

**Accepted Manuscript** - *This is an Accepted Manuscript of an article published by the Australian Social Policy Association in the Australian Journal of Social Issues 53 (1):34-55 Received 16 January 2017, accepted 23 September 2017, and available online 26 March 2018. DOI: <https://doi.org/10.1002/ajs4.33>.*

## Educational inequality across three generations in Australia

Kirsten J. Hancock<sup>a,b</sup> ([kirsten.hancock@telethonkids.org.au](mailto:kirsten.hancock@telethonkids.org.au))

Francis Mitrou<sup>a,b</sup> ([francis.mitrou@telethonkids.org.au](mailto:francis.mitrou@telethonkids.org.au))

Jenny Povey<sup>c</sup> ([j.povey@uq.edu.au](mailto:j.povey@uq.edu.au))

Alice Campbell<sup>c</sup> ([alice.campbell@uq.edu.au](mailto:alice.campbell@uq.edu.au))

Stephen R. Zubrick<sup>a,b</sup> ([stephen.zubrick@uwa.edu.au](mailto:stephen.zubrick@uwa.edu.au))

- a. Telethon Kids Institute, The University of Western Australia. PO Box 855, West Perth, Western Australia 6872, Australia.
- b. Graduate School of Education, The University of Western Australia. M428, 35 Stirling Highway, Crawley, Western Australia 6009, Australia
- c. Institute for Social Science Research, The University of Queensland. Cycad Building (1018), 80 Meiers Road, Indooroopilly Queensland 4068, Australia

### **Corresponding Author:**

Kirsten Hancock | Telethon Kids Institute, The University of Western Australia  
PO Box 855 West Perth WA 6872 Australia | [kirsten.hancock@telethonkids.org.au](mailto:kirsten.hancock@telethonkids.org.au)  
+61 08 9498 7738

### **Acknowledgements**

This study used data from the Longitudinal Study of Australian Children (LSAC). The LSAC was conducted in partnership between the Department of Social Services (DSS), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The study was supported by the Australian Research Council Centre of Excellence for Children and Families over the Life Course (CE140100027). The Centre is administered by the Institute for Social Science at the University of Queensland, with nodes at the University of Western Australia, The University of Melbourne and The University of Sydney.

## **Abstract**

The transfer of advantage and disadvantage across multiple generations is receiving increasing attention in the international literature, however, transfers of resources across multiple generations in Australian families are less well understood. Using a longitudinal data set of Australian children and their families, we have the opportunity to not only investigate the transfer of educational resources across three generations in Australia, but also to investigate the gendered nature of these transfers, which has been a limitation of other studies. We find no evidence of individual grandparent education effects on numeracy and reading scores for grandchildren in Year 3, independent of parent educational attainment and other covariates. However, significant effects on numeracy and reading scores were observed for children in families where both the grandmother and grandfather in maternal and paternal grandparent sets had high educational attainment (a diploma or university qualification), and where either or both the mother and father had a university qualification. These results suggest that the contribution of grandparents to the academic achievement of grandchildren cannot be fully explained by the parent generation, and that the concentration of human capital in families contributes to educational inequalities across multiple generations that can be observed by eight years of age.

## **Introduction**

Traditionally, studies of the intergenerational transfer of advantage and disadvantage have focused on transfers from parents to children. Broadly, the more resources that parents have, the better able they are to provide the emotional, educational, financial, material, and social resources to their children that promote health (Kahn, Wilson, & Wise, 2005), social-emotional wellbeing (Mistry, Vandewater, Huston, & McLoyd, 2002) and cognitive development (Bradley & Corwyn, 2002; Duncan & Brooks-Gunn, 1997). When their children reach adulthood, the economic and social opportunities that have been provided to them throughout the life course can then influence their investment in their own children.

The international literature concerning transfers of advantage and disadvantage has largely focused on transfers from one generation to the next, from parent to child. However, in more recent years there has been a rapidly expanding literature examining how transfers may occur across multiple generations. Earlier economic theories of capital transfers assumed that the outcomes of grandparents and grandchildren would be correlated, but that any such association would only occur via the parent generation (Becker & Tomes, 1986). Similarly, social reproduction theory (Bourdieu, 1984) suggests that inequality in financial, cultural, human and social capital is passed on from one generation when individuals with capital resources act to maintain their advantage, either consciously or unconsciously, and those without struggle to get ahead. Genetics also plays a strong role in transfer of advantage from one generation to the next, with research suggesting that intelligence, personality and psychopathology together accounts for 75% of the heritability of educational achievement (Krapohl et al., 2014). However, each of these processes ignores the other influences that grandparents may have on grandchildren. Ecological models of human development acknowledge that multiple systems may interact together to contribute to human development, including the immediate family, extended family, peer groups, schools,

and communities (Bronfenbrenner, 1986; Zubrick et al., 2009). Grandparents may therefore influence the outcomes of grandchildren both indirectly (via parents) and directly through their relationship with the child, but any influence will vary according to the broader systems they are embedded in.

The extent to which grandparents directly and indirectly influence the outcomes of their grandchildren has been a primary focus of the emerging multigenerational literature, and transfers of educational attainment— the topic of the current study— have featured strongly in this literature. The rationale for the presence of direct grandparent effects on educational outcomes among grandchildren is clear. Just as grandparents invested in the education of their own children, they may also have the opportunity to contribute different types of capital directly to grandchildren (Bol & Kalmijn, 2016). These contributions may include direct financial transfers or support, for example, assisting with educational expenses or child care, by fostering a family culture that promotes the value of education, or by connecting grandchildren with other well-resourced families in their social networks and the potential opportunities those networks offer. These investments can be made across the lifespan of the grandchild, building the human capability profile of the grandchild from infancy to adulthood. As a result, grandparent resources may contribute to grandchildren’s educational outcomes over and above the resources provided by parents.

While the rationale for direct grandparent effects is straightforward, empirical support for these ‘direct effects’ has been equivocal thus far. Whereas some studies find that an association between grandparent and grandchild educational attainment remains after controlling for parent education (Møllegaard & Jæger, 2015), others find no such effect (Bol & Kalmijn, 2016; Jæger, 2012). The variability in types of models, measures, data and populations likely contribute to these inconsistencies. Furthermore, when controls for the middle generation become more stringent in the models, the remaining effect of grandparent educational status become weaker (Bol & Kalmijn,

2016). This pattern might be expected, given that higher educational attainment among grandparents will provide an increased likelihood of higher educational attainment among parents, but also an increased likelihood of higher occupational class, income, and housing stability, which in turn will be beneficial for the educational trajectories of their grandchildren.

Mare (2014) argues that differing cultural and institutional contexts between countries may affect the degree to which grandparents (and parents) can influence the transmission of educational advantage to grandchildren, and these differences may also explain inconsistencies in direct effect findings across countries. As the current study focusses on Australian families, several aspects of the Australian cultural and educational context are worth noting. For example, Pilkauskas and Martinson (2014) report that grandparent-grandchild co-residence during early childhood is less prevalent in Australia (~11%) than in the United States (up to 25%), and is slightly higher than the United Kingdom (8%). Australia also has a higher proportion of the population born overseas (28%) than similar countries like Canada (20%), the United Kingdom (12%) or the United States (13%) (OECD, 2013), potentially limiting the contact that grandchildren have with grandparents, because of distance and language, among other factors. Enrolment in private education is also substantially higher in Australia than in other countries, with at almost 40% of students attending non-government schools compared with an OECD average of 15% (OECD, 2011). Notwithstanding the expanding Australian research indicating that there are few academic advantages to attending a private school once student-level socioeconomic characteristics have been taken into account (Nghiem, Nguyen, Khanam, & Connelly, 2015; Thomson, De Bortoli, & Buckley, 2013, though see Marks, 2015), Australian grandparents may have more opportunities to invest financially in the education of their grandchildren, for example, by contributing to school costs (fees, textbooks or uniforms) or supporting extracurricular activities like sport. Grandparents may also help parents to secure

housing in the catchment areas of desirable public schools, either by providing financial support, or by providing free child-care that enable parents to generate more income and have greater choice with respect to housing.

