

**UNION DISSOLUTION**  
**AND CHILDREN'S**  
**EDUCATIONAL ACHIEVEMENT:**  
**DECOMPOSING EFFECTS OF**  
**SCHOOL AND NON-SCHOOL**  
**ENVIRONMENTS**

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**UNION DISSOLUTION AND CHILDREN'S EDUCATIONAL ACHIEVEMENT:  
DECOMPOSING EFFECTS OF SCHOOL AND NON-SCHOOL ENVIRONMENTS\***

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## **Abstract**

We study whether the educational disadvantage of children from households where parents have dissolved their union is due to initial selection, less return to learning from time in school, or less return to learning from time spent in non-school environments. Using a differential exposure approach, we conceptualize and identify children's learning as a function of joint exposure to school and non-school environments. We use test scores from biannual nationwide reading comprehension tests of all Danish public-school children including information on test date and yearly information on parental separation. We consistently find lower returns to exposure to non-school environment for children who have experienced union dissolution across grades. Parental union dissolution functions as a dosage treatment. Placebo regressions and dosage treatment models make plausible a causal interpretation of the findings. Results indicate that degrading non-school environment following parental union dissolution decreases children's learning, thereby increasing inequality in educational achievement across family forms.

Children whose parents no longer live together do on average worse in school compared to peers whose parents are still together. Their grades are lower (Elliott & Richards, 1991; Heinesen, 2019; Piketty, 2003; Sigle-Rushton et al., 2014) and their educational length is shorter (Björklund et al., 2007; Björklund & Sundström, 2006; Heinesen, 2019; Jonsson & Gähler, 1997). These distinct differences in important life outcomes have led scholars to suggest that children will see diverging destinies across the family forms they grow up in (McLanahan, 2004; McLanahan & Percheski, 2008). A substantial part of the educational divide between those growing up in dissolved and non-dissolved families is attributable to differences in parental characteristics across union status (Björklund et al., 2007; Björklund & Sundström, 2006; Elliott & Richards, 1991; Fallesen & Gähler, 2020b; Laird et al., 2020; Piketty, 2003; Sigle-Rushton et al., 2014), thus living situation might simply reflect underlying selection and not necessarily be a direct cause of inequality. Yet, a union dissolution changes the home environment. Parents may have less time to invest in their children's ability development because of changed time constraints after separation and dissolution, which in turn means less time to spent on their children (Fallesen & Gähler, 2020b).

However, home is not the only environment that children are continuously exposed to during childhood. They also spent a large amount of time at school. On the one hand, the school environment may further increase differences in ability and performance between children growing up with parents with and without a dissolved union. Such an increase would occur if investments made in the home and school predominantly are complementary, for example, if having help with homework from parents also increases learning at school, or if differences in school learning environments across dissolution are even more unequal than the environments that children from dissolved and non-dissolved unions would experience at home. On the other hand, school exposure may function as a compensatory substitute to the home environment if schools and teachers increase learning investment in children, or

if differences in school learning environments across dissolution are lower than differences in the counterfactual home learning environments.

We study the extent to which the lower educational achievement of school-age children with dissolved parents is a function of exposure to school and non-school environments. Also, we explore whether children from dissolved unions benefit less from non-school learning environments due to negative selection into dissolution or because of the deterioration of non-school environments after dissolution. We rely on the differential exposure approach (DEA, see Passaretta and Skopek, 2021,2022) to separate the effect of aging (exposure to non-school environment) and schooling (exposure to the school environment) for educational achievements. Both school and non-school environments contribute to children's learning over a school year. The DEA decomposes such learning rate into a 'non-school environment' and a 'school environment' component by exploiting random variation in test dates and date of birth of children entering school on the same calendar day. Such decomposition approach allows us to contribute new knowledge on the mechanisms that underlie the educational deficit of children from dissolved homes and the debate around the role of schools for achievement inequality in Western societies. We focus on the learning of primary school children living in either with both biological parents or in a dissolved family in Denmark, a country characterized by relatively low barriers to union dissolution and a comparatively low amount of inequality in both school and non-school learning environments. Thus, theoretically we are considering a setting where the type of family you live in should matter little for the type of school you go to, but where the average family who ends up dissolving may on average reflect a less bad home environment pre-dissolution relative to other contexts because of the low legal and normative barriers to divorce.

We find that children from dissolved unions benefit less from exposure to non-school environments than their peers from intact families in all primary-school grades, indicating either less parental

investment or less returns to parental investment. Danish schools seem not able to compensate for those inequalities because children from dissolved and non-dissolved unions benefit from school exposure alike. Some compensation occurs at lower grades, but children from dissolved families benefit less from school exposure at later grades. Further, children with parents' who dissolved earlier in the child's life course benefit less from non-school environments compared to peers who experienced parental dissolution later in life. Placebo tests using children who will experience parental dissolution but have not done so at testday as negative controls suggest that the lower returns are attributable to deteriorated non-school environment after dissolution and not negative selection into dissolution. Overall, we find strong support for the idea that the deterioration of non-school learning environment is an important factor contributing to lowered achievements after parental union dissolution. Sadly enough, even a comparatively equal primary school system seems not able to compensate for the detrimental effects of union dissolution for children's achievement.

The study provides three key contributions to the literature on children's living arrangement and inequality. First, we demonstrate that there exists divergence in educational achievement across children's living arrangement and that differences in learning returns to time spent outside the school environment drives the divergence. Thereby, we contribute new important insights into how inequalities in education develop across family background. Even if there is selection into what types of family forms children grow up in, these results demonstrate that the effect of that selection is not static but instead evolves dynamically as children age. Second, we make plausible that the effect of parental union dissolution is at least partly causal—that is, in the counterfactual state of parents remaining together and the home environment not deteriorating children would learn more. Third, we show that length of exposure matters—the more of the life course spent with parents not together, the more children's learning development is slowed down relative to their peers. In total, our study

provides evidence that further our understanding of how educational diverging destinies emerge across the types of households that children grow up in.

## **Background**

Parental union dissolution is by far the most common adverse childhood experience that children are subjected to, and it fundamentally changes families' living situations, time constraints, economic resources, and mental well-being (Amato, 2000, 2005, 2010). Given the likely dynamic nature of returns to parents' investment in children, the deterioration of home environments may lead to a 'diverging destinies'-style development in children's ability and performance over childhood (McLanahan, 2004). Children who grow up with parents who have dissolved their union generally have worse educational outcomes and report lower well-being (Amato & Sobolewski, 2001; Fallesen & Gähler, 2020a; Jonsson & Gähler, 1997), although disentangling selection effects from the causal impact of union dissolution is difficult (see however Björklund et al., 2007; Björklund & Sundström, 2006; Heinesen, 2019; Piketty, 2003; Sigle-Rushton et al., 2014).

A key mechanism for why children from dissolved families has worse educational outcomes is that union dissolution affects parents' material and immaterial resources to invest in their children's development. Divorced parents face a loss of economics of scale resulting in less disposable income. Parents also face additional time constraints following a union dissolution due to a loss of planning efficiency. Fallesen and Gähler (2020b) find that after a union dissolution parents spend the same amount of time on the logistical aspects of childcare (transportation, feeding, etc.), but less time on developmental childcare (helping with homework, talking, etc.). Correlational studies also find that children of parents who share physical custody (joint living) generally fair better (Baude et al., 2016; Fallesen & Gähler, 2020a; Fransson et al., 2016; Spruijt & Duindam, 2009). While this likely partly

reflects selection, it may also reflect the possibility to share custody when parents live close enough to each other.

Schools may compensate for a lower investment in the development, whether this is caused or simply signaled by union dissolution. The literature on school equalization argues that school exposure is more advantageous for students from a low-resource environment than for students from a high-resource environment (Downey et al., 2004). The situation occurs if the disadvantage that low-resource students incur from the non-school environment is larger than what they incur at school, even if they attend on average worse schools.

One way to conceptualize this is to consider the parent/child ratio at home and the teacher/student ratio in the classroom. In a two-child intact family, the parent/child ratio is 1:1 while in a dissolved family it is 1:2. Even if children from dissolved families attend classrooms with a less favorable 1:25 ratio and children from non-dissolved families enjoy a more favorable 1:15 ratio, the relative disadvantage for children from dissolved unions at home (one half) is still larger than in the classroom (one third) (Downey, 2021:85-86). Even if attending worse schools, children from dissolved unions may over-proportionally benefit from schooling because the relative improvement of learning environments these children experience in school is larger compared to children from intact families.

