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Age at Childbearing over Two Generations and Grandchildren's Cognitive Achievement

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Abstract

We examine whether grandparents' and parents' ages at birth are associated with grandchildren's early cognitive achievement, and whether grandparents' or parents' socioeconomic status, health, and marital status mediate those associations. Our analysis is based on data from the Panel Study of Income Dynamics and its Child Development Supplement. A grandparent's age at the birth of their own children is robustly and positively associated with grandchildren's verbal achievement, but not with grandchildren's applied mathematics achievement, after controlling for parents' age at the grandchild's birth. The associations are similar in magnitude for grandmothers and grandfathers. A variety of indicators of social class in the grandparent and parent generations did not mediate this age effect. However, many of those indicators of grandparents' social class were directly or indirectly related to grandchildren's achievement.

1.1 Introduction

The family is the primary social institution through which resources are transferred from one generation to the next, making it one of the most powerful engines of social and economic inequality in the contemporary United States (McLanahan & Percheski, 2008). Resources transferred within families include *material assets* like income and wealth (Conley, 2009); components of *human capital* like educational attainment, labor force experience, and occupational status (Blau & Duncan, 1967); *social capital*, including kin networks, friends, and formal contacts (Portes, 1998); and *cultural capital*, including the skills to negotiate complex social institutions (Lareau, 2011). These resources cohere and accumulate across multiple generations, resulting in socioeconomic advantage or disadvantage.

The majority of literature on the intergenerational transmission of socioeconomic advantage in families focuses on two-generation models, that is, from parents to children (Blau & Duncan, 1967; Bowles, Gintis, & Osborne, 2005; Musick & Mare, 2004; Sewell, Haller, & Portes, 1969). Two generation models rely—implicitly or explicitly—on the Markovian assumption that socioeconomic resources in a family are transferred directly to children through their parents and that any influence of prior generations operates only indirectly through what parents share with their children. Our research challenges this Markovian

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assumption by incorporating age at childbearing as a demographic event to evaluate the utility of three-generation models of status transmission. Specifically, we examine whether grandparents' and parents' ages at birth are associated with grandchildren's early cognitive development, and whether grandparents' and parents' socioeconomic status, health, and marital status explain those associations. Our analysis is based on data from the Panel Study of Income Dynamics (PSID), a longitudinal, nationally-representative study of families first interviewed in 1968 and followed to the present day. We include families in which at least one grandchild participated in the Child Development Study, a supplement to the PSID introduced in 1997 and designed to track the development of descendants of original PSID household heads from early childhood to early adulthood.

2.1 Background

A small body of empirically-based three-generation models of social stratification supports the assertion that the intergenerational transmission of status attainment is adequately explained by two-generation models. Using data from the Wisconsin Longitudinal Study, Warren and Hauser (1997) concluded that a grandparent's income, education, and occupational status had no direct effect on young adults grandchildren's status attainment after accounting for parents' characteristics. Erola and Moisio (2007) analyzed Finnish census data and concluded that accounting for grandparents' social class added "very little explanatory power" to the analysis of intergenerational social mobility (p. 169). Finally, Cherlin and Furstenberg (1992) drew on interviews with 510 grandparents in the National Children's Study to conclude that grandparents are valued kin, but their direct influence on grandchildren's well-being is minimal.

Each of these studies has been subject to criticisms regarding sample design and research methodology. Warren and Hauser's work was drawn from a sample of largely white, middle-class families residing in one region of the United States, and thus lacked population representativeness, particularly at the upper and lower ends of the socioeconomic spectrum where the intergenerational transmission of status has been observed to be the strongest. Chan and Boliver (2012) re-analyzed Finnish census data and concluded that Erola and Moisio overlooked significant improvement in model fit in models that allow for a direct grandparent/grandchild association in social class. Cherlin and Furstenberg's conclusions, while drawn from a nationally representative sample in the United States, were based on interviews conducted with grandparents several years after parents and grandchildren were observed.

Beyond the methodological limitations of prior research, critics have argued that researchers potentially undervalue the influence of grandparents on grandchildren's status attainment by ignoring their indirect influence through parents' status attainment. When parents' characteristics fully mediate the relationship between grandparents' characteristics and grandchildren's outcomes, the evidence in favor of a Markovian process is taken as evidence against grandparents' influence. However, grandparents may be able to provide important resources to grandchildren, even if those benefits operate through parents. For example, grandparents' care to grandchildren may allow parents to maintain their socioeconomic status by continuing to work or to work longer hours than they would with other care

arrangements, and grandparents' good health may free parents up to invest more time in their children.

2.1.1 Demography and multigenerational models of inequality

Demographers recognize that intergenerational social class reproduction and mobility work through fertility, mortality, and union formation. In order for intergenerational transfers to occur, the first generation must reproduce; in order to have any resources to transfer, the first generation also must survive long enough to accumulate something of value, and children must survive to receive it. Social demographers also recognize that legal mechanisms for the transfer of resources favor families related by marriage, blood relationships, or adoption. Corollary to these observations, a demographic model would predict that the timing and union context of childbirth, total achieved family size, and the onset of morbidity and mortality in one generation further constrain opportunities for the transmission of capital to the next. Rather than playing out anew in each pair of generations as a Markovian model would predict, demographic processes potentially have lasting consequences for successive generations if third- and higher-generation descendants stand to receive socioeconomic resources or contributions of time or instrumental or emotional support from a surviving ancestor. Indeed, three-generation mobility models posit non-Markovian transmission processes, such that grandparents' characteristics may influence grandchildren's status attainment, independent of a parent's characteristics. The motivation to engage in these transfers has become increasingly salient in late-demographic transition countries characterized by high life expectancy and low fertility (Coall & Hertwig, 2010; Uhlenberg, 1996).

Given the potential for three-generation processes in families, demographers have recently sought to better articulate the production and reproduction of social inequality over time, particularly at the top and bottom of the socioeconomic hierarchy. Leading this initiative, Robert Mare remarked in his 2010 presidential address to the Population Association of America that "[w]e ignore the effects of ancestors and higher-order social contacts at the peril of sound demographic research. It is likely that we have overstated intergenerational mobility in this country and elsewhere or, at the very least, have misunderstood the pathways through which it occurs (Mare 2011)." His assertion is based on recent studies that have documented the long-term intergenerational persistence of wealth or poverty at the extreme ends of the socioeconomic hierarchy as well as social class differences in how kin share resources over three generations in different contexts and historical eras (Kahlenberg, 2010; Keister, 2000; Phillips, Brooks-Gunn, Duncan, Klebanov, & Crane, 1998; Sharkey & Elwert, 2011; Uhlenberg, 2009).

2.2 Research aims

2.2.1 Association of grandparent's age at childbearing with grandchild achievement

Our first aim responds to Mare's call for innovative, multigenerational research on stratification processes (2011) by examining whether variation in age at childbearing in the grandparents' generation is associated with grandchildren's cognitive achievement, independent of parent's age at birth. Demographers have demonstrated that the timing of

childbearing is tied to other components of the transition to adulthood like leaving the parental home, finishing school, getting a first job, and getting married. Young adults who begin these transitions relatively early are also likely to have children at young ages. Adults who defer childbearing to remain in school or to experience career gains have their first children at older ages. As a result, the life chances of children depend in part on the life course position of parents at the time they begin to have children and the life course transitions parents continue to make as their children age. Given evidence of the intergenerational transmission of age at birth (Barber, 2001), we anticipate that adults born to older parents will themselves delay childbearing, thus extending generation length between grandparents and grandchildren. (For an assessment of the influence of grandparents' and parents' fertility on the related topic of achieved family size in the third generation, see Kolk in this volume.)

