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Multigenerational Effects on Children's Cognitive and Socioemotional Outcomes: A Within-Child Investigation

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Associations between grandparental investment and child outcomes were investigated using three waves of a longitudinal British Millennium Cohort Study that included children between the ages of 9 months and 5 years (n = 24,614 person-observations from 13,744 children). Grandparental investment was measured by parent–grandparent contact frequency and grandparental financial support. Child cognitive development was measured using the British Ability Scale and socioemotional outcomes using the Strength and Difficulties Questionnaire. Grandparental investment was associated with improved cognitive and socioemotional outcomes among children. However, these associations occurred because of between-person effects and did not exist in within-person analyses that compared the same children over time. The results are discussed in terms of their contribution to multigenerational relationships research.

Across societies, grandparents are known to invest time and resources in their offspring (Euler & Michalski, 2008). Although grandparents have been an important part of families, especially in historical populations, in present-day Western countries, the opportunities for grandparents to be involved in the lives of their grandchildren might be greater than ever before. Due to an increase in life expectancy, grandparents and grandchildren now have more years of shared lifetime (Bengtson, 2001). Because of the decreased fertility rates, grandparents today have fewer grandchildren; thus, they can invest more resources in a particular grandchild (Euler, 2011). Last but not least, grandparents tend to be healthier and wealthier than before, allowing them to invest more in their grandchildren (Coall & Hertwig, 2010). In the present study, we investigate whether grandparental investment, measured by parent–grandparent contact frequency and grandparental financial support, is associated with improved cognitive and socioemotional outcomes among British children.

During recent decades, grandparental investments have received increased attention in several disciplines (Arber & Timonen, 2012; Coall & Hertwig, 2010; Mare, 2011). Certain scholars have argued that grandparents can play a significant role in improving the well-being of their offspring. In alignment with this prediction, evidence indicates that grandparental investment is associated with improved cognitive functioning, improved academic achievement, and decreased emotional and behavioral problems among children (Sear & Coall, 2011; but see Dunifon & Bajracharya, 2012). Family scholars have often assumed, at least implicitly, that these associations are based on the causal effects of grandparental investment in child well-being. However, almost all prior studies on non-coresiding grandparents have used either cross-sectional data (e.g., Attar-Schwartz, Tan, Buchanan, Flouri, & Griggs, 2009; Wild, 2016) or study samples with only one baseline measure of grandparental investment (e.g., Fergusson, Maughan, & Golding, 2008; Yorgason, Padilla-Walker, & 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

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effects (Curran & Bauer, 2011). In this study, we utilize both between-person and within-person models, where between-person associations represent the results across individuals and within-person associations 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 increases 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 United Kingdom.

Evolutionary psychologists have argued that grandparental investment is a natural aspect of human family life (e.g., Euler, 2011). The evolutionary significance of grandparental investment is based on the concept that by providing additional support and resources to their offspring, grandparents can receive fitness benefits in terms of spreading their genes to future generations (Hamilton, 1964a, 1964b). Thus, it is expected that grandparents will invest a large amount of time and resources in their offspring. Indeed, several studies have found that this is the case. For instance, a study from the United Kingdom showed that 63% of grandparents with grandchildren < 16 years old look after them at least occasionally (Wellard, 2011). Moreover, it is reported that 44% of British toddlers are looked after by their grandparents at least on a weekly basis (Fergusson et al., 2008).

Grandparental investment includes several actions, for example, staying in contact with grandchildren and providing financial aid, emotional support, care, and practical help (Coall & Hertwig, 2010, 2011). Additionally, grandparental coresidence with grandchildren can be seen as an investment (Augustine & Raley, 2012; DeLeire & Kalil, 2002; Pilkauskas, 2014), although in the present study, we do not investigate the potential effect of coresiding grandparents on child outcomes because it is difficult to assess the level of investment among coresiding grandparents compared to non-coresiding grandparents. Moreover, multigenerational coresidence is relatively scarce in the present-day United Kingdom, at least when compared to the United States (Pilkauskas & Martinson, 2014).