However, the equalization of school learning environments might not translate into more equal achievement because gains from instructional inputs in school hinge on previous skills (Raudenbush & Eschmann, 2015). As such, students from dissolved families, who enter school with lower achievement on average, could benefit less from schooling even if schools provide more equal learning environments. There are multiple mechanisms with the potential to either increase or decrease inequality at play in school, which could result in students from worse or better-off families having similar gains from schooling. For example, Passaretta and Skopek (2021) show that for Germany

schooling overall do not decrease or increase inequality across socioeconomic background. However, this may not be the case for other countries and other measures of social disadvantages, such as parental union dissolution.

***Theoretical Model***

Union dissolution may deteriorate children’s non-school learning environments (i.e., their learning return to aging), and this comes at the expense of cognitive achievement. The process leading to lowered achievement is relatively straightforward when we look at children before school age. Suppose we measure achievements in the year right before children enter school, say around age 6 ( $\theta_6$ ). We let  $\theta_6$  be a function of previous exposure to non-school environments ( $NS_5$ ) and, according to dynamic accounts of skill formation (Heckman and Cunha, 2007), previous achievement ( $\theta_5$ ):

$$\begin{aligned} \theta_6 &= f(\theta_5, NS_5) \\ \text{and } \theta_5 &= f(\theta_4, NS_4) \end{aligned} \tag{1}$$

Note that non-school environments in Equation (1) include all non-school-related factors that are consequential for children’s development, including family characteristics, such as parental education and a potential union dissolution. If union dissolution happens when children are age five, the deterioration of non-school environments ( $< NS_5$ ) has only *short-term* consequences on achievement at age six ( $\theta_6$ ). However, if a union dissolution happens at age four, the deterioration of non-school environments ( $< NS_4$ ) has both *short-term* consequences on achievements at age five ( $\theta_5$ ) and *long-term* consequences at age six ( $\theta_6$ ) through the dynamic consequences of the deterioration of age-five

achievements ( $\theta_5$ ). This simple model conveys two important messages. First, the process of cognitive maturation before children enter school will be hampered for children that experienced a union dissolution compared to children with intact families; ‘aging’ will be less beneficial for the development of children with split parents (because of the deterioration of non-school environments) and gaps may open as children grow older after the dissolution. Second, the detrimental consequences of a union dissolution will be proportional to the amount of exposure to deteriorated non-school environments after the dissolution had happened. Note that these two arguments do not hinge on whether (the timing of) dissolution is orthogonal to other parental characteristics and parenting practices and styles.

The transition to school complicates the scene. Children in school age spend from one-fourth to one-third of their time in the classroom, but they still spend most of their time out of school. Therefore, children’s learning in school age is influenced by both school ( $S$ ) and non-school ( $NS$ ) environments. We can express achievement in school, say at the end of the first year of schooling (around age seven), as follows:

$$\theta_7 = f(\theta_6, NS_6, S_6) \tag{2}$$

Equation 2 implies that the deterioration of non-school environments in non-intact families also impacts learning of children during school age. If all children benefit from school environments equally, then we can expect achievement gaps between children from intact and non-intact families to grow over schooling as they grew before schooling (as implied by Equation 1). This would be entirely due to the exposure to the deteriorated non-school environments during school age; that is the process of ‘aging’ in school. However, differential effects of exposure to non-school environments (‘aging’) may add to differential effects of exposure to school environments (‘schooling’). This very fact makes it impossible to infer the role of school and non-school factors by observing how gaps between children from intact and non-intact

families evolve over schooling. On the one hand, schooling may *compensate* for deteriorated home-learning environments and benefit children from non-intact families more. On the other hand, schooling may *exacerbate* the disadvantage due to deteriorated non-school environments, and benefit children from intact families more.

How can we disentangle the role of school and non-school factors for learning as children are ‘aging in school’? This challenge was recently addressed by Passaretta and Skopek (2021, 2022) who decompose school-year learning rates for children who entered school in the same academic year into ‘schooling’ and ‘aging’ components. Their differential exposure approach (DEA) requires only one test score per child over the school year and is based on a simple intuition: we gauge insights into the role of school environments by comparing the achievement of children of the same age at testing who differed randomly in the amount of school exposure received by the day of testing. This comparison allows us to disentangle the ‘schooling’ component from the process of ‘aging in school’. Conversely, we gauge insights on the role of non-school environments by contrasting the achievement of children who had the same schooling but differed randomly in age at the day of testing. This comparison brings out the ‘aging’ component of the process of ‘aging in school’. These contrasts can be empirically constructed only when there are sufficient (conditional) random variations in two out of three terms: children’s birth dates, school start dates, and test dates. Variations in the former two components usually rest on educational settings which, in many countries, combine enrolment rules based on children’s age relative to a cut-off date and fixed (or varying) dates of school start. Test date variations, instead, rest on characteristics of the national assessment data at hand. Our case study, Denmark, features these requisites as we will see later.

In line with Equation 2, the DEA conceives of achievement in school as affected by both school (school exposure or ‘schooling’) and non-school (‘aging’) factors:

$$y = a_0 + a_1 E_T + a_2 A_T + e \quad (3)$$

where  $E_T$  stand for the length of school exposure until test day and  $A_T$  for the age at test day;  $a_1$  and  $a_2$  represents the change in learning due to school-factors ('schooling') and non-school factors ('aging'). Note that  $a_1$  and  $a_2$  sum up to the rate of learning over the school year; that is what we called the consequences of 'aging in school' for achievement (see also Passaretta and Skopek, 2022). The model can be directly extended to incorporate our ideas about the aftermath of union dissolution by allowing 'aging' and 'schooling' effects to differ according to whether children experienced a family dissolution (D) before the test:

$$y = b_0 + E_T(b_1 + b_3 D) + A_T(b_2 + b_4 D) + b_5 D + e \quad (4)$$

Previous evidence suggests that children from non-intact families will have lower test scores in school age (that is  $b_5 + b_3 E_T + b_4 A_T < 0$ ). Also, our discussion suggests that a union dissolution deteriorates non-school environments, and this should reflect in aging being less beneficial for learning of kids from non-intact families, that is  $b_4 < 0$ . But do school environments *compensate* or *exacerbate* the disadvantage brought by deteriorated non-school environments after a union dissolution? This is essentially an empirical question. If  $b_3 = 0$ , then schooling benefitted children from intact and non-intact families equally. In this scenario, the evolution of the gap of children from intact and non-intact families will only depend on aging and, if our prediction is correct (that is if  $b_4 < 0$ ), such gap will increase over the school year. If  $b_3 < 0$ , the school environment *exacerbates* inequality because children from intact families gain more from schooling. In this scenario, the gap of children from non-intact families will increase even stronger over the school year than simply implied by aging (because  $b_3 + b_4 < b_4$ ). Last,

if  $b_3 > 0$ , the school environment *compensates* deteriorated non-school environments as children from non-intact families gain more from schooling. In this latter scenario, their gap with children from intact families may increase slower than simply implied by aging (if  $|b_3| < |b_4|$ ), remain constant (if  $|b_3| = |b_4|$ ), or even decrease over the school year (if  $|b_3| > |b_4|$ ).

## **Parental union dissolution and schooling in Denmark**

### ***Divorce and union dissolution in Denmark***

Denmark provides a theoretical interesting case for the study of the effect of parental union dissolution on children's learning because it has one of the most liberal family laws worldwide. Married and cohabiting parents have very similar legal rights, and more than 50 percent of recent cohorts are born outside wedlock (Statistics Denmark, 2022). Divorce is common and easily accessible (Fallesen, 2021) such that 40-50 % of marriages end in divorce. A third of all children in Denmark experience parental divorce or dissolution of a cohabiting union before age 15 (Heinesen, 2019), and married and cohabiting parents are highly similar in terms of rights and responsibilities, so little distinction exists between being a child of divorced or dissolved parents.