2.2.2 Mediating effect of grandparents' characteristics

Our second aim is to examine whether grandparents' socioeconomic status (SES), global health and vital status, or marital status at the time of the grandchild's birth mediates the relationship between the timing of grandparents' own childbearing and grandchildren's cognitive achievement. We expect that grandparents who had their children at later ages will have higher socioeconomic status at their grandchild's birth due to pre-existing characteristics that caused them to defer their own fertility (e.g., higher educational attainment and later age at marriage), the accumulation of assets and higher earnings made possible by delaying fertility, and delayed fertility in the parent generation, which gives grandparents more years to accumulate wealth and income. Because the timing of grandparents' births likely varies across their socioeconomic positions, we expect that any positive association between a grandparent's age at his or her child's birth and grandchildren's cognitive achievement will be partially mediated by grandparent's years of education, income, and home ownership (a key source of wealth for many families) at the time of a grandchild's birth. We also anticipate that grandparents' socioeconomic resources will be associated with grandchildren's cognitive achievement because resources, including income, wealth, and human, social, and cultural capital can be transformed into goods, services, and experiences that promote children's verbal and nonverbal reasoning skills in ways that are valued in formal education (Duncan & Magnuson, 2005).

Further, we expect that grandparents' health varies with grandparents' age at a grandchild's birth and will be associated with grandchildren's cognitive achievement. We build on two-generation models in stratification research that have documented that age at childbearing has enduring associations with the health and status attainment of both parents and their children (Mare & Tzeng, 1989; Mirowsky, 2002; Mirowsky, 2005; Powell, Steelman, & Carini, 2006; Pudrovska & Carr, 2009; Spence, 2008). Grandparents' better health may enable them to spend time with and provide care to grandchildren, but poor health may drain grandparents' personal financial resources and draw parents' time and money away from grandchildren and toward themselves. The association between grandparent age and grandparent health, however, is not clear-cut. On the one hand, grandparents who experienced early childbearing may be relatively young at the time of their grandchildren's birth and might be healthy enough to provide instrumental support for grandchildren and

avoid dependence on their adult children for their own care. On the other hand, grandparents who experienced later childbearing may have accumulated more socioeconomic resources and thus achieved better health (Fries, 2005; Masters, Hummer, & Powers, 2012), resulting in equivalent or even superior health to their counterparts who gave birth earlier. Further, grandparents who experienced earlier childbearing and who are likely older when their grandchildren are born may be better able to leverage their better health into greater instrumental support for grandchildren, especially if they are no longer in the labor force.

Finally, we expect that that grandparents' marital status at a grandchild's birth will be associated with grandchildren's cognitive achievement. Grandparents who experienced childbearing at older ages may be more likely to be widowed than grandparents who had children at younger ages. Grandparents who had children at younger ages may also be more likely to be never married, if their early births occurred outside of marriage. Grandparents who are married may have higher incomes and more wealth than never-married, divorced, or widowed grandparents, given the higher incomes and greater financial stability of married couples. At the same time, marriage may tie grandparents to a schedule or a geographical area that limits contact with grandchildren if one partner is employed. Grandparents who are divorced, widowed, or never married may have fewer competing obligations for their time and more residential mobility compared to married grandparents, but may vary in the accumulated wealth available to transfer to children.

2.2.3 The attenuating effect of parents' attributes

Our third aim is to examine whether a parent's socioeconomic, health, and marital status fully mediate the relationship between grandparent's characteristics and grandchildren's cognitive development. The timing of childbearing represents a pathway for the intergenerational transmission of inequality over multiple generations through variation in health and economic resources (DiPrete & Eirich, 2006; Ross & Wu, 1996; Willson, Shuey, & Elder, 2007). We expect that each dimension of grandparent characteristics that we consider will be echoed in parents' attributes. The intergenerational transmission of socioeconomic status, physical health (Ahlburg, 1998; Classen, 2010) and union status (Amato, 1996; Sassler, Cunningham, & Lichter, 2009) implies that the apparent association of grandparents' status with grandchildren's outcomes is explained by parents' status on those indicators, as the Markovian model would predict. Therefore, our analyses first introduce indicators of grandparents' attributes into statistical models predicting grandchildren's verbal and nonverbal achievement scores and then introduce parents' attributes on the same indicators to assess the magnitude of the second generation's attenuating effect. In sum, our purpose is to establish whether there is an independent effect or only an indirect effect of grandparents' characteristics measured at the time of a grandchild's birth on grandchildren's early cognitive achievement.

2.3 Cognitive achievement as a measure of status attainment

A substantial body of literature has established strong associations between early cognitive achievement and eventual academic performance, educational attainment, occupational status, and earnings (Boissiere, Knight, & Sabot, 1985; Duncan, et al., 2007; Entwisle, Alexander, & Olson, 2005; Heckman, 2008). Cognitive achievement is strongly associated

with parents' age at birth, with children born to young mothers or fathers more likely to exhibit diminished verbal and nonverbal ability at school entry. Much of this relationship is explained by young parents' low accumulation of human capital and socioeconomic resources (Mollborn & Dennis, 2012; Powell, et al., 2006). Thus, we expect that early cognitive achievement is a precursor of eventual status attainment, one that may be susceptible to policy intervention.

3.1 Data and Methods

We used data from the Panel Study of Income Dynamics, a longitudinal, multi-generational study that began as a nationally-representative sample of about 5,000 American families in 1968 (approximately 18,000 individuals). Those families and their descendants were followed annually until 1997 and biennially since then, mostly through telephone interviews since 1973. A child born into or adopted into a PSID family inherits the PSID "gene," and is tracked longitudinally as a study participant, even after establishing a separate household and beginning a new family. As a result, the study's most recent waves include information on three or four generations of family members related to the head of the original PSID household. This design permits the development of three-generation models of family process, one of the few nationally representative data sets in the world to do so. As of 2009, the PSID includes data on over 9,000 household-based families that have spun off of the original PSID sample, with information on nearly 25,000 individuals (Panel Study of Income Dynamics, 2012).[3] Response rates to the main PSID interview for the core sample have been consistently above 90 percent in each interview wave.[4]

At each wave, the PSID survey instrument collects in-depth data on the employment history, income, assets, expenditures, education, and marital and childbearing histories of the household head and his/her spouse or cohabiting partner. As adult children move out and establish their own households, they become household heads themselves, so a single family in one wave of the PSID may contribute data on household heads from two or more generations. In addition to the in-depth data on household heads and spouses/partners, the PSID instrument collects data on a subset of measures for all family members.

Since 1997, the PSID the Child Development Supplement (CDS) has collected data on grandchildren in the third (and sometimes fourth) generation of PSID families. Families with grandchildren who were between 0 and 12 years old in 1997 were eligible for inclusion, and the study includes up to two grandchildren from eligible households. The CDS contributes outcome measures for our study. The instrument includes standardized assessments of grandchildren's cognitive achievement, time use data, information on school or child care quality, parent reports of family process and grandchild behavior, and monetary investments parents and other family members, including grandparents, make in grandchildren. A second wave of the CDS was completed in 2002/03, when study grandchildren were 5 to 18 years

[3]Nearly 70,000 individuals have "passed through" the study since its inception. In 1997, 511 immigrant-headed families were added to the sample to make the PSID representative of the current U.S. population. In the same year, the core sample was reduced by approximately 2,200 families for cost savings. This reduction removed some three-generation data from the sample.

