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Tying the Extended Family Knot – Grandparents’ Influence on Educational Achievement

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Abstract

In present-day western societies grandparents and grandchildren have longer years of shared lifetime than ever before. We investigate whether children with more grandparent resources have a higher probability of achieving the general secondary degree compared with children with fewer resources, or whether shared life time with grandparents increases the probability of achieving the general secondary degree. We use high-quality Finnish Census Panel data and apply sibling random and fixed effects models that also control for all unobserved factors shared by siblings. Grandparents' education and socioeconomic status have only a limited ability to explain a grandchild's educational achievement. However, the sibling fixed effects model reveals that every shared year between grandparents and grandchildren increases a grandchild's likelihood of completing general secondary education by one percentage point, on average. The effect of shared life time was conditional on grandparental type, family resources and the size of the extended family. Maternal grandmothers have a positive effect on grandchildren's education in low-income families. Paternal grandmothers provide a link to the resources available through the extended family network, independent of their own resources. The same effects were not observed for grandfathers.

Keywords: Grandparental effects, shared lifetime, sibling fixed effects, educational achievement, register data

Introduction

One of the key questions in the social stratification literature has been to what extent and why do parental socioeconomic characteristics (i.e., educational attainment, occupational status or income) correlate with those of their children (e.g., Becker and Tomes 1986; Bourdieu 1977; Ganzeboom et al., 1991; Hout and DiPrete 2006). However, recently this two generational scope has broadened and a number of scholars have begun to investigating the potential multigenerational aspects of social stratification, particularly regarding whether the socioeconomic position of the grandparents is associated with the position of a grandchild (e.g., Chan and Boliver 2013; Erola and Moisio 2007; Warren and Hauser 1997; Hällsten 2014; Ziefle 2016).

Multigenerational stratification studies have investigated whether grandparental social class (e.g., Beck, 1983; Erola and Moisio, 2007; Chan and Boliver, 2013; Hertel and Groh-Samberg, 2014), earnings and income (e.g., Loury, 2006; Warren and Hauser, 1997; Lindahl et al., 2015; Zeng and Xie, 2014) or cultural capital (Møllegaard and Jæger, 2015; Ziefle 2016) have a direct effect on grandchildren's outcomes. However, these previous studies have shown mixed results. Although some have found that grandparental status correlates with grandchild's status, net of parental status (e.g., Chan and Boliver 2013; Modin et al., 2012), others have found that the effect is either very small or negligible (e.g., Bol & Kalmijn 2016; Erola and Moisio 2007; Jaeger 2012; Warren and Hauser 1997; Ziefle 2016). These mixed results indicate that despite of their obvious strengths, previous multigenerational stratification studies also have their limitations.

We argue that one of the limitations of the literature and a potential reason for the mixed results may simply be the inability to differentiate the three types of mechanisms involved. First, grandparents can directly transfer resources across generations, which is also called a *legacy* effect (Mare 2011). Second, grandparents' resources may provide *stability* for the nuclear family (Bengtson 2001), and third, grandmothers may show stronger investments in grandchildren, behaving as *kin keepers* (Astone et al. 1999; Coall and Hertwig 2010). To our knowledge, there is only one previous study (Knigge 2016, using historical Dutch data) that has tried to disentangle the two first mechanisms from each other, and no study that has attempted to disentangle all three mechanisms, particularly by using data from present-day societies.

However, in addition to studying the importance of the three previously suggested mechanisms together, we also consider a previously unexplored mechanism. We argue that the grandparents do not necessarily need to provide anything directly to the grandchildren themselves, but may simply provide a tie between them and other extended family members that would not exist otherwise. This tie enables resource transfers from the extended family network to the grandchildren. If this is the case, simply the shared lifetime between grandparents and grandchildren should have a positive correlation with grandchildren's socioeconomic attainment. This *exposure mechanism* can be considered particularly important when grandparents themselves cannot provide resources.

In this study, we compare the importance of these explanations of grandparent effects in Finland. To do this, it is necessary to have efficient ways to exclude the potential influence of the Markovian processes, that is, the intergenerational influences transmitted through the parental generation in between rather than directly from grandparents to grandchildren. We investigate the association between different grandparents' resources, shared lifetime with grandchildren and educational achievements with sibling random and fixed effect models, using high-quality Finnish register data.

Theoretical background

Legacy and stability effects

Because of the increase in longevity in contemporary western countries, grandparents may be more influential in grandchildren's attainment than ever before (Bengtson, 2001). Population aging means also that the total number of older adults and thus potential grandparents are increasing. Due to the decreased fertility rates, grandparents have fewer grandchildren, which means that they may be able to invest more in each grandchild. Grandparents today also tend to be healthier and wealthier than previously and thus able to provide more support to their offspring (Coall and Hertwig, 2010). Based on demographic changes in fertility and mortality, current grandparents have a great opportunity to influence their grandchildren, with whom they are likely to have a great amount of shared lifetime.

Mare (2011) has argued that because of increasing longevity and fewer descendants, grandparental resources that can be directly transferred from grandparents to grandchildren, also called *legacy effects*, should matter more than before. The evidence for this type of grandparental influence seems to be fairly consistent. An extensive review by Bol and Kalmijn (2016) indicates that if any grandparent effect was found in the previous multigenerational stratification studies, they were mainly limited to grandfathers who likely to had a higher social status and higher income than grandmothers. In Finland, while Erola and Moisio (2007) found the overall grandparent effect rather small, they did find statistically significant grandparent-grandchildren associations among the service class and among farmers, which are both potential indicators for the inheritance of family land or wealth.

Additionally, the influence grandparents have on educational outcomes among grandchildren may be related to the educational level attained by the grandparents themselves (Loury, 2006; McNeal 2001). Compared to grandparents without academic qualifications, those with academic credits more probably have socioeconomic and cultural capital that they can transmit to their offspring (Mare, 2011; Møllegaard and Jæger, 2015). Further, high-status grandparents who are well connected and have wide social networks can use their social capital for their grandchildren's advantage or may simply act as positive role models for the grandchildren (Hällsten, 2014). Therefore, the first hypothesis states the following: *Socioeconomic resources of the grandparents are positively associated with grandchildren's educational attainment, regardless of the parents' education (H1, legacy hypothesis).*

Bengtson (2001) has underlined the potential *compensatory* role of grandparents for replacing the missing relationship stability and material resources of the immediate family, resulting mainly from high divorce rates. Our second hypothesis follows Bengtson's reasoning and states: *The socioeconomic resources of grandparents are positively associated with grandchildren's educational attainment when parental resources are low or parents have separated (H2, stabilizer hypothesis).*

Research has shown that grandparents are highly involved in their grandchildren's lives still in the modern western societies (e.g., Hank and Buber, 2009; Igel and Szydlik, 2011). Moreover, there is consistent evidence showing that the involvement of grandparents correlates with several outcomes for children, such as increased academic achievements

(Falbo 1991), better cognitive development (Sear and Coall 2011; Tanskanen and Danielsbacka 2016) and improved psychological well-being (Lussier et al. 2002; Tanskanen and Danielsbacka 2012; Tanskanen et al. 2016).