The low normative costs of divorce and union dissolution in Denmark is consequential for its effect on children's outcomes. Historical studies leveraging the introduction of modern divorce laws and the increasing normalization of divorce as a family outcome, such as Piketty (2003), (Gruber, 2004), and Kreidl et al. (2017), have generally found less negative consequences for children's education when divorce was difficult to obtain and normatively uncommon. Yet, Kreidl et al. (2017) finds an increasing negative correlation as divorce becomes more common in a society. A likely explanation is that when barriers to divorce are high only the very worst marriages end in divorce. Hence, children may be better

off having parents living apart instead of together in a very dysfunctional home. However, when barriers to divorce are lower, the motives for divorce become less severe (de Graaf & Kalmijn, 2006) and the consequences for children worse: parents who now divorce did not form a dysfunctional home environment pre-divorce, and thus the constraints of the parents' post-dissolution resources results in a (larger) decrease in the quality of home environments. Thus, Denmark might present a “worst case” scenario because of the low barriers to union dissolution and divorce. And yet negative selection into union dissolution and divorce may be lower compared to institutional context where barriers to divorce are higher.

### ***Primary school in Denmark***

In Denmark, children start school after the summer break in the year they turn six. Comprehensive schooling lasts for 10 years. Parents have the option to send their children to subsidized private schools, free public schools, or homeschooling. Approximately 85 % of all students in Denmark start primary education in a public school, and 80 % of all eighth-grade students (age14) attend a public school (Phil, 2019). In our study, we focus on children in public schools only, who represents most children in the country. Importantly, co-payments by parents are not allowed in public schools. Public schools are administered by the municipalities, which have different tax revenue due to population composition. Expensive transfers between municipalities are used to counteract geographical inequalities in funding, thus making local tax revenue less decisive for school funds. Overall, school expenditures are very compressed across schools in Denmark, especially compared to the United States (Gensowski et al., 2020).

Enrolment in a particular school is regulated by the municipality and based on catchment areas. However, parents can decide not to comply with the assigned enrollment and send their child to a private school or enroll in another public school with spare capacity. High socioeconomic status (SES) households are particularly likely to use these alternatives if their assigned school is of low quality, and in general, high-SES schools attract high-SES households (Bjerre-Nielsen & Gandil, 2020). Moreover, teachers with higher GPAs from their teacher education and with longer tenure are more likely to work at high-SES schools (Gensowski et al., 2020). As such, there are variations in the quality of the school environment students are exposed to based on their parent's SES, despite school expenditures being relatively equal. Nevertheless, inequality in school learning environments is comparatively lower in the social-democratic context of Denmark compared to other liberal countries, such as the US or the UK. Hence, Danish primary schools may have a comparatively large potential for compensating achievement inequality between children from better- and worse-off families.

## **Data**

We linked data from two sources, the Danish administrative register data and a mandatory nation-wide reading comprehension test in public school collected in grades 2, 4, 6, and 8 by the Ministry of Education. We use test results from the period 2010-2018 for all grades. From the register data, we obtain yearly information on parents' dissolution and parental background characteristics. After removing children who were older or younger for grade and those who completed the test children outside the design period, we remained with 1,426,996 test scores (which we standardized within each grade and year) from 691,287 children overall. The data allows for longitudinal linkage of test scores across grades, but as we show below our empirical strategy does not require multiple observations per child, and we therefore treat the data as cross-sectional.

The tests were conducted within a period set by the Ministry of Education: February-to-April from 2010 to 2016 and, March-to-April in 2017 and 2018. Students, who missed the initial test are given a retesting date in June.<sup>1</sup> Hence, maximum variation in school exposure at the test day is 2–3 months, which amounts approximately to one third of a school year or the summer break. Teachers may decide on the specific test day within the assigned period (even for each student), but usually the whole class sits the test at the same time. The fact that the teachers decide on the specific test-date challenges one important requirement of the DEA, that is randomness in test dates. However, the tests are low-stakes for students, teachers, and school principals and used neither for rewarding nor for sanctioning (Andersen & Nielsen, 2020). The low-stakes nature of the test reduces the risk that teachers will try to influence the results of the test by setting a late test date or through teaching-to-the-test. Moreover, the whole class generally sits the test together and is unlikely that date is catered to the specific needs of students who had experienced a union dissolution. These arguments seem confirmed by the very weak association between family characteristics and test dates in Supplementary Table A1.

#### *Sample selection and school start in Denmark*

In Denmark, mandatory schooling starts in August the year a child turns 6 (grade 0). This rule of enrolment creates random variation in birth dates (and, hence, age at school start) among children that start primary school on the same calendar day. Parents can apply for a child to start school at age 5 if the child is born before October and is evaluated to have the competencies to participate in grade 0. Moreover, parents can apply for a postponement of 1 year, and the municipality can recommend a postponement. The postponement must be based on an individual assessment of the child's

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<sup>1</sup> We exclude these children from our analytical sample.

development and cannot happen without the parents' consent. In 2009/2010, 82% of all students started school at age 6 and this share raised to 90% in 2017/2018 (due to a decrease of late starters, see Andersen, 2020).

Following Passaretta and Skopek (2021), we exclude students who either enrol early or late in grade 0, as non-compliance with the enrolment rules is likely correlated with child development, or other factors affecting academic achievement (including union dissolution). Differently from Passaretta and Skopek (2021), we extend the analyses to older grades in primary school (grade 2, 4, 6, 8). Hence, we also drop students who were younger or older for grade because they were retained or skipped a year.

In principle, municipalities and schools have some autonomy in deciding on the specific day of school start. However, the start of the summer holiday (and most other holidays) is fixed at the national level and schools are committed to providing 200 days of teaching per academic year. This means that, in practice, schools can only slightly vary the school starting date by a couple of days. The "official" end of the summer holidays in Denmark is the starting date of grade 0, which is the first day of the second week of August in most years. We set the starting day at the midpoint of this range of dates and include year dummies to capture the variation around starting date.

### *Measure of academic achievement*

We measure academic achievement in terms of reading comprehension. Reading is one important dimension of language development and a crucial skill for learning through textbooks in other domains. The test is adaptive because the difficulty of questions rests on the correctness of previous answers given by students. All students are given 45 minutes to take the test and students can complete as many questions as possible to increase precision in the measurement. Students were tested in three domains related to reading comprehension: text comprehension, decoding, and language comprehension. Text

comprehension captures the student's ability to understand a text, based on knowledge of genre, composition, ability to read the neighboring languages (Norwegian and Swedish), as well as their reading strategies. Decoding entails a student's ability to identify different words. Language comprehension measures the student's vocabulary, knowledge of idioms, and understanding of homonyms (Pøhler, 2011). Test results in the three domains were scored separately on a Rasch-calibrated logit scale ranging from -7 to 7 (Beuchert & Nandrup, 2018).

Test scores are highly correlated with school-leaving GPA (Skov & Flarup, 2020), and thus provide an early-life measure of educational human capital. We follow the standardization procedure in Beuchert and Nandrup (2018) to construct a single relative measure of reading comprehension: we standardize test scores for each domain within grade and years, we average three z-scores, and then standardize the average within grade and year. Hence, the final z-scores reflect the relative position of children in the distribution of achievement in each grade and year.

#### *School exposure and age at testing*

School exposure is the difference between the test date and the start of primary school (grade 0). Age at test is test date minus birth date. Both variables are precise at the month level but measured in years. For the DEA to produce valid estimates of school exposure and age at test effects, test dates and birth dates (school start is fixed) should be unrelated to characteristics related to achievement (including union dissolution).

Supplementary Tables A1 and A2 present results from regression models predicting the length of schooling and age at test based on observable characteristics and an indicator of the students ever experiencing parental union dissolution. Estimates can be directly interpreted as the share of a year.

Overall, we find very few statistically significant associations between observable characteristics and length of schooling, and when associations are statistically significant at conventional levels the estimates are very small in magnitude. For example, children whose fathers have any college education has on average 0.1 percent less of a year's schooling (.3 days) when sitting the test compared to children whose fathers only had compulsory education.

There are more statistically significant associations between individual characteristics and age at test. However, sizes of the associations are very small and not substantially relevant. For example, the biggest coefficient in the table implies girls are on average 3–4 percent of a year younger than boys (10–15 days). Children with higher educated parents and parents with higher disposable income also tend to be slightly younger at time of test, but differences are in the order of 3–6 days. More importantly, associations between union dissolution and school exposure/age at test is generally not statistically significant or substantially relevant.

