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Grandparent investment and young children's cognitive and non-cognitive outcomes in the UK

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Abstract

This study investigated the relationship between grandparental investment and child outcomes using data that were obtained from three waves of a longitudinal British Millennium Cohort Study that included children between the ages of 9 months and 5 years (n = 25,446 person-observations from 14,065 unique individuals). Grandparental investment was measured by parent-grandparent contact frequency and grandparental financial support. Child cognitive development was measured using the British Ability Scale and emotional and behavioral problems are measured using the Strength and Difficulties Questionnaire. The results showed that grandparental investment is associated with increased cognitive assessment and decreased problems among children. However, these associations occurred because of between-person effects and did not hold for within-person analyses that compare the same participants over time. Therefore, the results did not provide evidence for a causal association between grandparental investment and child outcomes.

Keywords

Child well-being, fixed-effects regression, grandchildren, grandparents, Millennium Cohort Study

Introduction

During recent decades, intergenerational relationships between grandparents, parents and children have received increased attention in several disciplines (Arber and Timonen, 2012; Coall and Hertwig, 2010; Mare, 2011). Certain scholars who represent different disciplines have argued that grandparents can play a significant role in improving the well-being of their offspring. In alignment with this assumption, evidence indicates that grandparental investment is associated with improved cognitive functioning, improved academic achievement and decreased emotional and behavioral problems among children (Sear and Coall, 2011). Family scholars have often assumed, at least implicitly, that these associations are based on the causal effects of grandparental investments in child well-being. However, almost all prior studies on this topic used either cross-sectional data (e.g., Attar-Schwartz et al., 2009; Wild, 2016) or longitudinal samples with only one baseline measure of grandparental investment (e.g., Tanskanen and Danielsbacka, 2016; Yorgason, Padilla-Walker and Jackson, 2011), which implies that these findings may be the result of between-person rather than within-person effects.

To provide more causal evidence, the association between grandparental investment and child outcomes should be studied by using longitudinal data and fixed-effect models that focus on within-person variations in exposure and exclude between-person effects (Curran and Bauer, 2011). In this study, we utilize both between-person and within-person models, where between-person effects represent the results across individuals and within-person effects represent an individual's variation over time. Using the within-person approach, we test whether it is possible to provide evidence for the prediction that grandparental investment is causally associated with child well-being using data from a longitudinal cohort study that includes children

between the ages of 9 months and 5 years that were born at the beginning of the millennium in the UK.

For this study, we measure child well-being by cognitive development and a lack of emotional and behavioral problems. Prior studies have consistently demonstrated that both cognitive assessments in early life strongly correlate with multiple domains in later life. For example, Duncan, Yeung, Brooks-Gunn and Smith (2007) analyzed data from six longitudinal surveys that were conducted in the UK, the US and Canada and demonstrated that pre-school aged children's cognitive skills are strong predictors of educational success in adolescence. Longitudinal studies that were conducted in the UK determined that increased developmental skills in early childhood are associated with improved academic achievement in adolescence and higher salaries in adulthood (Currie & Thomas, 1999, 2001; Feinstein & Duckworth, 2006). Peet and colleagues (2015) analyzed cross-national cohort data from the UK, Finland and the Philippines and determined that improved cognitive development in early childhood is correlated to higher levels of education. Finally, it has been determined that low levels of childhood cognitive skills are associated with risk behavior later in life, which implies that individuals who have fewer skills are at greater risk for teenage pregnancies, daily smoking and drug use (Heckman et al., 2006).

Also better test scores that measure emotional and behavioral well-being are related to improved outcomes in adolescence and adulthood. For example, two separate studies conducted in the UK determined that behavioral difficulties at age 3 predict decreased academic achievements at age 14 (Bornstein et al., 2013) and 16 (Washbrook et al., 2013). Furthermore, prior studies that were conducted in New Zealand determined that increased behavioral difficulties at age 3 correlate with

increased financial difficulties, a higher risk of engaging in antisocial behavior and health problems at age 32 (Moffitt et al., 2011; Odgers et al., 2008). In summary, prior studies demonstrate that increased cognitive development and decreased emotional and behavioral problems during early childhood are appropriate proxies for children's future wealth, health and life choices.

Grandparental investment and child outcomes

Due to increased life expectancies, the proportion of elderly adults and total number of grandparents are increasing (OECD, 2017). Currently grandparents and grandchildren share more years than ever before (Bengtson, 2001). Because of decreased fertility rates (Billari and Kohler, 2004), grandparents today have fewer grandchildren than grandparents in the past, which implies that grandparents may be able to invest more time and resources in their grandchildren. Therefore, in present-day Western societies, grandparents have many opportunities to improve their grandchildren's well-being.

In prior studies regarding social stratification, the potential influence that older generations have on their offspring's well-being is argued to rely on either the older generations' investment in the younger generation or the endowments that are available for the children or grandchildren during their early years of life (Jæger, 2012). Grandparental investment includes several actions, for example, staying in contact with grandchildren and providing financial support, emotional support, care and practical help. These investments can be either direct or indirect, which implies that grandparental investments may occur via a third party (generally via the grandchildren's parents) (Coall and Hertwig, 2010; 2011). Consequently, certain prior studies have shown that support from grandparents to parents is associated with improved well-being among grandchildren (e.g., Scelza, 2011). One recent prior

study that was conducted in the UK demonstrated that increased interactions between parents and grandparents is associated with grandchildren's higher educational test scores (Tanskanen and Danielsbacka, 2016).