However, all grandparent types may not have equally beneficial impacts on grandchildren. Because of psychological, biological and socio-cultural factors, women typically interact with kin more than men do (e.g., Bracke et al., 2008; Dubas, 2001). These gender-based grandparental differences are explained by women's role as "kin keepers" among family network. Indeed previous studies have consistently shown that grandmothers tend to invest more than grandfathers and that maternal grandparents tend to invest more than paternal grandparents (e.g., Danielsbacka et al., 2011; Pollet, Nettle and Nelissen 2006, 2007) and investments of grandmothers, and maternal grandmothers in particular, tends to increase grandchild well-being more than that of grandfathers (Sear and Coall, 2011; Sear and Mace, 2008). Further, in line with compensatory mechanism children in families with low resources may benefit more from maternal grandmother than children growing up in high-status families because the children of the latter group simply do not need any benefits from outside of their own immediate family (Sear and Coall, 2011).

These gender differences mean that if the grandmothers, and particularly maternal grandmothers, are most inclined to invest in grandchildren then *maternal grandmothers should benefit grandchildren's educational achievement (H3, kin keeper hypothesis).*

Exposure effect

On could expect that in order to grandparents to play a role in grandchildren's life, they should be in contact. However, the evidence regarding the type of contact required in resource transfer between grandparents and grandchildren is not consistent. Zeng and Xie (2014) did find that in rural China grandparents had a positive effect on children's academic attainments only when grandparents, parents and grandchildren lived together in the same household. On the other hand, according to previous studies in the US and the Netherlands, physical proximity does not seem to matter (Jaeger 2012; Bol and Kalmijn 2016). Knigge (2016) used the presence of a grandparental generation (great-grandfathers vs. grandfathers) as a proxy for contact explaining grandchildren's status attainment in Netherlands 1812–1922. The life expectancy was so low in the Netherlands that the great-grandfather rarely had any overlapping years alive with the great-grandchildren. Despite this, both the great-grandparents appeared to have a direct influence on the great-grandchildren's status. Therefore, perhaps a more realistic assumption is that if the grandparents are still alive when the grandchildren are born, some contact tends to exist.

However, it might also be that the previous studies have assumed too much. It may be that the grandparents themselves do not provide any resources but are still a necessary part of intergenerational attainment. The previous studies have underlined the importance of other extended family members, such as aunts and uncles, for intergenerational attainment. The extended family network provides a pool of resources that may become especially valuable at times when the parents lack such resources (Coleman 1991; Lehti and Erola 2017; Milardo 2009). It may even be that often the observed but weak grandparent effect is in fact the unobservable effects of other extended family members.

This pool of resources does not, however, exist by chance. The necessary link between extended family members may be the grandparents. If this is the case, the positive grandparent effect would not depend at all on the resources the grandparents may have but simply on how long they remain to maintain the extended family network. Thus, simply the length of the overlapping lives of grandparents and grandchildren would have a positive effect on grandchildren's adult outcomes. This could also explain why proximity does not seem to matter for grandparent effects. The extended family network exists because of the existence of the grandparents, not because of their whereabouts.

If a grandparent is a link between the extended family members, the exposure effect can become stronger as the extended family network grows. This is because having more extended family relationships should increase the probability that at least some of the extended family members would influence the children's educational attainment. Thus, based on the grandparental exposure effect, we hypothesize that *the more overlapping years grandparents have with their grandchildren, the stronger their influence on the educational attainment of the grandchildren is (H4, exposure hypothesis).*

If the effects of the previous generations vary by kin, as assumed in Hypothesis 3, it might be that also this effect varies by the lineage. If women are indeed the important kin keepers, the grandparent's function as a tie between the immediate and extended families may not be needed, if mothers tend to keep in contact with their own relatives in any case.

Research design

Method

One of the biggest problems for identifying the "true" effect of grandparents on grandchildren are the confounding Markovian processes that often remain unobserved. These processes refer to the influences of the grandparents that are transmitted through the generation between grandparents and grandchildren. Usually, the problem is approached by using random effects models and controlling for some of the observed socioeconomic characteristics of the parents. However, some important Markovian processes would still be omitted, such as, for instance, the effects of aunts and uncles in the case of the Wisconsin study by Jaeger (2012).

To test our hypotheses, we apply two different types of multilevel linear probability regression models. We study the importance of *legacy effects* by fitting random effect models to the data clustered according to siblings. To exclude the influence of the Markovian processes, we follow the common procedure of the earlier literature, where observed family level variables are controlled for (see e.g., Chan and Boliver 2013; Erola and Moisio 2007; Hällsten 2014; Ziefle 2016). In random effects models, at the family level, we control for mother's and father's education, immediate family income (logged), socioeconomic status (using ISEI-scale) and the mean education among the aunts and uncles as well as parental divorce. The full random intercept models are estimated with the following model:

$$y_{ijk} = \beta_{0j} + \beta shared_{ij} + \beta gpEDU_{ij} + \beta gpSES_{ij} + \gamma Z_{ij} + \varepsilon_{ij} \qquad (1)$$

Intercept β_{0j} gives grand mean γ_{00} and random variation u_j between sibling clusters ($\beta_{0j} = \gamma_{00} + u_j$). $\beta shared_{ij}$ denotes the shared life between grandparents and grandchildren within family clusters. $\beta pEDU_{ij}$ refers to the grandparent educational dummy variable. $\beta ISEI_{ij}$ is grandparents' socioeconomic status measured by ISEI-scale. γZ_{ij} refers to the vector of specific control variables at the family and individual levels.

u_j refers to unobserved family-level heterogeneity, which does not vary between biological siblings, and ε_{ij} refers to the individual-level variance within families.

To test the *stabilizer hypothesis,* we also include interaction terms between parental resources/divorce and grandparental resources (ISEI and education) to random intercept models.

In the case of the *exposure effects*, we apply sibling fixed effects models that control for any observed or unobserved factors shared by siblings. This strategy removes the problem of unobserved heterogeneity at the family level. Because of this, it can also be argued that the fixed effects analyses provide more causal estimates than random intercept models. The family-constant endowments that are being controlled for include, for instance, the level of education, the cultural capital and even some genetic factors that siblings share. Further, these models control for any remaining Markovian processes, even physical proximity between grandparents and grandchildren, because siblings share the same household and thereby also have the same proximity to grandparents.