### *Union dissolution*

Parental union dissolution is based on housing information from the Danish population register, which holds information on people's dwellings down to the apartment. When parents stop residing in the same address, we consider a union dissolution has happened. Danes are required by law to report any address change within five days of moving and there is a strong incentive to do so because it directly impacts entitlement to housing and social benefits. A recent study (Holm, Fallesen and Heinesen, 2022) find an immediate negative test score response within a week of one parent registering their moving out of the joint home, which suggests the strong validity of the housing information. We measure union dissolution in two ways. First, as a 'dummy' indicating whether parents had dissolved their union prior

to the year of testing. Second, as a ‘dosage’ indicating the share of the child’s life that parents have not been residing together (using the midpoint of the year of dissolution as a threshold).

### *Analytical Strategy*

School exposure and age at test are not perfectly colinear because of variations in test dates and birth dates among children who enter primary school (grade 0 in Denmark) on the same calendar day (Passaretta and Skopek, 2021, 2022). This is what gives the DEA leverage to identify the separate contribution of ageing and schooling for educational achievement. Passaretta and Skopek (2021, 2022) applies the approach to achievement in first grade only. We perform the analyses by grade to measure aging effects the effects of exposure to later grades in primary school (grade 2, 4, 6, and 8). We estimate the effect of aging and school exposure on achievement inequality by parental union dissolution as discussed in Equation 4 as follows:

$$Y_i = \beta_0 + E_i(\beta_1 + \beta_3 D_i) + A_i(\beta_2 + \beta_4 D_i) + \beta_5 D_i + \mathbf{Y}\boldsymbol{\gamma} + \mathbf{X}_i\boldsymbol{\delta} + \epsilon_i \quad (5)$$

where  $Y_i$  is the child’s z-score,  $A_i$  is age at test for student  $i$ ,  $E_i$  is length of school exposure from start of grade 0,  $D$  is a dummy indicating parental union dissolution prior to the test,  $\mathbf{Y}$  is a vector of dummies capturing year, and  $\mathbf{X}_i$  is a vector of child and parent characteristics.

The estimates of aging, schooling, and their interactions with parental union dissolution have causal interpretations insofar that  $(A, E, A \times D, E \times D \perp \epsilon | X, Y, D)$ . The random variation in age at test and school exposure ensures that  $A$  and  $E$  are independent of the error term, whereas their interaction with union dissolution rests on the stronger assumptions that children whose parents divorce would have had the same return to school exposure and aging as peers had their parents not divorced (conditional on

observables). However, *even if that assumption does not hold*, asking whether school and non-school factors contribute to shape children’s cognitive achievement in the aftermath of a dissolution remains a key question. If children from non-intact families have lower achievement because of unobservables correlated with dissolution and not due to dissolution *per se*, it is paramount to understand where schools stand in the process. Schooling may contribute to the exacerbation of achievement gaps or provide a shelter for children with weaker achievement, whether they are caused or simply signaled by union dissolution.

We additionally carry out placebo analysis to test whether union dissolution has *per se* an effect on achievement. The placebo test is constructed by selecting a restricted sample and contrasting achievements of children who will never experience parental union dissolution (in our observation window) and children who will experience union dissolution but have not done so by the time of testing. Placebo tests on the restricted sample were only feasible for grades 2, 4, and 6 (because we only observe parental union dissolution until grade 8) and were constructed as follows:

$$Y_i = \beta_0 + E_i(\beta_1 + \beta_3 \text{NotYet}_i) + A_i(\beta_2 + \beta_4 \text{NotYet}_i) + \beta_5 \text{NotYet}_i + \mathbf{Y}\boldsymbol{\gamma} + \mathbf{X}_i\boldsymbol{\delta} + \epsilon_i \quad (6)$$

If  $\beta_3 = \beta_4 = 0$ , then this is a necessary condition for a causal interpretation of the interactions between union dissolution and aging and schooling. This is the strongest empirical test available with the data we have at our disposal.

#### *Dosage response*

Equation 5 (and 6) considers union dissolution as a static characteristic that children have or have not experienced at the test day. And yet short- and long-term effects of union dissolution (see Equation 1)

suggest that the higher the exposure to deteriorated non-school environments after dissolution, the worse the consequences for learning. Some children may spend the entire share of childhood in non-intact families because their biological parents were never together or dissolved their union during pregnancy. Others will experience a parental union dissolution sometime during their childhood and spend a smaller share of childhood in a deteriorated non-school environment before the test. On expectation, a union dissolution should have stronger negative consequences in case of higher shares of lifetime spent in a family characterized by a dissolved union. To account for dosage response of parental union dissolution, we augment Equation 5 with a variable (*Dose*) that captures the share of childhood a child has spent with parent living apart at time of test (with 0 indicating that parents are still together and 1 indicating that parents were not together at birth):

$$Y_i = \beta_0 + A_i(\beta_1 + \beta_3 Dose_i) + E_i(\beta_2 + \beta_4 Dose_i) + \beta_5 D_i + \beta_6 Dose_i + \mathbf{Y}\boldsymbol{\gamma} + \mathbf{X}_i\boldsymbol{\delta} + \epsilon_i \quad (7)$$

The J-test (Davidson & MacKinnon, 1981) that allows for comparison of non-nested models lets us ascertain whether the dosage specification improves the overall fit of the regression compared to regression presented in Equation 5.

## Results

### *Descriptive results*

Table 1 presents descriptive statistics for the sample by grade and whether parents had dissolved their union by the beginning of the year of testing. The table shows that there are no differences in age at test and school exposure between children whose parents dissolved their union and children whose parents remain together in any grade. Also, children whose parents have dissolved their union do worse in

school, are more likely to be female, have younger parents, come from backgrounds where parents have fewer years of education, and lower disposable income. These figures are in line with findings from the existing literature.

[Table 1 about here.]

### *Aging and school exposure effects*

Table 2 present results for the average effect of aging and schooling for achievement separately for each grade. Estimates are from simpler version of Equation 5 that leaves out interaction terms between dissolution and aging/schooling variables. In second grade, an increase in aging of 1 year increases test scores with 25 percent of a standard deviation, whereas increasing schooling with one year increases test scores with approximately 75 percent of a standard deviation. Worth noting is that school exposure has a 3-times larger effect on achievement compared to aging, which is virtually identical to the figure reported by Passaretta and Skopek (2021, 2022) in the case of first-grade exposure in Germany.

Returns to aging are decreasing across grades, with one more year of age increasing achievement by 17, 11, and 2% on an SD only in grades 4, 6, and 8 respectively. School exposure effects are also decreasing across grades and drop from 75 to 42% of an SD moving from grade 2 to 8. Decreasing returns to both aging and school exposure are understandable. On the one hand, they may simply reflect decreasing marginal rates of returns. On the other hand, the same absolute difference in aging/schooling represents a much smaller share of lifetime at later grades. Across all grades, parental union dissolution is associated with lower test scores, with children from dissolved homes seeing consistently 5-7 percent lower test scores.

[Table 2 about here.]

### *Differences in aging and school exposure effect by dissolution*

Figure 1 reports the main findings from the interaction models specified in Equation 5 where we use a binary indicator for whether the child has experienced parental union dissolution by the start of the year of testing. The full set of estimates is reported in Supplementary Tables A7-A10. All results are reported by grade. Again, we see positive and statistically significant effects of both aging and schooling across grades, and results are stable across model specifications. The standard errors are larger for schooling effects because of less variation in schooling exposure than in age.

Children who have experienced union dissolution seem to benefit less from aging across the board. In grade 2, the interaction term is negative and around 2-3 % of a standard deviation. This estimate implies that 2<sup>nd</sup>-grade children with dissolved parents benefit 8-11% less from aging than peers whose parents are still together (22–23% vs 25% vs of an SD per year of aging).

In grade 4, the interaction between aging and dissolution remains negative and significant and increases in absolute magnitude, so children with dissolved parents now see a 26-30 % lower return to aging. Although the main effects of aging continue to decline across grades 6 and 8, the interactions remain stable and negative, meaning that children from dissolved households increasingly see relatively smaller learning returns to aging than peers whose parents have remained together. All in all, these findings demonstrate that children whose parents are no longer together benefit less from their non-school environments.

But does school compensate for inequality by union dissolution? The results are not clear-cut. Point estimates suggest that school exposure compensates in grade 2 and grade 4 (they are partly statistically significant in grade 4 only). However, point estimates suggest increasing inequality in grade 6 (not statistically significant) and no effects of school exposure in grade 8. Altogether, there is no compelling

evidence suggesting that school exposure increases or decreases inequality in achievement by union dissolution.

