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The effect of grandparental involvement on grandchildren's school grades: Heterogeneity by the extended family characteristics

Francesca Zanasi and Valeria Bordone

Abstract

As the early years are crucial for individuals' lifelong socioeconomic success, extensive research has examined the impact of non-maternal childcare on children's development. This study aims to enhance the understanding of the relationship between grandparental involvement (defined as grandparent childcare, frequency of contact, and financial support) and grandchildren's school grades, exploring a mechanism of positive selection: children from extended families with specific socioeconomic characteristics are more likely to spend time with grandparents and benefit the most from this involvement.

We utilize data from the German Pairfam survey, which uniquely provides rich information on three family generations. By conducting a heterogeneous treatment effect analysis, we account for confounding factors associated with grandparental involvement and school performance that could bias our findings. For example, children from advantaged families could be more likely to spend time with grandparents and achieve better school grades. Additionally, this approach examines whether the effect of grandparental involvement systematically varies across children based on the extended family's characteristics. For example, children from advantaged families may benefit the most from spending time with grandparents who possess social, cultural, and cognitive resources conducive to their development.

After accounting for confounding factors and heterogeneity, our analyses do not reveal a statistically significant effect of grandparental investment on children's school grades. The study concludes by discussing possible reasons for this result and highlighting the implications for the intergenerational transmission of inequality.

Keywords: grandparents; childcare; school grades; social inequality; Pairfam; Germany

Introduction

In the last decades, grandparents have garnered special attention in the social sciences, which recognize them as invaluable support for families with young children. In Europe, about half of grandparents provide childcare (Zanasi et al., 2023), although there is significant variation across countries. This variation reflects differences in the availability of early childhood education and care (ECEC) services and the structure of the female labor market (Bordone et al., 2017).

Grandparents' assistance with childcare positively influences mothers' labor market participation (Arpino et al., 2014) and couples' fertility (Rutigliano, 2020). Additionally, such engagement benefits older people's cognition (Arpino & Bordone, 2014) and well-being (Danielsbacka et al., 2022). Grandparenthood is a highly valued and desired role that confers meaning and a sense of purpose (Mahne & Motel-Klingebiel, 2012; Werner et al., 1998). Grandparents are involved with their grandchildren beyond childcare, spending time together in enjoyable activities and providing economic support (Di Gessa et al., 2020; Dunifon et al., 2018).

Researchers have increasingly focused on the effects of grandparental involvement on grandchildren's lives. However, related results are mixed, depending on the research design. On one hand, evidence on ECEC compared to other arrangements, such as care by grandparents, is age-specific (for a review, see Melhuish et al., 2016) and outcome-specific (e.g., educational performance, socio-emotional development, school readiness) (Bryson et al., 2012; Fergusson et al., 2008; Hansen & Hawkes, 2009). It also depends on the formal-informal childcare mix adopted (Bryson et al., 2012). On the other hand, the frequency of contact with grandparents and financial transfers are associated with better cognitive and socio-emotional outcomes (Tanskanen & Danielsbacka, 2018) and vocabulary enhancement (Milovanska-Farrington, 2021) in grandchildren.

In the present study, we aim to advance the understanding of the association between grandparental involvement and grandchildren's school performance in two main ways. First, our analyses rely on data from the German Pairfam survey (Brüderl et al., 2023; Huinink et al., 2011), which allows for a comprehensive measurement of grandparental involvement, including childcare (e.g., helping parents look after children), frequency of contact, and financial gifts. To our knowledge, Pairfam is the only European survey that provides socioeconomic and demographic information on three generations, which we refer to as the extended family (grandparents, adult children, adult children's partners, and grandchildren). This is crucial for the second contribution of the study: exploring how the effect of grandparental involvement on grandchildren's schooling varies across population subgroups.

To do so, we employ heterogeneous treatment effect analyses as proposed by Xie and colleagues (2012). This approach accounts for two types of heterogeneity. First, heterogeneity in family background characteristics (called pre-treatment heterogeneity), associated with grandparental involvement and grandchildren's school performance, could bias our evidence. For example, the relationship under study could be spurious because children from advantaged families might be more likely to spend time with grandparents (as suggested by the literature; see Di Gessa, Glaser, & Zaninotto, 2022; Zanasi & Sieben, 2022) and have better school grades. Secondly, there may be heterogeneity in the returns to grandparental involvement (the treatment) for grandchildren's school grades, by the propensity (likelihood) of receiving grandparental involvement (called treatment effect heterogeneity). This propensity is a summary measure of the extended family's background characteristics, such as a propensity score.

Taken together, we ask whether grandchildren who are most likely to receive grandparental involvement, given the extended family's characteristics, receive higher returns in terms of schooling to grandparental involvement than grandchildren who are least likely to receive grandparental involvement. Our expectation is one of positive selection (see Brand & Xie, 2010): children from advantaged families could be the most likely to spend time with grandparents, who are invested in their school success and personal development. These children may benefit the most from grandparental involvement (e.g., getting better school grades), as their grandparents have the cultural and economic resources conducive to their progress and growth (Zanasi & Sieben, 2022).

This study is crucial for understanding the intergenerational transmission of resources and inequality. Extensive literature has explored the so-called grandparent effect, i.e., the relationship between grandparents' and grandchildren's socioeconomic status, independent of parental status (Anderson et al., 2018). One mechanism of status transmission is contact-based and develops throughout childhood. Specifically, advantaged extended families invest more resources (time, money) in their offspring to ensure future socioeconomic success—a phenomenon that has rarely been tested

empirically (exceptions include Bol & Kalmijn, 2016; Milovanska-Farrington, 2021; Tanskanen & Danielsbacka, 2018). Therefore, it is essential to investigate how grandparental involvement, influenced by specific socioeconomic characteristics, affects children's outcomes at an early age.

The present study focuses on Germany, where the role of grandparents is highly valued and desired across social classes, regardless of the presence of grandchildren (Mahne & Motel-Klingebiel, 2012). In Germany, grandparental childcare is also a social norm: most grandparents agree that they should help their children care for their grandchildren (Hank & Buber, 2009).

Approximately half of grandparents in Germany provide childcare to their grandchildren, with a third doing so almost weekly (Zanasi et al., 2023). While mothers are widely employed, thanks in part to the availability of part-time jobs and childcare services for children aged 0-3 are widely available, grandparents often complement formal childcare provisions (Bordone et al., 2017). They step in to cover childcare hours or provide emergency support, acting as a "reserve army" (Price et al., 2018).

Theoretical background and empirical evidence

Grandparental involvement and children's outcome: a review of the literature

There is widespread agreement that early childhood is a critical developmental window, with events in infancy having long-term consequences across various aspects of life, from health to socioeconomic success (Harvard University Center on the Developing Child, 2007). With the rising rates of maternal employment, numerous studies have investigated how non-maternal childcare arrangements—whether provided by family members (e.g., fathers or grandparents) or early childhood education and care (ECEC) services (including any regulated arrangements offering education and care before compulsory primary school age)—influence child development.

In an extensive literature review, Bryson, Brewer, Sibieta, and Butt (2012) confirmed differences between children cared for solely by grandparents and those attending formal childcare. The direction of the relationship, however, depends on several factors. While some studies found a positive effect of exclusive grandparental childcare (compared to centre-based childcare) on vocabulary development (Bryson et al., 2012; Del Boca et al., 2018; Hansen & Hawkes, 2009), this arrangement, in conjunction with a mother's early return to work or a father's absence, decreased children's literacy scores (Gregg et al., 2005) and cognitive ability test scores (Bernal & Keane, 2011). The detrimental effect of grandparental childcare compared to formal care was also observed for school readiness (Del Boca et al., 2018; Hansen & Hawkes, 2009) and behavioral problems such as hyperactivity or peer relationship issues (Bryson et al., 2012; Fergusson et al., 2008; Hansen & Hawkes, 2009). Other studies found a negative effect only when grandparental childcare is used in conjunction with full-time daycare, rather than as a primary childcare arrangement (Barschkett et al., 2021). All the mentioned studies focused on childcare arrangements for children under three years old (see also Melhuish et al., 2016). However, the effects are usually no longer evident after age five, as childcare arrangements become progressively less relevant with age (ibidem).

When considering grandparental involvement more broadly, studies examine contact with grandparents (beyond the childcare needs of the parental generation) and financial support. Empirical evidence based on UK data (Tanskanen & Danielsbacka, 2018) showed that children who have more contact with grandparents and receive financial support score, on average, better on cognitive and socio-emotional outcomes. However, this result was only detected "between" children and

disappeared in the “within-individuals” analysis (i.e., over time, thus accounting for time-constant unobserved heterogeneity), disputing the idea of a causal relationship between grandparental involvement and children's development. Using a similar fixed-effect panel model, Milovanska-Farrington (2021) found that spending more time with parents than with grandparents benefits children's social and behavioral development, while grandparental childcare positively affects children's vocabulary skills more than parental care does.

In the present study, we focus on older children (i.e., 8+ years old) who have yet to be included in existing literature as a unit of analysis. Since they are in compulsory education, grandparental childcare could be less relevant in their lives, manifesting instead as contact frequency and financial support. For this reason, we employ a multifaceted measure of grandparental involvement. Moreover, as noted in the literature (Melhuish et al., 2016), commonly used outcomes such as cognitive development become less relevant with age. Therefore, we examine grandchildren's school performance, which is more closely linked to family socioeconomic status, as will be explored in the following paragraphs.

The literature we reviewed often overlooks population heterogeneities. In this respect, sociological literature on the socioeconomic determinants of grandparental caregiving and the intergenerational transmission of inequality could greatly complement the aforementioned research.

Heterogeneity in grandparental involvement by the extended family characteristics

This study's first source of heterogeneity is in preexisting conditions, specifically individual and family characteristics associated with the propensity for grandparental involvement. Accounting for these characteristics is crucial for two reasons: these factors (e.g., family socioeconomic status) could confound the relationship between grandparental involvement and grandchildren's school grades, in case they are associated with both (pre-treatment heterogeneity), and grandchildren could respond differently to grandparental involvement based on these characteristics (treatment effect heterogeneity).