The problem of sibling fixed effect models is that only the effects of the factors that vary between siblings can be estimated. Thus, we cannot make conclusions about the importance of grandparents' (and also parental) resources that do not vary between siblings, except through the interaction effects between the factors that do vary, such as grandparental exposure. Further, families with one child do not contribute to the effects that can be estimated through the differences between siblings in the same families and are thereby omitted from the analyses.

Even though sibling fixed effect models control for all the unobserved factors shared by siblings, the factors that vary may still bias the results and need to be taken into account explicitly. For instance, women's educational attainment has increased over time and surpasses that of men in our data. Unless controlled for, the exposure effect would be confounded with gender. Similarly, because of the educational expansion of recent decades, later born children have a higher probability of achieving higher educational levels compared to those born earlier. This would also be correlated with the exposure effect. We control for the potential contemporary trend in education by adding the child's birth year as a covariate.

Similarly, we control for the birth order in the immediate family. Previous studies have shown that birth order among siblings may make a difference in the sense that first-born children achieve higher success than later-born children (e.g., Conley and Glauber, 2006; Härkönen 2014; Sigle-Rushton et al. 2014). Maternal age can also be a confounding factor, as older mothers tend to have more resources (Barclay and Myrskylä 2016), which is why we also control for maternal age at birth.

The full sibling fixed effect models are estimated with the following equation:

$$y_{ij} = a + \beta shared_{ij} + \gamma Z_{ij} + a_j + e_{ij} \qquad (2)$$

Register Data

For our analyses, we use the register-based *Finnish Growth Environment Panel* (*FinGEP*) obtained from Statistics Finland. The dataset is based on a 10 % representative random sample of the entire population residing in Finland for at least one year in 1980. The data are entirely based on administrative registers. They include individual-level records from censuses and administrative sources such as tax, employment and education registers, providing information on the socioeconomic, educational and demographic characteristics of each individual included in the data. The dataset runs from 1980 to 2010, containing information from the years 1980, 1985 and annually from 1987 onwards. The sample persons in the dataset are linked with their children, partners and partner's parents. All persons are followed until 2010 or when they dropped out of the data either because of death or moving abroad. Unlike usual survey data, the register data do not suffer from misreporting, memory errors or non-response.

To identify the extended family networks, we linked all biological parents (second generation) with their children born 1972–1990 (third generation) and then further to the grandparents (first generation). This makes a three-generation dataset that includes the ancestors of the first generation and family members from the second generations. In order to be included at least two generations of the three need to have sample persons. Because *FinGEP* is based on a sample of second generation parents, in most cases, we were able to match grandchildren only from either the maternal or paternal side. The side of the grandparent is taken into account in all models, either as an indicator variable or as separate models for each grandparental lineage. For the children included to the analyses the data cover all their maternal or paternal cousins, aunts and uncles and grandparents.

The final *total sample* consists of 71 551 children and 48 337 families. For those cases where grandparents from both sides were included in this sample (6 % of the children), we randomly selected the side of the grandparent included in our data. After omitting missing values (1.3 % of the cases) and siblings who do not share the same household with at least one of the parents (~0.7 % of the cases), the sample included information from 70 639 children, clustered in 47 738 families. This total sample is used in the random effect models.

The sample that is used for the sibling fixed effect models (*the fixed effects sample*) is further restricted to those having at least two siblings in the data. Further, because only the siblings that vary in their exposure to grandparents are informative in these models (shared lifetime with their grandparent), the dataset is restricted to the clusters where at least one of the siblings experienced the grandparents' death before entering general secondary school by age 16 (see Sigle-Rushton et al. 2014; Frisell et al. 2012). These restrictions leave 5117 children from 2059 families (see figure 1). Children are excluded from both the random and the fixed effect analyses (~0.7 % of the cases).

Finally, for the models comparing the exposure effects of different grandparents in the sibling fixed effect models, we use the data on 6 percent of the children that cover grandparents from both the maternal and paternal sides. This subsample (*the full information FE sample*) includes 3053 grandchildren from 1237 families.

Dependent and independent variables

Our outcome variable indicates whether a grandchild has acquired a general secondary education (*lukio*) degree by age 20. In our total sample 48 percent of the children have completed general secondary education (see table 1). In Finland, children typically enroll in general secondary school or vocational secondary school at age 16 after compulsory school which begins when children at the age of 7. Approximately 90 percent graduate within three or four years later when they are 19. Completing general secondary school (*lukio*) provides children with access to university level education (academic track), making it an important indicator for social stratification that takes place later in life. Education in Finland is free of charge at all levels.

In the random effects models, the main explanatory variables include grandparents' highest level of education, socioeconomic status and the shared lifetime between grandparents and their grandchildren.

Grandparent's education level is categorized into two groups[1] (dummy 0= compulsory or less, 1= secondary or higher). In our sample, the educational level of the grandparents is low: 76 % of the grandfathers and 80 % of the grandmothers had compulsory level education at the maximum. Educational homogamy among the grandparents is commonplace: 71 % of the grandparents from the same family share the same education level (see appendix figure 1).

We measure grandparental and parental socioeconomic status with the International Socio-Economic Index of occupational status (ISEI scores). ISEI scores form a scale of occupations (ranging 16 to 90), which is constructed by regressing occupations with their income and education, thus making them closely related to both (Ganzeboom et al., 1992). Because the ISEI scale is based on occupational data, it is less sensitive to short-term variation than income is but includes more long-term variation during the different phases of life than education does.

We use the latest value of grandparental education and the ISEI score observed during the period when children were 0–15 years old (before they chose the secondary education track). If the grandparent died before the child was born, we selected the value closest to the child's birth year. Quite a few grandparents had retired before the year 1980 (the first year of the dataset). Because of this, the occupational status is missing from every fifth grandparent (19.7 %). We imputed these values using grandparent's income, education and age at the grandchild's birth by using multiple imputations. Appendix figure 2

[1] Only two categories are distinguished in the analyses because we did not find any differences between secondary and tertiary educated grandparents. Further, only 11 % of the grandparents in the selected cohorts were tertiary educated.

compares the distribution of the imputed values to the observed values. The distributions are very similar, suggesting that the imputations can be considered completely accurate.

We use grandparents' education and socioeconomic status as proxies for the legacy effects; because of the high age of the grandparents and the gaps in the data, properly comparable income or wealth information was not available.