Grandparental endowments refer to any available resources that children potentially benefit from, including economic, human or cultural capital, social status, networks, and genetics (Jæger, 2012). Grandparental endowments benefit grandchildren simply by existing and may influence grandchildren's well-being even after the death of grandparents through inheritances, trusts and accumulated wealth (Madoff, 2010). In contrast to grandparental endowments, grandparental investments require grandparental action. In this study, we analyze the relationship between grandparental investment and child well-being and measure grandparental investment using two indicators: parent-grandparent contact frequency and grandparental financial support.

Grandparental investment may have beneficial outcomes among grandchildren for several reasons. Financial support provided by grandparents may help parents to manage their everyday lives, which could indirectly benefits the grandchildren. Grandparents can also buy instructive toys and gifts or teach important skills and share knowledge to grandchildren, which in turn may improve child development. Grandparents can also act as mentors for their grandchildren and provide important support and encouragement (Dunifon, 2013). This support may improve children's emotional well-being and prevent conduct problems. Furthermore, grandparents may take care of their grandchildren or contribute to household tasks and provide support to parents who, in turn, have more time to spend with their children. Finally, grandparents' additional support may decrease parental stress, which can indirectly

improve the well-being of grandchildren (Dunifon and Kowaleski-Jones, 2007; Mutchler and Baker, 2009).

Evolutionary anthropologists have argued that grandparental investment is a natural aspect of human behavior (e.g., Hawkes and Coxworth, 2013; Meehan et al., 2014). Evolutionary significance of grandparental investment is based on the concept that by providing additional support and resources to their offspring, grandparents receive fitness benefits in terms of spreading their genes to future generations (Lahdenperä et al., 2004). Scholars argue that in our evolutionary past, grandparental investment may have increased grandchild survival and, therefore, the fitness of the grandparents (Euler, 2011). Evidence from traditional and historical populations indicates that grandparental presence often correlates with increased survival rates of grandchildren (see Sear & Coall, 2011; Sear & Mace, 2008 for reviews). Furthermore, evidence indicates that in traditional and historical populations, grandmother presence benefited children much more than the presence of grandfathers (e.g., Dong, Manfredini, Kurosu, Yang and Lee, 2016; Lahdenperä, Russell and Lummaa, 2007). However, because of increased gender equality in contemporary societies, grandfathers may have similar or more beneficial roles than grandmothers (Coall, Hilbrand, Sear and Hertwig, 2016).

Evidence suggests that in traditional and historical populations, grandparents may have been “child saviors” in the true meaning of the term; in modern developed societies, grandparents are not needed to ensure their grandchildren’s survival as they may be in subsistence societies (Sear and Coall, 2011). However, grandparental investment may benefit grandchildren when child outcomes are measured by “softer” indicators such as cognitive development and lack of emotional and behavioral problems. In alignment with this prediction, a literature review

demonstrated that in 10 of 13 studies, grandparental investment was associated with increased well-being and development among grandchildren (Sear and Coall, 2011). Furthermore, a positive relationship between grandparental investment and child outcomes were indicated across children of various ages and among various family structures and conditions (Attar-Schwartz et al., 2009; Buchanan and Rotkirch, 2016; Ruiz and Silverstein, 2007).

Although, increased grandparental investment could be associated with improved outcomes among grandchildren, increased grandparental investment may not always benefit grandchildren. Coall and Hertwig (2010) hypothesized that grandparental influence on child well-being may result in a reversed U-shape curve, which implies that moderate grandparental investment benefits grandchildren the most and very low and very high amounts of investment may be associated with decreased child well-being. Children that do not interact with their grandparents do not receive any of the potential benefits, but when grandparents are forced to be significantly involved with the grandchildren or if they are the sole caregivers the children's outcomes may be adversely affected. When grandparents are exhausted, they may not able to engage in activities that have the most impact on improving the children's well-being. In alignment with the Coall-Hertwig hypothesis, a prior study determined that children who had monthly or weekly contact with grandparents obtained higher educational test scores when compared to children who did not have any contact with their grandparents (Tanskanen and Danielsbacka, 2016). However, when compared to grandchildren that had "no contact at all", daily contact with grandparents was not associated with increased scores (Tanskanen and Danielsbacka, 2016).

Potential confounding factors

Prior studies have determined that certain factors may impact child outcomes during the early years, which highlights the significance of controlling for these potentially confounding variables to attain more robust results. With respect to child gender, studies have consistently demonstrated that girls obtain higher scores for developmental tests than boys (e.g., Parsons and Bynner, 2008; Tanskanen and Danielsbacka, 2016). Girls also report fewer emotional and behavioral problems than boys (e.g., Jones and Schoon, 2008). One of the most common findings is that older children receive higher developmental test scores than younger children (e.g., Jones and Schoon, 2008). Furthermore, the number of siblings in a household is associated with child well-being, although prior studies that analyzed young children reported mixed results (e.g., Gottfried, 2017; Schoon et al., 2011).

Prior studies that were conducted in the UK demonstrated that ethnic minorities score lower on cognitive test and report more behavioral problems than the ethnic majority (e.g., Jones and Schoon, 2008). In addition, children who live with both biological parents earn higher scores than children who live with only one biological parent (e.g., Hansen and Jones, 2008; Schoon, et al., 2011). Finally, prior studies have consistently demonstrated that parental socioeconomic conditions are associated with cognitive and non-cognitive test scores; higher parental educational levels and higher incomes are correlated to children's improved outcomes (e.g., Duncan and Brooks-Gunn, 1997; Jones and Schoon, 2008).