Concerning grandparental characteristics, grandparental childcare is more often provided by grandmothers than grandfathers (Coall et al., 2016; Di Gessa et al., 2020; Zamberletti et al., 2018) and by maternal grandparents (Di Gessa et al., 2016; Hank & Buber, 2009; Helle et al., 2022). Notably, many studies across different contexts have shown a positive educational gradient in the probability of grandparents providing childcare (Craig & Jenkins, 2016; Dunifon et al., 2018; Igel & Szydlik, 2011; King & Elder, 1998; Lakomý & Kreidl, 2015; Luo et al., 2012; Zamberletti et al., 2018). However, when considering intensive commitment (e.g., weekly care), families from lower socioeconomic backgrounds rely more on grandparental childcare due to reduced spending power for formal childcare (Di Gessa et al., 2022; McGarrigle et al., 2018; Rutter & Evans, 2011). Recent research with English data (Di Gessa, Glaser, & Zaninotto, 2022; Zanasi & Sieben, 2022) indicates differences in activities with grandchildren and the motives behind them, according to grandparents' socioeconomic status. For example, highly educated grandmothers are more often involved in helping with homework than their lower-educated counterparts, likely due to their higher skills and competencies. Similarly, highly educated grandparents are more likely to spend time with grandchildren to aid their personal development (children as a “developmental project”; see Dotti Sani & Treas, 2016; Gracia, 2014) and secure their educational and occupational achievements. Finally, research consistently shows across various contexts and data sources that poor health of

grandparents, being employed, not having a partner, and having multiple grandchildren are negatively associated with the probability of providing childcare (Craig & Jenkins, 2016; Dunifon et al., 2018; Igel & Szydluk, 2011; King & Elder, 1998; Lakomý & Kreidl, 2015; Luo et al., 2012; Zamberletti et al., 2018).

Concerning parental characteristics, grandparental childcare is more likely when mothers are employed (Aassve et al., 2012; Bordone et al., 2017; Di Gessa et al., 2016; Hank & Buber, 2009) and when they are not married (Di Gessa et al., 2016), as these situations make it harder to reconcile work and family responsibilities. Regarding children's characteristics, they are more likely to receive grandparental childcare in their early school years than when they are less than one year old (Di Gessa et al., 2016; Hank & Buber, 2009; Zamberletti et al., 2018). Some evidence suggests a relationship between grandparental involvement and grandchildren who have suffered adverse early life experiences, including health issues (Helle et al., 2022).

All the studies mentioned focus on the characteristics associated with grandparental childcare, conceived as substituting or complementing parental time. To our knowledge, no studies have investigated the correlates of frequency of contact and financial transfers to grandchildren. While similar characteristics to grandparental childcare may influence the former, financial transfers may be less linked to the family's opportunity structure (e.g., grandparents' bad health, maternal employment) and more dependent on grandparents' socioeconomic resources (e.g., educational level, occupation). All the listed characteristics from a three-generational perspective will be summarized by a score measuring the overall propensity of grandparental involvement.

Heterogeneity in the returns to grandparental involvement

The previous paragraph listed a set of characteristics from three family generations associated with the propensity for grandparental involvement, illustrating the extent to which grandparental involvement varies across population subgroups. The next step is to understand whether the effect of grandparental involvement on grandchildren's school grades varies according to this propensity. Our paper focuses on the positive selection hypothesis (see Brand & Xie, 2010), which posits that the higher the propensity for receiving grandparental involvement, the stronger the positive effect on grandchildren's school grades.

To our knowledge, no study has investigated the heterogeneity in the returns to grandparental involvement. It is worth sourcing from the literature on the so-called grandparent effect, i.e., the (debated) causal relationship between grandparents' socioeconomic characteristics and grandchildren's outcomes (such as socioeconomic status and ability) independent of parents' socioeconomic characteristics and ability (Anderson et al., 2018). Many studies have explored this effect in the long term, considering the intergenerational transmission of resources (e.g., socioeconomic status) from grandparents to adult grandchildren in terms of educational attainment, income level, and social class (Chan & Boliver, 2013; Deindl & Tieben, 2017; Dribe & Helgertz, 2016; Knigge, 2016). Other studies focus on young grandchildren, who are more likely to experience face-to-face interaction with grandparents, and find a relationship between grandparental resources and grandchildren's cognitive and non-cognitive abilities as well as school grades (Ferguson & Ready, 2011; Hällsten & Pfeffer, 2017; Klein & Kühhirt, 2021; Modin et al., 2013). It is important to stress that actual time spent with grandparents is not directly measured in these studies; instead,

grandparental resources and socioeconomic status serve as proxies for specific behaviors and attitudes.

There are three main channels of status transmission (Bol & Kalmijn, 2016). First, the relation between grandparental resources and children's outcomes could be indirect: grandparents' resources influence the resources of their adult children, who influence grandchildren's outcomes. For this reason, it is crucial to account for the parental generation's characteristics (Anderson et al., 2018). The relation may remain when controlling for parental characteristics, hinting toward a direct effect of grandparents' resources. A second mechanism is, therefore, economic. Grandparents with high socioeconomic status have economic resources and they can transfer money to their descendants. Financial transfers from grandparents could support grandchildren's schooling, for example, paying for private lessons. Later in life, inheritance of money after grandparents die could further ameliorate grandchildren's life situation. A third mechanism lies in cultural resources. As explained in the previous paragraph, grandparents of high educational level are more likely than their lower educated counterparts to spend time with grandchildren to help them develop as people (children as a "developmental project", see Dotti Sani & Treas, 2016; Gracia, 2014) and secure their educational and occupational achievements. For example, they are more often involved in homework with their grandchildren than lower educated counterparts (Di Gessa, Glaser, & Zaninotto, 2022; Zanasi & Sieben, 2022), probably thanks to their higher skills and competencies, potentially improving their school grades.

To wit, this literature review has shown that specific characteristics, such as family socioeconomic status, are associated with grandparental involvement. Grandparents with high socioeconomic status are allegedly more likely to spend time with their grandchildren because they are invested in their development. Additionally, these grandparents possess substantial economic and cultural resources, which can be utilized to support children's schooling both economically and culturally (e.g., helping with homework). The positive selection hypothesis (Brand & Xie, 2010) posits that grandchildren who are more likely to receive grandparental involvement will experience greater benefits in their schooling outcomes.

Data and methods

Data & Sample selection

Our analyses rely on annual data from waves 2, 4, 6 and 8 (2009/2010-2015/2016) of the German Family Panel Pairfam, release 14.0 (Brüderl et al., 2023; Huinink et al., 2011). The Pairfam (panel analysis of intimate relationships and family dynamics) study is designed as an annual survey of a random sample of German residents from the birth cohorts 1971-1973, 1981-1983, and 1991-1993. Data collection started in 2008 with approximately 4,000 interviews from each cohort using computer-assisted personal interviews (CAPI). Pairfam focuses on partnership dynamics and dissolution, fertility attitudes and generative behaviour, parenting and child development, and intergenerational relationships. To capture information from multiple perspectives, Pairfam implements a multi-actor design, including the anchor (i.e., the main respondent), the anchor's partner, and, from the second wave onwards, the anchor's parents and children aged 8 to 15. A detailed description of the study can be found in Huinink et al. (2011).

The choice of the waves used in this study is driven by the availability of information on both grandparents' support and children's school grades. All the waves are pooled together to maximise

statistical power; robustness checks are provided with a different sample selection (see Table A2 and A3), leading to virtually unchanged results.

From 4,815 initial observations, 282 were excluded because both grandparents were deceased. After deleting observations with missing information on the variables of interest (N=1,346), our final sample amounts to 3,187 anchor-child observations.

Variables

Our dependent variables are children's school grades in mathematics and German. Children aged 8-15 are asked "how good are you in your school subjects?" and they can answer on a scale between 1 (best grade) and 6 (worst grade) separately for mathematics and German. Missing values are recorded when children do not have the specific subject, do not get grades (or do not have any grades yet), do not know, and if do not answer the question. If children do not get grades, they however answer the question "can you tell me how good you are in your school subjects?" on a scale between very good and poor. We recoded the answers so that 5 and 6 (this latter comprises very few cases) to the first question and "very good" to the second question correspond to the best grade.

Grandparental involvement is measured through three variables. First, grandparental childcare is derived from the question to anchors "During the past 12 months, how often did you receive help from [your mother; your father] in looking after or taking care of your children?". The variable takes a value 1 if the anchor's mother and/or father have looked after grandchildren often or very often (= 0 if never, seldom, sometimes, or no contact between them have been selected).

Second, financial transfers from grandparents are derived from the question "During the past 12 months, how often did you receive substantial gifts or financial support for your children from [your mother; your father]?". As this type of transfer is less common, the variable takes a value 1 if anchors declare to have received financial help from their parents at least sometimes (i.e., sometimes, often, or very often; =0 if never, seldom, or no contact between them have been selected).

The third grandparental involvement variable measures (face-to-face) contact frequency between grandparents and grandchildren. In this case, the information is derived from the children interview, where they are asked "How often do you see [anchor's mother; anchor's father]?". The variable takes the value of 1 if children report meeting either grandparent at least once a week (i.e., almost every day or once per week; =0 if about once per month, once or several times per year, or never have been selected).

We use several variables to compute the propensity score (see Method section), i.e., we compute the propensity for each Anchor-child dyad to receive grandparental involvement. This allows to account for spuriousness, and at the same time, to study the differential impact of this involvement on children's schooling. The first set of variables relates to the anchor: age; sex (female vs. male); educational level (tertiary vs. else); employment status (not employed; full-time; part-time); intact family (i.e., anchor's current partner is the parent of the study child); household income in terciles; self-reported health status (very good/good vs. bad/not so good/satisfactory); migration background (native vs. else); whether living in East or West Germany. The second set of variables relates to the partner: educational level (tertiary vs else); whether employed – if the partner is absent, both variables score zero. The third set of variables relates to the study child: age; sex (female vs male); self-reported health status (very good, good vs. bad, not so good, and satisfactory); and presence of siblings. At the

(extended) family level, i.e., related to the anchor’s parents, we measure the highest grandparental educational level (tertiary vs. else) between the grandmother and the grandfather; if any grandparent has a limitation with activities of daily living (“Has your [mother; father] needed regular help within the last 12 months with daily tasks such as eating, standing up, dressing, bathing, or going to toilet?” Yes vs. No); attitudes on grandparental obligations (“How much do you agree with the statement Grandparents should contribute to the economic security of their grandchildren and the grandchildren’s parents? on a scale from 1=Disagree Completely to 5=Agree Completely); emotional closeness, averaged between the grandmother and the grandfather (“How close do you feel to your [mother; father] today emotionally?” 1=Not at all close; 5=Very close); support given to parents (how often, in the last 12 months, anchor has provided to his/her mother/father the following types of support: advice; money and valuables; help with paperwork; financial support; help with domestic chores; 1= Often, and Very Often). The distribution of our variables is shown in Table 1.