The shared lifetime between grandchildren and grandparents that is used as an indicator for the exposure to a grandparent is measured until the grandchildren reach the age of 16, which is again because the choice of secondary education track is completed by that age. In the cases where grandparents died before the grandchildren were born, the shared lifetime is coded as 0 years even if the death occurred several years before birth. It follows that the shared lifetime ranges from 0 to 16 years (RE sample: M = 15.45, SD = 2.19; FE sample: M = 11.83, SD = 4.42). Because children can have two grandparents on each side (or four in a subsample), we analyze the grandparent who dies latest and shared the longest lifetime with the grandchildren. In the smallest subsample, with all four grandparents, we nonetheless needed to model only the effects of the grandparent who died latest from both the maternal or paternal side, as the dataset was too small to provide consistent estimates if all four were included in the model at the same time.

Control variables

In the random effect models, we control for the following variables at the family level: highest parental education categorized into three groups (1. compulsory, 2. secondary, 3. tertiary, and dummies for each), mean household taxable income[2] when children were 10–15 years old (adjusted annually according to the value of the euro in 2014, log-transformed and z-standardized), parental ISEI score when children were 10–15 years old, parental dissolution before age 15 (dummy variable 0=Intact family 1=Non-intact family) and aunts and uncles' mean number of years of education (when children were 10–15 years old).

[2] We calculated together co-residential father's and mother's taxable labor and entrepreneurial income.

At the individual level, we control for grandparental lineage (dummy for maternal), sibling order (dummies for the firstborn and the third or later born within sibship), the number of siblings and cousins, the child's year of birth (dummy for two groups: 0=1972–1975, 1=1976–1990), the mother's age at birth, the child's sex (dummy 0=male, 1=female) and a dummy for whether the child lives in urban or rural area (latest value when children were 10–15 years old).

In the sibling fixed models, we control for variables that vary between siblings: year of birth, birth order, family income, child's sex, and mother's age at birth[3] (see table 1 for variables). In the sibling fixed effect interaction models we used the following variables: shared life time by grandparental type, number of aunts and uncles and number of relatives (cousins, aunts and uncles) (see appendix table 1b).

Descriptive statistics

Figure 1 shows the density and cumulative distribution function of grandparents' and grandchildren's shared lifetime variable[4] for the whole sample. This means the figure describes the grandparents who died latest, either on the maternal or paternal side. It shows that overall approximately 45 % of children's grandparents had died by 2010, the last year of the dataset.

In the sibling fixed effect models, we have to restrict the sample to those families that have at least two children and at least one child who experienced his/her grandparents' deaths by the age of 16. Thus, siblings vary according to grandparental exposure (we omitted two-child twin families). In figure 1, the red dashed line is the cutoff point of the fixed effect sample and shows that for approximately 10 % of the children, both grandparents, from either the maternal or the paternal side, had died by the time the child turned 16. The restrictions may influence the representativeness of the fixed effect sample. For example, it may be that grandparental death is more common for disadvantaged, lower status children than for others.

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[3] The year of birth and maternal age are entirely collinear between siblings, so we categorized the year of birth into two groups because there were no statistically significant differences between cohorts from 1976-1990.

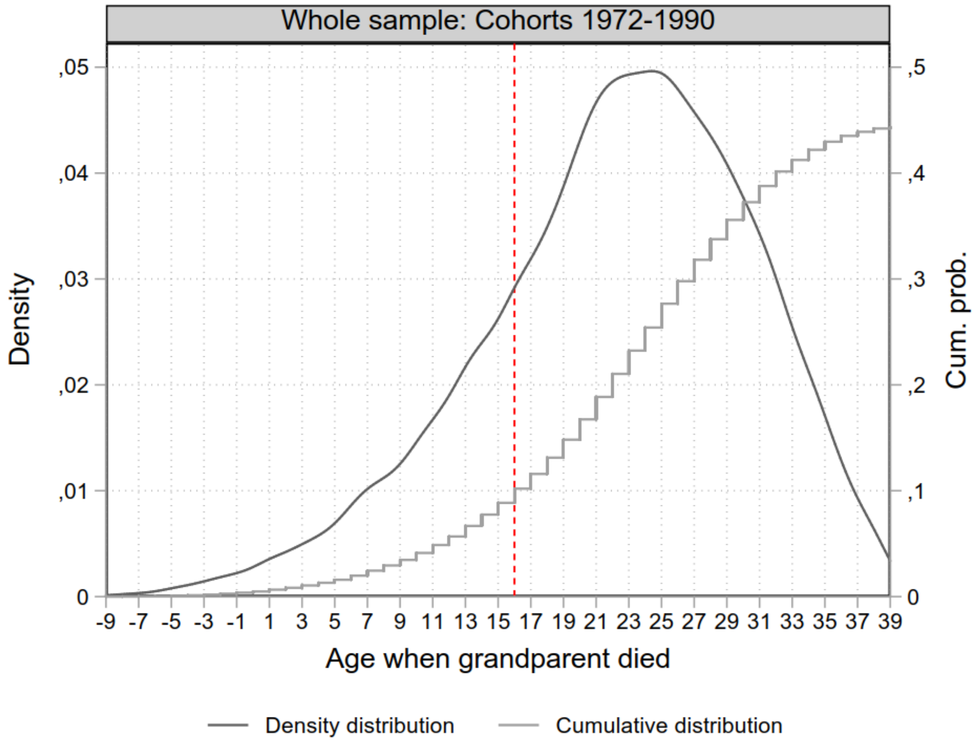

Figure 1. Child's age when grandparent died in the whole sample of cohorts 1972–1990.

Table 1 presents the means, overall standard deviations and within-sibling standard deviations of the applied dependent and independent variables for the total and the fixed effect sample; appendix tables 1a and 1b provide the imputed total sample and the full information FE sample. The fixed effect sample is somewhat downward biased according to grandparental socioeconomic resources (education and ISEI) but not by the parent-level socioeconomic characteristics (education, ISEI and family income). The imputed total sample does not differ from the non-imputed total sample. In the full information FE sample, parental separation is somewhat more downward biased compared to the total and fixed effect sample. While they are important to acknowledge, the biases are too small to have substantial impacts on the results.