[4]In 1997, the first year from which we draw outcome data from the accompanying Child Development Supplement, the core sample re-interview rate was 95.7 percent. In 2007, the last year from which we draw CDS data, the core sample re-interview rate was 96.4 percent.

old, and a third wave in 2007 observed grandchildren who were 10 to 18 years old.[5] We excluded children in the 1997 immigrant refresher sample because grandparents of those grandchildren were not included in the PSID sample. CDS interviews with caregivers and grandchild assessments were completed in person. Child care providers, teachers, and school administrators responded to mailed surveys. The 1997 wave of the CDS included 3,563 grandchildren from 2,380 households.

3.2 Key independent variables

Grandparent age at CDS parent's birth—A grandparent's age at the parent's birth is calculated as the grandparent's year of birth subtracted from the parent's year of birth. This introduces some error where a grandparent had not yet experienced a birthday in the year when their child (the CDS child's parent) was born. We assume that this error is randomly distributed. Consistent with prior research on three-generation models of status attainment (Erola & Moisio, 2007; Warren & Hauser, 1997), we conduct separate analyses for grandmothers and grandfathers. Where grandparents were married or cohabiting when they entered the PSID sample in 1968, both grandparents could contribute their age at their child's birth to our analysis. However, 864 grandparent households included only one grandparent or the other (820 female-headed, 44 male head with no spouse/partner) in 1968. The resulting sample size for grandmothers is larger than that for grandfathers.

Parent's age at grandchild's birth—Parent's age at the grandchild's birth is measured as parent's age minus the grandchild's age. We also control for the parent's gender. About 62 percent of parents in the sample are women.

3.3 Dependent variables

Verbal and nonverbal cognitive achievement—We use grandchildren's age-normed standard scores from the Letter-Word Identification and Applied Problems components of the Woodock-Johnson Revised (WJ-R) Tests of Achievement. Field interviewers administered these items to grandchildren aged 3 years or older. We use the earliest available report for each grandchild (recall that grandchildren are administered the tests in up to three waves, depending on their age eligibility: 1997/2002/2003, and 2007) and control for the year of administration. The Letter-Word battery tests for symbolic learning (matching pictures with words) as well as reading identification skills (identifying letters and words). The Applied Problems battery measures children's skill in solving practical problems in mathematics. WJ-R standard scores are population-normed to have a mean of 100 and a standard deviation of 15.

3.4 Mediating variables

We anticipate that grandparents' age at the parent's birth and parent's age at the grandchild's birth are associated with cognitive achievement through mechanisms associated with social class in each generation. We used measures of grandparents' and parents' characteristics observed in the year when a grandchild was born. This results in

[5]Adolescents and young adults who had aged out of the CDS by 2007 were included in the new Transition to Adulthood study, which tracks their experience in postsecondary education, early labor force participation, and family formation.

contemporaneous measures those characteristics in each generation, rather than temporally sequenced measures that would allow us to better estimate the direct and indirect effects of grandparents' characteristics (for example, grandparent's characteristics in a particular calendar year or at parent's particular age and parent's characteristics at a grandchild's birth). However, given the nature of the PSID design, it is challenging to identify a calendar year or a point in a parent's life course that would include information for all families in the sample.

To account for grandparents' *socioeconomic status*, we included the grandparent's years of education, relative poverty status and home ownership status at the grandchild's birth. Years of education was calculated as the grandparent's highest year of schooling. Relative poverty status was a dichotomous indicator of whether the grandparent's household income-to-needs ratio was below 60 percent of the median income-to-needs ratio in the sample. While a more straightforward measure of absolute poverty would have been preferred, the PSID did not use a consistent metric for identifying household absolute poverty thresholds across waves of the study. As a result, the percentage of households in absolute poverty varies from year to year (beyond expected annual fluctuations), and measures of central tendency on a constructed income-to-needs ratio also change dramatically in value from year to year. Using a relative measure of poverty captured households in the lower tail of the income distribution using a commonly-recognized measure of hardship (Smeeding, 2008). Home ownership was based on respondents' self-report (own versus rent or neither own nor rent).

Grandparents' health was measured by a dichotomized measure of responses to the general health measure. Respondents who were in poor or fair health (1) were compared to respondents who reported being in good, very good, or excellent health (0). Union status at the grandhild's birth included five categories: married (the excluded category), never married, widowed, divorced, or separated. Mediation models also included an indicator of whether a grandparent had died by the grandchild's birth. If the grandparent had died, he/she has a value of zero on the foregoing mediating variables. All models also indicated whether a living grandparent was not interviewed in the year of the grandchild's birth.

We used parallel measures of socioeconomic status, health, and marital status in the parent generation at the grandchild's birth. Because of small cell sizes, we combined widowhood, divorce, and separation into a single "formerly married" category in the union status variable. We also included two variables that account for missingness on mediating variables. The first indicated whether a parent was living in the grandparents' household at the grandchild's birth. Because the PSID collects data on income, homeownership status, physical health, and marital status only for the household head and spouse/partner, these data are missing for adult children who co-reside in a household where their parent (the grandparent) is the head. The second variable indicates that a parent was a nonrespondent in the year of the grandchild's birth. We treat all parents living in a grandparent's household as never married on the union status variable; otherwise parents who co-reside with grandparents and nonresponding parents are scored 0 on all mediating variables except years of education.

3.5 Control variables

Our models control for parity in the grandparent's generation with a measure of the number of children ever born to the PSID grandmother. We also control for the birth order of the grandchild to his or her mother (whether or not the mother is in the PSID lineage). We found that where the head and spouse in the grandparent generation had relatively low education, they began union formation and childbearing early and were likely to achieve larger family sizes compared to grandparents who delayed union formation and childbearing. As a result, grandparents with lower education were relatively young at the birth of their first grandchild when that grandchild was born to the oldest child in the parent generation, but relatively old at the birth of their youngest grandchild, born to the youngest child in the parent generation. That is, larger families in one generation took more years to exhaust their reproduction into the next generation compared to smaller families. Controlling for parity in the grandparent generation and the grandchild's birth order helped to establish a linear association between grandparents' educational attainment and age at grandchild's birth, a crucial assumption in making the argument that generation length varies by socioeconomic status over two generations.

Our models also control for grandchild sex, grandchild race (non-Hispanic black, Hispanic, or non-Hispanic other race vs. non-Hispanic white), the sex of the parent, and the grandchild's age in months at the WJ-R assessment. We also control for the wave of the CDS from which the dependent variable is drawn to account for any differences in administration across waves. All analyses are weighted using the 1997 CDS household weight and clustered on the PSID family-level identifier.

3.6 Modeling strategy

In separate models for grandmothers and grandfathers, we initially predict grandchild outcomes as a function of grandparent's age at the parent's birth and our control variables. We then introduce the PSID parent's age at birth. Subsequent models further assess the impact of grandparents' socioeconomic status, health, and union status, and then add in parallel measures for parents. We use ordinary least squares regressions to estimate grandchildren's Woodcock-Johnson scores. The analytic sample includes 2,487 grandchildren in the analyses of grandmother's age and 1,883 in the analyses of grandfather's age. The N is smaller for grandfathers because men were more likely than women to be absent from households with children when the PSID began in 1968 either because a mother had never married or because she remained with her children as a household head after divorce, separation or widowhood. Woodcock-Johnson Letter-Word scores are available for 2,690 grandchildren, and Applied Problems scores are available for 2,687 grandchildren descended from 1,023 PSID 1968 households. We use listwise deletion to arrive at our analytic sample sizes.