Table 1. Descriptive statistics, weighted estimates

	Mean	SE	Min	Max
Math	3.53	0.02	1	5
German	3.52	0.01	1	5
Grandparental childcare (Often; Very Often)	0.26	0.01	0	1
Contact with Grandparents (Weekly)	0.54	0.01	0	1
Financial transfers from grandparents (Sometimes; Often; Very Often)	0.44	0.01	0	1
Anchor				
Age	38.74	0.07	26	45
Female	0.69	0.01	0	1
Educational level (Tertiary)	0.42	0.01	0	1
Not employed	0.17	0.01	0	1
Employed full-time	0.43	0.01	0	1
Employed part-time	0.4	0.01	0	1
Intact family	0.75	0.01	0	1
Household income terciles: 1st	0.3	0.01	0	1
Household income terciles: 2nd	0.35	0.01	0	1
Household income terciles: 3rd	0.35	0.01	0	1
Health (Very good; Good)	0.62	0.01	0	1
Native	0.79	0.01	0	1
East Germany	0.22	0.01	0	1
Anchor's partner				
Educational level (Tertiary)	0.42	0.01	0	1
In employment	0.8	0.01	0	1
Child				
Age	10.86	0.04	8	15
Female	0.49	0.01	0	1
Health (Very good; Good)	0.85	0.01	0	1
Has siblings	0.85	0.01	0	1
Grandparents				
Educational level (Tertiary)	0.15	0.01	0	1
Health (has received help with ADL Often; Very Often)	0.1	0.01	0	1
Support by children (Sometimes; Often; Very Often)	0.44	0.01	0	1
Grandparental obligations	2.21	0.02	1	5
Emotional closeness grandparents-anchor	3.7	0.02	1	5

Note: weighted estimates. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8

Methods

We use a heterogeneous treatment effect approach with the stratification-multilevel method as proposed by Xie, Brand, and Jann (2012). Heterogeneity of treatment effects analysis follows three steps. In the following lines, grandparental involvement (childcare, contact, and financial transfer) will be referred to as the treatment.

First, a propensity score is estimated for grandparental involvement, given the set of covariates listed above (Table 1). Operationally, for each anchor-child dyad, the propensity score is estimated with a probit regression model, as follows (equation 1):

$$P = p(t_i = 1 | X_i) = \alpha + \sum_{k=1}^K \beta_k X_{ik} \quad (1)$$

P is the estimated propensity score; t is the probability of receiving the treatment, grandparental involvement, for each anchor-child dyad i . X represents a set of covariates referring to grandparents, anchor, anchor's partner, and children, as listed in the paragraph above and Table 1. The approach lies upon the ignorability assumption (also called unconfoundedness and selection on observables) that, after controlling for a rich set of covariates, there are no additional sources of confounding between dyads who do and do not receive the treatment. Conditional on the propensity score, selection into treatment (grandparental involvement) is independent of the outcome (grandchildren's school grades), which is to say that there is no pre-treatment heterogeneity bias.

In the second step of the analysis, linear regression models for grandchildren's school outcomes (math and German) are estimated. The first set of models (equation 2a) regresses grandchildren's outcomes on the three measures of grandparental involvement separately, without controlling for the propensity scores estimated in the first step of the analysis. The second set of models adds the propensity scores, as in equation 2b:

$$grades = \alpha + \beta_1 t_i + \varepsilon_i \quad (2a)$$

$$grades = \alpha + \beta_1 t_i + \beta_2 P_i + \varepsilon_i \quad (2b)$$

Equation 2b estimates the homogeneous effect of grandparental involvement on children's school performance. The comparison between the models with (2b) and without (2a) the propensity scores hints toward the presence of confounding factors in the relation between grandparental involvement and children's school grades.

Third, we explore heterogeneity in the returns to grandparental involvement, namely, whether the heterogeneity in the propensity to receive the treatment (grandparental involvement) corresponds to heterogeneity in the effect of the treatment (grandparental involvement) on mathematics/German grades. Operationally, anchor-child dyads are grouped into propensity score strata according to the propensity scores estimated with equation 1. The underlying idea is to keep constant, within each propensity-score-group (called stratum) the background characteristics that can confound the relation under study. In this way, the group that receives the treatment is comparable to the group that does not receive the treatment. Anchor-child dyads who partake in the first propensity score stratum have a low propensity of grandparental involvement, and anchor-child dyads in the last propensity score

stratum have a high propensity of grandparental involvement, given the set of observed covariates referring to theirs, their parents, and their grandparents' characteristics. The strata are created within the common support region, which means that for each stratum, both treated and control dyads are present (e.g., in the low-propensity stratum, there are both dyads receiving and not receiving grandparental involvement).

The strata are computed so that the average propensity score and the average of each covariate used to compute the score do not statistically ($p < 0.001$) differ between the treated (t , receive grandparental involvement) and the control (c , do not receive grandparental involvement) groups. To quantify the bias between the two groups, we compute the standardised mean difference (SMD, see equation 3), which contrasts the mean value of the variables in the treated and control groups, standardised using the average standard deviation in the two groups:

$$SMD = \left| \frac{\bar{X}_t - \bar{X}_c}{0.5 \sqrt{S_t^2 + S_c^2}} \right| \quad (3)$$

Finally, variance-weighted least squares regression models are computed within each propensity score strata, where mathematics/German grades are regressed upon each of the three grandparental involvement variables, separately. For mathematics, for example, three models are computed for each of the grandparental involvement variable: mathematics on childcare for stratum 1, mathematics on childcare for stratum 2, and so on. Overall, nine models are computed for mathematics, and nine models for German.

Notably, the anchor-child dyads in our sample have repeated observations, and children in our sample can be siblings. Keeping only one child for each anchor or restricting our sample at survey entry would posit additional strains on our already limited sample size and introduce selection bias. Therefore, to account for the correlation between repeated observations, we cluster standard errors at the anchor-child dyad level in each step (for further robustness checks, see Appendix, Table A2)

Finally, calibrated survey-provided weights are applied to all the analysis steps (Wetzel et al., 2021).

Robustness checks

We additionally carry out robustness checks.

First, our dataset includes observations that are repeated over time because we pool several waves. As aforementioned, we account for these correlations by adding cluster standard errors at the anchor-child dyad level in the main analyses. Moreover, we repeat our analyses on the sub-sample of anchor-child dyads at survey entry; our results (Table A2 in Appendix) are unchanged.

Second, given the data structure, some possibly relevant information are missing for specific sub-samples. Indeed, the anchor can be either the mother or the father of the study child (to a similar extent) and the partner questionnaire refers to anchor's partner at the time of the interview. Important information on the study child's absent parent is thus missing in case of a non-intact family. This is particularly important if the anchor is the study child's father because it would mean missing information on maternal employment that is one of the main drivers of grandparental childcare. Similarly, variables on grandparental childcare refer to the anchor's parents; with missing information on in-laws. As maternal grandparents usually provide the most childcare and tend to be the closest to

their daughter's family (e.g., Hank & Buber, 2009), important information is thus missing if the anchor is the study child's father. To partially address these issues, we have performed all our analyses on a sample that selects only mothers as anchors (see Appendix, table A3). Our results are unchanged in comparisons to those presented below.

Results

Homogeneous treatment effect of grandparental involvement on school grades

As a first step, we estimate probit models (Table A1) to calculate the propensity score for each dyad. This score represents the probability of receiving grandparental childcare, the frequency of contact with grandparents, and financial transfers, given the covariates described earlier (see equation 1). The results are generally consistent with the existing literature. However, it is important to note that while grandparents' education does not influence grandparental childcare and frequency of contact when accounting for parents' education, it does affect financial transfers.

Table 2 presents the average mathematics (Models 1-3, upper panel) and German (Models 4-6, lower panel) grades by each grandparental involvement variable. This is shown both without (models with the -A suffix, based on equation 2a) and with (models with the -B suffix, based on equation 2b) the inclusion of the propensity scores estimated from the models in Table A1.

For both school grades considered, the only significant effect of grandparental involvement is observed in the case of grandchild care (Model 1A). Here, significance is evident both statistically and in terms of effect size. Children receiving grandparental childcare score on average 0.11-0.12 points higher on a 1-5 scale. Interestingly, when the propensity score is included in the model (Model 1B), this effect loses statistical significance and approaches zero. Thus, once we account for confounding factors, there appears to be no relation between grandparental involvement and school grades. However, this overall effect may mask differences across dyads with varying family backgrounds.

Table 2. Homogenous treatment effect: linear regression models for the effect of grandparental involvement (grandparental childcare, frequency of contact with grandparents, and financial transfers) on children’s school grades

	Mathematics											
	(1A)		(1B)		(2A)		(2B)		(3A)		(3B)	
	Coef.		Coef.		Coef.		Coef.		Coef.		Coef.	
Grandparental childcare	0.11	*	0.02									
SE	0.05		0.05									
Frequency of contacts					0.04		0.03					
SE					0.04		0.04					
Financial transfers									0.04		0.01	
SE									0.04		0.04	
Propensity score			0.84	***			0.03				0.52	**
SE			0.15				0.13				0.18	
Constant	3.45	***	3.26	***	3.46	***	3.44	***	3.46	***	3.25	***
	0.03		0.05		0.03		0.07		0.03		0.09	
German												
	(4A)		(4B)		(5A)		(5B)		(6A)		(6B)	
	Coef.		Coef.		Coef.		Coef.		Coef.		Coef.	
Grandparental childcare	0.12	**	0.04									
SE	0.04		0.04									
Frequency of contacts					0.02		0.02					
SE					0.04		0.04					
Financial transfers									0.03		0.00	
SE									0.04		0.04	
Propensity score			0.78	***			-0.06				0.40	**
SE			0.13				0.11				0.15	
Constant	3.46	***	3.29	***	3.48	***	3.51	***	3.48	***	3.32	***
	0.02		0.04		0.03		0.06		0.03		0.07	

Note: SE in italics. Weighted estimates; standard errors clustered at the anchor-child dyad level. Propensity score was generated by probit regression models as shown in Table A1. * p<0.05, ** p<0.01, *** p<0.001 N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Grouping observations according to the propensity of grandparental involvement

After examining the homogeneous treatment effect (Table 2), which pertains to the overall effect of grandparental involvement on children’s schooling, we now turn to investigating heterogeneities. To explore heterogeneity in the treatment effect, we divide the propensity scores estimated in Table A1 into strata. These strata must be balanced, meaning that within each group, the average propensity score and the means of each covariate do not differ between dyads receiving grandparental involvement (treated) and those who do not (controls) (p<0.001).