In this study, we measure grandparental investment using two indicators: parent–grandparent contact frequency and grandparental financial support. Contact between the parental and grandparental generation often involves the child, especially when children are very young. Thus, when seeing their adult children, grandparents can at the same time look after the grandchildren and provide nurturance to them, which can be considered as a direct grandparental investment. When grandparents are present, they may also indirectly benefit grandchildren, for instance, contributing to household tasks and providing support to parents who, in turn, have more time to spend with their children. Grandparents' additional support may decrease parental stress, which can also indirectly improve the well-being of grandchildren (Dunifon & Kowaleski-Jones, 2007; Mutchler & Baker, 2009). Finally, when children are small, parent–grandparent contact frequency can be seen as an indicator of overall grandparental investment because several other forms of investment, like aforementioned grandparental child care, often require at least some type of contact between parents and grandparents.

In addition, grandparental financial support can represent either direct or indirect forms of grandparental investment. Financial support provided by grandparents to parents may help parents manage their families' everyday life, which could indirectly benefit their grandchildren. Grandparents can also buy essentials or instructive gifts that help to improve child development. Thus, both direct and indirect financial transfers can improve grandchild outcomes.

For this study, we measure child outcomes by cognitive development and a lack of emotional and behavioral problems. Prior studies have consistently demonstrated that improved cognitive assessments in early life strongly correlate with multiple domains, including better educational success, higher salary, and lower likelihood of risky behavior, in later life (e.g., Currie & Thomas, 2001; Duncan, et al., 2007; Heckman, Stixrud, & Urzua, 2006). Also, lower rates of emotional and behavioral problems in early childhood are found to relate to better outcomes, including improved academic achievements in adolescence and decreased health problems in adulthood (e.g., Bornstein, Hahn, & Wolke, 2013; Moffitt et al., 2011; Odgers et al., 2008). Thus, increased cognitive development and decreased emotional and behavioral problems during early childhood are appropriate proxies for children's future wealth, health, and life choices.

Several studies have found that grandparental investment is associated with child outcomes measured by cognitive development and lack of emotional and behavioral problems (Sear & Coall, 2011). In these studies, grandparental investment was measured via several indicators, namely, contact frequency, childcare help, financial support, and emotional closeness. Furthermore, a positive relation between grandparental investment and child outcomes is indicated across children of various ages and among various

family structures and conditions (e.g., Attar-Schwartz et al., 2009; Buchanan & Rotkirch, 2016; Ruiz & Silverstein, 2007). In addition, certain prior studies have detected that not only direct but also indirect grandparental investment is associated with improved outcomes among grandchildren. For instance, a recent prior study demonstrated that increased interaction between parents and grandparents was associated with grandchildren's higher educational test scores (Tanskanen & Danielsbacka, 2016).

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 reverse U-shaped curve, which implies that moderate grandparental investment benefits grandchildren the most and that very low and very high amounts of investment may not be associated with increased child well-being. Children who do not interact with their grandparents do not receive any of the potential benefits, but when grandparents involve themselves "too much," they could become exhausted and unable 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 & Danielsbacka, 2016). However, when compared to grandchildren that had "no contact at all," daily contact with grandparents was not associated with increased scores (Tanskanen & Danielsbacka, 2016).

Method

We use data that were obtained from the British Millennium Cohort Study (MCS), which includes longitudinal data for children who 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 18,552 children who 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. Among those who dropped out between the MCS waves, families with younger and less-educated mothers belonging to ethnic minorities, those with lower income, and families with more household mobility were overrepresented (Hansen, 2010; Ketende, 2010; Plewis, 2007).

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. Finally, children who did not have grandparents alive and children living with their grandparents were excluded. Our final sample includes 24,614 person-observations from 13,744 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) 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 ($M = 30.2$, $SD = 11.12$).

For the MCS, emotional and behavioral problems were measured by the Strength and Difficulties Questionnaire (SDQ; Goodman, 1997, 2001). During the second and third waves 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 $\alpha = .78$). The scale of the summed variable is between 0 and 30; a higher number indicates a larger number of emotional and behavioral problems ($M = 8.8$, $SD = 4.92$).