### ***Placebo results***

Figure 2 reports the placebo results for the only three grades for which we have data on future dissolution (grades 2, 4, and 6). In general, neither interaction terms between future dissolution and aging, nor union dissolution and school exposure are statistically significant (even though standard errors are also very large in the case of the interaction term with school exposure). The absence of any interaction effects means that random differences in aging and school exposure effects on achievements do not change when contrasting children who will experience parental union dissolution but had not yet done so and children who will never experience dissolution. Once we have controlled for general selection into union dissolution with the will-ever divorce indicator, as well as controlled for differences in observable characteristics, it appears that any differential effects of aging and schooling are driven by the union dissolution event in and of itself. This very finding points towards a causal interpretation of the union dissolution parameter in our models, although we should bear in mind that estimates from this restricted sample have high uncertainty.

[Figure 2 about here.]

### ***Dosage response***

Figure 3 report the main findings from Equation 7 where we allow the exposure to parental union dissolution to take the form of a dosage response. Results are generally in line with those found using the binary indicator: the higher the share of lifetime spent in a family characterized by a dissolved union, the lower the benefit children retain from aging. Worth noting is that magnitude of the dosage specification results in interaction terms between union dissolution and aging are more distinctly

different from zero. Hence, the dosage approach conveys a more informative formulation of the relationship between union dissolution and learning compared to the binary indicator. To formally test this, we carry out a set of J-test (Davidson & MacKinnon, 1981) for non-nested alternative models, allowing us to establish whether including dosage response would have improved the binary model, and if including binary response would improve the dosage model. The results from these tests are reported in Table 3. Across all grades, the dosage model dominates the binary response model by providing a better fit (it also dominates a model including a dosage main effect together with the binary indicator, but with binary interactions).

[Figure 3 about here.]

[Table 3 about here.]

This finding emphasizes two important things. First, unless the unobserved selection into union dissolution is linearly related to dosage, the divorce event in and of itself has a causal effect on children's learning. Second, the divorce effect is dynamic not only in the sense that lower learning gains in one period are carried over into the next period but also in the sense that longer exposure to a dissolved household is more detrimental.

### ***Geographical availability of the other parent***

Parents who have dissolved their union have less possibility to invest in their children's learning, reflecting a lower return to non-school environment ('aging'). If some of the investment loss is due to the post-dissolution family being less efficient because of increased time constraints, the geographical closeness of the partner may matter for lowering the efficiency loss. That is, if parents live close to each other post-dissolution, they may be able to parent more 'efficiently' jointly. Whereas Denmark is a geographically small country, we are concerned with children's access to both parents in their

everyday lives and thus even not residing in the same municipality will place barriers on day-to-day interactions.

We test these ideas by allowing the interaction between aging (schooling) and union dissolution to differ across whether dissolved parents reside in the same municipality in Figure 4. For grade 2, we only observe significant aging interaction for children whose parents reside in the same municipality, going counter to the expectation that geographical closeness may mitigate negative consequences of union dissolution for children's learning. For the rest of the grades and for school exposure, the three-way interaction remains insignificant, and for aging the point estimate is close to zero. As seen from Tables A16-A19 in Supplementary materials, the indicator for parents living in the same municipality post-dissolution is positive and highly significant, so children whose parents remain in close geographical proximity are more positive selected, but this initial selection does not translate into less decline in the return to learning from non-school environments.

[Figure 4 about here.]

### ***Sociodemographic heterogeneity***

Last, we explore sociodemographic heterogeneity across two dimensions—child gender and maternal education (less than college/college). Results are presented in appendix Tables A20 and A21. We find no indication of significant different consequences of parental union dissolution across child gender. However, across maternal education, effect sizes are larger and predominantly only significant for children whose mother had at least some college level education, although parameter estimates remain in the same direction for children whose mothers have less than college education.

## Discussion

In this study, we have consistently shown that children of parents who dissolve their union benefit less in terms of educational achievement from exposure to non-school learning environment. The main difference between the non-school environment of a child from a dissolved family compared to a peer is the likely deterioration of parent-child relationships due to time constraints. Both dosage-response models and placebo regression make it plausible that children from dissolved families benefit less from non-school environments because of deterioration in home environments caused by union dissolution *in and of itself* (which is also corroborated in a recent study by Holm et al., 2022 using similar outcome measure).

While not statistically significant, we saw indications of school-reducing differences in academic achievement in second and fourth grade. However, results point toward schooling increasing inequality in sixth grade and having no effect in grade eight. A potential explanation for the estimate turning toward zero in the later years of schooling could be that the children from dissolved families start benefitting less from school, as their deteriorated home environment has set them more behind academically, making them less able to benefit from the better learning environment enjoyed at school rather than at home. This is consistent with the relation between schooling and inequality suggested by Raudenbush & Eschmann (2015), where schooling is expected to reduce inequality in the early years, but increase it in the later years, as the lower-status students fall further behind academically, making them benefit less from schooling. Lastly, we found no evidence of the geographical availability of both parents playing any consistent role in mitigating the learning loss incurred from parental union dissolution.

Three main channels might drive the relationship we observe. First, the social-medical literature has documented delayed or regressed maturation in children following a parental union dissolution (Gerra

et al., 1993; Sheppard et al., 2015; see Vezzetti, 2016 for review), although such developmental delay likely should also result in less learning also occurring in school. Second, a union dissolution adversely affects parents' economic resources and imposes new budget constraints. While we have sought to control for this in the present paper, we have not fully accounted for the dynamic nature of such changes to parents' opportunities to invest in their children. Third, parents may lower their time investment in children following a union dissolution. Fallesen and Gähler (2020b) studied changes in parents' time with children in a Danish longitudinal sample and found that following a union dissolution, parents spent less time on children, with the decrease in time only coming from a decline in developmental time use, such as helping with homework and talking with children. Our results are very much in line with parents being constrained on investment in their children, and this results in lower returns to learning in the home environment.

The findings beg the question of how to address the disparity in children's educational achievement originating from parents' union dissolution. Forcing parents to remain together are both ethically and politically untenable and assumes that the parents' relationship would not degenerate to a state as harmful for children learning in the home as it would be if the parents dissolved their union. Studies of the consequences of the introduction of modern divorce have generally found no effect on early treated cohorts (e.g., Piketty, 2003), likely because the divorcing relationships were of such low quality that children were as well off with their parents being divorced. More recent work from Denmark (Fallesen, 2021), the Netherlands (Kabátek, 2019), and South Korea (Lee, 2013) all corroborate that forcing divorcing couples to have a mandatory separation or 'cooling-off' period causes about 10 percent of couples to reconsider their decision. If the home environment does not deteriorate further after such a change of heart, it might be a viable intervention to avoid "unnecessary" union dissolution, where parents change their minds if given time to reconsider.

For the remaining children whose parents will dissolve their union regardless, one might be inclined to look towards the school as the lever to improve the academic achievement of these children. Yet, our results show that the differences in academic achievement should be attributed to the children's non-school environment. As such, policies targeting the non-school environment have a much greater potential for reducing the differences in academic achievement and could prevent the differences to emerge in the first place (Downey, 2021). Most differences in academic achievement between children are established at the start of schooling, which indicates that early interventions have a great equalizing potential (Passaretta et al., 2022; von Hippel & Hamrock, 2019). Intervening early on would also target the children, who had the longest exposure to dissolution, which were the ones we found to have the largest learning loss. If time and budget constraints are the driving force between the differences, we might need to consider policies that can relieve some of these constraints. One solution could be to increase the child benefits for single parents, potentially freeing up more time with the child, but this might create an incentive for divorce. Moreover, one might consider the wider use of interventions intended to help these parents become more effective.

### ***Limitations***

Our findings are subject to series of limitations that needs to be kept in mind when interpreting the findings. First, our variation in the timing of test dates during the school year is limited to three months, which means that standard errors in the interaction between schooling and parental union dissolution are large. Thus, whereas we cannot reject the null that at especially higher grades, schooling does not reduce inequality, our results do not take the form of a tightly estimated zero.