4.1 Results

Table 1 reports weighted descriptive statistics for grandmothers and grandfathers separately. The CDS youth in the analytic sample scored about one-half of a standard deviation above the nationally-normed average of 100 on the Woodcock-Johnson Letter-Word and Applied

Problems. Grandfathers were about three years older than grandmothers at the parent's birth, and parents on average were two years older than grandmothers and a half year younger than grandfathers at the grandchild's birth. The majority of parents included in the study were women.

Considering the mediating variables, PSID grandparents had just over 12 years of education on average, and parents had achieved slightly less than two years of college education, on average. About one-sixth of grandmothers and 11 percent of grandfathers were in relative poverty at the grandchild's birth, compared to 27 percent of parents in the grandmother sample and 21 percent of parents in the grandfather sample. Nearly 20 percent of grandmothers and grandfathers were in poor health at the grandchild's birth; grandfathers were more likely than grandmothers to have died by the grandchild's birth (11 percent vs. 6 percent). Grandmothers were more likely than grandfathers to have been never married, widowed, divorced, or separated. Parents had higher rates of being never married than grandparents.

4.2 Multivariate analyses

Table 2 shows unstandardized coefficients from an OLS model predicting grandchildren's WJ-R Letter-Word and Applied Problems scores as a function of grandparent's age at the parent's birth (the first model for each outcome) and parent's age at the grandchild's birth (the second model). Models are separate for grandmothers and grandfathers. Before accounting for parent's age, grandparents' age at the parent's birth was significantly positively associated with grandchildren's predicted Letter-Word scores, but not with their Applied Problems scores. The magnitude of the association was larger for grandmothers than for grandfathers, although post-hoc tests showed that the difference was not statistically significant. Every additional year of grandmother's age at a parent's birth was predicted to increase a grandchild's Letter-Word score by about one-third of a point, and every additional year of grandfather's age increased the predicted score by almost one-quarter of a point. Supplemental models (not shown) included cubic splines with knots at ages 20 and 35 (approximately the 10^{th} and 90^{th} percentiles) to test for a nonlinear association between grandparents' age at parent's birth and grandchild outcomes, but the linear specification presented herein provided the best model fit.

Accounting for parent's age at the grandchild's birth attenuated the magnitude of grandparent's age at birth by about one-quarter, but the coefficients for grandparent's age at birth remained statistically significant at $p<.01$ for grandmothers and $p<.05$ for grandfathers. The magnitude of the coefficients for grandparents' age is about half that for parents. As expected, parent's age at birth predicted grandchildren's Letter-Word and Applied Problems scores.

Table 3 presents unstandardized coefficients for the mediating models that account for grandmothers' and parents' socioeconomic status, health, and union status at the grandchild's birth in predicting grandchildren's Letter-Word scores. Table 4 summarizes parallel models predicting Applied Problems scores. Tables 5 and 6 consider the same outcomes with the same modeling strategies but focus on grandfather's attributes. In the interest of space, we have removed coefficients associated with control variables from tables

5 and 6 (available from authors upon request). Beginning with table 3, a grandmother's age at parent's birth remains associated with grandchildren's Letter-Word scores after accounting for her own and the parent's socioeconomic status, health, and union status at the grandchild's birth. Accounting for *parent's* socioeconomic status had the largest attenuating effect on this association, but the slope for grandmother's age at the time of the parent's birth remained statistically significant in model 2 (B=.194, p<.05). In models that did not account for parents' socioeconomic status (i.e., model 1 and models 3 through 6), the magnitude of the coefficient associated with grandmother's age is the same or larger compared to Model 2 in Table 2.

Table 3 also shows the direct association of grandmother's characteristics with grandchildren's Letter-Word scores In model 1, before accounting for parent attributes, grandmother's years of education and relative poverty status at her grandchild's birth were significantly associated with grandchildren's predicted Letter-Word scores in the expected direction. After accounting for parents' attributes, those indicators were statistically insignificant, suggesting that the influence of grandparents' socioeconomic status operated through parents' accumulation of human capital and income. Neither grandmother health nor union status at the grandchild's birth was directly or indirectly associated with the outcome, but grandchildren who have parents in poor physical health at their birth or who are born to an unmarried parent have lower predicted Letter-Word scores compared to their peers born to healthier or married parents.

Grandmother's age at the parent's birth remained unrelated to grandchildren's Applied Problems scores in the mediating models in Table 4. However, grandmother's death by the time of the grandchild's birth was strongly associated with the outcome, indicating a one-fifth to one-third standard deviation drop in grandchildren's predicted scores compared to those with a living grandparent. As in the models predicting grandchildren's vocabulary scores, the influence of grandmother's educational attainment appears to operate indirectly through the parent's education. Grandparent health and union status were unrelated to the outcome, but parent's poor health and status as formerly married were negatively associated with grandchildren's Applied Problems scores.

In the main, the results considering grandfather's age at parent's birth summarized in tables 5 and 6 are similar to those for grandmother's age. Table 5 shows that a grandfather's age at parent's birth remains associated with grandchildren's Letter-Word scores after accounting for his own and the parent's socioeconomic status, health, and union status at the grandchild's birth. The magnitude of the association is similar to that for grandmothers. Grandfather's age at parent's birth remains unrelated to grandchildren's Applied Problems scores. Again, grandfather's socioeconomic status appears to operate largely through grandchildren's status attainment, with the influence of his years of education on both outcomes attenuated by parent's schooling, and the positive association of his homeownership with grandchildren's nonverbal achievement explained by parent's poverty status. Unlike for grandmothers, grandfather's poor health is negatively associated with grandchildren's Letter-Word scores, and grandfather's status as never married or widowed is negatively associated with Applied Problems scores after controlling for parents' parallel

measures. A grandfather's death prior to the grandchild's birth is also negatively associated with both outcomes.

5. Conclusion

Family demographers have begun to explore the utility of three-generation models of the transmission of social inequality in order to understand whether grandparent characteristics and roles influence grandchildren's status attainment independent of parent characteristics. We asked how age at childbearing in the grandparent and parent generations constrains the process of intergenerational transmission of status attainment by shaping the material and instrumental resources grandparents are able to provide to grandchildren. Specifically, we considered whether the association of age of childbearing over two generations with grandchildren's cognitive achievement is explained by grandparents' socioeconomic status, physical health and mortality, or union status at a grandchild's birth. Our outcomes included grandchildren's age-normed, standardized scores on the Woodcock-Johnson Letter-Word and Applied Problems batteries.

We found that both grandmother's and grandfather's age at the birth of a grandchild's parent had a persistent, independent association with grandchildren's Letter-Word scores after accounting for parent attributes, but not with grandchildren's applied mathematics skills. The magnitude of the unstandardized coefficients associated with grandparent age at the parent's birth was statistically similar for grandmothers and grandfathers. After accounting for parent's age at the grandchild's birth, each additional year of a grandmother's age at the parent's birth increased a grandchild's Letter-Word score by about one-quarter of a point. That is, a decade of difference between grandparents' age at parent's birth among otherwise similar grandchildren would yield a predicted increase in grandchildren's verbal achievement of about 2.5 points, or one-sixth of a standard deviation. This association is a bit less than one-half of the magnitude for parent's age at the grandchild's birth.