Australia has also undergone significant education culture and policy shifts in recent decades. Most noteworthy has been the expansion in the proportion and gender ratio of Australians who obtain university qualifications. Higher education participation rates for school leavers more than doubled between 1982 and 2012 (Norton & Cherastidtham, 2014). In the 1950s, university places were predominantly male, at around 80%. Since that point, the share of university places taken up by women has steadily increased to just under 60%, and women have been the majority of university students since 1987. Norton and Cherastidtham (2014) note that this increase is due to several reasons, including the improved social position of women, higher education qualifications for traditionally female-dominated professions like teaching and nursing, and that young men have better-paying vocational education options than young women.

The number of years of schooling that Australians are expected to complete has also expanded in recent decades. In 1980, high rates of student retention to the end of the compulsory Year 10 (91%) were achieved, at which point only a few students (35%) progressed onwards to complete Year 12. By 1990, following the introduction of targeted policies by the Federal Government, Year 12 retention rates had increased to 65% (Australian Bureau of Statistics, 1993) and by 2011 they had risen to 84% for females and 75% for males (Australian Bureau of Statistics, 2011).

A significant limitation in the multigenerational educational attainment literature has been the absence of information on the full family pedigree. The majority of studies report only on paternal or maternal grandparent sets, or on grandmothers or grandfathers (maternal vs. paternal). This limitation may also explain inconsistencies in findings across studies, but also, without the full pedigree studies have had limited

capacity to explore the gendered nature of transfers across generations. With respect to gendered transfers of educational attainment, the changes in educational attainment patterns for men and women in recent decades suggest that mobility patterns in educational attainment will vary by gender, though again, the literature is mixed. Some studies have found that grandparent effects have been limited to grandfathers, or have been stronger for grandfathers than grandmothers (Chan & Boliver, 2013; Hertel & Groh-Samberg, 2014; Modin, Erikson, & Vagero, 2013). Others have found grandparent effects for both grandmothers and grandfathers (Wightman & Danziger, 2014). Loury (2006) found that the education of uncles and grandfathers had stronger effects on sons, whereas aunts and grandmothers had a stronger effect on daughters.

Similarly, without information on the full family pedigree the role of homogamy or assortative partnering in transfers of resources across generations cannot be fully understood. In their study, Daw and Gaddis (2016) found that grandparent education was associated with grandchild education independently of parent education, however, this association was greatly reduced once spousal education was accounted for. They argued that spousal mediation, reflecting assortative partnering where individuals tend to partner with people from a similar educational background, is a key mechanism of the intergenerational transmission of educational advantage. Analyses of multigenerational patterns should therefore account for accumulation of resources within families (i.e. through partnering), and not simply assess the independent contributions of family members, however this approach has been largely overlooked in the literature.

Data on the educational outcomes of three generations of Australian family members have only become available in recent years. Using data from the Longitudinal Study of Australian Children, the aim of this study was to explore the nature of multigenerational transfers of educational resources in the Australian context. With data available on the full pedigree of grandparents and parents, this study also

addresses some key limitations of previous research, that is, to examine the gendered nature of transfers across generations, and the extent to which concentrations of educational advantage within families relates to the early academic outcomes of grandchildren.

To aid with clarity both in the description of measures and results, family members are hereafter referred to by their relationship to the study child, who in turn is referred to as the grandchild, granddaughter or grandson. For example, when describing how a mother's educational attainment varies by the educational attainment of her father, we refer to the father as the maternal grandfather, even when the association does not include a specific reference to the study child. In total, eight family members are referred to throughout the methods and results; grandsons, granddaughters, mothers, fathers, maternal grandmothers, maternal grandfathers, paternal grandmothers and paternal grandfathers.

## **Method**

### **Study design and population**

This study draws upon data from the Longitudinal Study of Australian Children (LSAC) a nationally representative study of Australian children and their families. LSAC data were initially collected in 2004 from two cohorts of children, including 5,107 infants aged 3–19 months (B-cohort) and 4,983 children aged 4–5 years (K-cohort). The same study children were followed up every 2 years. Wave 6, the sixth round of data collection, was completed in 2014 (See Table 1). We draw upon data for both cohorts for this study.

The sampling methodology and design of LSAC has been extensively detailed elsewhere (Soloff, Lawrence, & Johnstone, 2005; Soloff, Lawrence, Misson, Johnstone, & Slater, 2006). Briefly, the LSAC sampling frame was based on the Medicare Australia enrolment database, which had an estimated coverage of 90% of



children by 4 months of age, and 98% by 12 months (Soloff et al., 2005). A two-stage clustered sample design was used, with Australian postcode area as the first-stage sampling unit (approximately 1-in-10 postcodes randomly selected), and children were then randomly selected within postcode area as the second-stage sampling unit. The initial response rate was 54.8% for the B-cohort and 47.0% for the K-cohort. Compared to the 2001 Australian Census, these initial samples were broadly representative of the Australian population of families with children in the relevant age group, but single-parent, non-English speaking families living in rental properties or in remote areas were under-represented (Soloff et al., 2006). Over subsequent waves of data collection these same characteristics were over-represented in the families who dropped out of the study (Australian Institute of Family Studies, 2015; Siphthorp & Misson, 2009).

### **Data collection methods**

The majority of data were collected during in-home interviews conducted at each wave with the study child's primary carer (Parent 1). Other collection methods included self-complete questionnaires for both Parent 1 and a second parent (Parent 2, where available), parents living elsewhere (PLE, typically, but not exclusively, a biological parent residing elsewhere following separation), teachers, home-based and centre-based carers of the study child, and when old enough, from the study child. Primary caregivers were also asked for consent to link survey data of the study child with external databases, including government administrative databases and national assessments of children's literacy and numeracy. Parent 1 and Parent 2 respondents include biological, adoptive and step-parents.

### **Measures**

Information on maternal grandparent education was mainly collected from mothers at Wave 5 during the in-home interview (97% of Parent 1 respondents were mothers), and information on paternal grandparent education from fathers primarily using the Parent 2 self-complete questionnaire that was mailed back separately (96% of

Parent 2 respondents were fathers). The response rate on the mail-back survey was 70% among households where there was a Parent 2 (84% of households). Therefore 62% of participating households at Wave 5 provided Parent 2 data, which predominantly related to fathers and paternal grandparents. Mothers and fathers of the study child were each asked “When you were 14 years old, what was your mother's/father's highest educational qualification?” Ten response options were available, ranging from never attended school to a university qualification. To simplify these categories and collapse small cell sizes, these responses were combined to the following categories: University qualification; post-school qualification including a diploma/certificate, trade or apprenticeship; Year 11 or 12; and Year 10 or less, including never attended school or other.

Mothers and fathers were asked questions pertaining to their educational attainment at each wave. Responses to these questions were then combined to derive the following categories of highest educational attainment: Less than year 12; Less than year 12 with a post-school qualification; Year 12 only; Year 12 with a post-school qualification; and Year 12, with a bachelor degree or higher. Educational attainment was taken as of Wave 5 for the B-cohort and Wave 3 for the K-cohort to correspond with their approximate age of the achievement outcome measures (8–9 years). For some analyses, these variables were transformed to represent the total years of education attained for each parent.

Academic achievement was assessed using test scores from the National Program of Literacy and Numeracy (NAPLAN; Australian Curriculum Assessment and Reporting Authority, 2016), which were linked to the LSAC dataset for families who consented to data linkage at Wave 3 and 4 (Daraganova, Edwards, & Siphthorp, 2013). The NAPLAN is a suite of standardised tests of numeracy, reading, spelling and writing, and has been administered to all Australian students in Years 3, 5, 7 and 9 each year since 2008. For this study, we limited analysis to the numeracy and reading scores

from the Year 3 assessments from each cohort in order to pool data across the cohorts and maximize the sample size. All regression analyses were adjusted for differences between the cohorts. Of the 4,400 grandchildren whose father provided education information on grandparents, 3,523 (80%) also had linked Year 3 assessment data available.