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 was alive. We formulated a contact frequency variable that measures the highest level of parent–grandparent contact between grandmothers and grandfathers, meaning that we chose the grandparent (i.e., either maternal grandmother or grandfather) who had the most contact with the target child's mother. The parent–grandparent contact frequency variable includes seven categories: 0 = less than once a year (including never; 6%), 1 = once a year (2%), 2 = once every few months (11%), 3 = at least once a month (11%), 4 = once or twice a week (23%), 5 = 3–6 times a week (21%), and 6 = everyday (26%). In addition, for sensitivity purposes, we included interaction terms in the models and analyzed 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 child, helped with household expenses, provided gifts and extras for the child, provided financial help for child care, or provided any other financial support. We classified the answers into two categories: 0 = no financial support received (21%), 1 = received financial support (79%). In addition, for sensitivity purposes, we investigated more direct and indirect financial support. Direct support was indicated by summing up the answers to two questions: whether grandparents provided essentials for the child and whether they provided gifts and extras for the child. These responses were combined and classified into two categories: 0 = no financial support received (22%), 1 = received financial support (78%). Indirect financial support was measured by three questions: whether grandparents helped with household expenses, provided financial help for child care, or provided any other financial support. Again, the answers were combined and classified into two categories: 0 = no financial support received (88%), 1 = received financial support (12%). Regarding 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, regarding financial support, we are unable to analyze the relation between grandparent gender and financial support. There is a weak positive correlation between parent–grandparent contact and grandparental financial support variables ($r = .26$, $p < .05$).

For the MCS, coresiding 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 coresiding 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 relation between paternal grandparents' investment and child well-being.

In the present analyses, we control for several factors that have been shown to associate with children's cognitive and socioemotional outcomes in prior studies (e.g., Hansen & Jones, 2008; Jones & Schoon, 2008; Schoon, Jones, Cheng, & Maughan, 2011). These potentially confounding factors are assessed at the baseline (i.e., one study wave before the outcome measure). Covariates include the child's gender, age in months, ethnicity, and number of siblings; maternal age, education (as indicated by the National Vocational Qualification [NVQ], where a higher level of NVQ signifies higher educational qualifications), employment status, and health (ranging from 0 = poor to 3 = excellent); family finances; the presence of the biological father in the household; child-care arrangements (i.e., whether the children are primarily cared for by the parents themselves, an informal child-care provider, such as relatives, friends, and baby sitters, or a formal child-care provider, such as child-care centers and registered child minders); and country.

Finally, the time period between the baseline and outcome measure interview (in months) is taken into account ($M = 26.5$, $SD = 3.51$). Descriptive statistics are presented in Table 1.

In addition, for the BAS analyses, we control for child development delay scores at age 9 months measured by the seven questions from the Denver Development Screening (DDS) test (Frankenburg & Dodds, 1967) and five questions from the MacArthur Communicative Development Inventories (CDI; Fenson et al., 1993). The DDS measures infant gross and fine motor skills, and the CDI measures early communicative gestures. These 12 measures were dichotomized so that 0 indicates that the infant does not have a certain delay, and 1 indicates that the infant has a certain developmental delay ($M = 9.5$, $SD = 1.25$). For the SDQ analyses, we control for child temperament and behavior outcomes at age 9 months as measured by 12 questions from the Carey Infant Temperament Scale (Carey, 1972; Carey & McDevitt, 1978). Temperament dimensions covered with this scale were

Table 1
Descriptive Statistics of the 24,614 Person-Observations From 13,744 Persons in the British Millennium Cohort Study

	Total no.	No. of persons	%	*M* (*SD*)	Within-person *SD*
Child's gender					
Girl	12,178	6,788	49.4		
Child's age at interview (in months)	24,614	13,744		23.1 (14.29)	13.37
Child's ethnicity					
White	21,505	11,798	87.4		
Mixed	655	377	2.7		
Indian	568	331	2.3		
Pakistan	1,088	740	4.4		
Black	580	356	2.4		
Other	218	142	0.9		
Number of siblings	24,614	13,744		1.0 (1.03)	0.28
Maternal age	24,614	13,744		30.7 (5.84)	1.16
Maternal education					
NVQ Level 1 (lowest)	1,975	1,139	8.3		
NVQ Level 2	7,265	4,027	29.3		
NVQ Level 3	3,664	2,021	14.7		
NVQ Level 4	7,342	3,934	28.6		
NVQ Level 5 (highest)	930	493	3.6		
Other	3,438	2,130	15.5		
Maternal employment status					
Working	13,117	8,218	53.3		
Maternal health (0 = poor, 3 = excellent)	24,614	13,744		2.1 (0.74)	0.35
Financial situation of family					
Finding it difficult	2,276	1,980	9.3		
Just about getting by	6,475	5,264	26.3		
Doing alright	9,516	7,422	38.7		
Living comfortably	6,347	4,731	25.8		
Presence of biological father in household					
Yes	20,718	11,962	84.1		
Child-care arrangement					
Parent	16,512	9,460	67.08		
Informal	5,011	2,849	20.36		
Formal	3,091	1,659	12.56		
Country					
England	15,240	8,543	61.9		
Wales	3,875	2,138	15.7		
Scotland	3,072	1,707	12.5		
Northern Ireland	2,427	1,356	9.9		

Note. 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; NVQ = National Vocational Qualification.

mood, withdrawal, adaptability, and regularity, and in the sample, the scale ranged from 0 to 39 (M = 10.8, SD = 5.72), where the higher numbers indicate a higher rate of behavioral challenges or difficulties.