Table 1. Descriptive statistics

	Whole sample			Fixed effect sample			
Variable	Mean	Std. Dev.	N	Mean	Std. dev.	Within Sib. Std.dev	N
General secondary school	0.48	0.50	71450	0.48	0.50	0.31	5117
GP-GC shared life time	15.45	2.19	71551	11.83	4.42	1.82	5117
GP ISEI	36.12	14.91	57281	31.73	13.07	0.97	2873
GP edu Secondary (Ref. Compulsory)	0.19	0.39	71407	0.14	0.35	NA	5095
GP edu tertiary	0.11	0.31	71407	0.06	0.25	NA	5095
Par edu: Secondary (Ref. Compulsory)	0.46	0.50	71513	0.47	0.50	NA	5117
Par edu: Tertiary	0.43	0.49	71513	0.39	0.49	NA	5117
Par ISEI	46.96	16.02	71429	45.52	16.61	4.32	5117
Non-intact family	0.31	0.46	71468	0.27	0.44	0.17	5117
Aunt/Uncle mean education years	9.91	4.16	71551	8.94	4.48	0.26	5117
Number of siblings	2.21	1.46	71551	3.16	1.74	NA	5117
Number of cousins	3.87	5.52	71551	4.22	6.96	1.44	5117
First born	0.64	0.48	71551	0.38	0.49	0.46	5117
Third or later born	0.10	0.30	71551	0.23	0.42	0.33	5117
Yb:1976–1990 (Ref. 1972–1975)	0.86	0.34	71551	0.89	0.32	0.24	5117
Log-family income	10.83	0.48	71087	10.79	0.50	0.16	5117
Family income	56739	37793	71088	55157	37226	11876	5117
Mother's age at birth	26.21	4.60	71551	27.75	5.11	3.27	5117
Maternal side	0.54	0.50	71551	0.52	0.50	NA	5117
Female	0.51	0.50	71551	0.50	0.50	0.38	5117
Rural (ref. Urban)	0.19	0.39	71519	0.21	0.41	NA	5117

Results

Grandparental resources

Table 2 reports our analyses based on three random effect models, which are clustered according to siblings. The table provides estimates for the shared life in years between grandparents and grandchildren, grandparents' social class and education. The observed immediate family characteristics, parental education, SES and income as well as aunts' and uncles' education are controlled for only in the second model (see appendix table 2 for all the estimates for the imputed and non-imputed samples).

Table 2. The effect of grandparent's and grandchildren's shared life time, grandparent's ISEI and grandparent's education on grandchildren's general secondary education. Random effects models.

	1	2
GP-GC shared life	0.0042***	0.0012
	0.0009	*0.0009*
GP ISEI	0.0025***	0.0004*
	0.0002	*0.0002*
GP Sec. or higher	0.0640***	0.0113*
	0.0047	*0.0044*
Individual level controls	YES	YES
Family level controls	NO	YES
N	70639	70639

Standard errors in second row

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results show that in the random effect models, grandparents and grandchildren's shared life time (the exposure) matters only in Model 1, where only individual level control variables are added to the models. When parental characteristics are added in Model 2, and the observed Markovian effects are controlled for, the exposure effect is not statistically or substantially significant. The effect of grandparents' socioeconomic status is significant in both models. In the first model, before controlling for the observed parental characteristics, the linear effect of grandparental ISEI is 0.0025. This means that a 10-point increase in the grandparent's ISEI scale yields a 2.5 percentage point effect in the grandchild's ISEI. Because the ISEI scale ranges from 16 to 90, the difference between the minimum and maximum is 18.5 percentage points (74*0.0025=0.185). This association can be considered substantial. However, in the second model, the estimate decreases to 0.0004. Over four-fifths of the grandparent-grandchild association is explained by parental characteristics rather than grandparental socioeconomic status directly. Further, although a grandparent's ISEI is still statistically significant, the estimate is very small, and the difference between the minimum and the maximum is only approximately 3 percentage points (0.0004*74=0.029).

Additionally, the positive estimate of grandparents' education (secondary or higher) remains statistically significant in the second model, although the association is no longer substantially important, suggesting only a one percentage point advantage for the children of secondary or higher and compulsory educated grandparent. Therefore, in practice, nearly all grandparent associations that are observed in Model 1 can be explained by the observed parental characteristics included in Model 2, although still many parental level characteristics remain unobserved.

Next, we test whether the estimates for parental resources (ISEI, family income and education) and their dissolution varied according to grandparents' resources. According to our results, reported in figure 2, this does not seem to be the case. Although some of the interactions are statistically significant, the linear effects in these cases are very weak, nearly zero (see the estimates in Appendix table 3 for the estimates). The strongest statistically significant interaction between a grandparent's education and family income (the estimate is on average only 0.009) is the only one that seems to visibly differ from zero in the figure. The estimate suggests that when family income increases by one standard deviation, the probability of completing general secondary education increases by 0.9 percentage points if the children have a secondary or higher educated grandparent.

All interactions point in the opposite direction than was assumed in the hypothesis regarding grandparental resources as a stabilizer: An increase in parental resources seems to increase, not decrease, the effects of the grandparental resources. Overall, the results from the random effect models suggest that the assumption about the growing stabilizer role of grandparents' resources does not apply to the Finnish case. Additionally, the results do not much support the legacy effect hypothesis because the magnitudes of the statistically significant estimates for grandparents' education and ISEI appear to be relatively weak.

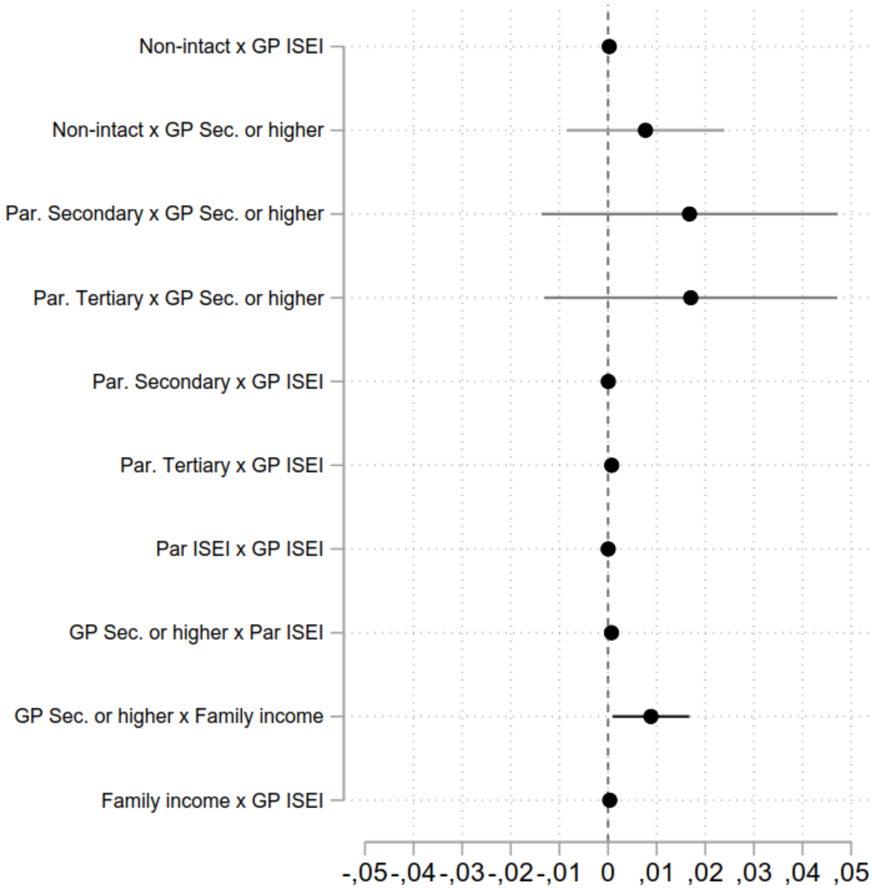

Figure 2. Interaction effects of parental resources and dissolution with grandparents' resources, random effect models. Note: Interaction controls for individual and family level variables and are modeled separately (10 models).