Control variables included the study child's age at the time of their NAPLAN test (in years), equivalised household income (total household income divided by the number of household members), the occupational status of each parent (at the 2-digit level using the Australian and New Zealand Standard Classification of Occupations; Australian Bureau of Statistics, 2013), whether grandparents were born outside of Australia (yes or no), and the age of grandparents in the year that grandchildren sat their Year 3 NAPLAN tests. The mean grandparent age ranged from 66 years (maternal grandmothers) to 72 years (paternal grandfathers), however grandparent age extended from 40 years up to 110 years. As this range potentially means that great-grandparents were referred to in survey responses instead of grandparents, all analyses were limited to those families where grandparents were aged 85 years or less.

We also included a summary measure of the grandchild's home education environment at 6–7 years. The development and assessment of this measure has been detailed elsewhere (Hancock, Christensen, & Zubrick, 2017). Briefly, the index is based on items including the frequency with which study children participated in activities at home such as reading, playing games, singing and dancing, along with out of home activities (e.g. going to the library, museum, playground), number of books in the home and parental expectations about education. Each of the contributing measures were dichotomized to identify the lowest 20% of families (i.e. representing lower educational capital in the home), and then averaged to create an overall score ranging from 0 to 1. A score of 1 corresponds with the child being in the highest 80% for each item, and a score of 0 means the child was in the lowest 20% on each item. The home

education environment is intended only as an indicator of the construct, rather than a precise measure. The results corresponding to this measure should be interpreted with this limitation in mind.

### **Statistical analysis**

Analyses progressed in three parts. First, we examined the transfer of educational attainment from the grandparent generation to the parent generation. To simplify analyses, the educational attainment of mothers and fathers was recoded to represent years of education. A linear regression model then estimated maternal years of education as a function of the educational attainment of maternal grandmothers and grandfathers, as well as her partner (father) and his parents (paternal grandparents). The aim of this model was to examine transfers within a family, but also, the degree of homogamy (i.e. the association in educational attainment between mothers and fathers). The corresponding model was then estimated for paternal education.

Second, we examined the relationships between each parent and grandparent and the academic outcomes of grandchildren. We provide a descriptive account of these relationships by plotting the unadjusted mean test score values for grandchildren by the attainment of each family member. We then use linear regression models to estimate the standardised numeracy and reading scores of grandchildren as a function of the educational attainment of each of their parents and grandparents to determine the independent contributions of each family member. For example, the regression estimates provide the association between grandparent educational attainment and grandchild achievement outcomes independent of parent educational attainment. These models also adjust for the covariates listed earlier, including parent occupational status, equivalised household income, cohort, child age, grandparent age and the home education environment index.

Third, we assess how concentrations of advantage within families contribute to grandchild achievement. We attempt this by collapsing the educational attainment of 6 family members into three variables that summarise which family members have ‘high’ educational attainment in each parent and grandparent set, each summary variable had four levels. For parents these levels were neither parent; mother only; father only; or both parents. For grandparents the levels were neither grandparent; grandmother only; grandfather only; or both grandparents. For mothers and fathers, high attainment corresponds to those with a university qualification (~34% of mothers, 30% of fathers). For grandparents, high attainment corresponds to those with a diploma or university qualification (~23% of grandparents).

SAS 9.4 (SAS Institute Inc., 2002-2012) was used for all analyses. Survey weights available with the dataset were used in all analyses to adjust for non-response and adjustments were made to account for the complex survey design and sample clustering. All analyses were stratified by grandchild gender.

## **Results**

Table 2 provides the highest educational attainment of grandparents, along with the educational attainment of mothers and fathers by grandparent attainment. Briefly, about twice as many grandfathers had achieved a university qualification than grandmothers (~16% vs. 9%), or similarly a post-school qualification (~32% vs. 19%). Conversely, a higher proportion of grandmothers than grandfathers did not progress beyond Year 10 (~53% vs. 40%). The figures show a substantial increase in the proportion of women achieving a university qualification in one generation, from 9% of grandmothers to 30% of mothers of the study child. A substantially higher proportion of mothers and fathers had completed a bachelor degree if grandparents also had the same (over half), as compared to grandparents with lower education levels. For

example, less than one-quarter of mothers and fathers had attained a bachelor degree where grandmothers or grandfathers had not progressed beyond Year 10.

Tables 3 and 4 provide the results of the linear regression models estimating the years of education of mothers (Table 3) and fathers (Table 4). As expected, mothers had higher levels of education where maternal grandparents also had higher educational attainment. For example, a university qualification in maternal grandmothers was associated with an additional 0.7 years of education in mothers compared to those where maternal grandmothers had not progressed beyond Year 10, and 0.8 years of education if the maternal grandfather had a university qualification. With similar results found for the maternal grandmother and grandfather, no own-gender effects were evident in this analysis.

Notably, the educational attainment of mothers was strongly linked to that of fathers, supporting the notion of homogamy, or like partnering with like. Mothers who partnered with university-educated fathers had an additional 2.3 years of education than those partnered with fathers with less than a Year 12 education, and an additional 1.3 years of education if the father had completed Year 12 and post-school qualification. Also of interest was the finding that a university qualification among paternal grandfathers was associated with a modest increase in maternal years of education (0.3 years), after controlling for the educational attainment of the maternal grandparents and the father.

For fathers (Table 4) similar patterns were observed. Higher educational attainment in both paternal grandmothers and grandfathers were associated with higher years of education in fathers. Unlike mothers, an own-gender effect was apparent, as a university qualification in paternal grandmothers was associated with an additional 0.4 years of education in fathers (95% CI = 0.1–0.6), whereas a university qualification in paternal grandfathers was associated with an additional 1.3 years of education in fathers (95% CI = 1.1–1.5).

As was observed for mothers, a university qualification in maternal grandfathers (i.e. a father's father-in-law) was associated with an additional 1.2 years of education in fathers, after controlling for the attainment of paternal grandparents and the mother. Together with the results of Table 3, these findings suggest that higher educational attainment among grandparents relates to the attainment of their son- or daughter-in-law, independently of the attainment of their own child.

Figure 1 provides the unadjusted mean test scores for grandchildren by the educational attainment of mothers and fathers. For grandsons and granddaughters alike, and for both numeracy and reading test scores, a general trend was observed where higher attainment among parents was associated with higher achievement in grandchildren. Children of parents with a university qualification appeared to achieve substantially higher than children of parents without a university qualification.

Figure 2 shows that higher educational attainment among grandparents was associated with higher test scores in grandchildren, and again, this was particularly evident among grandchildren where a grandparent had a university qualification. As would be expected, the association between grandparent educational attainment and grandchild achievement was weaker (i.e. flatter) than the association observed between parent educational attainment and grandchild outcomes. Also notable were differences in the patterns between grandmothers and grandfathers. While higher levels of attainment in grandmothers was associated with progressively higher achievement in both grandsons and granddaughters, the pattern for grandfathers suggested that achievement in grandsons was higher where grandfathers had a Year 11 or 12 level education, compared to those with a post-school qualification, or up to a Year 10 attainment. This pattern may signal a difference in typical male education pathways when grandfathers were at school. When these grandfathers were at school, Year 11 and 12 was a less frequently chosen pathway. If grandfathers chose to stay on at school instead of entering post-secondary vocational or employment pathways, they may only

have done so if they were doing well at school, or seeking employment in industries requiring a higher level of secondary attainment (e.g. the public service).