Present study

This study investigates the association between grandparental investment and child well-being. The primary goal is to determine whether an increase in grandparental

investment results in improved child well-being. Based on previous studies one can hypothesize that such association should exist. Moreover, because prior studies report matrilateral bias in kin relationships, which implies that the involvement of maternal grandparents correlates more strongly with improved child well-being than the involvement of paternal grandparents (e.g., Lussier et al., 2002; Tanskanen and Danielsbacka, 2012), we conducted separate analyses for maternal and paternal grandparents. Furthermore, certain prior studies demonstrated that grandmothers' investment, rather than grandfathers' investment, was more likely correlated to child well-being, although other studies did not report a gender difference (see Buchanan and Rotkirch, 2016 for discussion). Because the effect of grandparental involvement may vary by gender, this study also compares the effects between grandmothers and grandfathers.

Material and methods

We use data that were obtained from the British Millennium Cohort Study (MCS), which includes longitudinal data for children that were born in England, Wales, Scotland, and Northern Ireland at the beginning of the millennium. The first MCS wave was conducted in 2001 and 2002 and included 18,818 children that were 9 months old. Additional data were collected when the children were aged 3 and 5. The second wave of the survey collected data for 15,590 children and the third wave of the survey collected data for 15,246 children. In the MCS cohort member children are targets and data were collected from their parents who were interviewed in their homes. The primary respondents are, in almost all cases, the biological mothers of the children (in the first survey wave, all but 37 of the primary respondents were biological mothers). Partner respondents are generally the biological fathers of target children or the mothers' new partners. For the MCS, mothers and fathers are interviewed separately (see Hansen, 2010 for the full MCS description).

In this study, we included all person-observations for target children who have data available for all the variables studied and for both the baseline (the primary independent variable and covariates are measured) and outcome (the dependent variable is measured) study waves. In the case of twins or triplets only one child of the set was included. Our final sample includes 24,745 person-observations from 13,798 unique persons across 3 study waves and during a 5-year follow-up period.

The dependent variables represent the young children's cognitive development scores and emotional and behavioral problems. Cognitive development was measured by the British Ability Scale (BAS) Naming Vocabulary assessment during the second (at age 3) and third (at age 5) waves of data collection when children completed the BAS Naming Vocabulary component with the assistance of trained interviewers. This component indicates the verbal skills of young children and measures vocabulary comprehension, language skills, stimulation and general knowledge. The BAS scales are age adjusted and indicate children's cognitive development when compared to peer groups. The BAS assessment ranges between 0 and 60; a higher score reflects greater cognitive development among the children (M = 31.2, SD = 11.12).

For the MCS, emotional and behavioral problems were measured by the Strength and Difficulties Questionnaire (SDQ) (Goodman, 1997; 2001). During the second and third wave of the MCS, mothers were asked to report their children's difficulties using four subscales: emotional symptoms, conduct problems, hyperactivity and peer problems. Each subscale includes five items that are separated into three categories (0 = not true, 1 = somewhat true, 2 = certainly true), which implies that mothers were asked to respond to a total of 20 items. The total difficulties score was calculated by

summing the scores for emotional symptoms, conduct problems, hyperactivity and peer problems (Cronbach's alpha = 0.78). The scale of the summed variable is between 0 and 33; a higher number indicates a larger number of emotional and behavioral problems (M = 9.3, SD = 5.14).

The primary independent variables measure the baseline grandparental investment. For the MCS, the mothers of target children were asked to report how often they were in contact with their mothers (i.e., maternal grandmother) and fathers (i.e., maternal grandfather). Participants were only asked the contact frequency question if the respective parent is alive. We formulated a contact frequency variable that measures the highest level of parent-grandparent contact with the maternal grandmother and grandfather. The parent-grandparent contact frequency variable includes seven categories: 1 = Less than once a year (including never) (6%), 2 = Once a year (2%), 3 = Once every few months (11%), 4 = At least once a month (11%), 5 = Once or twice a week (23%), 6 = 3–6 times a week (21%), and 7 = Every day (26%). In addition, we include interaction terms in the models and analyze the interactions between contact frequency and grandparent gender.

For the MCS, responding mothers were asked whether they received financial support from their parents (i.e., maternal grandparents). Respondents answered whether their parents provided essentials for the baby; helped with household expenses, gifts and extras for the baby; provided financial help for childcare; or provided any other financial support. We classified the answers in two categories: 0 = No financial support received (21%), 1 = Received financial support (79%). In regards to financial support, respondents report if support is provided by the respondents' parents but did not differentiate whether the support was received from mothers (i.e., maternal grandmothers) or fathers (i.e., maternal grandfathers).

Therefore, in regards to financial support, we are unable to analyze the relationship between grandparent gender and financial support.

For the MCS, co-residing biological fathers of target children who were defined as partner respondents were asked questions regarding parent-grandparent contact frequency and grandparental financial support. Fathers were asked questions that measured contact with and financial support from their own parents (i.e., paternal grandparents) that were similar to the questions that the mothers were asked. The MCS missed approximately 20% of the co-residing biological fathers of target children whose female partners were the primary respondents. In addition, single fathers are not included in the data which implies that a large number of biological fathers are not reported in the data. Because of this limitation, we do not include paternal grandparents in the primary analyses, but rather conduct sensitivity analyses for these data. It is important to consider these data limitations when interpreting the results regarding the relationship between paternal grandparents' investment and child well-being.