Grandparental Exposure

Because random effect models do not take into account all the unobserved heterogeneity at the parental level, even these interactions may just reflect omitted variable bias at the parental level (i.e., all the parental characteristics shared by siblings are not controlled for). Next, we analyze the effects of grandparental exposure using sibling fixed effect models, controlling for the remaining, unobserved Markovian processes entirely.

Table 3 reports the main results for these analyses. Model 1 is without control variables, while in Model 2, we add observed controls that vary between siblings. Table 3 shows that in both models, grandparental exposure is statistically significant, although adding control variables doubles the standard error. However, the estimate is hardly changed. On average, a 1-year increase in the shared lifetime increase the probability of the grandchild graduating from general secondary school by approximately 1.1 percentage point. This means that from 1 year to 16 years, the difference is over 16 percentage points. The main conclusion appears to be that the exposure effect does really matter.

Table 3. The effects of grandparents' and grandchildren's shared lifetime on grandchildren's general secondary education, sibling fixed effect linear probability models.

	1	2
GP-GC shared life	0.0124^{***}	0.0110^{*}
	0.00249	*0.00468*
Female		0.1972^{***}
		0.01394
Family income		0.005
		0.01672
First born		0.0756^{***}
		0.01644
Third or later born		-0.0329
		0.02147
Year of born 1976–1990		0.1320^{***}
		0.0269
Mother's age birth		0.0038
		0.0039
BIC	2426.982	2069.854
N	5117	5117

Standard errors in second row

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Next, we test the kin hypothesis with the exposure effects. Table 4 reports the results of grandparental exposure by grandparental type. In both models, we see that none of the exposure effects of grandparents are statistically significant, and the effects are much smaller than those reported in table 3. The average exposure effect of a father's father is even negative. These models provide little further information to explain why grandparental average exposure is positive in table 3.

Table 4. The effect of grandparent's and grandchildren's shared lifetime on grandchildren's general secondary education according to the type of grandparent, sibling fixed effect linear probability models.

	1	2
MM-GC shared life	0.0075	0.0036
	0.006	*0.006*
MF-GC shared life	-0.0009	0.0023
	0.006	*0.006*
FM-GC shared life	0.0067	0.009
	0.005	*0.006*
FF-GC shared life	0.0055	-0.0021
	0.005	*0.006*
First born		0.0680**
		0.022
Third or later born		-0.0567*
		0.028
Female		0.2112***
		0.018
Family income		0.0502
		0.029
1976–1990		0.1903***
		0.04
Mother's age birth		-0.0005
		0.007
BIC	1489.928	1247.665
N	3053	3053

Standard errors in second row
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Parental resources and the size of the extended family network

In the next part of our analyses, we study whether grandparents' and grandchildren's shared life time is dependent on family resources and the size of the (extended) family. To do this, we interact grandparents' shared life time with the number of cousins, aunts/uncles and relatives (all cousins, aunts and uncles). It was assumed above that if the grandparents matter because they provide access to the pool of resources available through the extended family network, the positive effect of overlapping lives should become stronger if the extended family network is wider. The unreported analyses suggest that unless the effects are differentiated by the type of the grandparent, the size of the extended family network does not play much of a role. However, the conclusion changes when we differentiate the interaction by the type of a grandparent.

Table 5 shows the positive interaction effect between the shared life time between father's mother's shared life time and the *number of cousins* as well as the number of all relatives (all cousins and aunts/uncles). Additionally, the estimate for the *number of aunts and uncles* is nearly significant (p<0.10). Thus, the positive influence of a fathers' mother only becomes more important as the size of the extended family network increases. Figure 3 plots the interaction between shared life time and number of relatives by the type of grandparent. It shows that when siblings have 12 extended family members from the father's side, the linear effect of the father's side is on average 1 percentage point. Thus, 16 years of shared lifetime yield, on average, 16 percentages point higher probability of graduating from general secondary school. The result indicates that paternal side grandmother act as a link between other relatives among the extended family network.

Table 5. Interactions between grandparent-grandchildren shared life and number of cousins, aunts/uncles and all relatives (cousins + aunts and uncles). Sibling fixed interaction effects modeled separately.

	Number of cousins	Number of aunts/uncles	Number of relatives
MM-GC shared life	-0.0004	-0.0024	-0.0004
	<0.001	*0.002*	*<0.001*
MF-GC shared life	-0.0005	-0.0004	-0.0004
	0.001	*0.002*	*<0.001*
FM-GC shared life	0.0005*	0.0025^{+}	0.0005*
	<0.001	*0.001*	*<0.001*
FF-GC shared life	0.0005	0.0026	0.0005
	<0.001	*0.002*	*<0.001*
N	3053	3053	3053

Standard errors in second row
$^{+}$ $p < 0.10$. * $p < 0.05$
Note: Interaction models controls for child's sex, family income, first born, third or later born, year of born dummy, maternal age and grandparent-grandchild shared life by grandparental type. Maternal and paternal side is modelled separately.