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) associations, where between-person associations represent the results across individuals and within-person associations indicate the individual's variation over time (Curran & Bauer, 2011). In practice, between-person models provide mean scores for respondents. 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. Moreover, in fixed effect models, we control for several time-variant factors, as discussed earlier (see Table 1).

Although within-person regression models have several strengths, they also have some limitations. One limitation is that these models obviously do not account for the time-variant unobserved characteristics. Fixed effect models may also exacerbate measurement errors. With these models, then, it is important to avoid overinterpretation (Angrist & Pischke, 2008). In addition, there could be a small number of participants who experience a change in the case of both outcome and main independent factors and, consequently, the sample size may be reduced in within-person models. Finally, and related to the low number of observations, within-person models often suffer from high confidence intervals. Despite these limitations, within-person regressions provide a strong test for causality in the association between grandparental investment and child outcomes.

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 those further apart (Table A1). Similarly, according to transition probabilities in financial support, a large majority of grandparents remain in the same category between waves (Table A1). 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. The intraclass correlation for BAS assessments is .66 and for SDQ scores is .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

Table 2
Associations Between Maternal Grandparents' Investment and Cognitive Development Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
Parent–grandparent contacts									
Less than once a year	Ref			Ref			Ref		
Once a year	0.98	.48	[0.03, 1.93]	1.22	.66	[−0.06, 2.51]	−0.29	.71	[−1.69, 1.10]
Once every few months	3.22	.36	[2.52, 3.92]	4.19	.42	[3.36, 5.02]	0.18	.65	[−1.10, 1.45]
At least once a month	3.66	.36	[2.97, 4.36]	4.78	.43	[3.94, 5.62]	0.33	.65	[−0.95, 1.61]
Once or twice a week	2.75	.33	[2.10, 3.40]	3.69	.39	[2.92, 4.45]	−0.25	.63	[−1.49, 1.00]
3–6 times a week	2.85	.34	[2.19, 3.51]	3.76	.40	[2.98, 4.54]	0.27	.64	[−0.99, 1.52]
Everyday	2.24	.33	[1.59, 2.89]	2.62	.38	[1.87, 3.37]	0.54	.64	[−0.72, 1.80]
Grandparental financial support									
No	Ref			Ref			Ref		
Yes	0.76	.16	[0.45, 1.07]	1.42	.22	[1.00, 1.85]	−0.14	.22	[−0.57, 0.30]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 24,614 person-observations from 13,744 unique persons.

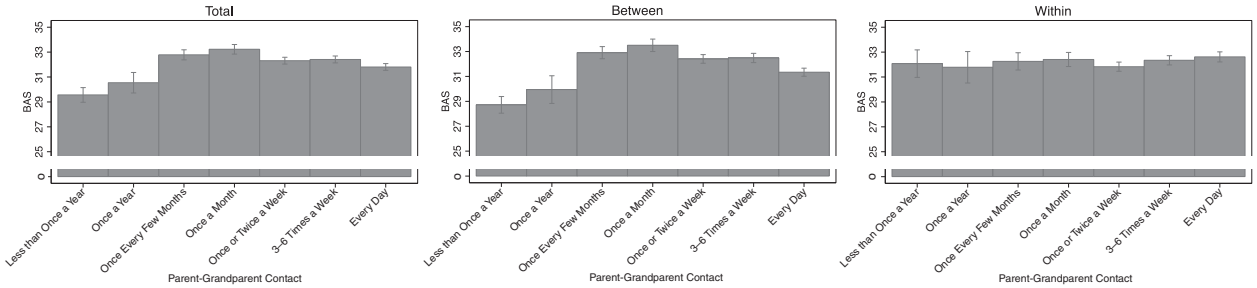

Figure 1. Associations between mother–maternal grandparent contact and cognitive development among children (predictive margins and 95% confidence intervals; see Table 2 for statistical details).

