

# **Family Instability and Children's Genetic Influence on Test Scores: The Role of Parental Separation and Re-Partnering by Mother's Education**

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## **Introduction**

Decades of research have focused on how family instability during childhood, encompassing parental separation and re-partnering, negatively affects children's educational outcomes (Amato, 2010; D. Lee & McLanahan, 2015; Raley & Sweeney, 2020). This line of research has shown that the negative effects of family instability are however heterogeneous (Bernardi & Boertien, 2016; Bernardi & Comolli, 2019). For example, studies have shown that parental separation is more disruptive for socioeconomically advantaged households, who may least expect it and have more resources to lose. Research integrating social and genetic perspectives has similarly shown that not only social background (Lee et al., 2018; Liu, 2018), but also genes affect children's educational outcomes and that these effects are heterogeneous by family context (Baier & Lang, 2019). More advantageous households are argued to create more tailored and enhancing environments, which strengthen the influence of children's genes on their educational outcomes (Rowe et al., 1999).

Recent studies have sought to combine these two lines of research by assessing whether family instability lowers children's genetic influences on education (Baier & Van Winkle, 2020; Bernardi & Ghirardi, 2025; Van Winkle & Baier, 2025). A study based on twins from Germany showed that the importance of genes on school-related skills was lower for children who experienced a parental separation than for those who grew up with both parents even when adjusting for mothers' education and household income (see Baier & Van Winkle, 2020). More recent research based on molecular genetic data in the US also showed that parental separation, but not parental death, was associated with a weaker genetic effect on educational attainment (see Van Winkle & Baier, 2025). While these two studies have advanced our understanding of how parental separation may impact children's educational outcomes via genetic influences, numerous gaps remain.

First, previous research has yet to address whether parental re-partnering moderates the link between children's genes and their educational attainment. Although a new partner may increase household resources and create a more enhancing environment, new household members may also generate stress which in turn may suppress children's genetic influences on education (Jeynes, 1999; Raley & Sweeney, 2020). Second, previous studies have only begun to examine potential heterogeneity in the moderating effect of family instability (see Bernardi & Ghirardi, 2025 for parental separation). Highly educated parents, for example, may be able to compensate for household instability and offset the negative impact of separation or re-partnering. Finally, most studies have been unable to account for genetic nurturing – the effect of non-transmitted genetic influences – as a potential confounding mechanism (Kong et al., 2018; Nivard et al., 2024). Non-transmitted genetic influences operate through the (family-)environment; for instance, parents' genes may shape their parenting behaviors, resources, or educational investments, which can confound estimates of direct genetic effects if not considered (Kong et al., 2018; Liu, 2018; Trejo & Domingue, 2018). Thus, to examine whether family structure moderates genetic influences on education, it is important to take indirect genetic effects into account.

In this study we begin to fill these gaps by addressing three research questions. First, how do genetic influences on test scores vary across children living with both parents, those who experienced a parental separation, and those who additionally experienced parental re-partnering? Second, does the moderation of genetic effects by parental separation and re-partnering vary by mother's education? Third, to what

extent does genetic nurturing account for the moderation of genetic effects by parental separation and re-partnering?

## **Data and Methods**

Our study uses two distinct data sources. First, the Norwegian Mother and Child Cohort Study (MoBa) (Magnus et al., 2016). MoBa is a population-based pregnancy cohort study that includes pregnant women recruited between the years of 1999 and 2009. MoBa genotyped children, mothers and participating fathers. We restrict the sample to children whose parents were cohabitating or married when they were born. In addition, we focus on family members with valid genotypic information and - as standard in the genetics literature - on individuals from European ancestry. These restrictions result in a baseline sample of almost 35.000 adolescents. As a second data source, we use population registers, which include information on children's national test scores, parental income and education, and parental cohabitation.

As our main dependent variable, we use national test scores in grades 5 (i.e., age 10), 8 (i.e., age 14) and 9 (i.e., age 15). We average the results on the English, Norwegian reading comprehension and mathematics tests for grades 5 and 8, and for Norwegian and mathematics tests for grade 9 (here no English scores are available), after z-standardizing the scores within each test and year to ensure comparability across years and test versions. As our main independent variable, we focus on the Polygenic Index (PGI) for educational attainment (Okbay et al., 2022). In general terms, a PGI is a measure that summarizes an individual's genetic predisposition to a trait (here: education) by aggregating the small effects of many genetic variants.

As our moderating variable of interest, we analyze the role of family structure. Specifically, we differentiate whether parents remained coupled, separated or re-partnered after separation. Parental separation is defined as a discontinuation of parental marriage or cohabitation without the mother finding a new partner, while re-partnering is defined as the formation of a new cohabitating or marital unit for the mother after separation.

To acknowledge the presence of indirect genetic effects (so-called "genetic nurture") we include mothers and fathers PGIs for education. As control variables, we include mother's and father's income measured as personal gross income from all sources (i.e., work and capital) in thousands of Norwegian Kroner, averaged across childhood. The analyses also control for the first ten components of population stratification as well as the gender and birth year of the child.