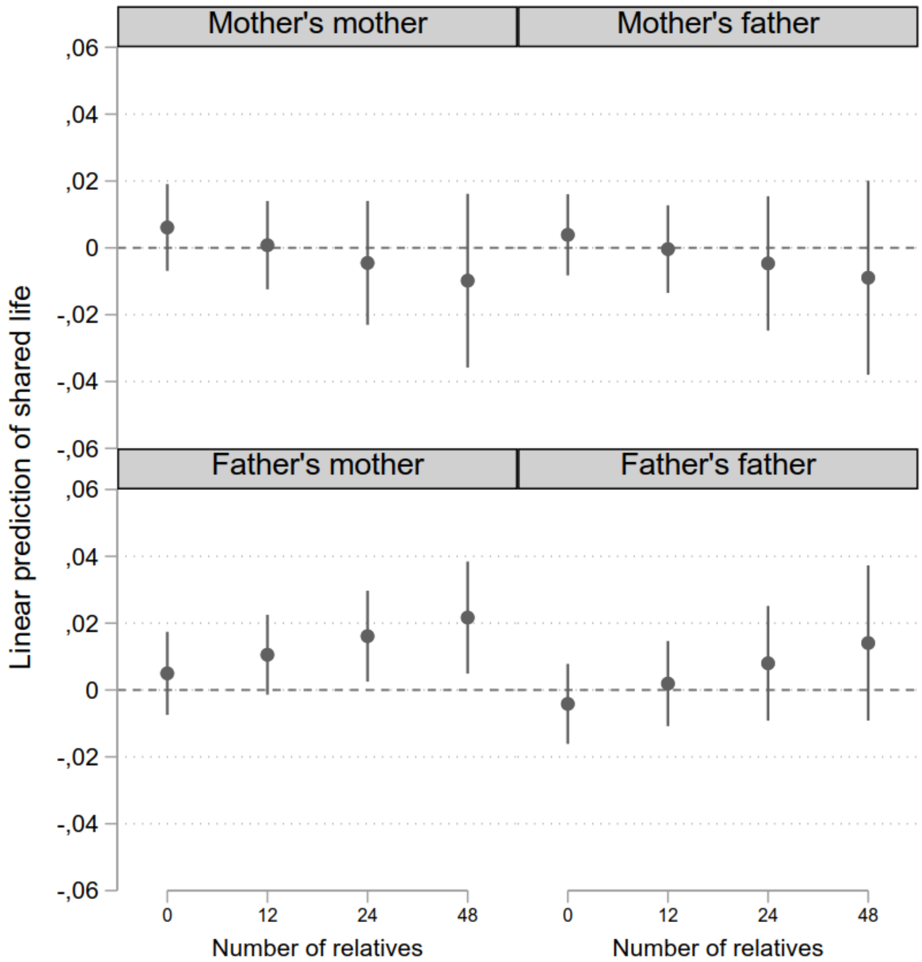

Figure 3. Interaction effects between grandparents-grandchildren shared life and number of relatives (cousins + aunts and uncles), sibling fixed effect models.

Table 6 reports the results of the interaction models between grandparent-grandchildren shared life and family income, parental education, parental ISEI and parental separation by grandparental type. Exposure to the mother's mother is significant when family income or parental status is low. This means that the positive effect of the mother's mother is restricted to low-resource families. Figure 4 illustrates the interaction between grandparent-grandchildren shared life and family income. It shows that the linear effect of the mother's mother exposure is on average 2 percentage points – although the confidence intervals are admittedly rather large – when income of the family is in the lowest fifth quantile but is insignificant when the family income is in the highest ninety-fifth quantile.

These results support the exposure hypothesis but are conditional on the type of grandparent, the size of the extended family network, family income and parental socioeconomic status. The kin keeper hypothesis is partly supported by the sibling fixed analyses because maternal grandmothers' exposure has influence only in low-income and low-status families, and the effect of paternal grandmothers is dependent on the size of the extended family. Thus, the shared life time with grandmothers compensates for low resources on the maternal side but gives access to the family's pool of resources on the paternal side.

Table 6. Interactions between grandparent-grandchildren shared life and family income, parental education, parental ISEI and parental separation. Sibling fixed interaction effects modeled separately.

	Family income	Par edu: Secondary	Par edu: Tertiary	Parental ISEI	Non-intact family
MM-GC shared life	-0.00774*	0.01185	-0.0036	-0.00029*	-0.0039
	0.0033	*0.0125*	*0.0129*	*0.0001*	0.004
MF-GC shared life	-0.00122	0.01057	0.00864	-0.00017	-0.0079^{+}
	0.0031	*0.0111*	*0.0113*	*0.0001*	0.005
FM-GC shared life	0.00008	0.01531	0.00758	-0.00021	-0.0015
	0.0033	*0.0118*	*0.012*	*0.0001*	0.004
FF-GC shared life	-0.00113	0.00701	0.00481	-0.00003	-0.0033
	0.0031	*0.0113*	*0.0113*	*0.0001*	0.005
N	3053	3053	3053	3053	3053

Standard errors in second row $^{+}$ $p < 0.10$, * $p < 0.05$.

Note: Interaction models controls for child's sex, family income, first born, third or later born, year of born dummy, maternal age and grandparent-grandchild shared life by grandparental type.