Accounting for various grandparent and parent characteristics at the grandchild's birth – socioeconomic status, global health and vital status, and union status – explained little of the grandparent's age at parent's birth association with grandchildren's Letter-Word score. Parent's years of education and relative poverty status at a grandchild's birth had the largest attenuating effect, implying that younger grandparents were more likely to have had children who attained lower levels of education and had a greater risk of economic hardship, which in turn translated into diminished vocabulary skills in the grandchild's generation. However, grandparents' age at parent's birth remained positively associated with grandchildren's verbal achievement after adjusting for grandparent and parent socioeconomic, health, and marital status characteristics. Prior work has suggested that parents' older ages at birth increases the financial, social, and cultural capital available to children (Powell, et al., 2006); if grandparents' advancing age increases these forms of capital as well, our models do not capture all types of resources that grandparents may transfer to grandchildren. Further, older parents and grandparents may have amassed sufficient human capital prior to a grandchild's birth to able to accrue further occupational status or wealth after a grandchild is born, rather than reaching a plateau at or before the grandchild's birth (Mare & Tzeng, 1989). Hence, our use of point-in-time measures of socioeconomic status may inadequately

explain the positive relationship between age at childbearing in the grandparents' generation and verbal achievement.

The weak attenuating performance of our mediators suggests at least two pathways for future related research. The first is to follow the grandchild as s/he ages to identify more proximate indicators of grandparents' relationships with grandchildren that potentially vary by age at birth over two generations. Such mechanisms include financial transfers and time investments in grandchildren. For example, older and more financially secure grandparents may be more likely to invest in grandchildren's college savings plans, either as an altruistic gesture or to reduce their own tax burden. On the one hand, retired or widowed grandparents in good physical health also may be more likely to move near grandchildren or to provide care on a routine basis if they are less likely than younger grandparents to have competing obligations from employment or a spouse. Lower-income families with relatively short generation cycles may be more likely to remain in residential proximity to each other, allowing routine care to happen more easily.

Research on proximate indicators of grandparents' relationships with grandchildren might also help to explain a surprising result presented here: grandparents' age at parent's birth was positively associated with grandchildren's verbal achievement, but not with their applied mathematics achievement. Grandparents' caregiving roles in families may promote grandchildren's language development by providing further opportunities for conversation, sharing stories and reading. Financial investments in grandchildren such as attendance at cultural events and summer camps or enrollment in child care also may promote early verbal achievement. Grandparents may be less directly involved in promoting skills associated with mathematical achievement. Children's mathematical achievement is also somewhat more amenable to school interventions than is verbal achievement (Tuttle, et al., 2013), so more distal disadvantage like grandparent's age at a parent's birth may be inconsequential once grandchildren begin formal learning.

The second pathway is to look back in time to build deeper models of emerging social class trajectories over the grandparent and parent generations as a function of grandparents' age at the parent's birth. What grandparents and parents possess at the time of a grandchild's birth is the culmination of a lifetime of demographic process, income dynamics, and resource exchanges between the first and second generations. Indicators that take into account cumulative labor force experience, wealth accumulation, and household resources as parents were growing up would provide a more complete picture of the long-term impact of grandparent's age at their own childbearing. (See, for example, Wightman and Danziger in this volume.)

Although grandparents' attributes measured at the grandchild's birth did relatively little to mediate the relationship between grandparent's age at the parent's birth and grandchildren's cognitive achievement, they were directly and indirectly associated with both grandchildren's verbal and mathematical achievement. Grandparents' socioeconomic characteristics, including years of education, relative poverty status, and for grandfathers, home ownership at the grandchild's birth were each associated with parents' socioeconomic status. Although our models lack temporal sequencing, these contemporaneous measures

observed in two generations highlight the intergenerational transmission of educational attainment, income, and wealth. Grandmother's and grandfather's deaths, in contrast, had strong independent effects on grandchildren's cognitive achievement, and grandfather's poor health had a negative association with grandchildren's verbal achievement. A grandparent's death may represent a loss of resources or support in the grandchild's family, or may be indicative of underlying hardship in the grandparent and parent generations not captured by the measures we have included. One avenue for future research is to consider whether there are differential effects of grandparent mortality depending on the grandparent's age at the parent's birth. Families that experience the death of a relatively young grandparent may lose a source of income, while those that lose an older grandparent may be more likely to inherit accumulated wealth. More generally, future analyses using distributional regression techniques would allow us to consider whether the influence of grandparent's age at birth is stronger at the lower and higher ends of the continuum of Woodcock Johnson scores than in the middle of the range.

Among the grandparent attributes considered, marital status had the weakest association with grandchildren's outcomes. In part, this may be attributable to heterogeneity among married grandparents. The measure we used did not distinguish grandparents in first marriages from those in higher-order marriages where one spouse would be a step-grandparent to grandchildren. Prior research has documented that stepparents' obligations to children are often more ambiguous or constrained compared to biological parents' as a result of role ambiguity and family complexity. The same may be true in the relationship between step-grandparents and grandchildren, resulting in conflict in the grandparent generation about investments in grandchildren or about the wider dispersal of resources to grandchildren in families blended through grandparents' remarriage. However, research on norms and expectations about grandparent involvement suggests that adults do not perceive that grandparents and step-grandparents have different obligations to grandchildren (Ganong & Coleman, 1998).

Only grandfather's status as never married or widowed at the birth of a grandchild was associated with grandchildren's Applied Problems scores. This association may be attributable to widowed or never married grandfathers' lower years of education or to a weaker attachment between unmarried grandfathers and their grandchildren. Disparate patterns like these highlight the importance of considering the gendered expression of social class by grandparents within families. With the same resources at their disposal, grandmothers and grandfathers may invest differently in grandchildren as a result of their available time, their relationship quality with parents, or normative expectations about grandparent roles.

This research has several limitations. First, we used point-in-time estimates of grandparent and parent attributes observed when grandchildren were born. These measures were relatively straightforward and provided a picture of family resources at the starting gate for children. However, our identification of direct and indirect effects was hampered by the lack of temporal ordering of grandparents' and parents' attributes. One solution would be to use grandparents' attributes in a particular calendar year or when parents were a particular age, like 14 years or 18 years, in a structural equation modeling framework. Given the nature of

the study design, however, it is challenging to identify a historical moment or biological age that would be equally meaningful across the sample. Some parents were already young adults when grandparents were recruited into the PSID study in 1968, while others had not yet been born. The grandchild's birth represents a generational fulcrum that is meaningful for all families.

Further, the CDS sample is not representative of the contemporary U.S. population of children in terms of race/ethnicity to the extent that grandchildren from recent immigrant cohorts are not included. While the PSID more broadly has maintained its population representativeness through the addition of an immigrant cohort in 1997, those families have not been in the study for at least three generations. Therefore, we exclude those families from our analysis. Hence, our results are representative of grandchildren whose grandparents were in the United States since 1968. Given findings from other three-generation studies that have found the least social mobility over three generations among those who are more disadvantaged, our findings may be a conservative estimate of grandparents' influence on grandchildren.