Linear regression models estimating grandchildren's test scores as a function of the educational attainment of each family member, and a range of control variables, are provided in Table 5 (numeracy) and Table 6 (reading). The results for numeracy test scores indicate that after controlling for parent education and other covariates, the educational attainment of grandparents was not associated with numeracy scores for either grandsons or granddaughters. Granddaughters had higher numeracy scores where mothers had completed Year 12 and post-school qualification (including university), and grandsons had higher numeracy scores where fathers had a university qualification, indicating own-gender effects. Beyond this finding, there was limited evidence that parent education was significantly associated with numeracy scores. Further analysis indicated that including the home education environment as a covariate (strongly correlated with both parent education and grandchild test scores) substantially reduced the association between parent education and numeracy test scores in grandchildren.

A similar pattern was observed for reading scores in grandchildren (Table 6). A Year 11 or 12 attainment in maternal grandmothers was associated with lower reading scores in grandsons (-0.25) and higher scores in granddaughters (0.25). However, combining this information with the broader patterns observed in Figure 2 and Table 4, this appears to be a questionable finding. Again, higher maternal education was associated with the higher reading scores of granddaughters but not grandsons, and higher paternal education was associated with higher reading scores of both granddaughters and grandsons.

Finally, the results of the linear regression models estimating numeracy and reading scores in grandchildren as a function of the summary attainment variables are provided in Table 7. In contrast to the earlier regression models, these results suggest that grandparent educational attainment *is* associated with grandchild test scores



independent of parent education. However, this only appears to be the case where both the grandmother and grandfather have high attainment. For example, both grandsons and granddaughters had significantly higher numeracy scores (0.21 of a standard deviation) if the maternal grandmother and grandfather both had high attainment, compared to grandchildren where neither maternal grandparent had high attainment. Having two high-attainment grandparents (either maternal or paternal) was associated with higher test scores for both numeracy and reading for granddaughters. For grandsons, the attainment of paternal grandparents was not associated with numeracy scores, and the attainment of maternal grandparents was not associated with reading scores.

The results in Table 7 also conflict with the own-gender effects observed in Tables 5 and 6 with respect to the attainment of mothers and fathers. In Table 7, having *either* parent with high attainment was associated with higher test scores for both grandsons and granddaughters. That is, no own-gender effects were apparent in this analysis. Given the high degree of association in attainment within families, the contrasting results may reflect collinearity issues in the models that include each family member separately (i.e. Tables 5 and 6). The earlier models examining the roles of each family member separately should be therefore be interpreted with some caution.

As the regression estimates in Table 7 are additive, these results suggest that grandchildren benefit from assortative partnering patterns across generations. For example, the numeracy scores of granddaughters where all family members had high educational attainment would be 0.7 standard deviations higher than granddaughters where no family members had high attainment. To demonstrate these additive effects more clearly, we provide the estimated marginal means for numeracy and reading scores by the total number of family members with high attainment (see Figure 3). The marginal means were adjusted for the full list of covariates, including parent occupation, equivalised household income, grandchild age, grandparent age, home

education environment and grandchild gender. Figure 3 suggests that each additional high attainment family member corresponds to higher numeracy and reading achievement in grandchildren. The gap in achievement for grandchildren with four or more high attainment family members and those with none was approximately 0.5 of standard deviation, after adjusting for covariates. When this gap is transformed back to the original NAPLAN scale, this difference equates to approximately 1.4 years of learning by Year 3.

## **Discussion**

The aim of this study was to examine transfers of educational attainment and achievement across three generations of Australian families and investigate the gendered nature of these transfers. While our descriptive analyses suggested that achievement scores were higher among grandchildren whose grandparents had higher levels of educational attainment, evidence for this pattern was limited when all family members were simultaneously considered, and after adjusting for covariates. Alone, this pattern would suggest that there is unlikely to be a ‘direct’ effect of grandparents on grandchildren, instead, the association between higher grandparent education and higher achievement in grandchildren can largely be explained by the higher education of mothers and fathers and the quality of the home education environment they provide to their children.

Beyond this initial finding, we also found that the way educational resources are combined in families appears to have implications for the achievement outcomes of grandchildren. We found that among maternal grandparents, grandchildren had significantly higher numeracy and reading scores when both the maternal grandmother and grandfather had high educational attainment (defined as a diploma or university qualification), independently of paternal grandparent and parent education. No

achievement advantage was observed if only the maternal grandmother or grandfather had a university qualification. A similar pattern was observed for paternal grandparents. Furthermore, children who had both a mother and father with a university qualification substantially out-performed peers whose parents had no such qualification. Our analyses that totalled the number of high attainment family members further suggested that by Year 3 both grandsons and granddaughters with four or more high-attainment family members achieved at a level approximately 0.5 standard deviations higher than children with no high attainment family members, a difference that equates to over a year of learning.

Together, these results suggest that educational advantages are concentrated in families, and such a concentration of human capital may contribute further to educational inequalities in subsequent generations. This finding is consistent with social reproduction theory, which posits that individuals with resources or relative advantage will use those resources to reproduce that advantage in the next generation, however our results suggest those processes occur over multiple generations. One way this social reproduction occurs is through assortative partnering. There were few families where a grandmother had a university qualification without the grandfather also having the same, reflecting gender differences in opportunities for, and attainment of, a university degree. These grandparents then have children who by adulthood not only have a greater likelihood of a higher qualification, but are also more likely to partner with someone with the same educational background. By eight years of age, the grandchildren in families with high concentrations of educational capital are already achieving at levels significantly beyond their peers.

Our results also suggested that gender plays a role in these associations. We found that the educational attainment of mothers was more clearly associated with the achievement of granddaughters, and the numeracy and reading achievement of grandsons was mainly associated with the educational attainment of fathers, indicating

own-gender effects. However, the analysis including the combinations of high attainment in parents and grandparents clearly showed that both grandsons and granddaughters achieved significantly higher when either parent (or both parents) had a university qualification, relative to grandchildren where neither parent were university-qualified. These results suggest that studies concerned with gendered intergenerational effects of educational attainment or educational outcomes should examine interactions between the education of mothers and fathers to fully understand the role of each parent.

This study also suggested that having two high-attainment grandparents (either maternal or paternal) was associated with higher achievement for granddaughters in both numeracy and reading. However, for grandsons, the attainment of paternal grandparents was not associated with numeracy scores, and the attainment of maternal grandparents was not associated with reading scores. Previous research offers few insights regarding this finding. For example, there is limited research on differences in grandchild-grandparent relationships by grandchild gender. Some research suggests that granddaughters have closer relationships with their grandparents than grandsons (Hyde & Gibbs, 1993), or that grandparents spend less time with grandsons than granddaughters (Viguer, Melendez, Valencia, Cantero & Navarro, 2010), which could explain our findings. However, other studies find no differences in grandparent-grandchild relationships by grandchild gender (Mueller & Elder, 2003). Australian research on the interactions between grandparents and grandchildren by child gender is needed to understand these patterns in greater detail.

The results of this study highlighted the advantages grandchildren enjoy if they have several university-qualified family members. Partly, this focus on university attainment was driven by the data which showed that incremental levels of higher attainment in parents and grandparents (e.g. less than Year 12 attainment versus a Year 12 attainment only) were associated with smaller gains in achievement, whereas larger

gains were observed where family members had university qualifications. There are limitations to this focus. One is that an underlying assumption that aspiring to a university qualification should be considered within the realm of possibility for all young people. Of course, there are other pathways to gaining meaningful and valued skillsets that are of great value to society. Another limitation is that while children's NAPLAN scores correlate with access to higher education (Houng & Justman, 2014), they are not the only indication of their development or future aspirations. Future research that examines the post-secondary pathways of the LSAC study children would provide valuable insight about the role of parent and grandparent education on outcomes other than academia.