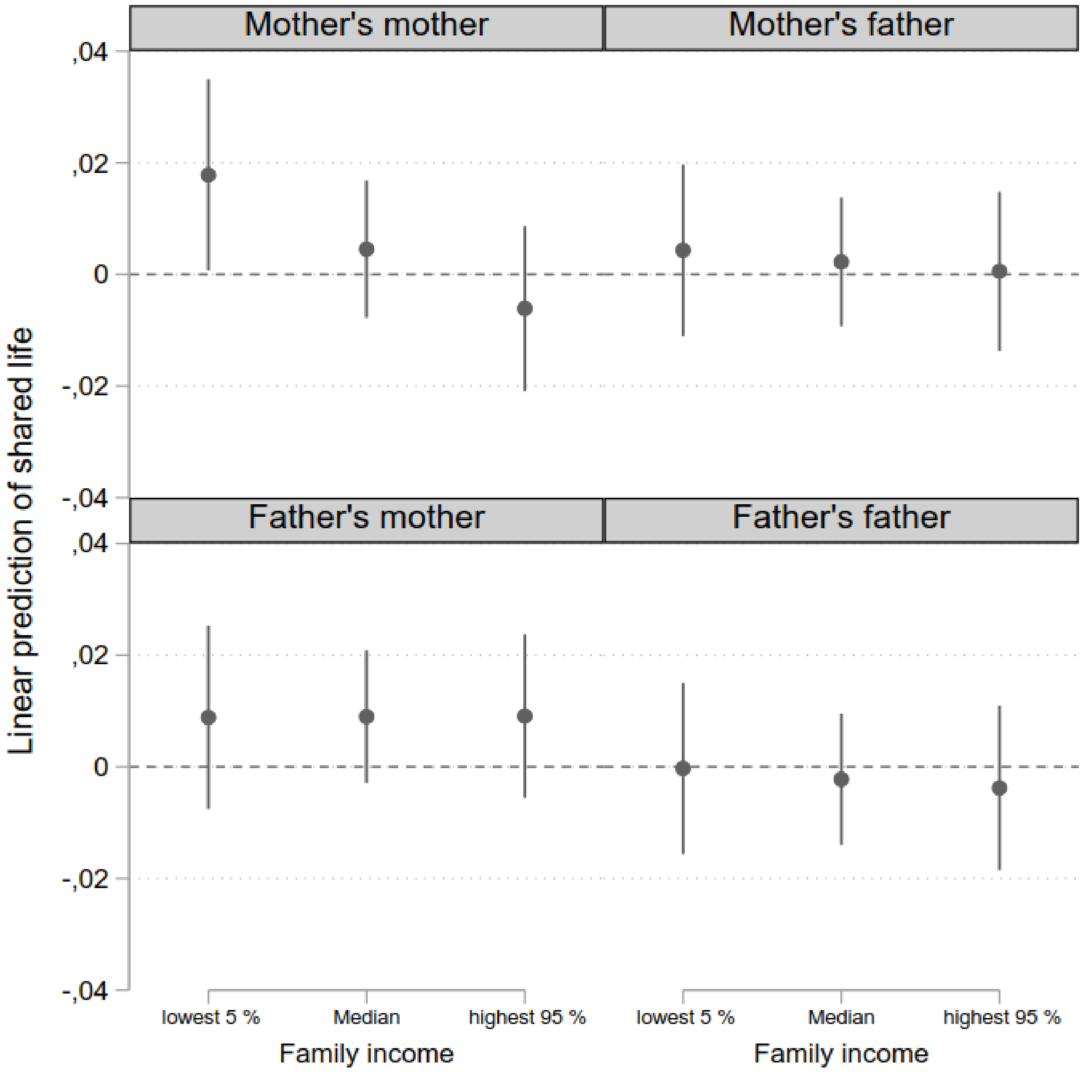

Figure 4. Interaction effects between grandparents' shared life time with grandchild and family income, sibling fixed effect models. Note: The lowest 5 % and the highest 95 % refer to family income quantiles.

Robustness analyses

For sensitivity purposes, we run all main random and fixed effect models using multilevel logit regression models with similar results, reported in the results section (see appendix table 4a and 4b).

We also test whether grandparent-grandchildren shared life time varies according to grandparents' education and socioeconomic status (ISEI score), because exposure to the shared life time of grandparents with greater resources would influence siblings' educational attainment more than grandparents with fewer resources. In particular, higher grandparental education should have an impact if the effect of the shared life time was related to cultural capital. Grandparental socioeconomic status should have an effect if the results could be explained by grandparents' economic standing. To conduct these robustness tests with as large a sample as possible, we select the highest education level and ISEI from the paternal or maternal side grandparents. Appendix table 5 shows the results of these tests. We do not find any statistically significant interactions, and in general, the estimates are small. Thus, we conclude that grandparental economic or educational resources are not moderating the grandparental exposure effect on grandchildren's educational attainment.

Further, we also analyzed interaction between grandparent-grandchildren shared life time and birth order and number of siblings. Birth order may matter because the earlier-born sibling may have received more grandparental investment compared to later-born siblings, and families with fewer children may benefit more from "grandparenting" (Coall and Hertwig, 2010). However, the interaction effects of birth order or the number of siblings was not statistically significant (see Appendix table 6).

Discussion

In this study, we have investigated four potential explanations for the grandparent effects on multigenerational attainment. Our results provided only very weak support for legacy effects. Grandparents seem to have a direct effect on grandchildren attributable to their educational attainment and socioeconomic status (ISEI score). However, once the Markovian observed effects were controlled for, the positive effect of grandparents' education and socioeconomic status were very small. This finding is in line with the previous results, showing only a small positive effect of grandparents' resources on grandchildren's adult attainment in Finland (Erola and Moisio 2007). These results may simply be explained by a number of unobserved Markovian processes that still remain uncontrolled in the random effect models.

Interestingly, we found evidence that grandparental exposure is more important than grandparents' resources on grandchildren's general secondary educational attainment.

The effect of grandparents' exposure is conditional on grandparental type, family resources and number of relatives.

The effect of maternal side grandmother exposure varies according to the resources of the parents (family income and socioeconomic status). Hence, maternal grandmother exposure influences only families with low income and socioeconomic status. This is partially in line with Bengtson's (2001) assumption about the importance of grandparents in times of need but more in a way that is expected in the evolutionary literature on kin-specific grandparent effects (Sear and Coall 2011; Lussier et al 2002). This finding provides evidence for *compensation* (see Erola and Kilpi-Jakonen 2017). Linking this compensatory effect directly to grandparents is in line with the previous findings on the compensatory effects of extended family members from the US (Jaeger, 2012).

Most interestingly, and as a new contribution to the literature, we found a positive interaction between the shared life of the paternal side grandmother and the number of relatives (cousins and aunts/uncles). These findings particularly indicate the importance of *paternal* side grandmothers in maintaining the extended family network. The finding suggests that paternal grandmothers provide access to the family's pool of resources through the relatives, while the maternal side grandmother seems to be more important when family resources are low. These kin-specific differences may explain why grandparents' resources, on average, matter only a little.

While the effects of grandfathers are somewhat similar to those of grandmothers in the case of exposure, the effects of the grandfathers are non-significant in all cases. This is line with previous studies that have shown that grandmothers typically are more inclined to invest in grandchildren than grandfathers are (e.g., Danielsbacka et al., 2011; Hank and Buber, 2009).

While supporting some aspects of Bengtson's argument about the importance of grandparents as stabilizers for increasingly turbulent immediate families, our findings limit the original rather broad argument in an important manner. There was no interaction with parental separation, and the interaction effect between parental resources and the positive effect of grandparent's resources were small and pointed in the incorrect direction. Additionally, the resources of the grandparents themselves in the sibling fixed effect models were insignificant.

Previous multigenerational stratification studies have investigated the associations between the socioeconomic attainments of grandparents and grandchildren, with mixed results. Although some have detected that grandparental status correlates with grandchildren's status (e.g., Chan and Boliver 2013; Modin et al., 2012), others have not found such a correlation (e.g., Warren and Hauser, 1997). Bol and Kalmijn (2016) have argued that these mixed results could be related to methodological issues in the way that different modeling strategies may lead different results. Based on their review, 80 % of the studies using loglinear models but only 33 % of studies using regression models have shown support for the grandparental effect. However, our results using multilevel models come relatively close to the previous Finnish findings acquired with loglinear models (cf. Erola and Moisio, 2007). The current results suggest that perhaps the most important reason for the mixed results is that the previous multigenerational stratification studies have almost solely concentrated on the socioeconomic characteristics of the grandparents, which tend to be relatively small, and have largely missed the exposure effects that can potentially be fairly substantive.

To conclude, the present study has extended the previous multigenerational stratification research on kin influences by analyzing the effect of shared lifetime between grandparents and grandchildren on educational attainment among grandchildren. Previously, it has been argued that the importance of multigenerational relations at the societal level should improve with the increased number of shared years between generations (Bengtson 2001; Coall and Hertwig 2010; Mare 2011). Our results indicate that grandchildren benefit the more shared years they have with their grandparents, and the results indicate this positive effect is not much dependent on grandparents' or parents' socioeconomic resources but rather on the pool of resources of the extended family that is maintained by the grandparents. Grandmothers in particular appear to be the knot that ties the extended family resources together.

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