Despite these limitations, this work contributes a new perspective on multigenerational models of social inequality by investigating how one indicator of demographic process – age at childbearing – operates over two generations to influence the context in which grandchildren acquire verbal and mathematical skills. Consideration of age at childbearing adds another dimension to existing scholarship that has focused on parents' and grandparents' educational, occupational, and wealth attainment. By focusing on grandchildren's cognitive achievement as an outcome, this research has also identified an early marker of eventual status attainment that is potentially amenable to intervention. These characteristics distinguish our research from prior work that has rejected non-Markovian models of intergenerational social mobility (Cherlin & Furstenberg, 1992; Erola & Moisio, 2007; Warren & Hauser, 1997). We also note that the PSID sample is more representative of the United States population in terms of race and socioeconomic status than prior studies, providing a useful framework for exploring race/ethnic variation in status attainment over multiple generations. The contemporary United States is a context where resource accumulation is profoundly constrained by family structure (McLanahan & Percheski, 2008). Hence, a demographic perspective that incorporates information about fertility and mortality over multiple generations is vital to explain the intergenerational transmission of advantage or disadvantage.

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Table 1

Weighted descriptive statistics by grandparent gender, Panel Study of Income Dynamics and PSID Child Development Supplement

	Grandmothers		Grandfathers	
	Mean	**SD**	**Mean**	**SD**
WJ Letter-Word	106.42	17.88	107.45	17.37
WJ Applied Problems	108.08	17.36	109.25	17.01
Grandparent's age at parent's birth	26.10	6.01	29.24	6.79
Parent's age at child's birth	28.53	6.06	28.71	5.80
Control variables				
Grandchild's birth order	1.89	0.98	1.83	0.91
Grandmother's parity	4.17	2.28	4.08	2.21
Grandchild is non-Hispanic white	0.77		0.84	
Grandchild is African-American	0.16		0.11	
Grandchild is Hispanic	0.02		0.02	
Grandchild is other race	0.04		0.04	
Grandchild is female	1.49		1.49	
Child age (in months) at WJ assessment	107.20	57.93	107.48	56.79
WJ score from 1997	0.68		0.68	
WJ score from 2002	0.28		0.29	
WJ score from 2007	0.04		0.04	
Parent is female	1.60		1.59	
Grandparent not interviewed at child's birth	0.06		0.08	
Parent not interviewed in birth year	0.03		0.02	
Parent in grandparent home at birth	0.09		0.07	
Mediators				
Granparent years of education	12.22	2.50	12.64	3.10
Grandparent in relative poverty at birth	0.16		0.11	
Grandparent owns home at birth	0.72	0.45	0.78	0.42
Parent's years of education	13.57	2.16	13.74	2.06
Parent in relative poverty at birth	0.27		0.21	
Parent owns home at birth	0.49		0.54	
Grandparent died by birth	0.06		0.11	
Grandparent in poor health	0.19		0.18	
Parent in poor health	0.04		0.04	
Grandparent married	0.63		0.72	
Grandparent never married	0.02		0.00	
Grandparent widowed	0.09		0.02	
Grandparent divorced	0.09		0.05	
Grandparent separated	0.04		0.02	
Parent never married	0.19		0.14	
Parent formerly married	0.04		0.04	

	Grandmothers		Grandfathers	
	Mean	**SD**	**Mean**	**SD**
N	2490		1885	

Table 2

Results from ordinary least squares regression models predicting grandchild Woodcock Johnson Letter-Word and Applied Problem scores by grandparent gender

	Grandmothers				Grandfathers			
	Letter-Word		Applied Problems		Letter-Word		Applied Problems	
	B/(SE)	B/(SE)	B/(SE)	B/(SE)	B/(SE)	B/(SE)	B/(SE)	B/(SE)
Grandmother's age at parent's birth	0.339*** (0.089)	0.252** (0.084)	0.143 (0.081)	0.0481 (0.077)				
Grandfather's age at parent's birth					0.231** (0.080)	0.180* (0.077)	−0.024 (0.075)	−0.080 (0.071)
Grandhild's birth order	−1.681*** (0.462)	−3.013*** (0.511)	(0.416) (0.436)	−1.878*** (0.475)	−2.213*** (0.539)	−3.540*** (0.607)	−0.671 (0.528)	−2.135*** (0.560)
Grandmother's parity	−0.169 (0.247)	−0.225 (0.246)	0.0198 (0.249)	−0.0424 (0.240)	0.069 (0.266)	0.021 (0.263)	0.266 (0.269)	0.213 (0.259)
Grandchild is African-American	−6.954*** (1.215)	−5.047*** (1.231)	−11.16*** (1.129)	−9.054*** (1.172)	−7.799*** (1.371)	−6.129*** (1.370)	−11.52*** (1.219)	−9.672*** (1.313)
Grandchild is Hispanic	−10.24 (6.560)	−7.446 (5.426)	−15.03*** (3.612)	−11.96*** (2.674)	−2.792 (4.268)	−1.650 (3.808)	−10.59** (3.336)	−9.324** (3.011)
Grandchild is other race	−5.987 (3.058)	−4.143 (2.697)	−4.612 (4.517)	−2.582 (4.085)	−6.091 (3.824)	−4.953 (3.265)	(0.623) (4.735)	0.638 (4.187)
Grancdhild is female	2.023* (0.870)	1.853* (0.837)	−2.195* (0.891)	−2.373** (0.870)	2.350* (0.947)	2.227* (0.908)	−2.525* (0.985)	−2.652** (0.943)
Grandchild's age at WJ assessment (months)	0.023 (0.012)	0.0259* (0.013)	0.014 (0.012)	0.018 (0.013)	0.0252 (0.015)	0.0298 (0.016)	0.0118 (0.014)	0.017 (0.016)
WJ score drawn from 2002	1.175 (1.133)	1.461 (1.105)	−3.865*** (1.128)	−3.546** (1.090)	1.55 (1.249)	1.682 (1.215)	−4.153*** (1.215)	−4.001*** (1.183)
WJ score drawn from 2007	−4.505 (2.383)	−3.862 (2.329)	−4.209* (2.071)	−3.499 (1.971)	−2.554 (2.447)	−2.176 (2.354)	−3.152 (2.218)	(2.731) (2.080)
Parent is female	−0.587 (0.986)	1.118 (0.970)	−1.27 (0.974)	0.602 (0.982)	−0.736 (1.090)	0.892 (1.082)	−1.069 (1.066)	0.726 (1.066)
Grandparent not interviewed at birth	0.474 (2.430)	0.187 (2.228)	−1.222 (1.571)	−1.532 (1.463)	−2.373 (2.160)	−1.642 (2.057)	−1.783 (1.592)	−0.971 (1.554)
Parent's age at grandchild's birth		0.653*** (0.091)		0.717*** (0.088)		0.622*** (0.100)		0.687*** (0.097)
Intercept	98.38*** (3.279)	81.43*** (4.023)	112.5*** (3.078)	93.85*** (3.777)	100.4*** (3.528)	83.44*** (4.545)	117.2*** (3.293)	98.42*** (4.174)
N	2490	2490	2490	2490	1885	1885	1885	1885
adj. R-sq	0.067	0.105	0.092	0.14	0.056	0.09	0.063	0.106

Robust standard errors in parentheses

* p<0.05,

** p<0.01,

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***p<0.001

Table 3

Results from ordinary least squares regression models predicting grandchild Woodcock Johnson Letter-Word scores accounting for grandmother's and parent's socioeconomic status, health, and marital status