Due to the limited number of observations in our sample, we collapse extreme intervals of the propensity score to create three strata for each grandparental involvement variable. Figures without this adjustment are reported in the Appendix (Figures A1-A3). Differences in results, particularly for the frequency of contact, are discussed in more detail below.

In Tables A4 (grandparental childcare), A5 (frequency of contact), and A6 (financial transfers), we report descriptive statistics for the characteristics of dyads within each propensity score stratum.

Additionally, we include a measure of bias commonly used in the literature, the standardized mean difference (SMD), and the sample size for both treated and control groups.

When comparing Stratum 1 (anchor-child dyads with the lowest probability of receiving grandparental involvement) to Stratum 3 (anchor-child dyads with the highest probability of receiving grandparental involvement), several differences emerge, consistent with previous literature. In Stratum 3, anchors are generally younger and more likely to be female, leading to greater involvement from maternal grandparents. Additionally, anchors in this stratum are slightly more likely to hold a tertiary educational degree, as are their partners. They are also more likely to work part-time and have an employed partner. Other notable differences include a higher probability of being German natives and residing in East Germany. Regarding children's characteristics, those in Stratum 3 are less likely to have siblings. For grandparents, anchors in this stratum are much more likely to engage in various activities with them, indicating a reciprocal support relationship, and are more emotionally close to their parents. There are no significant differences in grandparental education between the strata.

The characteristics of dyads with respect to the frequency of contact variable show similar trends. However, there are a few notable differences: in Stratum 3, anchors, their partners, and grandparents are less likely to hold a tertiary education degree compared to those in Stratum 1. Similarly, they are less likely to be in the highest household income tercile of the distribution. Additionally, grandparents in Stratum 3 are less likely to have poor health and exhibit stronger intergenerational relationship norms.

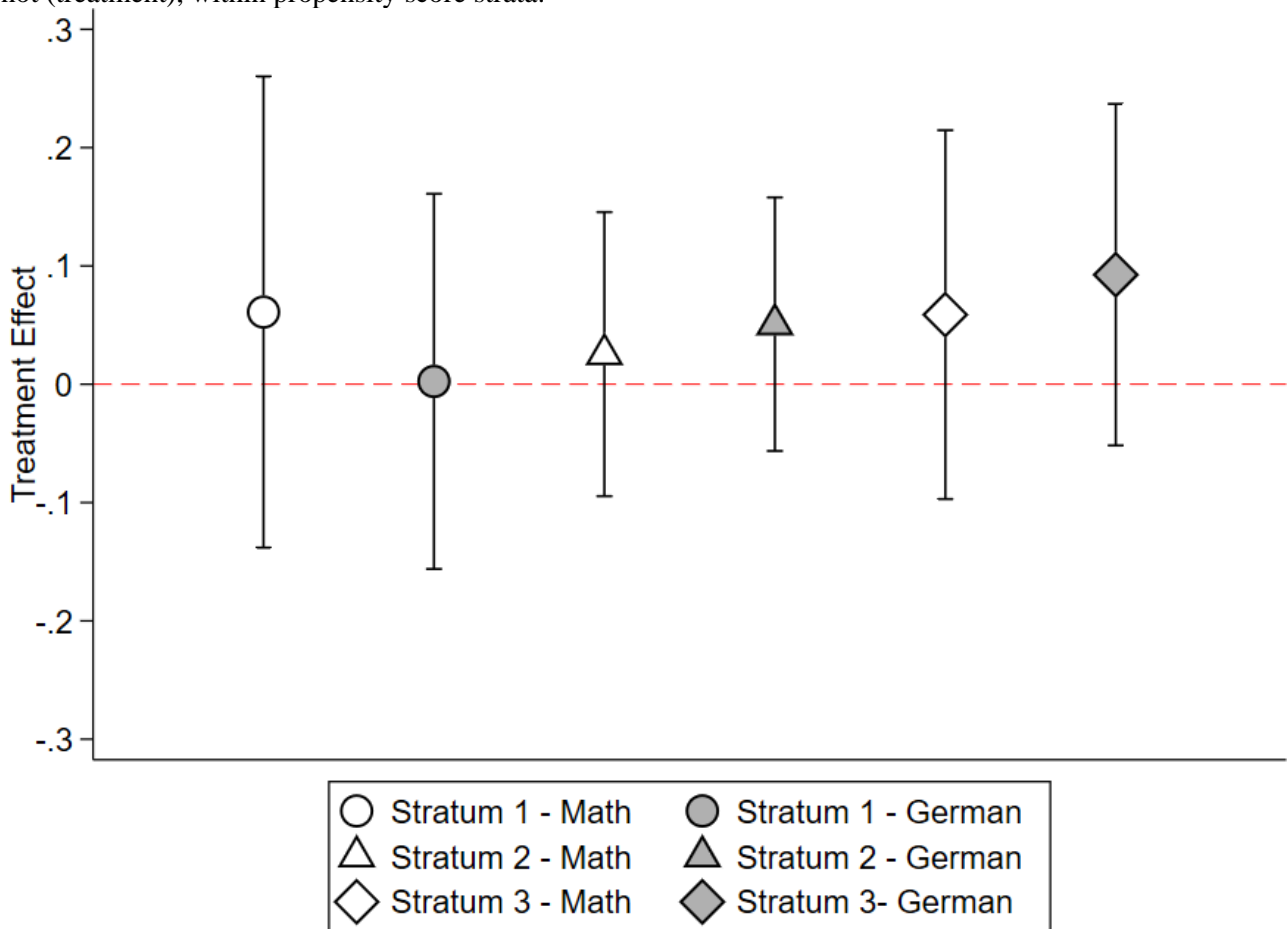
For financial transfers, like grandparental childcare, anchors, their partners, and grandparents in Stratum 3 are more likely to have tertiary education and be in the highest income tercile. They also exhibit stronger intergenerational relationship norms. Other differences closely resemble those observed for grandparental childcare.

In relation to the positive selection hypothesis, which is partially contradicted by these findings, the educational level of the grandparent influences their involvement in different ways depending on the type of involvement. Highly educated grandparents are equally likely to provide childcare, less likely to engage in frequent contact with their grandchildren, and more likely to offer financial support compared to their less educated counterparts.

Heterogeneity in the returns of grandparental involvement on school grades

We now examine the effect of grandparental involvement on children's school grades within each propensity score stratum. The goal is to explore how the returns to grandparental involvement vary for children based on their background characteristics, which also influence the likelihood of receiving such involvement. Figure 1 displays the effect of receiving grandparental childcare on children's grades in mathematics (represented by white symbols) and German (represented by grey symbols) across different propensity score strata. Each coefficient represents the difference in school grades between children who receive grandparental involvement and those who do not. The figure shows that all coefficients are very close to zero, indicating no significant difference in school grades between children with and without grandparental involvement. This suggests that there is no heterogeneous relationship between grandparental childcare and school grades.

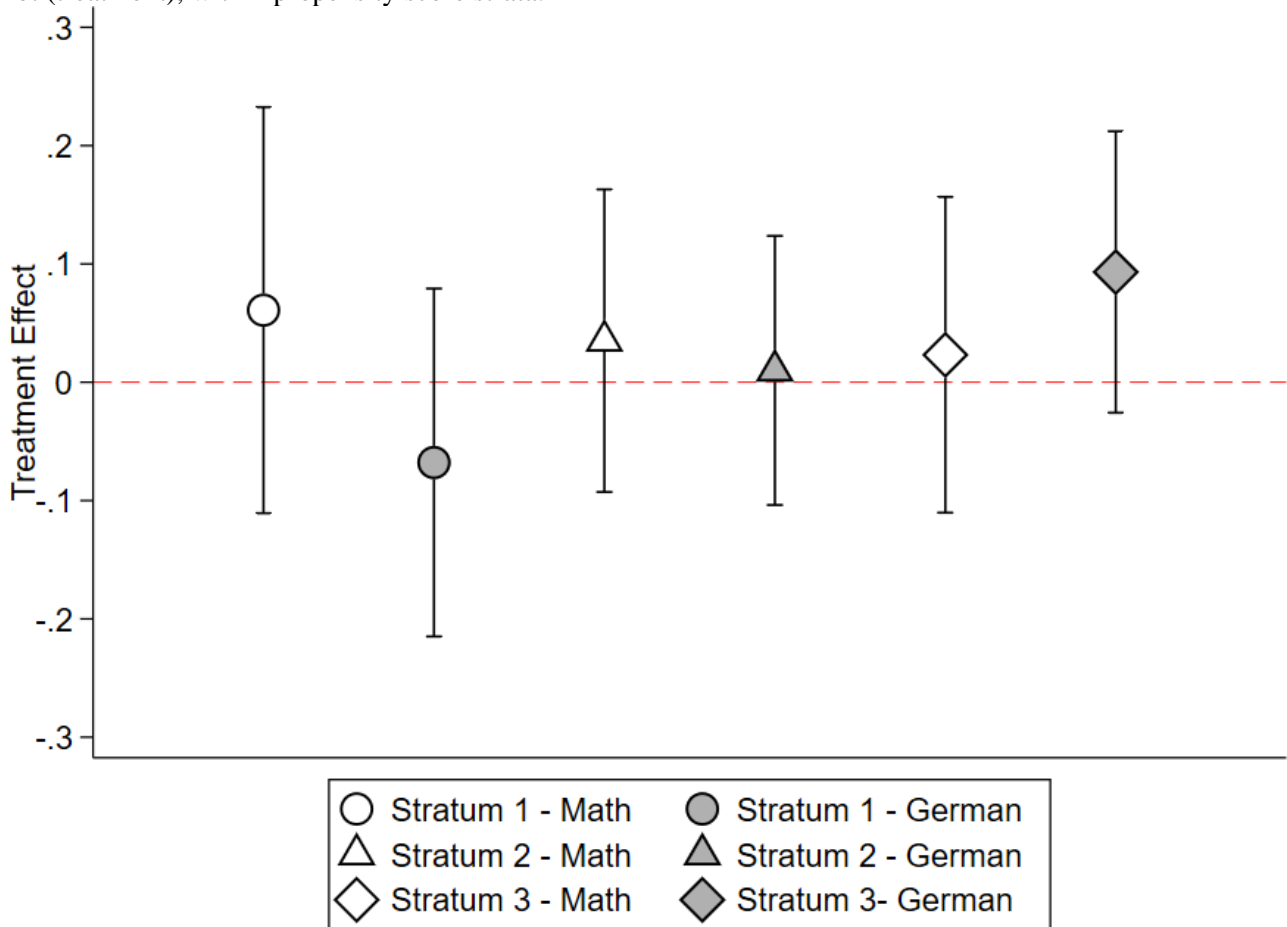
Figure 1. Heterogeneous treatment effect: differences in grandchildren’s grades in mathematics (white symbols) and German (grey symbols), between dyads who receive grandparental childcare, and those who do not (treatment), within propensity score strata.