In all the models, we control for certain potentially confounding factors, which are assessed at the baseline (i.e., one study wave before the outcome measure). Covariates include the child's gender, age in months, ethnicity, maternal age, maternal education, presence of biological father in the household, family finances and the time period between the baseline and outcome measure interview. For the BAS analyses, we also control for child development scores at age 9 months measured by the Denver Development Screening Test (Frankenburg et al., 1967) and the MacArthur Communicative Development Inventories (Fenson et al., 1993). For the SDQ analyses we control for child temperament and behavior outcomes at

age 9 months as measured by the Carey Infant Temperament Scale (Carey, 1972; Carey and McDevitt, 1978). Descriptive statistics are presented in Table 1.

Table 1. Descriptive statistics of the 24,745 person-observations from 13,798 persons over waves 1, 2 and 3 in the British Millennium Cohort Study

	Total no.	No. of persons	%	Mean (SD)	Within-person SD
Child's gender					
Boy	12,499	6,984	50.5		
Girl	12,246	6,814	49.5		
Child's age at interview (in months)				23.1 (14.29)	13.39
Child's ethnicity					
White	21,626	11,848	87.4		
Mixed	659	379	2.7		
Indian	571	332	2.3		
Pakistani	1,089	740	4.4		
Black	582	357	2.4		
Other	218	142	0.9		
Number of siblings				1.0 (1.03)	0.28
Maternal age				30.7 (5.84)	1.16
Maternal education					
Nvq level 1	1,980	1,141	8.0		
Nvq level 2	7,298	4,042	29.5		
Nvq level 3	3,687	2,030	14.9		
Nvq level 4	7,396	3,954	29.9		
Nvq level 5	939	497	3.8		
Other	3,445	2,134	13.9		
Financial situation of family					
Finding it difficult	2,286	1,988	9.2		
Just about getting by	6,505	5,288	26.3		
Doing alright	9,561	7,451	38.6		
Living comfortably	6,393	4,758	25.8		
Presence of biological father in household					
No	3,907	2,791	15.8		
Yes	20,838	12,013	84.2		
Developmental stage (9 months)				17.9 (2.62)	
Temperament and behavior (9 months)				33.2 (7.24)	
Country					
England	15,314	8,571	61.9		
Wales	3,898	2,147	15.8		
Scotland	3,097	1,720	12.5		
Northern Ireland	2,436	1,360	9.8		

Notes. Total no. = Number of total person-observations; No. of persons = Number of unique persons; SD = Overall standard deviation; Within-person SD = Within-person standard deviation; Grandparent = Maternal grandparent

We analyze the longitudinal MCS data using multilevel ordinary least squares regression models, where the repeated measures (i.e., person-observations) are nested within the data for the target children. We test both between-person and within-person (or fixed-effect) effects, where between-person effects represent the results across individuals and within-person effects indicate the individual's variation over time (Curran and Bauer, 2011). For the within-person models, observed children serve as their own controls and these models eliminate all time-invariant components (Allison, 2009), such as ethnic background, numerous genetic factors and other selection effects. Within-person regressions provide a strong test for causality in the association between grandparental investment and child well-being.

Because in the MCS data information on grandparental investment is collected only during waves 1 and 2, it is possible to investigate the potential effect of grandparental investment on child outcomes between the children at age 9 months and 3 years (waves 1 and 2) and between 3 years and 5 years (waves 2 and 3). Therefore, the within-person regressions are used to analyze whether grandparental investment affects the BAS or SDQ assessments during this period. We illustrate our results by calculating predictive margins (and 95% confidence intervals) from the regression models.

Results

First, we provide descriptive results for the participants who have within-person data and are included in the fixed-effect models. According to transition probabilities of parent-maternal grandparent contact frequencies, a majority of individuals remain in the same category and when changes occur, there is more often, a transition between categories close to each other than further apart (Appendix Table 1). Similarly, according to transition probabilities in financial support, a large majority of

grandparents remain in the same category between waves (Appendix Table 1). Stability and changes in BAS and SDQ scores are measured by intraclass correlations that report the correlation of person-observations for an individual over time. Intraclass correlation for BAS assessments is 0.67 and for SDQ scores is 0.72, which indicates a relatively strong stability between study waves.

Grandparental investment and child development

Table 2 and Figure 1 present the results of associations between parent-grandparent contacts and child cognitive outcomes for maternal grandparents. We provide the results from the total, between-person and within-person multilevel regressions. The total model results indicate that a nonlinear reversed U-type curve exists for the association between parent-grandparent contacts and child scores. However, this effect is based on between-person rather than within-person variation. Next, we included the interaction term in the fixed-effect model and analyzed the interaction between contact frequency and grandparental gender (results not provided). However, we were not able to determine any significant interaction effects.