Empirically we proceed as follows: to examine whether genetic influences on national scores differ by family structure we run linear regression models with interaction terms for PGI for education and family structure, i.e. parental separation as well as re-partnering. To examine whether the impact differs by social background, we run separate models differentiating between mothers with and without tertiary education. Lastly, we include mothers' and fathers' education PGIs to account for indirect (genetic nurture) effects. All our analyses are conducted separately per grade (grade 5, 8, and 9) and use clustered standard errors for family identifiers to account for siblings in the data.

## **Results**

Table 1 displays the results of the regression models on test scores in grades 5, 8 and 9 for the whole sample (i.e., All), for mothers who do not have tertiary education (i.e., Below tertiary) and for mothers who do have tertiary education degrees (i.e., Tertiary). Our analyses show that the Education PGI consistently predicts children's national test scores in grades 5, 8, and 9. Across all models, for parents

who stay together, a one-unit increase in the Education PGI is associated with an increase of about 0.2 standard deviations in children's test scores.

With respect to family structure, we find no evidence that parental separation per se weakens genetic influences on children's test scores. The interaction terms between the Education PGI and family structure are insignificant in all samples. This contrasts previous findings based on the US and Germany (Baier & Van Winkle, 2020; Bernardi & Ghirardi, 2025; Van Winkle & Baier, 2025).

However, we find important heterogeneities by maternal education: Among children of mothers without tertiary education, re-partnering significantly reduces the impact of the Education PGI on test scores in grades 5 and 8. By contrast, we do not find such moderation for children of higher mothers, and furthermore there is no such interaction when looking at children in grade 9.

Our findings suggest that re-partnering following separation lowers genetic influences on education among children in less advantaged families, whereas more advantaged families may compensate for the potential stress associated with multiple family transitions. Moreover, this pattern seems to be limited to earlier school years, as no evidence of moderation is found in grade 9 indicating age-dependent vulnerabilities among children.

## **Discussion**

This paper examined the impact of family structure on children's genetic influences on educational achievement. In contrast to previous research, we distinguished not only between children of separated/divorced and cohabiting parents, but also among those whose parents re-partnered following separation or divorce. In addition, we explored whether these associations differ by maternal education, thereby contributing to the growing literature on heterogeneous effects by social background.

Our first results show no evidence that parental separation itself reduces genetic influences on educational outcomes in Norway unlike previous studies for Germany and the United States. Conflicting findings maybe explained in light of the comprehensive Norwegian welfare state, which is known for comparatively generous social benefits and the compensation of adverse consequences of negative life events such as divorce.

Second, we find heterogeneous effects by maternal education: re-partnering affects children of lower but not highly educated mothers. This suggests that re-partnering is associated with stress that suppresses the realization of children's genetic influences for education. Importantly, it seems that highly educated mothers are better able to buffer negative spillovers from parents to children.

Finally, the fact that differences in the impact of family structure on the importance of genetic influences on educational achievement are observed only in grades 5 and 8 but not in grade 9 suggests that children's vulnerability to family instability and related stress is not constant across the life course. Instead, our findings point to age-dependent sensitivities, with earlier developmental stages being more sensitive to stress than later stages.

All our findings are robust to indirect genetic effects. So-called "genetic nurture" effects have the potential to inflate direct genetic estimates, as shown in previous research (Kong et al., 2018; Liu, 2018; Nivard et al., 2024; Trejo & Domingue, 2018). That we find these associations while accounting for genetic nurture strengthens our conclusion that family transitions—particularly maternal re-partnering in less advantaged households—directly relate to the extent to which children's genetic predispositions for education can be realized.

Table 1. Association between the PGI for education and its interaction with family structure on test scores in grades 5, 8 and 9

	Grade 5			Grade 8			Grade 9		
	All	Below tertiary	Tertiary	All	Below tertiary	Tertiary	All	Below tertiary	Tertiary
Educational PGI	0.198***	0.214***	0.193***	0.226***	0.248***	0.219***	0.218***	0.253***	0.208***
Parental separation									
Staying together (ref.)									
Separation	-0.044***	-0.027	-0.030	-0.081***	-0.064***	-0.063***	-0.143***	-0.136***	-0.119***
Re-partnering	-0.088***	-0.086***	-0.044***	-0.129***	-0.105***	-0.092***	-0.216***	-0.199***	-0.169***
Educational PGI x Separation	0.006	-0.027	0.023	0.004	-0.001	0.000	0.009	-0.001	-0.002
Educational PGI x Re-partnering	-0.018	-0.072**	0.006	-0.020	-0.055*	-0.009	0.001	-0.044	0.012
N	35009	9761	25228	35277	9884	25374	35450	9943	25486

Note. These analyses are controlled for 10 principal components for population stratification, child gender and birth year, parental income and PGIs of education of both parents.  
 \*p < 0.05 ; \*\*p < 0.01 ; \*\*\*p < 0.001

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