Questions concerning the education levels of paternal grandparents of residing fathers (either biological, adoptive or step fathers) were collected from residing fathers in a leave-behind survey. Paternal grandparent education data were therefore missing for families where there was no father residing with the child or in families where fathers did not return the leave-behind survey. The questionnaire response bias, and exclusion of data from fathers residing elsewhere, resulted in a sample that only included two-parent families. Lone parents tend to have lower levels of educational attainment, on average, than partnered parents (Australian Bureau of Statistics, 2007). The exclusion of families with lower grandparent and parent attainment levels, and grandchildren with lower NAPLAN scores may potentially underestimate the magnitude of educational advantage that children of highly educated parents enjoy. Additionally data on grandparent educational attainment relies on secondary and retrospective recall rather than self-report or register data. We would expect that most mothers and fathers could recall with a considerable degree of accuracy the highest educational attainment of their own parents. However, for some respondents, recall of their parents' educational attainment may be less accurate and recall accuracy may vary across families.

## **Conclusion**

The educational attainment of grandparents has clear implications for the educational success of their own children, and also their grandchildren. The higher educational attainment of grandparents is associated with an increased likelihood of parents partnering with someone from a similar background, which has the effect of concentrating educational capital within families. The concentration of these resources among more highly educated families then has implications for inequality in educational outcomes among grandchildren, and for policy makers aiming to reduce socioeconomic inequality in children's achievement. Children in families with lower levels of education have fewer resources to draw upon in order to match the educational outcomes of families with high educational capital. These results suggest that compensating for educational inequalities among students is a significant hurdle for schools to overcome alone. Substantial support is required for schools and other organisations to help students achieve this outcome. For example, schools that predominantly cater to children who do not have a strong educational background at home will need support (i.e. resources) from multiple agencies to overcome these disadvantages. These supports may include assisting families to provide optimal educational environments for children both at home and at school, across early childhood and the school years. This is not a process that will happen quickly. Closing the gap in child outcomes between the least and most disadvantaged will take a concerted and sustained effort over time, and across generations.

## References

- Australian Bureau of Statistics. (1993). *Schools Australia, 4221.0*. Canberra: Australian Bureau of Statistics.
- Australian Bureau of Statistics. (2007). *Australian Social Trends, Cat. No. 4102.0*. Canberra: Australian Bureau of Statistics Retrieved from <http://www.abs.gov.au/ausstats/abs@.nsf/0/F4B15709EC89CB1ECA25732C002079B2?opendocument#DEMOGRAPHIC%20CHARACTERISTICS>.
- Australian Bureau of Statistics. (2011). *Schools Australia: 4221.0*. Canberra: Australian Bureau of Statistics.
- Australian Bureau of Statistics (2013). *Australian and New Zealand Standard Classification of Occupations, 2013, Version 1.2. Cat No. 1220.0*. Canberra: Australian Bureau of Statistics.
- Australian Curriculum Assessment and Reporting Authority. (2016). *NAPLAN Achievement in Reading, Writing, Language Conventions and Numeracy: National Report for 2016*. Sydney: ACARA.
- Australian Institute of Family Studies. (2015). *Longitudinal Study of Australian Children Data User Guide - November 2015*. Melbourne: Australian Institute of Family Studies.
- Becker, G. S., & Tomes, N. (1986). Human capital and rise and fall of families. *Journal of Labor Economics, 4*, S1-S39.
- Bol, T., & Kalmijn, M. (2016). Grandparents' resources and grandchildren's schooling: Does grandparental involvement moderate the grandparent effect? *Social Science Research, 55*, 155-170.
- Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgement of Taste*. London: Routledge.
- Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53*, 371-399.

- Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, 22(6), 723-742.
- Chan, T. W., & Boliver, V. (2013). The grandparents effect in social mobility: Evidence from British Birth Cohort studies. *American Sociological Review*, 78(4), 662-678. doi: 10.1177/0003122413489130
- Daraganova, G., Edwards, B., & Siphthorp, M. (2013). *Using National Assessment Program - Literacy and Numeracy (NAPLAN) data in the Longitudinal Study of Australian Children (LSAC) (LSAC Technical Paper no. 8)*. Melbourne: Australian Institute of Family Studies.
- Duncan, G., & Brooks-Gunn, J. (Eds.). (1997). *Consequences of growing up poor*. New York: Russell Sage Foundation.
- Hancock, K. J., Christensen, D., & Zubrick, S. R. (2017). Development and assessment of cumulative risk measures of family environment and parental investments in the Longitudinal Study of Australian Children. *Social Indicators Research*, 1-30. doi:10.1007/s11205-017-1607-3
- Hertel, F. R., & Groh-Samberg, O. (2014). Class mobility across three generations in the U.S. and Germany. *Research in Social Stratification and Mobility*, 35, 35-52.
- Houng, B., & Justman, M. (2014). NAPLAN scores as predictors of access to higher education in Victoria. *Melbourne Institute working paper series*, 22/14.
- Hyde, V., & Gibbs, I. (1993). A very special relationship: Granddaughters' perceptions of grandmothers. *Ageing and Society*, 13, 83-96.
- Jæger, M. M. (2012). The extended family and children's educational success. *American Sociological Review*, 77(6), 903-922. doi:10.1177/0003122412464040



- Kahn, R. S., Wilson, K., & Wise, P. H. (2005). Intergenerational health disparities in socioeconomic status, women's health conditions, and child behavior problems. *Public Health Reports, 120*, 399-408.
- Kraphol, E., Rimfield, K., Shakeshaft, N. G., Trzaskowski, M., McMillan, A., Pingault, J. B., . . . Plomin, R. (2014). The high heritability of educational achievement reflects many genetically influenced traits, not just intelligence. *Proceedings of the National Academy of Sciences of the United States of America (PNAS), 111*(42), 15273-15278.
- Loury, L. D. (2006). All in the extended family: Effects of grandparents, aunts, and uncles on educational attainment. *The American Economic Review, 96*(2), 275-278.
- Mare, R. D. (2014). Multigenerational aspects of social stratification: Issues for further research. *Research in Social Stratification and Mobility, 35*, 121-128.
- Marks, G. N. (2015). Do Catholic and Independent schools “add-value” to students’ tertiary entrance performance? Evidence from a longitudinal population of data. *Australian Journal of Education, 59*, 133-157.
- Mistry, R. S., Vandewater, E. A., Huston, A. C., & McLoyd, V. C. (2002). Economic well-being and children's social adjustment: The role of family process in an ethnically diverse low-income sample. *Child Development, 73*, 935-951.
- Modin, B., Erikson, R., & Vagero, D. (2013). Intergenerational continuity in school performance: Do grandparents matter? *European Sociological Review, 29*(4), 858-870. doi: 10.1093/esr/jcs064
- Møllegaard, S., & Jæger, M. M. (2015). The effect of grandparents' economic, cultural and social capital on grandchildren's educational success. *Research in Social Stratification and Mobility, 42*, 11-19.  
doi:<http://dx.doi.org/10.1016/j.rssm.2015.06.004>

- Mueller, M. M., & Elder, G. H. (2003). Family contingencies across the generations: grandparent-grandchild relationships in holistic perspective. *Journal of Marriage and Family*, 65, 404-417.
- Nghiem, H. S., Nguyen, H. T., Khanam, R., & Connelly, L. B. (2015). Does school type affect cognitive and non-cognitive development in children? Evidence from Australian primary schools. *Labour Economics*, 33, 55-65.
- Norton, A., & Cherastidtham, I. (2014). *Mapping Australian higher education 2014-2015*. Melbourne: Grattan Institute.
- OECD. (2011). *PISA 2009 results: What makes a school successful? Resources, policies and practices (Volume IV)*. Paris: OECD.
- OECD. (2013). *International Migration Outlook 2013*: OECD Publishing.
- Pilkauskas, N. V., & Martinson, M. L. (2014). Three-generation family households in early childhood: Comparisons between the United States, the United Kingdom, and Australia. *Demographic Research*, 30, 1639-1652.  
doi:10.4054/DemRes.2014.30.60
- SAS Institute Inc. (2002-2012). SAS for Windows (Version 9.4). Cary, NC: SAS Institute Inc.
- Sipthorp, M., & Misson, S. (2009). *Wave 3 weighting and non-response*. Melbourne: Australian Institute of Family Studies.
- Soloff, C., Lawrence, D., & Johnstone, R. (2005). *Sample design: LSAC technical paper No. 1*. Melbourne: Australian Institute of Family Studies.
- Soloff, C., Lawrence, D., Misson, S., Johnstone, R., & Slater, J. (2006). *Wave 1 weighting and non-response*. Melbourne: Australian Institute of Family Studies.
- Thomson, S., De Bortoli, L., & Buckley, S. (2013). *PISA 2012: How Australia measures up* (A. C. f. E. Research Ed.). Melbourne: Australian Council for Educational Research.