Table 2. Associations between maternal grandparents' investment and cognitive development among children

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Parent-grandparent contacts												
Less than once a year	ref				ref				ref			
Once a year	0.98	0.48	0.03	1.93	1.20	0.66	-0.09	2.49	-0.30	0.71	-1.69	1.09
Once every few months	3.49	0.36	2.79	4.19	4.51	0.42	3.68	5.34	0.25	0.65	-1.02	1.53
At least once a month	3.96	0.36	3.26	4.66	5.11	0.43	4.27	5.95	0.39	0.65	-0.88	1.67
Once or twice a week	2.99	0.33	2.34	3.64	3.97	0.39	3.21	4.73	-0.17	0.63	-1.41	1.07
3-6 times a week	3.11	0.34	2.45	3.77	4.10	0.40	3.32	4.88	0.36	0.64	-0.89	1.61
Every day	2.51	0.33	1.87	3.16	2.95	0.38	2.20	3.69	0.65	0.64	-0.60	1.91

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Grandparental financial support												
No	ref				ref				ref			
Yes	0.85	0.16	0.55	1.16	1.55	0.22	1.12	1.98	-0.09	0.22	-0.52	0.34

Values are β-coefficients of multilevel ordinary least squares regressions; n = 24,745 person-observations from 13,798

unique persons.

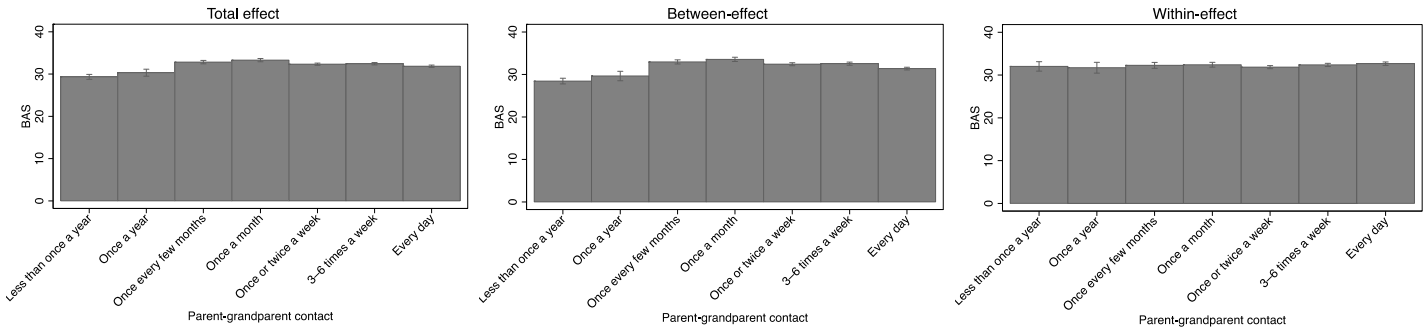

Figure 1. Associations between mother-grandparent contact and cognitive development among children (predictive margins and 95%
confidence intervals)

Then, we investigate the association between financial support provided by maternal grandparents and the cognitive assessments of the children. The results are presented in Table 2 and Figure 2. For the total and between-person models, there is a statistically significant difference, which indicates that children who receive financial support from maternal grandparents obtain higher cognitive test scores. However, this difference is not apparent for the within-person model.

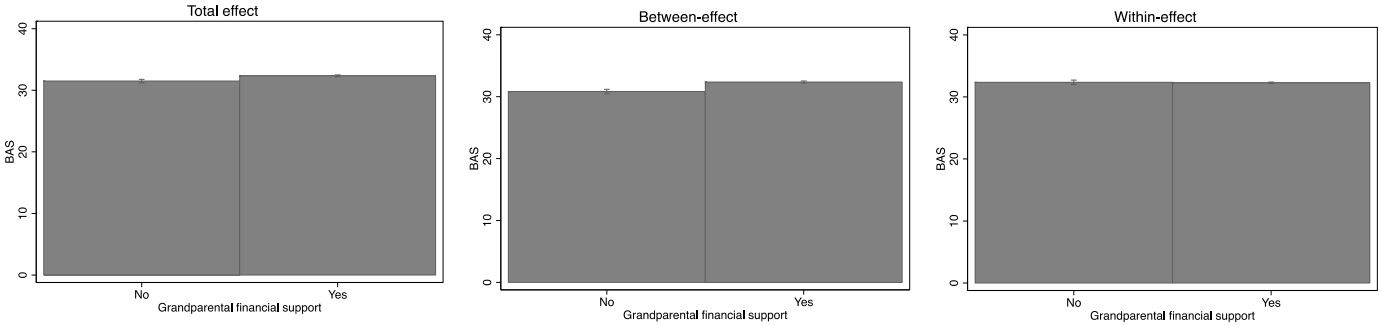

Figure 2. Associations between maternal grandparents' financial support and cognitive development among children (predictive margins
and 95% confidence intervals)

Next, we conduct sensitivity analyses and investigate the influence of paternal grandparents' investment (Appendix Table 2). Similar to maternal grandparents, we determine that for the total model, a nonlinear relationship exists between parent-grandparent contacts and child assessment scores; however, these associations are

based on between-person rather than within-person effects. Then, we included an interaction term in the within-person model and investigated the interaction between contact frequency and paternal grandparents' gender but did not determined significant interaction (results not shown). In addition, we analyzed the association between paternal grandparents' financial involvement and child cognitive assessments. As in the prior analysis, the results for paternal grandparents are similar to the results for maternal grandparents. The results for the total model demonstrate that children who receive financial support from paternal grandparents obtain higher scores than children who do not receive grandparental financial support. However, these results are based on between-person effects and are not replicated for the within-person models that compare the same individuals over time.