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 reverse U-type curve exists for the association between parent–grandparent contacts and child scores. In between-person model, the group "less than once a year" and "once a year" significantly differs from other groups. However, these effects do not hold in within-person model.

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.

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 between-person model, children whose mothers reported contact with their own parents once every few months reported fewer problems when compared to children with 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." In addition, we were unable to find any significant associations for the within-person model.

Then, we analyzed the association between maternal grandparents' financial support and child well-being (Table 3 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.

Sensitivity Analyses

In the first sensitivity analyses, we investigate whether the potential grandparental effect varies between maternal grandmothers and grandfathers. We include the interaction term in the fixed effect

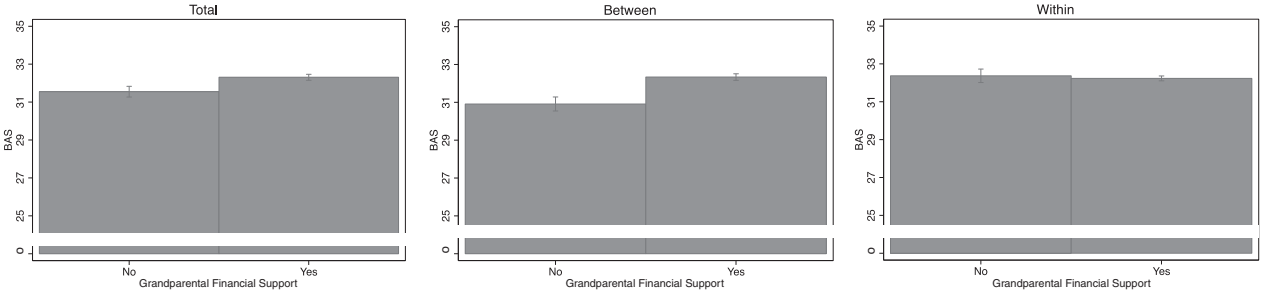

Figure 2. Associations between maternal grandparents' financial support and cognitive development among children (predictive margins and 95% confidence intervals; see Table 2 for statistical details).

Table 3
Associations Between Maternal Grandparents' Investment and Emotional and Behavioral Problems Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
parent–grandparent contacts									
Less than once a year	Ref			Ref			Ref		
Once a year	−0.21	.22	[−0.64, 0.22]	−0.54	.32	[−1.17, 0.08]	0.18	.30	[−0.40, 0.77]
Once every few months	−0.29	.17	[−0.62, 0.04]	−0.39	.21	[−0.80, 0.01]	0.07	.27	[−0.47, 0.60]
At least once a month	−0.10	.17	[−0.43, 0.22]	−0.12	.21	[−0.53, 0.29]	0.16	.27	[−0.38, 0.70]
Once or twice a week	−0.03	.15	[−0.33, 0.28]	−0.08	.19	[−0.45, 0.30]	0.26	.27	[−0.27, 0.78]
3–6 times a week	0.03	.16	[−0.27, 0.34]	−0.11	.19	[−0.49, 0.27]	0.34	.27	[−0.19, 0.87]
Everyday	0.07	.15	[−0.24, 0.37]	0.01	.19	[−0.36, 0.37]	0.23	.27	[−0.30, 0.76]
Grandparental financial support									
No	Ref			Ref			Ref		
Yes	−0.15	.07	[−0.29, −0.01]	−0.36	.11	[−0.57, −0.15]	0.11	.09	[−0.07, 0.29]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 24,614 person-observations from 13,744 unique persons.

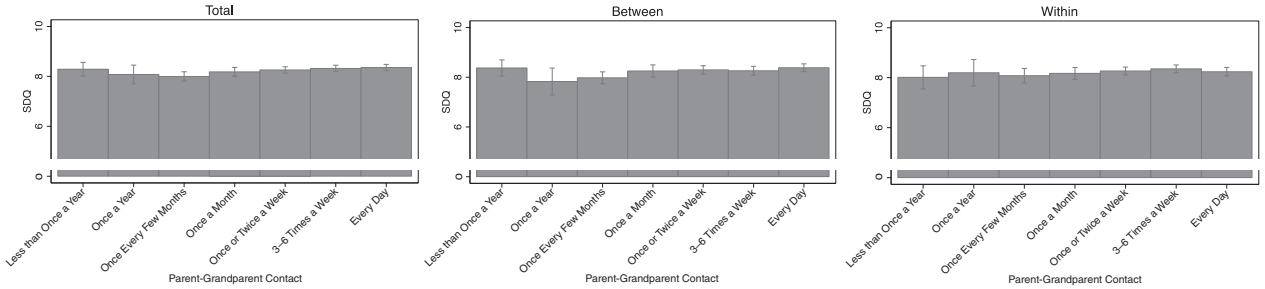

Figure 3. Associations between mother–maternal grandparent contact and emotional and behavioral problems among children (predictive margins and 95% confidence intervals; see Table 3 for statistical details).