- Viguer, P., Melendez, J. C., Valencia, S., Cantero, M. J., & Navarro, E. (2010). Grandparent-grandchild relationships from the children's perspective: shared activities and socialization styles. *The Spanish Journal of Psychology*, *13*, 708-717.
- Wightman, P., & Danziger, S. (2014). Multi-generational income disadvantage and the educational attainment of young adults. *Research in Social Stratification and Mobility*, *35*, 53-69. doi:<http://dx.doi.org/10.1016/j.rssm.2013.09.004>
- Zubrick, S. R., Taylor, C. L., Lawrence, D., Mitrou, F., Christensen, D., & Dalby, R. (2009). The development of human capability across the lifecourse: Perspectives from childhood. *Australasian Epidemiologist*, *16*, 6-10.

**Table 1.** Age range, sample size and study retention, B- and K-cohorts, Waves 1–5.

	Wave 1 (2004)	Wave 2 (2006)	Wave 3 (2008)	Wave 4 (2010)	Wave 5 (2012)	Wave 6 (2014)
B-Cohort						
Age (years)	0–1	2–3	4–5	6–7	8–9	10–11
Sample size	5,107	4,606	4,386	4,242	4,085	3,764
Sample retention (%)	-	90.2	85.9	83.1	80.0	73.7
K-Cohort						
Age (years)	4–5	6–7	8–9	10–11	12–13	14–15
Sample size	4,983	4,464	4,331	4,169	3,956	3,537
Sample retention (%)	-	89.6	86.9	83.7	79.4	71.0

**Table 2.** Highest education level of study child's mother and father, by highest education level of grandmother and grandfather.

Highest Education Level	Grandmothers					Grandfathers				
	Uni. qual.	Post-school qual.	Year 11/12	Year 10 or less	Total	Uni. qual.	Post-school qual.	Year 11/12	Year 10 or less	Total
<b>Mothers</b>										
N	582	1,258	1,195	3,543	6,578	992	1,946	773	2,607	6,318
(%)	(8.8)	(19.1)	(18.2)	(53.9)	(100.0)	(15.7)	(30.8)	(12.2)	(41.3)	(100.0)
Less than Year 12	5.3	7.8	13.0	17.5	14.0	4.3	11.1	10.9	16.8	13.4
Less than Y12, post-school qual.	15.7	23.3	24.5	33.9	28.8	14.8	29.8	25.6	30.1	28.5
Year 12	5.5	6.5	10.2	9.4	8.7	7.3	8.2	10.3	10.2	8.9
Year 12 with post-school qual.	16.1	23.9	22.6	18.1	19.8	17.8	21.5	21.1	18.7	19.08
Year 12 with bachelor degree	57.5	38.6	29.7	21.1	28.7	55.8	29.5	32.1	24.2	29.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>Fathers</b>										
N	350	707	750	2,016	3,823	617	1,240	456	1,434	3,747
(%)	(9.2)	(18.5)	(19.6)	(52.7)	(100.0)	(16.5)	(33.1)	(12.2)	(38.3)	(100.0)
Less than Year 12	4.7	4.6	8.4	12.6	9.7	2.7	5.5	8.7	14.3	9.0
Less than Y12, post-school qual.	15.5	22.9	24.3	35.9	29.6	9.9	34.0	17.9	36.5	29.4
Year 12	4.6	7.2	10.5	7.1	7.6	6.9	6.7	11.0	8.1	7.8
Year 12 with post-school qual.	16.9	20.9	23.4	20.3	20.7	18.3	22.7	26.8	18.5	20.8
Year 12 with bachelor degree	59.3	44.5	33.4	24.0	32.4	62.3	31.1	35.6	22.6	33.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Table 3.** Linear regression results modelling mother’s years of education, by the educational attainment of maternal grandmothers and grandfathers (top half) and the educational attainment of her partner (fathers) and his parents (paternal grandparents).

	Mothers		
	Est	95% CI	p-value
Intercept	11.6	11.2-12.0	<.001
Maternal grandmother’s education			
Year 10 or less	Ref		
Year 11/12	0.1	-0.1, 0.3	.226
Post-school	0.4	0.2-0.6	<.001
University qualification	0.7	0.4-0.9	<.001
Maternal grandfather’s education			
Year 10 or less	Ref		
Year 11/12	0.4	0.2-0.7	.001
Post-school	0.4	0.2-0.6	<.001
University qualification	0.8	0.6-1.1	<.001
Father’s education			
<Year 12	Ref		
<Year 12, post-school qual.	0.8	0.4-1.1	<.001
Year 12	0.8	0.4-1.3	<.001
Year 12, post-school qual.	1.3	0.9-1.7	<.001
Year 12, university qual.	2.3	1.9-2.6	<.001
Paternal grandmother’s education			
Year 10 or less	Ref		
Year 11/12	0.1	-0.1-0.3	.208
Post-school	0.0	-0.2-0.3	.780
University qualification	0.1	-0.2-0.4	.620
Paternal grandfather’s education			
Year 10 or less	Ref		
Year 11/12	0.0	-0.3-0.3	.934
Post-school	0.0	-0.2, 0.2	.936
University qualification	0.3	0.1-0.6	.014
Cohort (B vs K)	0.3	0.1-0.4	.001

**Table 4.** Linear regression results modelling fathers' years of education, by the educational attainment of paternal grandmothers and grandfathers (top half) and the educational attainment of his partner (mothers) and her parents (maternal grandparents).

	Fathers		
	Est	95% CI	p-value
Intercept	11.7	11.3-12.0	<.001
Paternal grandmother's education			
Year 10 or less	Ref		
Year 11/12	0.1	-0.1-0.3	.300
Post-school	0.4	0.2-0.6	<.001
University qualification	0.4	0.1-0.6	.002
Paternal grandfather's education			
Year 10 or less	Ref		
Year 11/12	0.6	0.4-0.9	<.001
Post-school	0.5	0.3-0.7	<.001
University qualification	1.3	1.1-1.5	<.001
Mother's education			
<Year 12	Ref		
<Year 12, post-school qual.	0.4	0.1-0.8	.007
Year 12	0.6	0.2-0.9	.002
Year 12, post-school qual.	1.1	0.8-1.4	<.001
Year 12, university qual.	1.9	1.6-2.2	<.001
Maternal grandmother's education			
Year 10 or less	Ref		
Year 11/12	0.1	-0.1-0.3	.203
Post-school	-0.1	-0.3-0.1	.454
University qualification	0.2	0.0-0.5	.101
Maternal grandfather's education			
Year 10 or less	Ref		
Year 11/12	0.2	0.0-0.4	.071
Post-school	0.1	-0.1-0.3	.213
University qualification	1.2	1.0-1.5	<.001
Cohort (B vs K)	0.0	-0.14-0.18	.796

Table 5. Estimated effects of grandparent and parent educational attainment on Year 3 numeracy scores (age 8–9 years), by child gender.