Grandparental investment and emotional and behavioral problems among children

Next, we investigate the association between grandparental investment and emotional and behavioral problems among children (Table 3 and Figure 3). We note that for the total and between-person models, children whose mothers reported contact with their own parents once every few months reported fewer problems when compared to mothers who reported they had contact with their parents "less than once a year". There were no statistically significant associations between other groups and the reference category "less than once a year". However, we were unable to find any significant associations for the within-person model. The within-person model that includes an interaction term between contact frequency and grandparental gender did not identify any significant associations (results not shown).

Table 3. Associations between maternal grandparents' investment and emotional and behavioral problems among children

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI lower	95% CI upper	β	SE	95% CI lower	95% CI upper	β	SE	95% CI lower	95% CI upper
Parent-grandparent contacts												
Less than once a year	ref				ref				ref			
Once a year	-0.19	0.22	-0.62	0.24	-0.48	0.33	-1.12	0.16	0.19	0.30	-0.39	0.78
Once every few months	-0.44	0.17	-0.77	-0.11	-0.62	0.21	-1.04	-0.21	0.07	0.27	-0.47	0.60
At least once a month	-0.25	0.17	-0.58	0.08	-0.29	0.21	-0.70	0.13	0.17	0.27	-0.36	0.71
Once or twice a week	-0.14	0.16	-0.44	0.17	-0.25	0.19	-0.62	0.13	0.25	0.27	-0.27	0.77
3-6 times a week	-0.08	0.16	-0.38	0.23	-0.27	0.20	-0.65	0.12	0.33	0.27	-0.20	0.86
Every day	-0.04	0.15	-0.34	0.26	-0.10	0.19	-0.47	0.27	0.20	0.27	-0.32	0.73
	Total effect				Between-effect				Within-effect			
	β	SE	95% CI lower	95% CI upper	β	SE	95% CI lower	95% CI upper	β	SE	95% CI lower	95% CI upper
Grandparental financial support												
No	ref				ref				ref			
Yes	-0.19	0.07	-0.33	-0.06	-0.47	0.11	-0.68	-0.26	0.11	0.09	-0.07	0.29

Values are β-coefficients of multilevel ordinary least squares regressions; n = 24,745 person-observations from 13,798 unique persons.

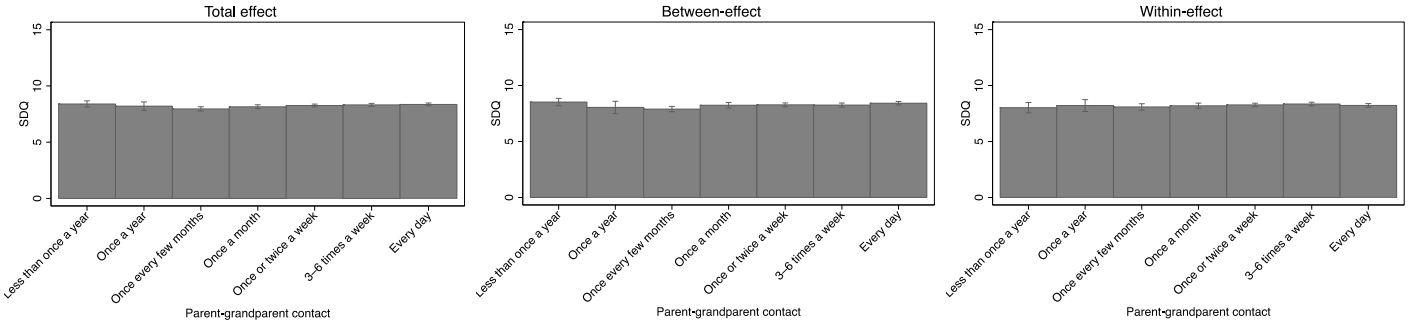

Figure 3. Associations between mother-grandparent contact and emotional and behavioral problems among children (predictive
margins and 95% confidence intervals)

Then, we analyzed the association between maternal grandparents' financial support and child well-being (Table 4 and Figure 4). For the total and between-person models, we determined that maternal grandparents' financial support was associated with fewer emotional and behavioral problems. As in the prior analysis, this effect

was not apparent for the within-person model that compared the same participants over time.

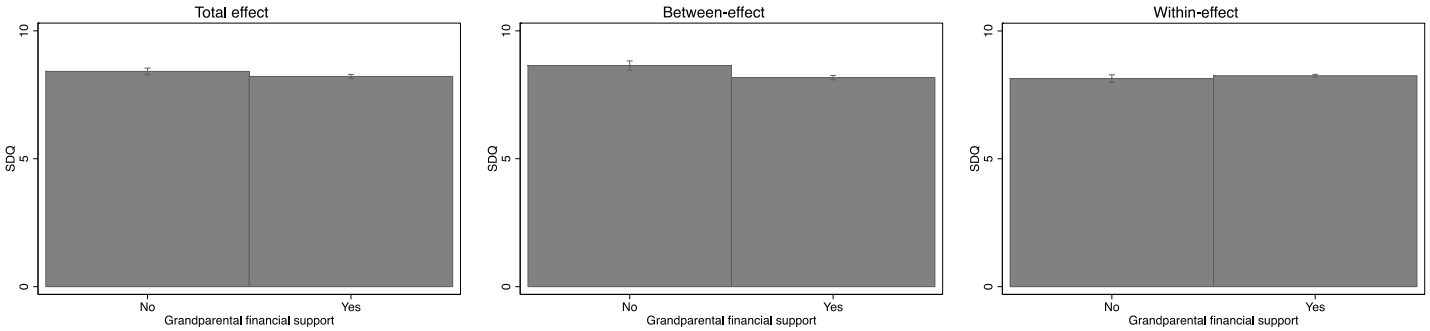

Figure 4. Associations between maternal grandparents' financial support and emotional and behavioral problems among children
(predictive margins and 95% confidence intervals)