Note: Results from variance-weighted least squares regression models. 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Similarly, Figures 2 and 3 present results for frequency of contact and financial transfers, respectively. However, there are a few noteworthy points. In Figure 2, children in Stratum 3 exhibit an increase in German grades associated with frequent contact with grandparents, though this effect is not statistically significant at the 95% level. This trend becomes more pronounced in Figure A2, where extreme categories are not collapsed. Specifically, the treatment effect for children in Stratum 6 shows an increase in German grades of 0.30 points for those who spend more time with grandparents. Nevertheless, we interpret this result with caution due to the small sample size in this stratum, which includes only 28 controls and 141 treated individuals, potentially leading to uncertain estimates.

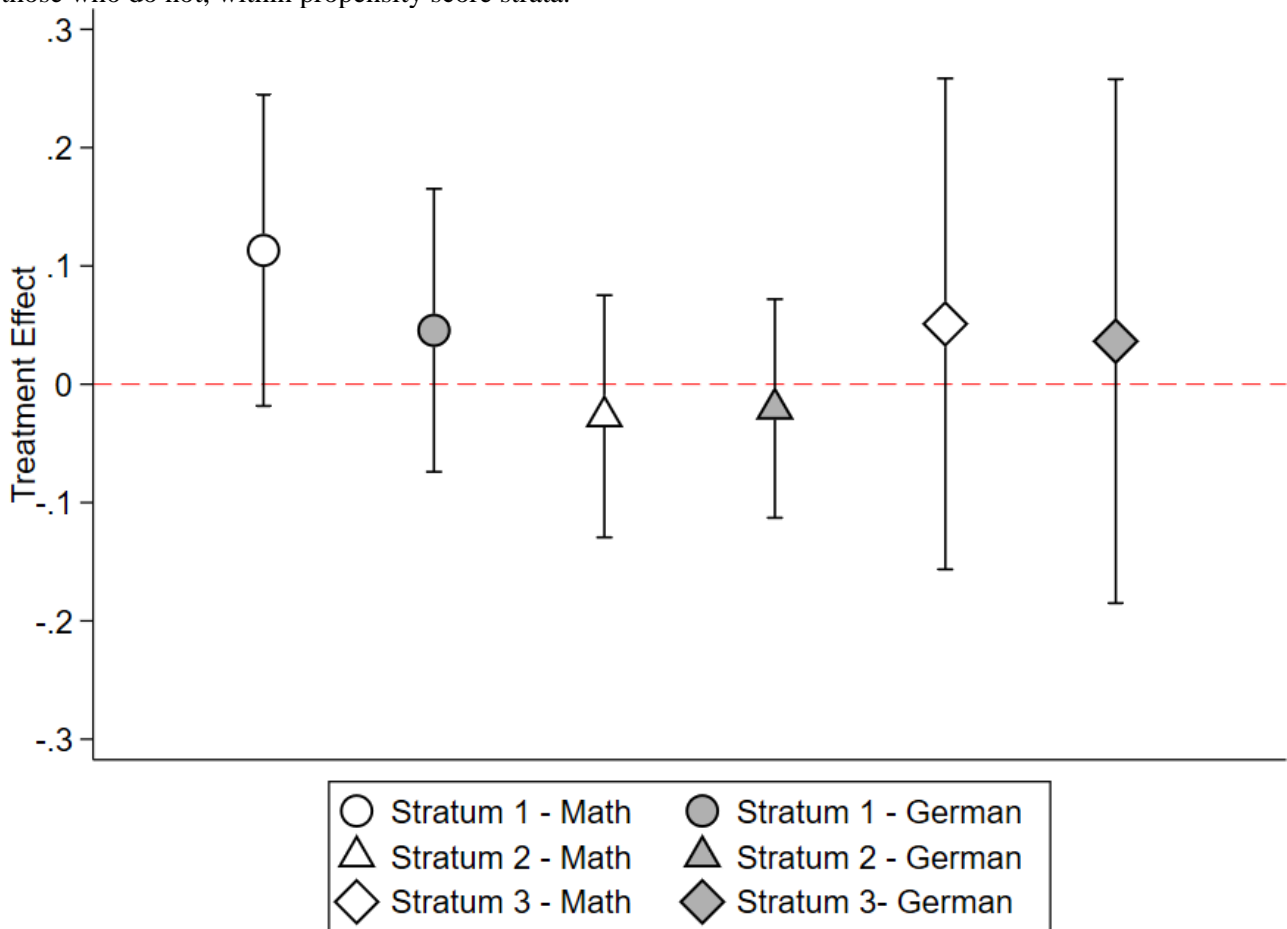
Figure 2. Heterogeneous treatment effect: differences in grandchildren's grades in mathematics (white symbols) and German (grey symbols), between dyads who have contact with grandparents, and those who do not (treatment), within propensity score strata.



Note: Results from variance-weighted least squares regression models, 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Similarly, there is evidence of higher grades in mathematics for children who receive financial transfers while having a low propensity to receive it (Stratum 1 in Figure 3). However, the difference between treated and control groups is not statistically significant at the 0.05 level of confidence.

Figure 3. Heterogeneous treatment effect: differences in grandchildren’s grades in mathematics (white symbols) and German (grey symbols), between dyads who receive financial transfer from grandparents, and those who do not, within propensity score strata.



Note: Results from variance-weighted least squares regression models. 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Discussion and conclusion

In this study, we aimed to determine whether there is a relationship between grandparental involvement and grandchildren's school outcomes, and whether this relationship varies according to the extended family's characteristics.

Operationally, we used data from the German Pairfam survey (2009/2010–2015/2016) (Brüderl et al., 2023; Huinink et al., 2011), which provides a unique opportunity in the European context to collect socioeconomic information across three family generations: grandparents, parents, and grandchildren – which we referred to as the extended family. We defined grandparental involvement broadly, encompassing not only childcare that substitutes or complements publicly provided options but also contact and financial transfers. Given that the children in our sample are aged 8-15 and thus enrolled in compulsory education, these forms of involvement may be more relevant. Furthermore, we chose to examine children’s school performance, focusing on educational outcomes rather than socio-emotional and cognitive development (as is often done in the literature, see Melhuish et al., 2016), to align with grandchildren’s age and with discussions on the intergenerational transmission of resources (Anderson, Sheppard, & Monden, 2018).

Our analysis addressed and accounted for potential confounding factors at the child, parental, and grandparental levels that could bias the relationship between grandparental involvement and children's schooling. For example, previous research has shown that more advantaged families are more likely to spend time with their children, aiming to foster their socio-emotional and cultural development (Dotti Sani & Treas, 2016; Zanasi & Sieben, 2022), which in turn is associated with better academic achievement. To account for this in the German context, we created a propensity score for each observation in our sample, considering a comprehensive set of covariates including socioeconomic status, health, employment conditions, and family norms across all three generations involved. We detected a positive association between grandparental involvement and school grades, both in German and Mathematics only for grandparental childcare and only when the propensity score was not included. This confirms the importance to account for the extended family's background characteristics.

We further investigated population heterogeneities, namely whether the returns to grandparental involvement on school performance vary according to the extended family's characteristics. We hypothesized that children from more advantaged socioeconomic backgrounds might be the most likely to receive grandparental involvement and benefit the most from it (positive selection hypothesis, Brand & Xie, 2010). This is because their grandparents may have better economic and cultural resources to support the grandchildren's schooling.

Operationally, we applied a heterogeneous treatment effect approach as proposed by Xie, Brand, and Jann (2012). We created propensity score strata, grouping individuals according to the propensity of receiving grandparental involvement, given a set of covariates.

Contrary to expectations, grandparents' high socioeconomic status was not associated with a higher propensity of providing childcare and contact, only financial transfers. This could be attributed to the operationalization of face-to-face grandparental involvement, which includes "often/very often" commitment. It is challenging to quantify what this frequency means for respondents. If involvement occurs on a weekly or daily basis, socioeconomic status may serve as a protective factor against intensive grandparental commitment (Di Gessa et al., 2016). Additionally, Pairfam does not provide detailed insights into the content of the grandparent-grandchild relationship—specifically, what activities grandparents and grandchildren engage in together. Socioeconomic status influences particular types of interactions, such as helping with homework or other educational activities. Finally, existing evidence (Di Gessa, Glaser, & Zaninotto, 2022; Zanasi & Sieben, 2022), particularly on shared time and activities, primarily pertains to the English context. Grandparental involvement might be differently stratified in the German context due to cultural and institutional differences, such as income inequality and mothers' labor force participation.