	Grandsons		Granddaughters		All Grandchildren	
	Est.	(SE)	Est	SE	Est	(SE)
Intercept	-0.69*	0.32	-0.80**	0.25	-0.72**	0.20
Maternal grandmother						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	-0.09	0.09	0.04	0.09	-0.03	0.06
Post-school qualification	0.07	0.10	0.08	0.09	0.07	0.07
University qualification	0.15	0.13	0.11	0.12	0.13	0.09
Maternal grandfather						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	0.10	0.12	-0.09	0.13	0.01	0.09
Post-school qualification	-0.01	0.09	0.11	0.08	0.06	0.06
University qualification	0.10	0.11	0.10	0.10	0.12	0.07
Paternal grandmother						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	-0.03	0.09	0.02	0.09	0.00	0.07
Post-school qualification	0.02	0.10	0.02	0.09	0.02	0.07
University qualification	0.02	0.12	0.15	0.13	0.10	0.09
Paternal grandfather						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	0.07	0.11	-0.17	0.12	-0.06	0.09
Post-school qualification	0.13	0.08	0.00	0.08	0.05	0.06
University qualification	0.18	0.11	0.09	0.10	0.10	0.08
Mother's education						
<Year 12	Ref		Ref		Ref	
<Year 12, post-school qual.	-0.11	0.18	0.05	0.10	-0.06	0.13
Year 12	0.11	0.21	0.26	0.17	0.15	0.14
Year 12, post-school qual.	-0.03	0.17	0.40*	0.16	0.15	0.12
Year 12, university qual.	0.18	0.17	0.35*	0.15	0.25*	0.12
Father's education						
<Year 12	Ref		Ref		Ref	
<Year 12, post-school qual.	0.07	0.16	0.04	0.15	0.06	0.11
Year 12	0.13	0.19	0.22	0.19	0.18	0.13
Year 12, post-school qual.	0.28	0.17	0.25	0.17	0.22	0.12
Year 12, university qual.	0.34*	0.17	0.14	0.16	0.31**	0.12
Child age (years)	0.43**	0.10	0.30*	0.09	0.37**	0.07
Cohort (K vs B)	0.11	0.07	0.32**	0.06	0.21**	0.05
Home education index	0.67**	0.26	0.46	0.21	0.56**	0.17
N	922		898		1,820	
R-square	0.17		0.16		0.14	

\*\* p < .01, \* p < .05. In addition to those listed in the table, models also adjust for parent occupational status, equivalised household income, grandparent age and the home education environment index.



Table 6. Estimated effects of grandparent and parent educational attainment on Year 3 reading scores (age 8–9 years), by child gender.

	Grandsons		Granddaughters		All Grandchildren	
	Est.	(SE)	Est.	(SE)	Est.	(SE)
Intercept	-0.87**	0.26	-0.78**	0.23	-0.79**	0.18
Maternal grandmother						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	-0.25*	0.11	0.20*	0.09	-0.03	0.07
Post-school qualification	0.04	0.09	0.15	0.09	0.09	0.06
University qualification	0.09	0.12	0.19	0.13	0.14	0.09
Maternal grandfather						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	0.18	0.11	-0.10	0.11	0.05	0.08
Post-school qualification	-0.06	0.09	0.06	0.08	0.00	0.06
University qualification	0.17	0.11	0.09	0.11	0.14	0.08
Paternal grandmother						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	0.05	0.09	0.08	0.09	0.08	0.07
Post-school qualification	0.12	0.09	0.17	0.10	0.16*	0.07
University qualification	0.20	0.13	0.14	0.13	0.21*	0.09
Paternal grandfather						
Year 10 or less	Ref		Ref		Ref	
Year 11/12	0.03	0.09	-0.18	0.11	-0.12	0.08
Post-school qualification	0.06	0.08	-0.09	0.08	-0.03	0.05
University qualification	0.08	0.09	-0.04	0.10	0.00	0.07
Mother's education						
<Year 12	Ref		Ref		Ref	
<Year 12, post-school qual.	-0.07	0.17	0.04	0.15	-0.03	0.12
Year 12	0.09	0.18	0.27	0.17	0.14	0.12
Year 12, post-school qual.	0.09	0.16	0.30*	0.15	0.15	0.11
Year 12, university qual.	0.18	0.15	0.29*	0.15	0.22*	0.11
Father's education						
<Year 12	Ref		Ref		Ref	
<Year 12, post-school qual.	0.29*	0.14	0.14	0.14	0.21*	0.10
Year 12	0.43**	0.17	0.39*	0.16	0.39**	0.12
Year 12, post-school qual.	0.45**	0.15	0.21	0.14	0.32**	0.10
Year 12, university qual.	0.55**	0.15	0.34*	0.15	0.46**	0.11
Child age (years)	0.57	0.10	0.24	0.10	0.40**	0.07
Cohort (K vs B)	-0.21	0.07	0.06	0.06	-0.10*	0.05
Home education index	0.66	0.24	0.57	0.21	0.59**	0.17
N	921		896		1,817	
R-square	0.20		0.15		0.15	

\*\* p < .01, \* p < .05. In addition to those listed in the table, models also adjust for parent occupational status, equivalised household income, grandparent age and the home education environment index.

**Table 7.** Regression estimates for numeracy achievement in Year 3 (8–9 years), by combinations of university qualifications in grandparents and parents, by child gender.

	Numeracy				Reading			
	Grandsons		Granddaughters		Grandsons		Granddaughters	
	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Intercept	-0.56*	0.24	-0.56**	0.21	-0.57*	0.22	-0.51*	0.21
Maternal grandparents with high attainment								
Neither grandparent	Ref		Ref		Ref		Ref	
Grandmother only	-0.06	0.11	0.03	0.10	0.13	0.12	0.13	0.11
Grandfather only	-0.10	0.11	0.07	0.09	-0.03	0.10	0.09	0.37
Both grandparents	0.21*	0.10	0.21*	0.09	0.17	0.10	0.21*	0.09
Paternal grandparents with high attainment								
Neither grandparent	Ref		Ref		Ref		Ref	
Grandmother only	0.15	0.12	0.00	0.10	0.13	0.11	0.07	0.12
Grandfather only	0.12	0.11	0.01	0.09	0.15	0.11	-0.10	0.09
Both grandparents	0.12	0.10	0.23*	0.10	0.27**	0.09	0.23**	0.08
Parents with university qualification								
Neither parent	Ref		Ref		Ref		Ref	
Mother only	0.25*	0.10	0.24*	0.09	0.21*	0.10	0.21*	0.10
Father only	0.22*	0.11	0.32**	0.13	0.19	0.12	0.28**	0.10
Both parents	0.42**	0.11	0.33**	0.10	0.37**	0.10	0.31**	0.10
Child age (years)	0.41**	0.10	0.31**	0.09	0.57**	0.09	0.23*	0.10
Cohort (K vs B)	0.09	0.07	0.26**	0.06	-0.23**	0.07	0.00	0.06
Home education environment	0.70**	0.26	0.51*	0.21	0.67**	0.24	0.66**	0.21
N	929		906		928		902	

