 0.10** | -0.06** | -0.06* |
| | (0.02) | (0.03) | (0.02) | (0.03) |
| High parental education X Male | | 0.01 | | -0.01 |
| | | (0.05) | | (0.05) |
| Maternal age | 0.01 | 0.01 | -0.00 | -0.00 |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| High parental education X Maternal | | 0.01 | | -0.02 |
| age | | (0.05) | | (0.04) |
| Close spaced sibling | -0.07 | -0.10 | -0.01 | -0.08 |
| | (0.05) | (0.07) | (0.05) | (0.07) |
| High parental education X | | 0.06 | | 0.15 |
| Close spaced sibling | | (0.10) | | (0.12) |
| Parental separation | 0.07 | 0.07 | -0.07 | -0.11† |
| | (0.06) | (0.07) | (0.05) | (0.06) |
| High parental education X Parental | | -0.03 | | 0.10 |
| separation | | (0.13) | | (0.13) |
| Controls for year of birth | Yes | Yes | Yes | Yes |
| Controls for track attendance | Yes | Yes | No | No |
| N | 1841 | 1841 | 1725 | 1725 |

Source: German Socio-Economic Panel Study (GSOEP), v29.

Note: All models are family fixed effects Linear Probability Models. Robust standard errors in parentheses.

[1] The reason for the lower N in the models on track attendance is that children who attend schools which combine all tracks in one school (*Gemeinschaftsschulen*) were dropped from the sample.

†: p ‹ .10; *: p ‹ .05; **: p ‹ .01