Sensitivity analyses of the paternal grandparents demonstrated that for the total and between-person models, children whose mothers reported contacts with their parents once every few months or on a monthly basis reported fewer problems when compared to mothers that had contact with their parents "less than once a year" (Appendix Table 3). However, for the within-person model, these associations were not apparent. Next, the interaction term between contact frequency and grandparental gender was included, but there was not a significant association between these variables (results not shown). Then, we analyzed the association between paternal grandparents' financial involvement and child emotional and behavioral problems. The results for the total model demonstrated that children who receive financial support from paternal grandparents obtain higher scores than children who do not receive grandparental financial support. These results are again based on between-person effects and could not be replicated for the within-person models.

Discussion

This study investigated if grandparental investment is associated with improved cognitive assessment and decreased emotional and behavioral problems among young children that live in the UK. In alignment with the Coall-Hertwig hypothesis (Coall & Hertwig, 2010), the total effect models demonstrated that a nonlinear association exists between parent-maternal grandparent contact frequency and cognitive assessment among children, which indicates that a moderate amount of grandparental investment is associated with improved outcomes. These results were, however, based on between-person effects and the reversed U-shape curve disappeared for the within-person models. Finally, we determined that children who receive financial support from maternal grandparents earn higher cognitive test scores when compared to children who do not receive grandparental support. Again, these results were based on between-person rather than within-person effects.

In regards to emotional and behavioral problems, we found that for the total and between-person model, children whose mothers reported monthly contact with their parents (i.e., maternal grandparents) reported fewer problems when compared to mothers reported minimal contact with their parents. Furthermore, for the total and between-person models we determined that children who received financial support from maternal grandparents reported fewer problems than children who did not receive grandparental support. However, these associations were based on between-person effects and could not be replicated for the within-person models. Therefore, the results of this study do not provide support for the prediction that a causal association exists between grandparental investment and child well-being. This conclusion holds whether grandparental investment was measured by contact frequency or financial support and whether child outcomes were measured by cognitive development or emotional and behavioral problems.

Increasingly, evidence indicates that grandparental involvement is associated with increased development and well-being among grandchildren (e.g., Buchanan and Rotkirch, 2016; Sear and Coall, 2011). However, these results are primarily based on either cross-sectional data (e.g., Attar-Schwartz et al., 2009; Tanskanen & Danielsbacka, 2012) or longitudinal samples that only utilize one baseline measure for grandparental investment (e.g., Tanskanen and Danielsbacka, 2016; Yorgason et al., 2011). Based on the results of this study, it may be assumed that the associations noted in prior studies reflect differences across individuals rather than a variation for individuals over time. Therefore, rather than a "grandparent effect" (i.e., grandparental investment improves child outcomes) the relationships could be based on either a "grandchild effect" (i.e., grandparents invest more resources in grandchildren who perform better) or a third factor that explains both grandparental investment and child outcomes. Because of the data limitations, we were unable to detect the causes for the between-person effects noted in this study and, therefore, we suggest that future studies analyze this issue. Although the question remains unanswered, the results of this study indicate that grandparental investment does not have a causal effect on child outcomes; this is important because numerous studies assume that this causal association exists (e.g., Coall and Hertwig, 2010; Buchanan and Rotkirch, 2016 for discussion).

Several prior studies have noted a matrilateral effect in multigenerational relationships, which implies that maternal grandparents invest more in grandchildren than paternal grandparents (e.g., Danielsbacka et al., 2011; Chan and Elder, 2000). In addition, certain studies noted that the investment of maternal grandparents is related to improved outcomes among grandchildren, but the investment of paternal grandparents is not (e.g., Lussier et al., 2002; Tanskanen & Danielsbacka, 2012). We

conducted sensitivity analyses and investigated the association between paternal grandparents' investment and child well-being. We found similar associations among paternal grandparents that were also detected among maternal grandparents. Because of the structure of the MCS data, the results regarding the paternal grandparents' effects on child well-being are not totally comparable to the results for the maternal grandparents, as discussed above.

In addition to lineage differences, prior studies have consistently demonstrated that grandmothers were more involved than grandfathers (e.g., Chan and Elder, 2000). In addition, certain studies demonstrated that children whose grandmothers invested in their well-being obtained higher developmental scores and better well-being assessments when compared to children whose grandfathers invested in their well-being, although certain studies did not report such a correlations (Sear and Coall, 2011). We found that both grandmothers' and grandfathers' investment correlates with child well-being. This was repeated for analyses using different measures for child outcomes and different measures for the involvement of maternal and paternal grandparents.

Compared to prior studies that analyzed multigenerational relationships, this study has certain strengths. In this study child well-being was investigated with both cognitive and non-cognitive outcomes. Furthermore, we analyzed cognitive development and emotional and behavioral problems during early childhood, which is important because these early scores have consistently predicted socioeconomic success later in life (e.g., Duncan et al., 2007; Heckman, 2006). Prior studies that analyzed the relationship between grandparental investment and child outcomes have generally used cross-sectional data (e.g., Attar-Schwartz et al., 2009; Tanskanen and Danielsbacka, 2012) and the most notable strength of this study is

that we analyzed large-scale, longitudinal and representative data. Methodologically, we used fixed-effect models and focused on within-person variations over time. To the best of our knowledge, this approach has not been used in prior studies that analyze the association between grandparental investment and child outcomes.