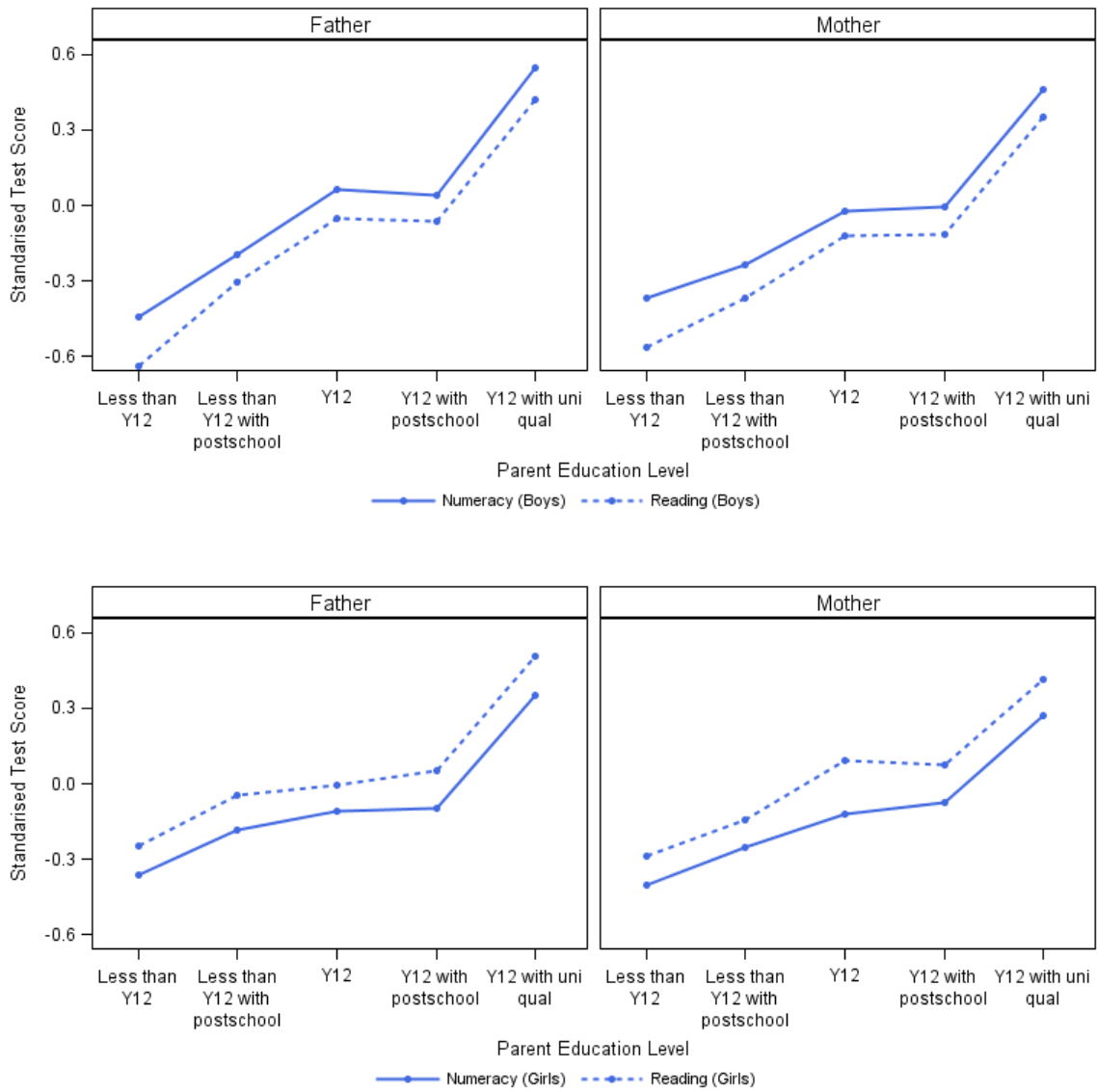
---

R-square	0.16	0.13	0.17	0.12
----------	------	------	------	------

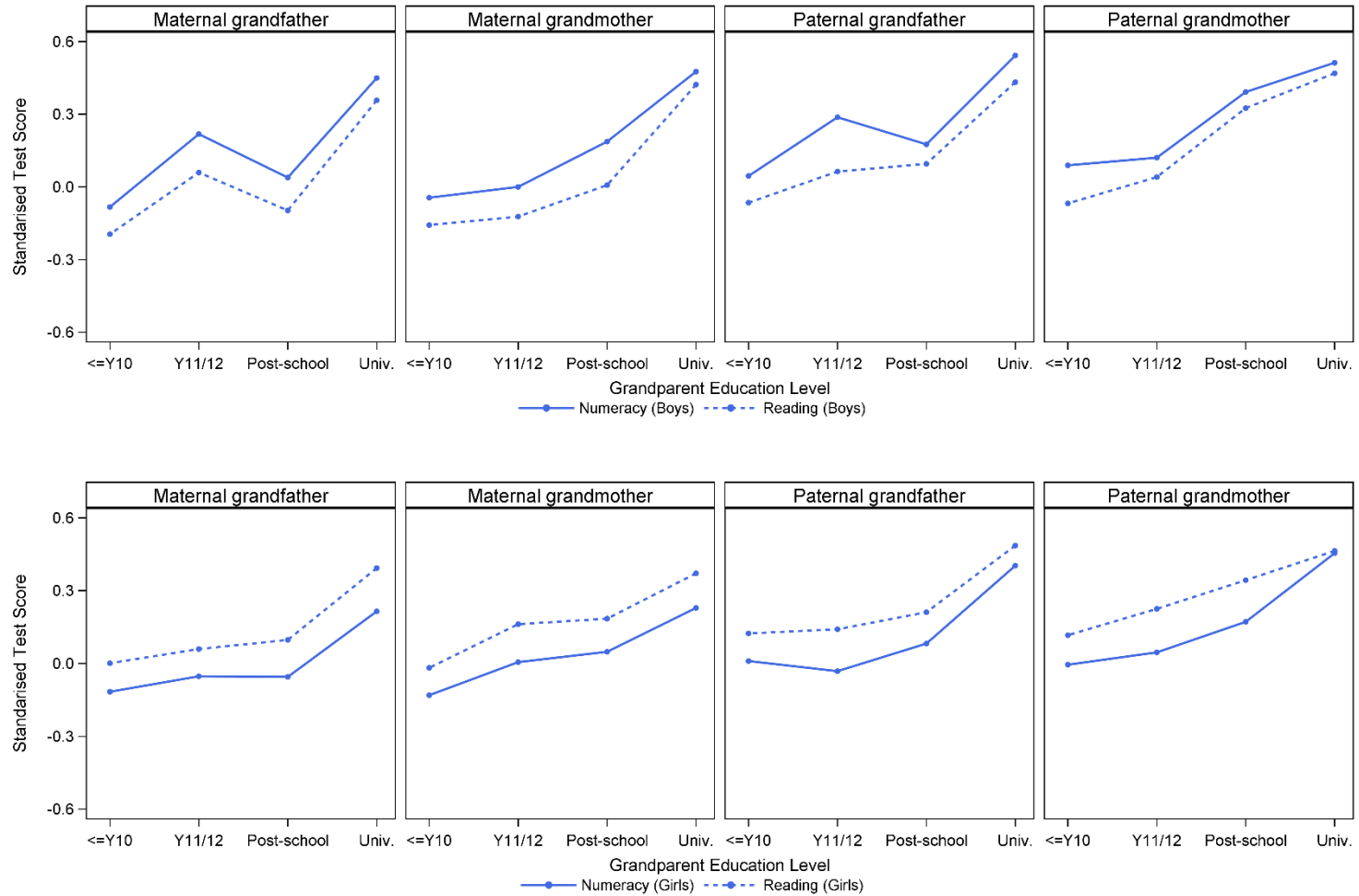
---

\*\* p < .01, \* p < .05. In addition to those listed in the table, models also adjust for parent occupational status, equivalised household income, grandparent age and the home education environment index.

**Figure 1:** Mean Year 3 numeracy and reading scores of boys (top panel) and girls (bottom panel), by the educational attainment of fathers and mothers.



**Figure 2: Mean Year 3 numeracy and reading scores of boys (top panel) and girls (bottom panel), by grandparent educational attainment**



**Figure 3:** Estimated marginal means of Year 3 numeracy and reading standardised scores, by number of family members with high educational attainment. Error bars represent 95% confidence intervals. Family members include mothers, fathers, maternal and paternal grandmothers and grandfathers. Means are adjusted for child age, gender, cohort, parent occupational status, equivalised household income, grandparent age and the home education environment index.