In addition, under the somewhat mild assumption that age and school exposure are conditionally random, our results provide evidence on the lower return to learning from aging for children whose

parents have dissolved their union. The interpretation of those findings as being caused by the dissolution requires much stronger assumptions about the extent to which we can control for necessary confounders, such as poor non-school environment or differential selection into the timing of dissolution that also affects the children's test score. Within the scope of our data, we have sought to make a causal interpretation of an indirect causal effect of divorce through less return to aging plausible by first providing evidence from placebo regressions of no negative interactions occurring among families yet to divorce, and by demonstrating that exposure to parental union dissolution is best modeled as a dosage-response relationship. However, if selection effects are linear relative to the timing of union dissolution, this would mean that we cannot make a strong causal claim on the effect of parental union dissolution on children's test scores. This caveat has little consequences for policy but is important to have in mind in terms of the theoretical implications of our findings.

Last, not all post-dissolution families are created equally. Stepparents may enter children's lives following a parental union dissolution and change the home dynamic. On the one hand, such additional adults may provide time and resources that can alleviate the loss of the non-residential parent (Erola & Jalovaara, 2016). On the other hand, children may have to 'compete' with the stepparent about the residential parent's time, thereby introducing additional time constraints, although previous work only has found limited support for this (Ivanova, 2017). Yet, given the heterogeneity across family forms in other child outcomes such wellbeing (Fallesen & Gähler, 2020a), future research should investigate further how these differences play out across distinct types of non-intact families.

## **Conclusion**

We consistently find lower returns to exposure to the non-school environment (aging effect) for children who have experienced union dissolution across grades, and only some indications of school

acting as a compensating factor in lower grades. The effect of parental union dissolution on learning appears to be dynamic due to the lower return to aging, but also due to the dosage response that the effect of union dissolution appears to take. Children of divorced parents have a five-to-six percent of a standard deviation learning disadvantage compared to their peers. A significant component of the learning deficit is driven by a lower degree of learning occurring outside the school environment following parental union dissolution. There is no evidence of any advantage gained from having parents residing close to each other post-dissolution. Parents likely face tighter constraints following a union dissolution that limit their possible investments in their children, which translates into dynamically increasing inequality in learning.

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**Table 1. Descriptive statistics across grades and family type**

	Grade 2		Grade 4		Grade 6		Grade 8	
	Intact	Dissolved	Intact	Dissolved	Intact	Dissolved	Intact	Dissolved
Test score	0.106 (0.949)	-0.116 (1.017)	0.127 (0.939)	-0.075 (0.987)	0.142 (0.930)	-0.050 (0.970)	0.143 (0.920)	-0.015 (0.960)
Female student	0.507 (0.500)	0.521 (0.500)	0.512 (0.500)	0.526 (0.499)	0.515 (0.500)	0.530 (0.499)	0.512 (0.500)	0.529 (0.499)
Schooling in years	2.667 (0.058)	2.667 (0.058)	4.659 (0.061)	4.658 (0.061)	6.655 (0.062)	6.654 (0.062)	8.642 (0.067)	8.643 (0.067)
Aging in years	8.788 (0.275)	8.789 (0.283)	10.787 (0.272)	10.787 (0.281)	12.792 (0.270)	12.792 (0.278)	14.787 (0.269)	14.784 (0.277)
Year	2014.200 (2.613)	2014.257 (2.618)	2014.184 (2.632)	2014.211 (2.634)	2014.127 (2.649)	2014.120 (2.639)	2014.055 (2.623)	2014.077 (2.611)
Mother's education								
Compulsory	0.104 (0.306)	0.255 (0.436)	0.106 (0.308)	0.234 (0.423)	0.114 (0.317)	0.227 (0.419)	0.124 (0.330)	0.218 (0.413)
High School	0.378 (0.485)	0.406 (0.491)	0.398 (0.489)	0.417 (0.493)	0.421 (0.494)	0.429 (0.495)	0.442 (0.497)	0.442 (0.497)
Any college	0.518 (0.500)	0.338 (0.473)	0.496 (0.500)	0.349 (0.477)	0.465 (0.499)	0.344 (0.475)	0.434 (0.496)	0.340 (0.474)
Father's education								
Compulsory	0.141 (0.348)	0.320 (0.467)	0.143 (0.350)	0.308 (0.462)	0.150 (0.357)	0.310 (0.463)	0.159 (0.366)	0.307 (0.461)
High School	0.455 (0.498)	0.440 (0.496)	0.462 (0.499)	0.442 (0.497)	0.475 (0.499)	0.441 (0.496)	0.488 (0.500)	0.442 (0.497)
Any college	0.405 (0.491)	0.240 (0.427)	0.394 (0.489)	0.250 (0.433)	0.375 (0.484)	0.249 (0.433)	0.353 (0.478)	0.251 (0.433)
Mother, disposable income (1k €)	35.765 (23.843)	32.266 (29.710)	36.486 (25.835)	33.289 (17.465)	36.656 (20.013)	33.855 (24.528)	36.699 (19.609)	34.502 (18.353)
Father, disposable income (1k €)	43.665 (53.461)	34.214 (44.282)	45.042 (118.652)	36.024 (55.763)	45.703 (110.456)	36.945 (60.930)	45.869 (107.503)	37.976 (53.089)
Age, mother	39.027 (4.433)	37.391 (5.354)	40.879 (4.397)	39.412 (5.185)	42.678 (4.398)	41.266 (5.079)	44.884 (4.418)	45.874 (4.497)
Age, father	41.396 (5.234)	40.320 (6.298)	43.262 (5.202)	42.283 (6.083)	45.086 (5.205)	44.118 (5.976)	46.884 (5.232)	45.874 (5.871)
Same municipality		0.660 (0.474)		0.657 (0.475)		0.647 (0.478)		0.639 (0.480)
Divorce dosage		0.565 (0.265)		0.573 (0.268)		0.584 (0.269)		0.595 (0.270)
N	266530	107528	247534	120761	227045	129930	199287	128381

**Table 2.** The effect of aging and schooling across grades

Grade 2			
Schooling	0.770 <sup>***</sup> (0.078)	0.742 <sup>***</sup> (0.061)	0.762 <sup>***</sup> (0.054)
Aging	0.255 <sup>***</sup> (0.007)	0.254 <sup>***</sup> (0.007)	0.254 <sup>***</sup> (0.006)
Dissolution =1	-0.067 <sup>***</sup> (0.006)	-0.060 <sup>***</sup> (0.006)	-0.055 <sup>***</sup> (0.004)
Grade 4			
Schooling	0.599 <sup>***</sup> (0.058)	0.598 <sup>***</sup> (0.058)	0.545 <sup>***</sup> (0.043)
Aging	0.172 <sup>***</sup> (0.006)	0.173 <sup>***</sup> (0.006)	0.175 <sup>***</sup> (0.006)
Dissolution =1	-0.058 <sup>***</sup> (0.005)	-0.057 <sup>***</sup> (0.004)	-0.052 <sup>***</sup> (0.004)
Grade 6			
Schooling	0.671 <sup>***</sup> (0.049)	0.636 <sup>***</sup> (0.051)	0.539 <sup>***</sup> (0.045)
Aging	0.111 <sup>***</sup> (0.007)	0.112 <sup>***</sup> (0.007)	0.115 <sup>***</sup> (0.006)
Dissolution =1	-0.063 <sup>***</sup> (0.007)	-0.058 <sup>***</sup> (0.006)	-0.051 <sup>***</sup> (0.004)
Grade 8			
Schooling	0.442 <sup>***</sup> (0.051)	0.422 <sup>***</sup> (0.049)	0.344 <sup>***</sup> (0.042)
Aging	0.016 <sup>*</sup> (0.007)	0.015 <sup>*</sup> (0.006)	0.019 <sup>**</sup> (0.006)
Dissolution =1	-0.056 <sup>***</sup> (0.004)	-0.053 <sup>***</sup> (0.004)	-0.047 <sup>***</sup> (0.003)
Control variables	YES	YES	YES
Municipality FE	NO	YES	NO
School FE	NO	NO	YES