When examining the propensity score-stratum specific effects of grandparental involvement on grandchildren's schooling, we did not find strong evidence supporting the presence of a heterogeneous treatment effect. In summary, grandparental involvement did not appear to impact 8-15 years-old grandchildren's school outcomes in Germany, neither on average, nor across population subgroups.

One of the reasons for this may however lie in the age of children under study. Indeed, studies on the role of grandparental childcare as compared to ECEC suggest that the care effect vanishes with increasing child's age (see Melhuish et al., 2016). Milovanska-Farrington (2021) confirms, with fixed-

effect panel models (accounting for time-constant unobserved heterogeneity) that grandparents' supervision time has a greater impact on children's vocabulary skills, than the one with parents, in children 0 to 10 years old – but the contrary holds for socio-behavioural development.

At the same time, our results align with the findings of Tanskanen and Danielsbacka (2018) on UK data, who used measures of grandparental involvement similar to ours (frequency of contact, financial transfers). They detected an effect of grandparental involvement "between" children, but not "within" children over time, thus accounting for time-constant unobserved heterogeneity. Similarly, Bol and Kalmijn's (2016) study in the Netherlands did not support evidence of a grandparent effect on children's socioeconomic status, even when considering the strength of ties between the two generations.

Overall, we cannot rule out the possibility that the differing results in our study compared to the existing literature may be attributed to our choice of dependent variable—children's school grades—which has not been extensively explored in relation to grandparental involvement. While children's school grades can be seen as a precursor to future educational achievements, our study aims to connect this to the broader literature on the so-called grandparent effect (Anderson, Sheppard, & Monden, 2018), which examines whether individuals' achieved status is influenced by the socioeconomic status of their grandparents as well as their parents. One potential mechanism for this status transmission, although rarely tested (with Bol and Kalmijn, 2016 being an exception), is contact-based. This mechanism suggests that highly educated parents and grandparents invest more time and resources in developmental activities with children to ensure their future socioeconomic success. Based on our findings, we provide indirect evidence that this channel of status transmission does not appear to hold for 8-year-old children in Germany.

The main limitations of this study lie in both the data available and the methodology employed. Beside the limitation mentioned above on the measurement of the grandparental involvement variables, it must be added that such information is based solely on reports from the "Anchor," who is part of the parental generation. Consequently, we lack information on the involvement of in-laws, which becomes particularly significant when the Anchor is the father, leaving out potentially active maternal grandmothers. We address these concerns in the "Robustness Checks" section and provide additional analyses to support the results presented. However, our estimates may not fully capture the impact of caregiving by both sets of grandparents, potentially introducing bias by comparing families with similar maternal but differing paternal grandparental involvement.

Secondly, the propensity score methodology only balances the covariates that we have measured, which does not account for residual confounding by unmeasured factors. For instance, due to the design of the Pairfam survey, information on the non-residential parent in cases of parental separation is unavailable—only the Anchor's partner is included. This limitation is particularly relevant for maternal employment, a key driver of grandparental childcare.

Finally, although the Pairfam survey is a panel study, our approach involves pooling data across multiple waves. This strategy was employed to maximize sample size and statistical power for the heterogeneity analysis and to mitigate the effects of selective attrition. A strictly longitudinal design could provide more precise insights into confounding factors and causality; however, restricting the study to only dyads observed at least twice would result in the exclusion of 740 observations. Despite these limitations, it is important to note that the Pairfam survey remains unique in Europe for its

comprehensive information on grandparental involvement alongside the socioeconomic and demographic characteristics of three generations.

To conclude, our paper largely contributes to the literature on the effects of intergenerational relationships for the family members involved, shedding light on the younger generation. This study does not detect any effect of grandparental involvement on school outcomes of children aged 8+ in Germany, suggesting the importance to investigate intergenerational relationships across the life course in a way that accounts for its meaning across the various development phases of children. Future studies, possibly drawing on richer data, should further extend the analyses carried out here considering the alternative (and/or the combination of) childcare arrangements used and to investigate possible heterogeneities across sub-groups within the population, for example considering additional characteristics of the children, of the parents, and of the grandparents – across the most important stratification lines, such as migration background.

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Appendix

Table A1. Propensity score probit regression models regressing grandparental childcare, frequency of contact with grandparents, and financial transfers on selected covariates

	Grandparental Childcare			Frequency of contact			Financial transfers		
	Coef.		SE	Coef.		SE	Coef.		SE
Anchor									
Age	-0.03	**	0.01	-0.02	**	0.01	-0.03	**	0.01
Female	0.22	*	0.11	0.00		0.10	0.04		0.09
Educational level: Tertiary	0.11		0.08	-0.10		0.08	0.08		0.07
Employed full-time (ref. Not employed)	0.00		0.12	0.06		0.11	0.02		0.11
Employed part-time	0.06		0.10	0.17		0.09	0.07		0.10
Intact family	-0.03		0.10	0.02		0.09	-0.04		0.09
Household income terciles: 2nd (ref. 1st tercile)	0.16		0.08	-0.05		0.08	0.12		0.09
Household income terciles: 3rd	0.16		0.10	-0.11		0.10	0.17		0.10
Health: Very good; Good	0.04		0.06	-0.04		0.06	-0.03		0.06
Native	0.23	**	0.09	0.42	***	0.09	0.18	*	0.08
East Germany	0.20	*	0.09	0.01		0.08	-0.05		0.08
Anchor's partner									
Educational level: Tertiary	0.13		0.08	-0.15		0.08	0.05		0.08
In employment	0.08		0.09	0.24	**	0.09	-0.01		0.09
Child									
Age	-0.07	***	0.02	-0.02		0.02	-0.02		0.01
Female	0.04		0.07	0.01		0.07	-0.01		0.06
Health: Very good; Good	-0.02		0.08	0.02		0.07	0.00		0.07
Has siblings	-0.20		0.10	-0.05		0.09	-0.13		0.09
Grandparents									
Educational level: Tertiary	0.00		0.10	-0.06		0.10	0.20	*	0.10
Need help	-0.56	***	0.12	-0.20	*	0.10	0.00		0.10
Give help with other activities	0.03		0.03	-0.01		0.03	0.07	*	0.03
Grandparental obligations	0.23	***	0.04	0.19	***	0.03	0.17	***	0.03
Emotional closeness grandparents-anchor	0.48	***	0.07	0.57	***	0.06	0.33	***	0.06
Constant	-0.48		0.40	-0.09		0.37	-0.12		0.37

Note: weighted estimates; standard errors clustered at the anchor-child dyad level. * p<0.05, ** p<0.01, *** p<0.001 N=3,187. Source: own calculations on pairfam waves 2, 4, 6 and 8.

Table A2. Robustness checks: Homogenous treatment effect: variance-weighted least squares regression models for the effect of grandparental involvement (grandparental childcare, frequency of contact with grandparents, and financial transfers) on children’s school grades – anchor-child dyads at survey entry

		Mathematics							
		Grandparental Childcare		Frequency of contact		Financial transfers			
		Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Grandparental involvement	0.11	*	0.02	0.08	0.09	0.14	**	0.07	
	<i>-0.05</i>		<i>-0.06</i>	<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>		<i>-0.05</i>	
Propensity score			0.77	***		-0.09		0.93	***
			<i>-0.18</i>			<i>-0.16</i>		<i>-0.21</i>	
Constant	3.57	***	3.39	***	3.56	***	3.61	***	3.54
	<i>-0.03</i>		<i>-0.06</i>		<i>-0.04</i>		<i>-0.09</i>		<i>-0.04</i>
									<i>-0.11</i>
		German							
		Grandparental Childcare		Frequency of contact		Financial transfers			
		Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Grandparental involvement	0.10	*	0.00	0.05	0.07	0.09	*	0.03	
	<i>-0.05</i>		<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>		<i>-0.05</i>	
Propensity score			0.88	***		-0.10		0.93	***
			<i>-0.15</i>			<i>-0.14</i>		<i>-0.18</i>	
Constant	3.56	***	3.35	***	3.56	***	3.61	***	3.55
	<i>-0.03</i>		<i>-0.05</i>		<i>-0.04</i>		<i>-0.08</i>		<i>-0.03</i>
N	1692		1692		1692		1692		1692

Note: SE in italics. Weighted estimates; standard errors clustered at the anchor-child dyad level. Propensity score was generated by probit regression models as shown in Table A1. * p<0.05, ** p<0.01, *** p<0.001. Source: Pairfam waves 2, 4, 6 and 8

Table A3. Robustness checks: Homogenous treatment effect: linear regression models for the effect of grandparental involvement (grandparental childcare, frequency of contact with grandparents, and financial transfers) on children’s school grades– only female anchors

	Mathematics							
	Grandparental Childcare		Frequency of contact		Financial transfers			
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	
Grandparental involvement	0.16	**	0.01	0.07	0.03	0.03	-0.01	
	<i>-0.05</i>		<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>	<i>-0.05</i>	
Propensity score			1.35	***	0.37	*	0.56	**
			<i>-0.17</i>		<i>-0.16</i>		<i>-0.21</i>	
Constant	3.41	***	3.07	***	3.41	***	3.24	***
	<i>-0.03</i>		<i>-0.06</i>		<i>-0.04</i>		<i>-0.09</i>	<i>-0.04</i>
							<i>3.44</i>	<i>***</i>
							<i>3.21</i>	<i>***</i>
							<i>-0.10</i>	
German								
	Grandparental Childcare		Frequency of contact		Financial transfers			
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	
Grandparental involvement	0.13	**	0.01	0.07	0.05	0.06	0.02	
	<i>-0.05</i>		<i>-0.05</i>	<i>-0.04</i>	<i>-0.04</i>	<i>-0.05</i>	<i>-0.04</i>	
Propensity score			1.19	***	0.20		0.63	***
			<i>-0.14</i>		<i>-0.14</i>		<i>-0.18</i>	
Constant	3.43	***	3.13	***	3.43	***	3.33	***
	<i>-0.03</i>		<i>-0.05</i>		<i>-0.03</i>		<i>-0.08</i>	<i>-0.03</i>
N	2212		2212		2212		2212	

Note: SE in italics. Weighted estimates; standard errors clustered at the anchor-child dyad level. Propensity score was generated by probit regression models as shown in Table A1. * p<0.05, ** p<0.01, *** p<0.001. Source: Pairfam waves 2, 4, 6 and 8