This study also includes some limitations. First, the MCS data for parent-grandparent contact frequency and grandparental financial support were collected only during waves 1 and 2. This limitation implies that it was not possible to investigate whether grandchild outcomes predict grandparental investment ("grandchild effect") as previously mentioned. Hawkins and colleagues (2007) demonstrated that child well-being predicted non-resident fathers' investment rather than vice versa. If the same is true for grandparents, the child's characteristics (i.e., improved skills and fewer behavioral problems) may predict grandparental investment and not vice versa. Second, in the MCS data, numerous variables are not measured the same between study waves, which implies that we could not control for some time-varying covariates.

The results of this study may disappoint certain family scholars and policymakers who are willing to see that grandparents and grandchildren form close ties with each other. Although we could not provide evidence for the prediction that grandparental investment has causal effects on child well-being, it is likely that close multigenerational ties benefit children in several ways. Close ties with grandparents can help children to learn about their family history and help them to build their own identities, values and ideologies. It is also likely that grandchildren highly value close ties with their grandparents, although grandparental investment does not appear to directly affect children's cognitive development or emotional and behavioral test

scores. Generally, interactions between generations helps to reduce barriers between younger and older individuals and increase social coherence.

To conclude, this study found that grandparental investment is associated with improved cognitive test scores and decreased emotional and behavioral problems among children in between-person models that present the results across individuals. However, these associations did not occur for the within-person models that analyzed an individual's variation over time. We hope that our results stimulate future child well-being studies to investigate the kin effects by analyzing longitudinal data with fixed-effect models.

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Appendix

Appendix Table 1. Transitions in grandparental investment over waves 1, 2 and 3 of the British Millennium Cohort Study

		Parent-grandparent contacts						
Parent-grandparent contacts		0	1	2	3	4	5	6
	0 Less than once a year	332	62	22	15	28	13	50
	1 Once a year	52	99	45	4	6	3	13
	2 Once every few months	32	85	867	145	35	30	46
	3 At least once a month	20	9	267	686	195	58	54
	4 Once or twice a week	24	6	82	324	1,460	417	155
	5 3-6 times a week	14	4	27	67	689	1,134	442
	6 Every day	18	9	35	38	245	695	1,790
Total n		492	274	1,345	1,279	2,658	2,350	2,550

		Grandparental financial support	
Grandparental financial support		No	Yes
	No	1,033	1,373
	Yes	884	7,658
Total n		1,917	9,031

Appendix Table 2. Associations between paternal grandparents' investment and cognitive development among children

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Parent-grandparent contacts												
Less than once a year	ref				ref				ref			
Once a year	0.57	0.52	-0.45	1.58	0.51	0.67	-0.81	1.82	-0.46	0.83	-2.08	1.16
Once every few months	2.29	0.42	1.47	3.10	3.22	0.49	2.27	4.17	-0.64	0.81	-2.23	0.94
At least once a month	2.47	0.41	1.67	3.27	3.01	0.47	2.09	3.94	0.21	0.81	-1.39	1.80
Once or twice a week	1.93	0.39	1.16	2.69	2.41	0.44	1.54	3.28	0.19	0.82	-1.41	1.79
3-6 times a week	1.67	0.42	0.85	2.48	2.09	0.48	1.14	3.04	0.16	0.86	-1.53	1.85
Every day	0.82	0.42	-0.01	1.65	1.10	0.47	0.17	2.02	-0.05	0.93	-1.87	1.76

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Grandparental financial support												
No	ref				ref				ref			
Yes	0.65	0.17	0.31	0.98	1.14	0.23	0.69	1.59	-0.06	0.25	-0.56	0.44

Values are β-coefficients of multilevel ordinary least squares regressions; n = 17,175 person-observations from 10,580 unique persons.

Appendix Table 3. Associations between paternal grandparents' investment and emotional and behavioral problems among children

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Parent-grandparent contacts												
Less than once a year	ref				ref				ref			
Once a year	0.07	0.23	-0.38	0.51	-0.16	0.32	-0.79	0.46	0.52	0.33	-0.12	1.16
Once every few months	-0.64	0.19	-1.01	-0.28	-0.81	0.23	-1.26	-0.36	-0.12	0.32	-0.75	0.51
At least once a month	-0.44	0.18	-0.80	-0.08	-0.64	0.22	-1.08	-0.20	-0.17	0.32	-0.80	0.46
Once or twice a week	-0.15	0.17	-0.49	0.19	-0.02	0.21	-0.43	0.39	-0.34	0.32	-0.98	0.29
3-6 times a week	-0.21	0.19	-0.58	0.15	-0.26	0.23	-0.71	0.19	-0.39	0.34	-1.06	0.28
Every day	0.23	0.19	-0.15	0.60	0.22	0.22	-0.22	0.66	-0.04	0.37	-0.77	0.68

	Total effect				Between-effect				Within-effect			
	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
			lower	upper			lower	upper			lower	upper
Grandparental financial support												
No	ref				ref				ref			
Yes	-0.21	0.07	-0.36	-0.06	-0.48	0.11	-0.69	-0.26	0.02	0.10	-0.17	0.22

Values are β-coefficients of multilevel ordinary least squares regressions; n = 17,175 person-observations from 10,580 unique persons.