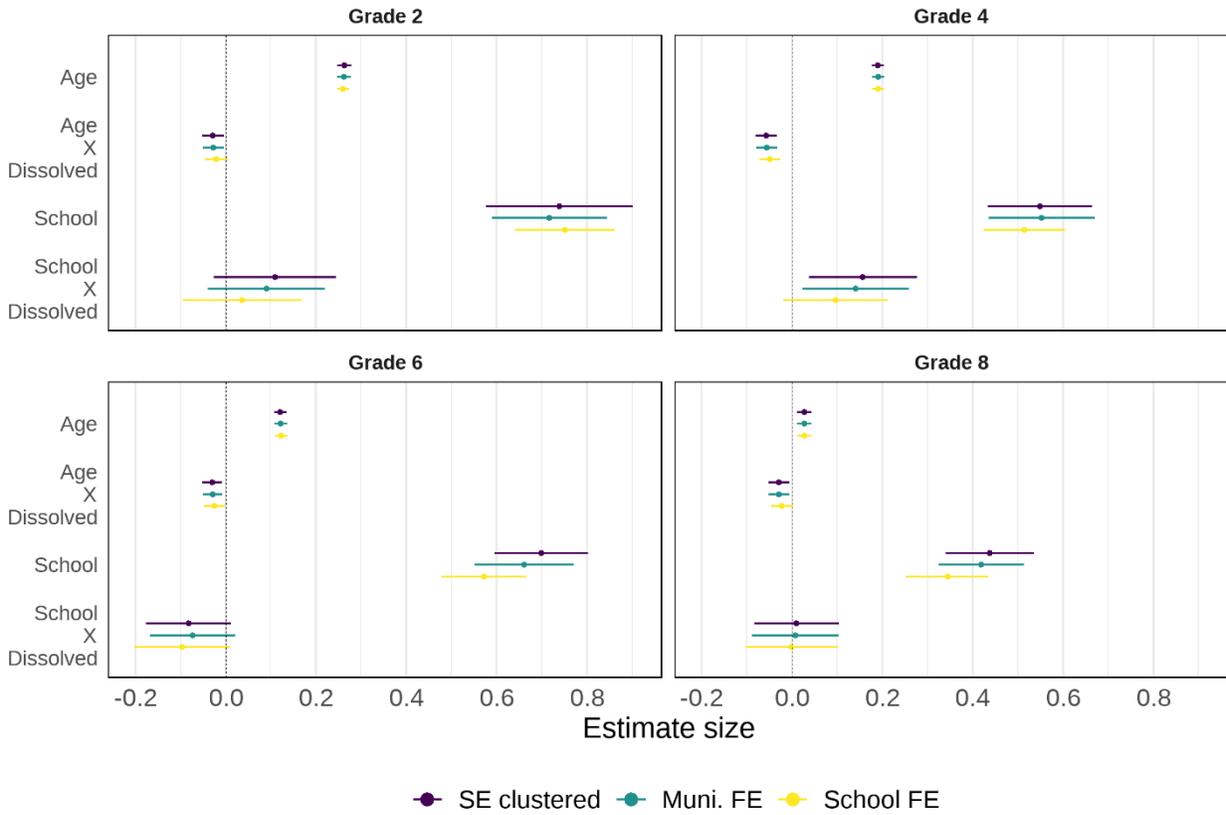
Control variables include year, gender, parental education, parental income, and parental age. Full models in Supplementary Tables A3-A6. Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 3.** Davidson and MacKinnon (1981) J-test

	Binary indicator	Dosage response
Grade 2	$p < .001$	$p = .024$
Grade 4	$p = .005$	$p = .796$
Grade 6	$p = .061$	$p = .525$
Grade 8	$p = .026$	$p = .360$

Notes: Results from school fixed effect models.

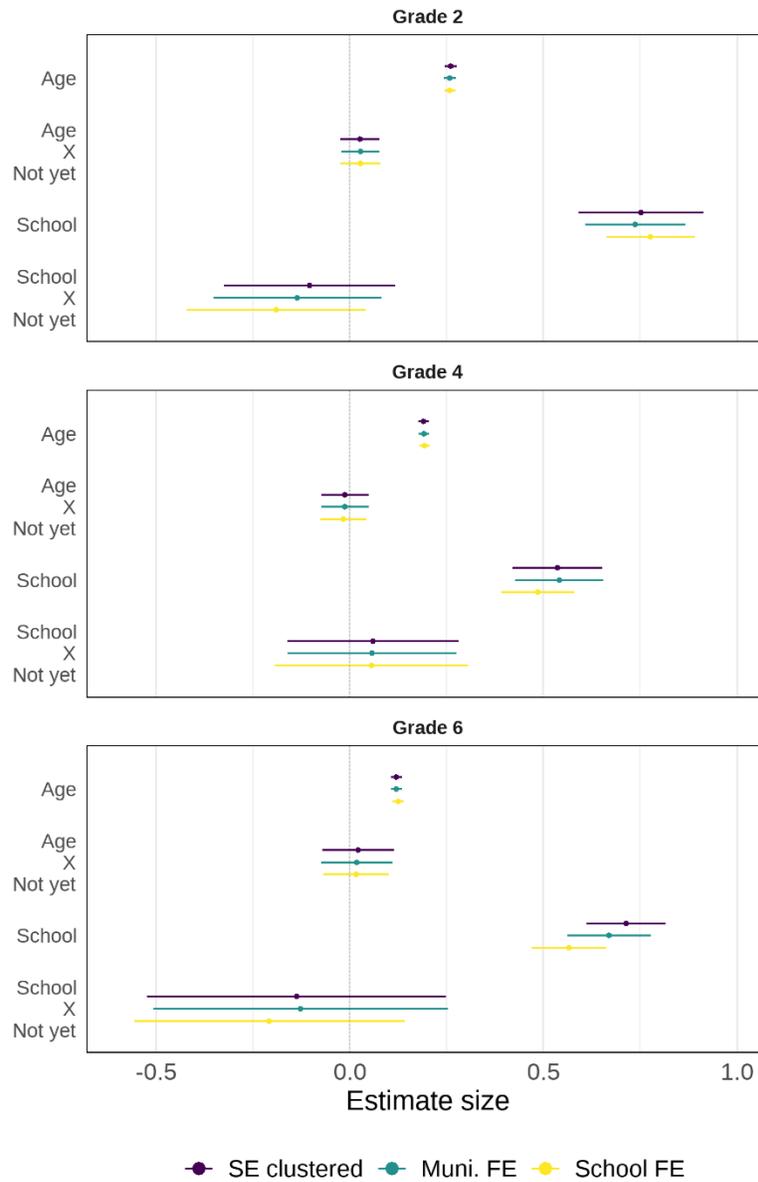
**Figure 1:** Differential effects across aging and schooling dependent on parental union dissolution.



Source: Own calculations on data from Statistics Denmark and the Danish Ministry of Children and Education.

Notes: See Tables A7-A10 for the full set of parameters.

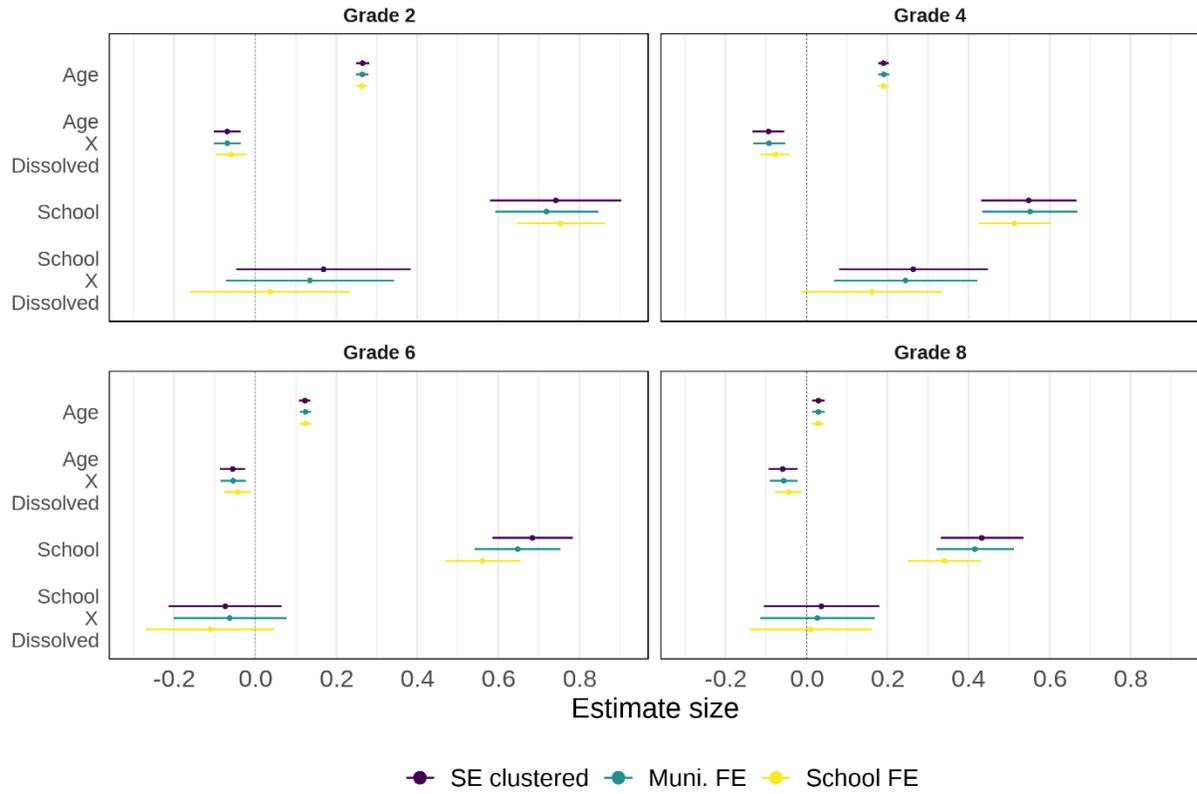
**Figure 2:** Results from placebo test using not-yet dissolved relationships as treatment



Source: Own calculations on data from Statistics Denmark and the Danish Ministry of Children and Education.