	GM SES[a] B/(SE)	Parent SES B/(SE)	GM Health B/(SE)	Parent Health B/(SE)	GM Union Status B/(SE)	Parent Union Status B/(SE)
Grandmother's age at parent's birth	0.252** (0.084)	0.194* (0.085)	0.272** (0.085)	0.274** (0.083)	0.284** (0.086)	0.264** (0.087)
Grandchild's birth order	−2.668*** (0.510)	−1.783*** (0.507)	−2.945*** (0.519)	−2.874*** (0.516)	−2.971*** (0.522)	−2.910*** (0.519)
Grandmother's parity	0.088 (0.247)	0.158 (0.214)	(0.218) (0.250)	(0.200) (0.247)	(0.241) (0.246)	(0.157) (0.251)
Grandchild is African-American	−3.678** (1.321)	(2.306) (1.230)	−4.733*** (1.249)	−3.774** (1.243)	−4.732*** (1.322)	(2.713) (1.403)
Grandchild is Hispanic	−6.297 (5.349)	−5.027 (4.364)	−7.289 (5.412)	−7.256 (5.156)	(7.444) (5.452)	−6.86 (5.008)
Grandchild is other race	−4.005 (2.739)	−3.204 (2.724)	−4.044 (2.691)	−3.563 (2.476)	−4.015 (2.711)	(2.461) (2.471)
Grandchild is female	1.964* (0.837)	1.775* (0.798)	1.847* (0.836)	1.713* (0.824)	1.861* (0.836)	2.005* (0.820)
Grandchild's age at WJ assessment (months)	0.0258 (0.014)	0.024 (0.013)	0.0259* (0.013)	0.0249* (0.013)	0.0258* (0.013)	0.024 (0.012)
WJ score from 2002	1.469 (1.098)	1.93 (1.071)	1.429 (1.105)	1.53 (1.091)	1.406 (1.108)	1.598 (1.087)
WJ score from 2007	−4.035 (2.321)	−2.896 (2.216)	−3.918 (2.321)	−3.792 (2.317)	−3.743 (2.300)	(3.164) (2.335)
Parent is female	0.985 (0.959)	0.972 (0.957)	1.054 (0.965)	1.214 (0.955)	1.166 (0.974)	1.725 (0.988)
Grandparent not interviewed at birth	−0.865 (2.290)	−0.253 (2.305)	−0.145 (2.239)	0.269 (2.240)	−0.226 (2.248)	0.892 (2.335)
Parent's age at child's birth	0.619*** (0.091)	0.176 (0.099)	0.666*** (0.092)	0.601*** (0.093)	0.685*** (0.094)	0.589*** (0.096)
Grandparent died by birth	−1.588 (1.820)	−1.494 (1.738)	−2.64 (1.730)	−2.265 (1.686)	−2.825 (1.771)	−2.167 (1.756)
Granparent years of education	0.870*** (0.218)	0.4 (0.210)				
Grandparent in relative poverty at birth	−2.633 (1.367)	−1.117 (1.281)				
Grandparent owns home at birth	−0.903 (1.312)	−1.929 (1.239)				
Parent's years of education		1.880*** (0.321)				
Parent in relative poverty at birth		−3.399** (1.269)				
Parent owns home at birth		1.359 (1.061)				
Parent not interviewed in birth year		0.522 (2.978)		−8.414*** (2.100)		−9.213*** (2.094)
Parent in grandparent home at birth		−1.899 (1.551)		−3.500* (1.580)		1.264 (1.869)
Grandparent in poor health			−0.923 (1.321)	−0.488 (1.309)		
Parent in poor health				−9.038*** (2.053)		
Grandparent never married					(0.277) (2.443)	0.184 (2.573)

	GM SES[a] B/(SE)	Parent SES B/(SE)	GM Health B/(SE)	Parent Health B/(SE)	GM Union Status B/(SE)	Parent Union Status B/(SE)
Grandparent widowed					−2.013 (1.705)	(1.717) (1.663)
Grandparent divorced					(1.015) (1.628)	−0.199 (1.603)
Grandparent separated					1.108 (2.473)	1.637 (2.412)
Parent never married						−5.974** (1.882)
Parent formerly married						−4.19 (2.290)
Intercept	70.85*** (4.826)	64.10*** (5.279)	80.79*** (4.073)	82.96*** (4.121)	79.98*** (4.207)	82.53*** (4.304)
N	2490	2490	2490	2490	2490	2490
adj. R-sq	0.12	0.167	0.105	0.119	0.105	0.118

Robust standard errors in parentheses

* p<0.05,

** p<0.01,

*** p<0.001

Table 4

Results from ordinary least squares regression models predicting grandchild Woodcock Johnson Applied Problems scores accounting for grandmother's and parent's socioeconomic status, health, and marital status

	GM SES[a] B/(SE)	Parent SES B/(SE)	GM Health B/(SE)	Parent Health B/(SE)	GM Union Status B/(SE)	Parent Union Status B/(SE)
Grandmother's age at parent's birth	0.060 (0.076)	0.013 (0.075)	0.087 (0.078)	0.093 (0.076)	0.105 (0.078)	0.101 (0.077)
Grandchild's birth order	−1.517** (0.477)	−0.804 (0.477)	−1.770*** (0.482)	−1.784*** (0.482)	−1.770*** (0.480)	−1.766*** (0.480)
Grandmother's parity	0.224 (0.234)	0.274 (0.207)	(0.047) (0.238)	(0.057) (0.236)	(0.063) (0.234)	(0.047) (0.231)
Grandchild is African-American	−7.499*** (1.237)	−6.182*** (1.188)	−8.608*** (1.193)	−7.752*** (1.189)	−8.498*** (1.262)	−7.366*** (1.418)
Grandchild is Hispanic	−10.94*** (2.918)	−9.710*** (2.248)	−11.79*** (2.656)	−11.64*** (2.546)	−11.84*** (2.698)	−11.52*** (2.633)
Grandchild is other race	−2.158 (3.976)	−1.587 (3.692)	−2.425 (4.091)	−2.232 (4.063)	−2.389 (4.056)	−1.89 (3.776)
Grandchild is female	−2.293** (0.857)	−2.463** (0.822)	−2.368** (0.866)	−2.412** (0.859)	−2.356** (0.870)	−2.258** (0.850)
Grandchild's age at WJ assessment (months)	0.0173 (0.014)	0.0155 (0.013)	0.0178 (0.013)	0.0167 (0.013)	0.0179 (0.013)	0.0167 (0.013)
WJ score from 2002	−3.624*** (1.086)	−3.079** (1.055)	−3.602*** (1.082)	−3.496** (1.085)	−3.613*** (1.085)	−3.449** (1.103)
WJ score from 2007	−3.706 (2.005)	−2.62 (2.055)	−3.553 (2.028)	−3.382 (2.014)	−3.541 (2.033)	−3.171 (2.093)
Parent is female	0.488 (0.966)	0.357 (0.969)	0.509 (0.980)	0.598 (0.976)	0.578 (0.971)	0.845 (0.974)
Grandparent not interviewed at birth	−1.105 (1.718)	−1.102 (1.729)	−2.038 (1.494)	−2.112 (1.486)	−2.136 (1.513)	−1.853 (1.522)
Parent's age at child's birth	0.683*** (0.087)	0.266** (0.090)	0.746*** (0.090)	0.678*** (0.094)	0.765*** (0.090)	0.688*** (0.098)
Grandparent died by birth	−3.694* (1.670)	−3.727* (1.600)	−5.330** (1.770)	−5.121** (1.748)	−5.584** (1.787)	−5.251** (1.800)
Parent not interviewed in birth year		3.128 (2.547)		−3.454 (2.121)		−3.81 (2.122)
Parent in grandparent home at birth		−2.443 (1.448)		−3.860** (1.480)		−2.179 (2.046)
Granparent years of education	0.683*** (0.202)	0.263 (0.195)				
Grandparent in relative poverty at birth	−1.772 (1.246)	−0.61 (1.150)				
Grandparent owns home at birth	1.416 (1.282)	0.491 (1.180)				
Parent's years of education		1.733*** (0.289)				
Parent in relative poverty at birth		(2.104) (1.154)				
Parent owns home at birth		1.712 (1.004)				
Grandparent in poor health			−0.976 (1.293)	−0.674 (1.290)		
Parent in poor health				−5.432** (1.688)		
Grandparent never married					(0.646) (2.297)	(0.108) (2.346)