Table A4. Mean of covariates for treated (receive grandparental childcare) and control (does not receive grandparental childcare) groups within each propensity score strata, and measure of bias (SMD, standardized mean difference)

	Stratum 1			Stratum 2			Stratum 3		
	Control	Treated	SMD	Control	Treated	SMD	Control	Treated	SMD
Anchor									
Age	39.83	39.86	0.01	38.82	38.19	0.16	36.51	37.07	0.12
Female	0.56	0.67	0.24	0.74	0.75	0.02	0.82	0.85	0.08
Educational level: Tertiary	0.37	0.39	0.02	0.45	0.44	0.02	0.45	0.47	0.04
Employed full-time	0.53	0.42	0.21	0.38	0.41	0.07	0.34	0.35	0.01
Employed part-time	0.29	0.37	0.17	0.45	0.45	0	0.46	0.52	0.13
Intact family	0.76	0.75	0.04	0.77	0.75	0.05	0.7	0.68	0.04
Household income terciles: 2nd	0.31	0.31	0	0.36	0.37	0.02	0.38	0.42	0.09
Household income terciles: 3rd	0.33	0.29	0.07	0.36	0.39	0.06	0.38	0.36	0.02
Health: Very good; Good	0.6	0.6	0.01	0.63	0.62	0.02	0.65	0.64	0.03
Native	0.72	0.75	0.06	0.82	0.8	0.03	0.87	0.89	0.06
East Germany	0.16	0.11	0.15	0.22	0.23	0.03	0.32	0.36	0.08
Anchor's partner									
Educational level: Tertiary	0.36	0.35	0.02	0.45	0.46	0.02	0.49	0.43	0.12
In employment	0.73	0.74	0.01	0.83	0.84	0.02	0.85	0.84	0.03
Child									
Age	11.62	11.63	0.01	10.7	10.6	0.05	9.95	9.55	0.24
Female	0.46	0.49	0.06	0.51	0.52	0.03	0.5	0.48	0.03
Health: Very good; Good	0.86	0.87	0.03	0.86	0.85	0.03	0.8	0.83	0.08
Has siblings	0.9	0.89	0.05	0.85	0.86	0.05	0.77	0.69	0.19
Grandparents									
Educational level: Tertiary	0.14	0.09	0.16	0.18	0.19	0.04	0.13	0.14	0.04
Need help	0.2	0.15	0.12	0.05	0.04	0.04	0	0.01	0.06
Give help with other activities	0.18	0.23	0.13	0.47	0.5	0.06	0.88	0.88	0
Grandparental obligations	2.17	2.19	0.02	2.21	2.2	0	2.33	2.29	0.04
Emotional closeness grandparents-anchor	3.09	3.36	0.3	3.91	3.89	0.02	4.37	4.51	0.21
Propensity Score	0.12	0.14	0.52	0.28	0.3	0.27	0.48	0.51	0.41
N	1073	150		945	422		328	269	

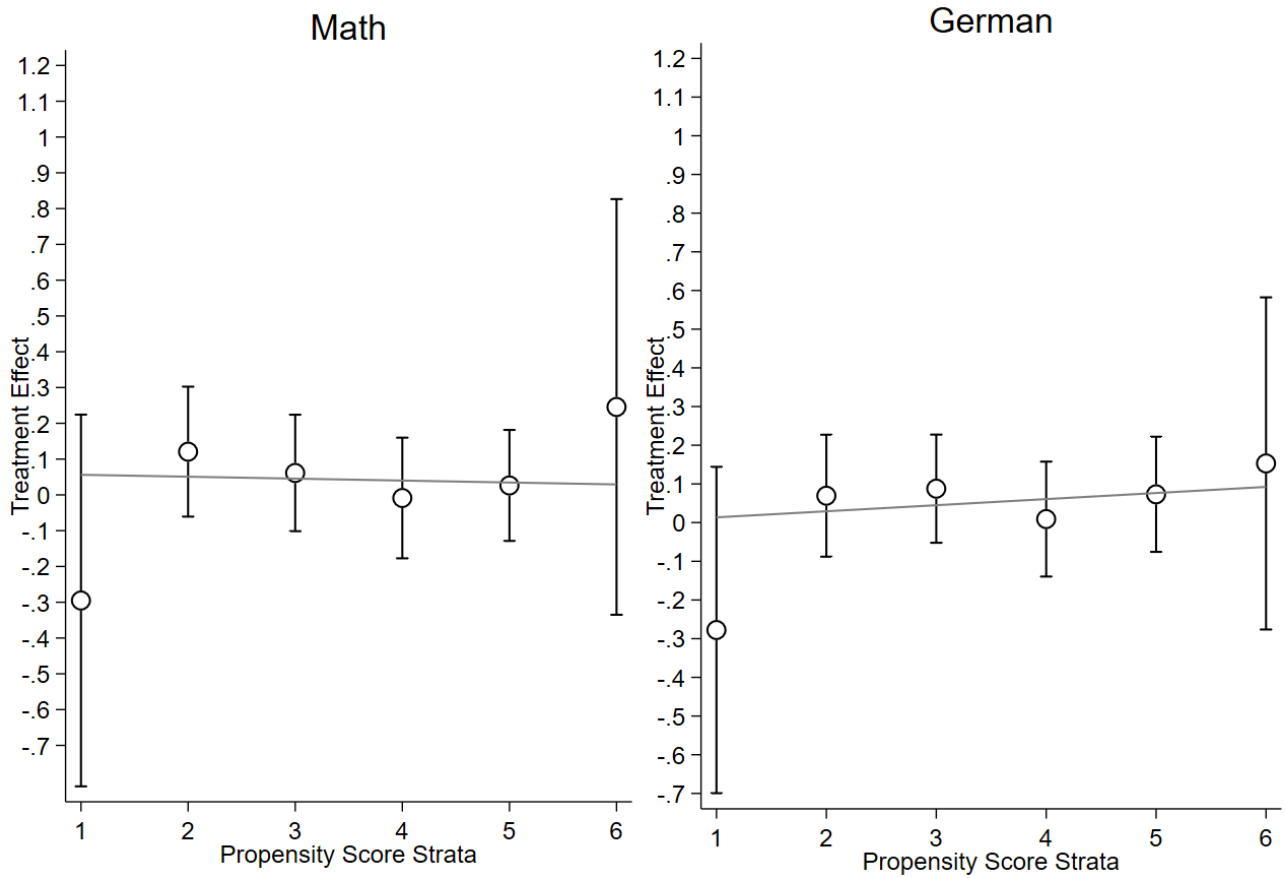
Table A5. Mean of covariates for treated (frequent contacts with grandparents) and control (no frequent contact with grandparents) groups within each propensity score strata, and measure of bias (SMD, standardized mean difference)

	Stratum 1			Stratum 2			Stratum 3		
	Control	Treated	SMD	Control	Treated	SMD	Control	Treated	SMD
Anchor									
Age	40.43	39.99	0.14	38.85	38.94	0.02	37.52	37.55	0.01
Female	0.56	0.69	0.26	0.7	0.73	0.06	0.75	0.72	0.07
Educational level:									
Tertiary	0.65	0.64	0.02	0.41	0.45	0.07	0.32	0.24	0.16
Employed full-time	0.56	0.48	0.15	0.43	0.42	0.02	0.35	0.36	0.02
Employed part-time	0.27	0.38	0.24	0.39	0.4	0.03	0.47	0.47	0
Intact family	0.76	0.76	0.01	0.78	0.78	0.01	0.7	0.71	0.03
Household income									
terciles: 2nd	0.29	0.29	0.01	0.35	0.36	0.02	0.37	0.4	0.06
Household income									
terciles: 3rd	0.48	0.5	0.04	0.37	0.36	0.01	0.27	0.24	0.08
Health: Very good;									
Good	0.7	0.73	0.06	0.62	0.59	0.05	0.57	0.57	0
Native	0.61	0.53	0.16	0.8	0.84	0.1	0.87	0.91	0.14
East Germany	0.19	0.19	0	0.25	0.22	0.07	0.2	0.23	0.06
Anchor's partner									
Educational level:									
Tertiary	0.61	0.61	0.01	0.42	0.42	0.02	0.33	0.27	0.14
In employment	0.72	0.74	0.05	0.8	0.81	0.03	0.84	0.83	0.03
Child									
Age	11.21	11.21	0	10.88	10.87	0	10.75	10.57	0.08
Female	0.48	0.47	0.01	0.51	0.48	0.06	0.46	0.5	0.07
Health: Very good;									
Good	0.87	0.89	0.06	0.85	0.84	0.04	0.81	0.84	0.08
Has siblings	0.86	0.91	0.17	0.85	0.84	0.01	0.86	0.83	0.1
Grandparents									
Educational level:									
Tertiary	0.27	0.26	0.02	0.17	0.13	0.1	0.09	0.07	0.08
Need help	0.14	0.14	0.01	0.1	0.07	0.1	0.08	0.07	0.04
Give help with other									
activities	2.15	2.19	0.04	2.28	2.12	0.15	2.22	2.28	0.06
Grandparental									
obligations	2.96	3.09	0.15	3.64	3.71	0.08	4.17	4.21	0.05
Emotional closeness									
grandparents-anchor	0.03	0.07	0.17	0.28	0.28	0.01	0.86	0.88	0.07
Propensity Score	0.3	0.32	0.19	0.49	0.51	0.22	0.7	0.72	0.29
N	557	248		578	605		330	869	

Table A6. Mean of covariates for treated (receive financial transfers from grandparents) and control (does not receive financial transfers from grandparents) groups within each propensity score strata, and measure of bias (SMD, standardized mean difference)