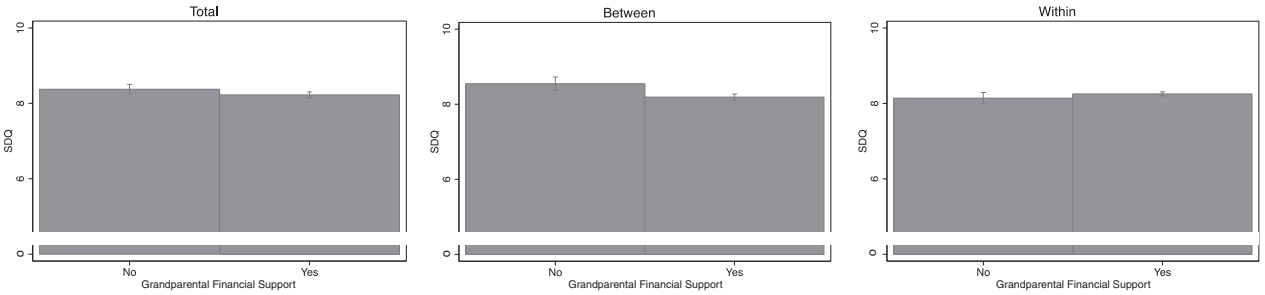

Figure 4. Associations between maternal grandparents' financial support and emotional and behavioral problems among children (predictive margins and 95% confidence intervals; see Table 3 for statistical details).

model and analyze the interaction between contact frequency and grandparental gender (results not provided in tables or figures). However, we are not able to determine significant interaction effects.

Second, we analyze more direct and indirect financial support. In the case of cognitive development, we find significant associations between direct financial support and outcomes in the total and between-person models (Table A2). However, there is no significant association in the within-person model. In the case of indirect financial support, we are unable to find significant

associations in the total, between-person, or within-person models.

Then, we turn to investigate emotional and behavioral problems among children. Table A3 shows that that there are significant associations between direct financial support and fewer emotional and behavioral problems among children in the total and between-person models, but not in the within-person model. In the case of indirect financial support, we find no significant associations in the total, between-person, or within-person models.

In the next sensitivity analyses, we detect the potential influence of paternal grandparents' investment (Table A4). Similar to maternal grandparents, we determine that for the total model, a nonlinear relation exists between parent–grandparent contacts and child assessment scores; however, these associations are based on between-person rather than within-person associations. Then, we include an interaction term in the within-person model and investigate the interaction between contact frequency and paternal grandparents' gender, but did not determine a significant interaction (results not shown).

In addition, we analyze the association between paternal grandparents' financial involvement and child cognitive assessments (Table A4). 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 associations and are not replicated for the within-person models that compare the same individuals over time.

Sensitivity analyses of the paternal grandparents also demonstrate that for the total and between-person models, children whose fathers report contacts with their parents once every few months or on a monthly basis report fewer emotional and behavioral problems when compared to fathers who have contact with their parents "less than once a year" (Table A3). However, for the within-person model, these associations are not apparent. Next, the interaction term between contact frequency and grandparental gender is included, but there is no significant association between these variables (results not provided).

Then, we analyze the association between paternal grandparents' financial involvement and child emotional and behavioral problems. 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. These results are again based on between-person associations 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 who live in the United Kingdom. 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 child outcomes. These results were, however, based on between-person effects, and the reverse U-shaped curve disappeared for the within-person models. We also 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.

Regarding emotional and behavioral problems, we found that for the total and between-person models, children whose mothers reported monthly contact with their parents (i.e., maternal grandparents) reported fewer problems when compared to mothers who 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. Similarly, in sensitivity analyses, we found that the direct grandparental financial support (i.e., when grandparents provided essentials or gifts directly to the child) was associated with fewer problems among children in the total and between-person models. However, all these associations were based on between-person effects and could not be replicated for the within-person models.