	GM SES[a] B/(SE)	Parent SES B/(SE)	GM Health B/(SE)	Parent Health B/(SE)	GM Union Status B/(SE)	Parent Union Status B/(SE)
Grandparent widowed					−2.449 (1.622)	−2.351 (1.605)
Grandparent divorced					(0.258) (1.480)	0.194 (1.472)
Grandparent separated					−0.224 (2.101)	−0.005 (2.054)
Parent never married						(2.120) (2.166)
Parent formerly married						−3.552* (1.690)
Intercept	83.70*** (4.786)	77.41*** (5.263)	92.44*** (3.812)	94.71*** (3.943)	91.47*** (3.879)	93.72*** (4.037)
N	2487	2487	2487	2487	2487	2487
adj. R-sq	0.155	0.193	0.144	0.15	0.144	0.148

Robust standard errors in parentheses

* p<0.05,

** p<0.01,

*** p<0.001

[a] GM = grandmother; SES = socioeconomic status

Table 5

Results from ordinary least squares regression models predicting grandchild Woodcock Johnson Letter-Word scores accounting for grandfather's and parent's socioeconomic status, health, and marital status[a]

	GF SES[b] B/(SE)	Parent SES B/(SE)	GF Health B/(SE)	Parent Health B/(SE)	GF Union Status B/(SE)	Parent Union Status B/(SE)
Grandfather's age at parent's birth	0.263*** (0.076)	0.232** (0.077)	0.246** (0.078)	0.252** (0.077)	0.249** (0.079)	0.246** (0.080)
Parent's age at child's birth	0.595*** (0.100)	0.207 (0.118)	0.668*** (0.102)	0.615*** (0.106)	0.704*** (0.106)	0.619*** (0.114)
Grandparent died by birth	−3.757* (1.495)	−3.292* (1.501)	−5.738*** (1.530)	−5.510*** (1.526)	−4.975** (1.534)	−4.875** (1.541)
Parent not interviewed in birth year		1.100 (3.495)		−5.604* (2.661)		−6.500* (2.695)
Parent in grandparent home at birth		−2.873 (1.643)		−3.22 (1.686)		1.509 (2.287)
Granparent years of education	0.966*** (0.178)	0.559** (0.199)				
Grandparent in relative poverty at birth	−1.788 (1.412)	−1.306 (1.322)				
Grandparent owns home at birth	−1.098 (1.465)	−2.039 (1.403)				
Parent's years of education		1.619*** (0.372)				
Parent in relative poverty at birth		−3.378* (1.452)				
Parent owns home at birth		0.665 (1.120)				
Grandparent in poor health			−3.174* (1.406)	−2.778* (1.382)		
Parent in poor health				−8.181*** (2.275)		
Grandparent never married					−7.263 (5.299)	−7.188 (5.890)
Grandparent widowed					−2.182 (2.461)	−2.208 (2.425)
Grandparent divorced					0.164 (1.998)	0.662 (2.037)
Grandparent separated					9.489 (5.211)	9.471 (4.987)
Parent never married						−5.445* (2.262)
Parent formerly married						−2.766 (2.737)
Intercept	69.18*** (5.379)	64.08*** (5.661)	81.16*** (4.693)	82.94*** (4.835)	79.37*** (4.766)	81.70*** (5.005)
N	1885	1885	1885	1885	1885	1885
adj. R-sq	0.121	0.153	0.1	0.109	0.099	0.106

Robust standard errors in parentheses

*p<0.05,

** p<0.01,

*** p<0.001

[a] Models also control for grandchild's birth order through whether grandparent interviewed in year of child's birth (see tables 3 and 4 for parallel variables excluded from presentation here).

[b] GF = grandfather; SES = socioeconomic status

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Table 6

Results from ordinary least squares regression models predicting grandchild Woodcock Johnson Applied Problems scores accounting for grandfather's and parent's socioeconomic status, health, and marital status[a]

	GF SES[b] B/(SE)	Parent SES B/(SE)	GF Health B/(SE)	Parent Health B/(SE)	GF Union Status B/(SE)	Parent Union Status B/(SE)
Grandfather's age at parent's birth	−0.042 (0.072)	−0.073 (0.072)	−0.038 (0.072)	−0.035 (0.071)	−0.040 (0.072)	−0.040 (0.071)
Parent's age at child's birth	0.629*** (0.097)	0.258* (0.103)	0.713*** (0.098)	0.665*** (0.103)	0.736*** (0.099)	0.693*** (0.109)
Grandparent died by birth	−1.543 (1.677)	−1.045 (1.675)	−3.575* (1.672)	−3.412* (1.674)	−3.339* (1.641)	−3.288* (1.633)
Parent not interviewed in birth year		5.201 (3.614)		−0.806 (2.930)		−0.877 (2.990)
Parent in grandparent home at birth		−2.829 (1.722)		−2.936 (1.700)		−2.728 (2.429)
Granparent years of education	0.691*** (0.181)	0.308 (0.198)				
Grandparent in relative poverty at birth	0.161 (1.405)	0.544 (1.329)				
Grandparent owns home at birth	2.949* (1.418)	2.148 (1.332)				
Parent's years of education		1.542*** (0.346)				
Parent in relative poverty at birth		−2.663 (1.367)				
Parent owns home at birth		0.831 (1.111)				
Grandparent in poor health			−2.597 (1.590)	−2.391 (1.584)		
Parent in poor health				−4.960* (2.132)		
Grandparent never married					−9.499*** (2.517)	−8.724*** (2.524)
Grandparent widowed					−6.703* (2.601)	−6.517* (2.595)
Grandparent divorced					−2.911 (1.853)	−2.812 (1.911)
Grandparent separated					3.623 (2.972)	3.38 (2.944)
Parent never married						0.095 (2.369)
Parent formerly married						−2.709 (1.867)
Intercept	86.72*** (5.088)	81.69*** (5.554)	97.14*** (4.232)	98.70*** (4.397)	96.48*** (4.242)	97.80*** (4.448)
N	1883	1883	1883	1883	1883	1883
adj. R-sq	0.123	0.15	0.111	0.114	0.112	0.112

Robust standard errors in parentheses

*p<0.05,

** p<0.01,

*** p<0.001

[a] Models also control for grandchild's birth order through whether grandparent interviewed in year of child's birth (see tables 3 and 4 for parallel variables excluded from presentation here).

[b] GF = grandfather; SES = socioeconomic status

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