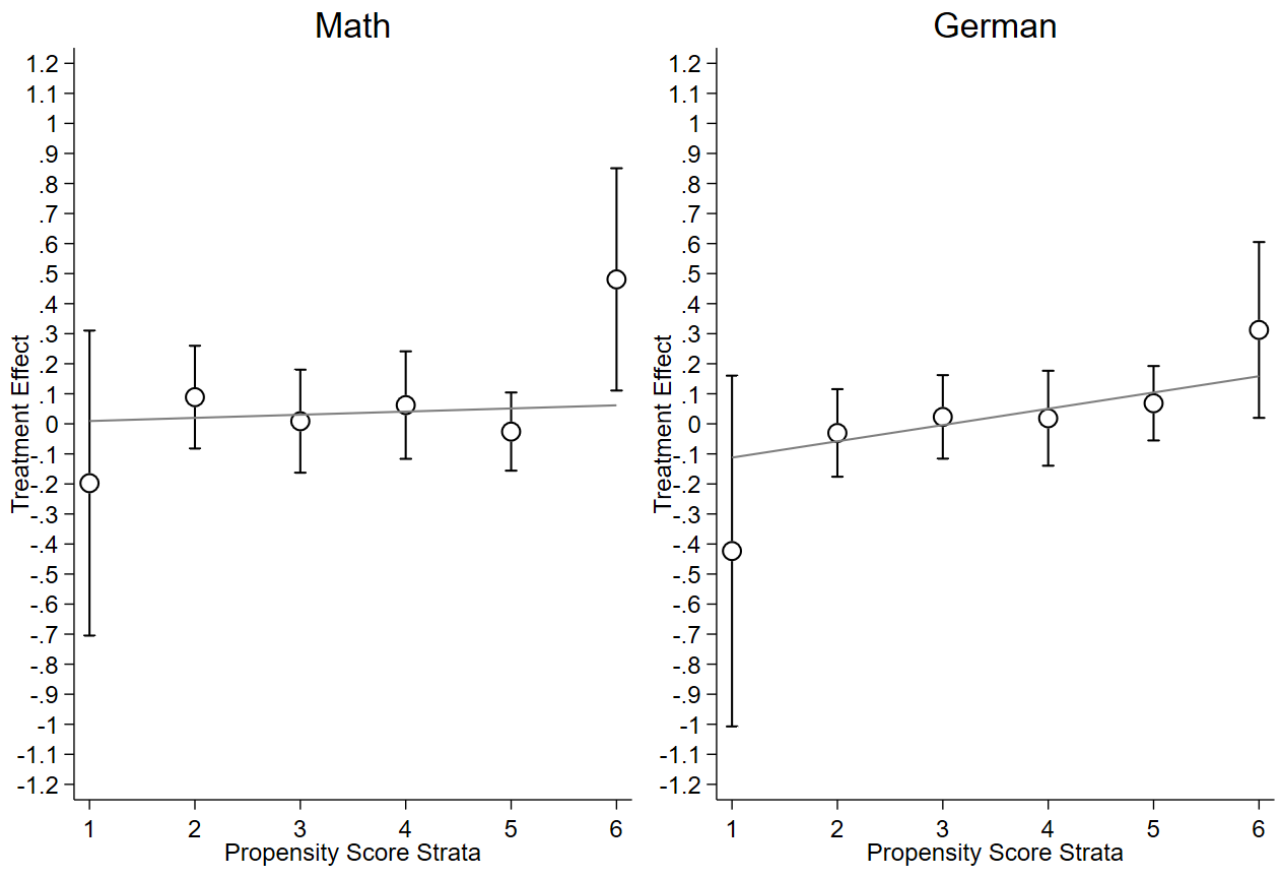
	Stratum 1			Stratum 2			Stratum 3		
	Control	Treated	SMD	Control	Treated	SMD	Control	Treated	SMD
Anchor									
Age	40.01	39.81	0.06	38.61	38.4	0.05	34.97	35.25	0.06
Female	0.62	0.64	0.04	0.73	0.72	0.01	0.85	0.78	0.16
Educational level: Tertiary	0.36	0.44	0.15	0.48	0.41	0.15	0.47	0.43	0.09
Employed full-time	0.5	0.45	0.08	0.39	0.41	0.04	0.37	0.34	0.04
Employed part-time	0.33	0.32	0.01	0.44	0.44	0.02	0.4	0.51	0.21
Intact family	0.79	0.79	0.01	0.76	0.74	0.04	0.58	0.55	0.05
Household income terciles: 2nd	0.35	0.29	0.14	0.34	0.38	0.08	0.33	0.36	0.08
Household income terciles: 3rd	0.3	0.31	0.03	0.39	0.35	0.08	0.44	0.42	0.04
Health: Very good; Good	0.66	0.63	0.06	0.61	0.59	0.04	0.54	0.62	0.16
Native East Germany	0.74	0.72	0.04	0.82	0.81	0.01	0.86	0.89	0.11
Anchor's partner Educational level: Tertiary	0.36	0.4	0.07	0.47	0.42	0.1	0.46	0.41	0.1
In employment	0.77	0.77	0.01	0.84	0.8	0.11	0.76	0.78	0.06
Child									
Age	11.37	11.25	0.06	10.66	10.75	0.04	9.91	9.82	0.05
Female	0.5	0.52	0.05	0.5	0.49	0.01	0.44	0.39	0.1
Health: Very good; Good	0.85	0.87	0.06	0.84	0.85	0.02	0.83	0.8	0.06
Has siblings	0.89	0.91	0.09	0.86	0.82	0.1	0.67	0.71	0.08
Grandparents Educational level: Tertiary	0.08	0.09	0.03	0.2	0.17	0.08	0.26	0.29	0.07
Need help	0.1	0.09	0.05	0.09	0.1	0.01	0.04	0.12	0.3
Give help with other activities	1.96	2	0.04	2.27	2.32	0.05	2.71	2.77	0.05
Grandparental obligations	3.05	3.2	0.17	4	3.99	0.01	4.49	4.59	0.17
Emotional closeness grandparents-anchor	0.12	0.15	0.1	0.57	0.61	0.1	0.95	0.93	0.11
Propensity Score	0.31	0.33	0.28	0.49	0.49	0.07	0.65	0.65	0.11
N	847	377		846	810		104	203	

Figure A1. Heterogeneous treatment effect: differences in grandchildren's grades in mathematics (white symbols) and German (grey symbols), between dyads who receive grandparental childcare, and those who do not (treatment), within propensity score strata (all strata).



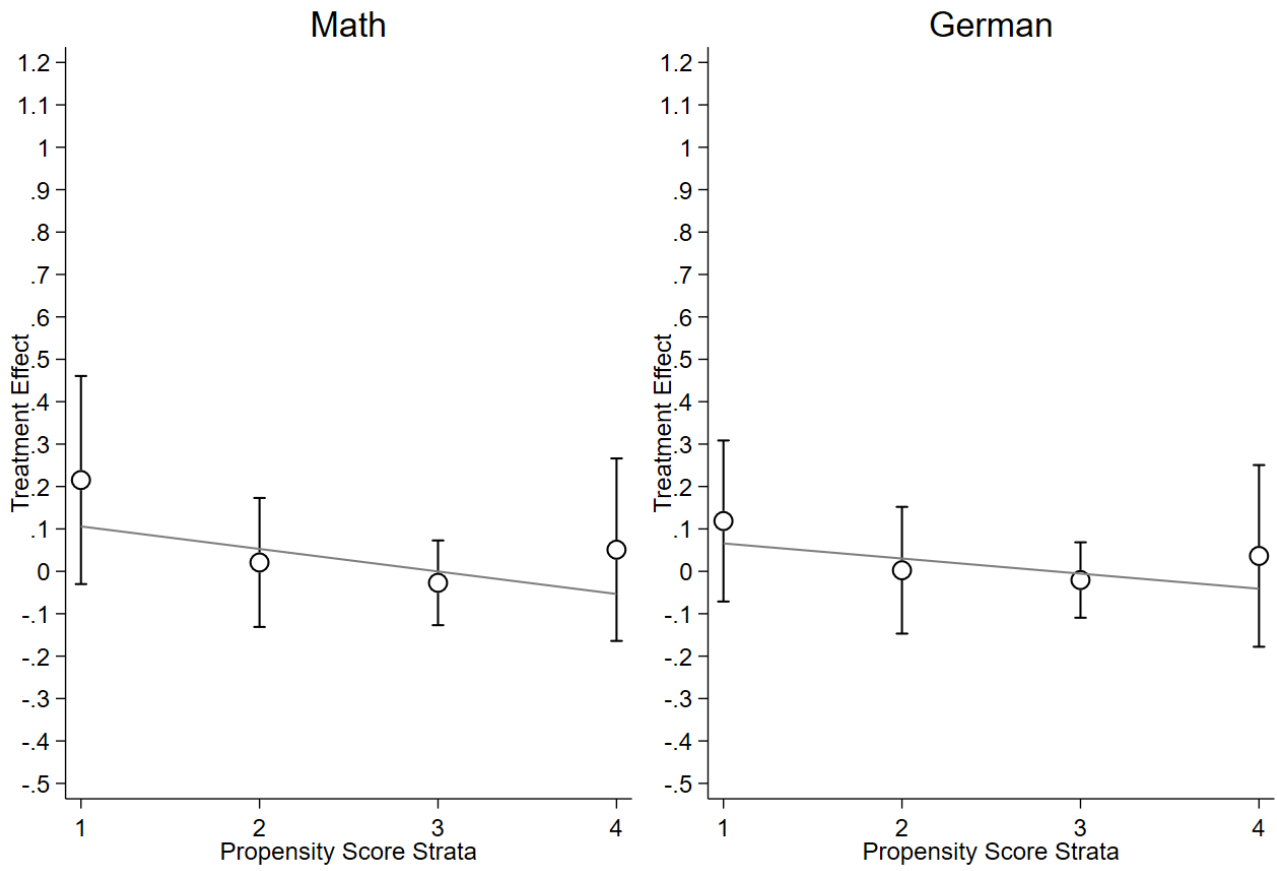
Note: Results from variance-weighted least squares regression models. 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Figure A2. Heterogeneous treatment effect: differences in grandchildren's grades in mathematics (white symbols) and German (grey symbols), between dyads who have contact with grandparents, and those who do not (treatment), within propensity score strata (all strata).



Note: Results from variance-weighted least squares regression models. 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.

Figure A3 Heterogeneous treatment effect: differences in grandchildren's grades in mathematics (left panel) and German (right panel), between dyads who receive financial transfer from grandparents, and those who do not, within propensity score strata (all strata).



Note: Results from variance-weighted least squares regression models. 95% CI. N=3,187. Source: own calculations on Pairfam waves 2, 4, 6 and 8.