Overall, the results of this study do not provide support for the prediction that a causal association exists between grandparental investment and child

outcomes. 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, previous evidence indicates that grandparental involvement is associated with increased development and well-being among grandchildren (e.g., Buchanan & Rotkirch, 2016; Sear & Coall, 2011). However, these results are primarily based on either cross-sectional data (e.g., Attar-Schwartz et al., 2009; Tanskanen & Danielsbacka, 2012) or study samples that only utilize one baseline measure for grandparental investment (e.g., Fergusson et al., 2008; 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 association 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 (see Buchanan & Rotkirch, 2016; Coall & Hertwig, 2010 for discussion).

Several prior studies have noted a matrilateral effect in multigenerational relationships, which implies that maternal grandparents invest more in grandchildren than do paternal grandparents (e.g., Chan & Elder, 2000; Danielsbacka, Tanskanen, & Rotkirch, 2015). 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, Deater-Deckard, Dunn, & Davies, 2002; Tanskanen & Danielsbacka, 2012). We conducted sensitivity analyses and investigated the association between paternal grandparents' investment and child outcomes. 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 outcomes are not totally comparable to the results for the maternal grandparents, as discussed earlier. However, these results indicate that the effect of maternal and paternal grandparents could be similar.

In addition to lineage differences, prior studies have consistently demonstrated that grandmothers are more involved than grandfathers (e.g., Chan & Elder, 2000; Danielsbacka, Tanskanen, Jokela, & Rotkirch, 2011). 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 correlation (Sear & Coall, 2011; Tanskanen & Danielsbacka, 2012). We did not found significant differences between the effects of grandmothers and grandfathers. This was repeated for analyses using cognitive and socioemotional measures for child outcomes and different measures for the investment of maternal and paternal grandparents.

Compared to prior studies that analyzed multigenerational relationships, this study has certain strengths. In this study, child outcome was investigated with both cognitive and socioemotional measures. Furthermore, we analyzed cognitive development and emotional and behavioral problems uring early childhood, which is important because these early scores have consistently been shown to forecast socioeconomic success later in life (e.g., Duncan et al., 2007; Heckman, 2006). Finally, we analyzed large-scale, longitudinal and representative data using fixed effect models that focused on within-person variation over time. This method provides a test for causality in the association between grandparental investment and child outcomes. 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.

The within-person models used in this study are not without limitations. For instance, some changes in grandparental investment reported across study waves could be based on response or coding errors. The same could be true in the case of responses related to child outcomes. Moreover, there could be some time-variant unobserved factors that affect child outcomes or investment variables that we cannot account for due to data limitations. Although we have controlled for several potentially confounding time-varying factors, all such factors are hard, if not impossible, to consider.

Other limitations include that in 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 et al. (2007) demonstrated that child well-being predicted nonresident 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 the 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 grandparental investment improves child well-being. However, it is important to note that in the present study, we have investigated the potential grandparental effect using only two grandparental investment variables, namely, parent–grandparent contact and grandparental financial support. Thus, it is possible that some other forms of grandparental investment, for instance, grandparental child care, may provide different results. Moreover, we have concentrated on small children, and future studies should investigate whether these results hold among adolescent grandchildren.

Although we could not provide evidence for the prediction that parent–grandparent contact or grandparental financial support improves 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, interaction between generations may help 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 development studies to use longitudinal data with fixed effect models.

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Appendix

Table A1
Transitions in Grandparental Investment in the British Millennium Cohort Study

	Parent–grandparent contacts in Wave 1						
	0	1	2	3	4	5	6
Parent–grandparent contacts in Wave 2							
0 Less than once a year	331	62	22	15	28	13	49
1 Once a year	52	99	45	4	6	3	12
2 Once every few months	32	85	858	145	35	30	45
3 At least once a month	20	9	265	678	195	57	54
4 Once or twice a week	24	6	82	323	1,447	414	154
5 3–6 times a week	14	4	27	66	684	1,122	437
6 Everyday	18	9	34	38	243	693	1,782
Total *n*	491	274	1,333	1,269	2,638	2,332	2,533

	Grandparental financial support in Wave 1	
	No	Yes
Grandparental financial support in Wave 2		
No	1,028	1,361
Yes	880	7,601
Total *n*	1,908	8,962

Table A2
Associations Between Maternal Grandparents' Investment and Cognitive Development Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
Direct grandparental financial support									
No	Ref			Ref			Ref		
Yes	0.81	.15	[0.51, 1.11]	1.48	.21	[1.06, 1.90]	−0.08	.22	[−0.50, 0.34]
Indirect grandparental financial support									
No	Ref			Ref			Ref		
Yes	−0.11	.19	[−0.49, 0.26]	−0.15	.28	[−0.70, 0.39]	−0.09	.26	[−0.60, 0.42]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 24,614 person-observations from 13,744 unique persons. Direct investment = grandparents provided essentials, gifts, and extras to child; indirect investment = grandparents helped to pay household costs, child-care payments, or provided other financial help.

Table A3
Associations Between Maternal Grandparents' Investment and Emotional and Behavioral Problems Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
Direct grandparental financial support									
No	Ref			Ref			Ref		
Yes	−0.14	.07	[−0.28, −0.01]	−0.33	.10	[−0.54, −0.13]	0.10	.09	[−0.07, 0.28]
Indirect grandparental financial support									
No	Ref			Ref			Ref		
Yes	0.03	.09	[−0.14, 0.19]	0.20	.14	[−0.06, 0.47]	−0.14	.11	[−0.35, 0.08]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 24,614 person-observations from 13,744 unique persons. Direct investment = grandparents provided essentials, gifts, and extras to child; indirect investment = grandparents helped to pay household costs, child-care payments, or provided other financial help.

Table A4
Associations Between Paternal Grandparents' Investment and Cognitive Development Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
Parent–grandparent contacts									
Less than once a year	Ref			Ref			Ref		
Once a year	0.50	.52	[−0.52, 1.52]	0.34	.67	[−0.98, 1.65]	−0.36	.83	[−1.99, 1.28]
Once every few months	2.19	.42	[1.37, 3.01]	3.14	.49	[2.18, 4.09]	−0.67	.81	[−2.26, 0.93]
At least once a month	2.38	.41	[1.58, 3.17]	2.94	.47	[2.02, 3.87]	0.13	.82	[−1.47, 1.73]
Once or twice a week	1.84	.39	[1.07, 2.60]	2.30	.44	[1.43, 3.17]	0.18	.82	[−1.43, 1.79]
3–6 times a week	1.51	.42	[0.70, 2.33]	1.94	.48	[0.99, 2.89]	0.05	.87	[−1.65, 1.75]
Everyday	0.70	.43	[−0.14, 1.53]	1.00	.47	[0.07, 1.93]	−0.12	.93	[−1.94, 1.71]
Grandparental financial support									
No	Ref			Ref			Ref		
Yes	0.61	.17	[0.27, 0.94]	1.09	.23	[0.64, 1.54]	−0.08	.26	[−0.58, 0.42]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 17,085 person-observations from 10,534 unique persons.

Table A5
Associations Between Paternal Grandparents' Investment and Emotional and Behavioral Problems Among Children

	Total			Between			Within		
	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]	β	*SE*	95% CI [lower, upper]
Parent–grandparent contacts									
Less than once a year	Ref			Ref			Ref		
Once a year	0.13	.23	[−0.32, 0.57]	−0.09	.31	[−0.70, 0.52]	0.55	.33	[−0.09, 1.20]
Once every few months	−0.53	.19	[−0.90, −0.17]	−0.69	.23	[−1.13, −0.24]	−0.06	.32	[−0.69, 0.57]
At least once a month	−0.36	.18	[−0.71, 0.00]	−0.55	.22	[−0.99, −0.12]	−0.10	.32	[−0.74, 0.53]
Once or twice a week	−0.06	.17	[−0.40, 0.29]	0.05	.21	[−0.36, 0.45]	−0.27	.32	[−0.91, 0.37]
3–6 times a week	−0.12	.19	[−0.48, 0.24]	−0.18	.23	[−0.62, 0.27]	−0.31	.34	[−0.98, 0.36]
Everyday	0.28	.19	[−0.10, 0.65]	0.27	.22	[−0.16, 0.71]	−0.01	.37	[−0.73, 0.72]
Grandparental financial support									
No	Ref			Ref			Ref		
Yes	−0.18	.07	[−0.32, −0.03]	−0.38	.11	[−0.59, −0.17]	0.01	.10	[−0.19, 0.20]

Note. Values are β coefficients of multilevel ordinary least squares regressions; n = 17,085 person-observations from 10,534 unique persons.