Notes: See Tables A11-A13 for the full set of parameters.

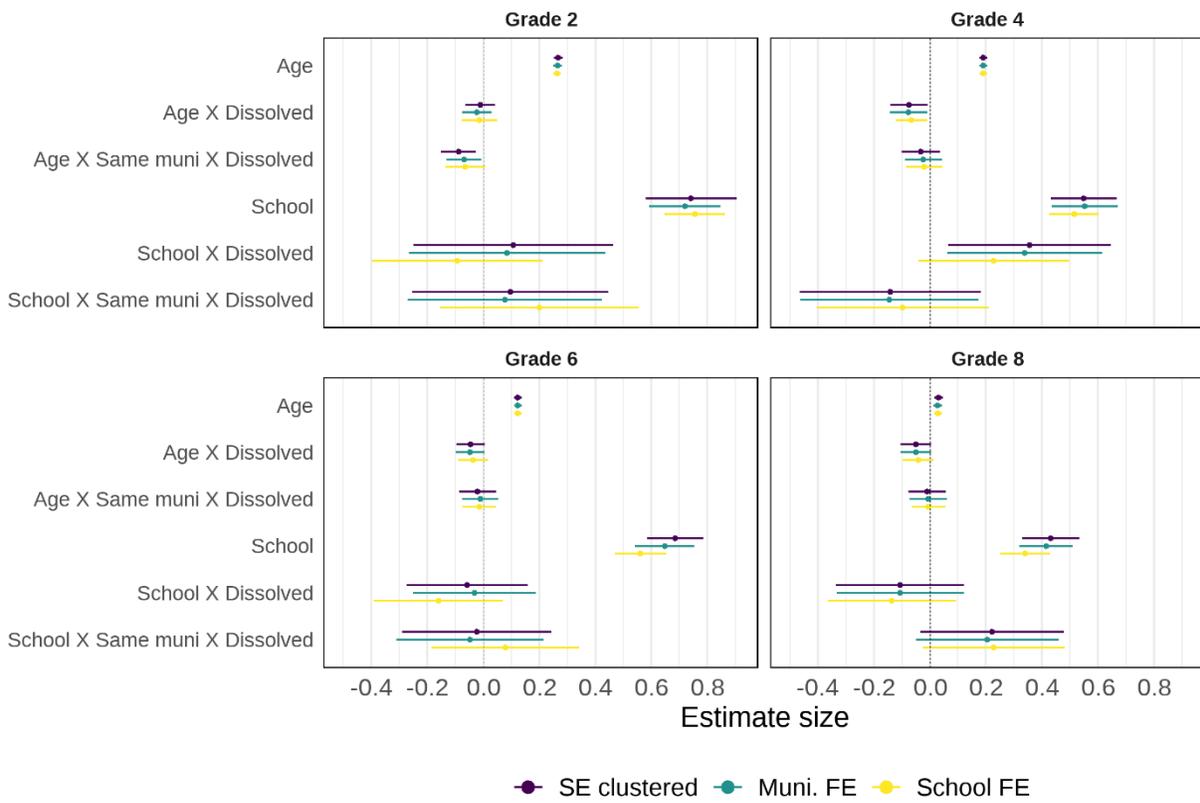
**Figure 3:** Results from dosage specification of parental union dissolution



Source: Own calculations on data from Statistics Denmark and the Danish Ministry of Children and Education.

Notes: See Tables A14-A17 for full set of parameters.

**Figure 4:** Results from dosage specification of parental union dissolution across geographical closeness of dissolved parents



Source: Own calculations on data from Statistics Denmark and the Danish Ministry of Children and Education.

Notes: See Tables A18-A21 for full set of parameters.

## Appendix

**Table A1.** Predicting length of schooling in years at test score.

	Grade 2	Grade 4	Grade 6	Grade 8
<b>Mother's education</b>				
Compulsory	Ref.	Ref.	Ref.	Ref.
High School	0.001 (0.000)	0.001* (0.000)	0.001* (0.000)	0.000 (0.000)
Any college	-0.000 (0.001)	0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
<b>Father's education</b>				
Compulsory	Ref.	Ref.	Ref.	Ref.
High School	0.001 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Any college	-0.003*** (0.001)	-0.002*** (0.001)	-0.003*** (0.001)	-0.002*** (0.001)
Mother, disposable income (1k €)	-0.000** (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)
Father, disposable income (1k €)	-0.000** (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age, mother	0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)
Age, father	-0.000* (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Female student	0.000* (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Ever divorce	-0.001** (0.000)	-0.001*** (0.000)	-0.001* (0.000)	0.001 (0.000)
<i>N</i>	362441	355438	342268	312189

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Year dummies not shown.

**Table A2.** Predicting aging in years at test score in years.

	Grade 2	Grade 4	Grade 6	Grade 8
Mother's education				
Compulsory	Ref.	Ref.	Ref.	Ref.
High School	-0.013*** (0.002)	-0.010*** (0.002)	-0.011*** (0.001)	-0.009*** (0.002)
Any college	-0.027*** (0.002)	-0.026*** (0.002)	-0.027*** (0.002)	-0.025*** (0.002)
Father's education				
Compulsory	Ref.	Ref.	Ref.	Ref.
High School	-0.008*** (0.001)	-0.009*** (0.001)	-0.009*** (0.001)	-0.008*** (0.001)
Any college	-0.023*** (0.002)	-0.024*** (0.002)	-0.025*** (0.002)	-0.022*** (0.002)
Mother, disposable income (1k €)	-0.000** (0.000)	-0.000* (0.000)	-0.000* (0.000)	-0.000*** (0.000)
Father, disposable income (1k €)	-0.000* (0.000)	-0.000** (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age, mother	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.000)
Age, father	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000* (0.000)
Female student	-0.031*** (0.001)	-0.034*** (0.001)	-0.040*** (0.001)	-0.042*** (0.001)
Ever divorce	-0.003** (0.001)	-0.003** (0.001)	-0.002* (0.001)	-0.005*** (0.001)
<i>N</i>	362441	355438	342268	312189

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Year dummies not shown.

**Table A3.** The effect of aging and schooling in grade 2

	Model 1	Model 2	Model 3
Schooling in years	0.770 <sup>***</sup> (0.078)	0.742 <sup>***</sup> (0.061)	0.762 <sup>***</sup> (0.054)
Aging in years	0.255 <sup>***</sup> (0.007)	0.254 <sup>***</sup> (0.007)	0.254 <sup>***</sup> (0.006)
2010	Ref.	Ref.	Ref.
2011	0.030 <sup>*</sup> (0.014)	0.031 <sup>*</sup> (0.014)	0.029 <sup>*</sup> (0.012)
2012	-0.002 (0.012)	0.001 (0.012)	-0.001 (0.012)
2013	-0.039 <sup>*</sup> (0.018)	-0.038 <sup>*</sup> (0.018)	-0.045 <sup>**</sup> (0.015)
2014	-0.029 <sup>*</sup> (0.013)	-0.025 (0.013)	-0.024 <sup>*</sup> (0.012)
2015	-0.033 <sup>*</sup> (0.013)	-0.029 <sup>*</sup> (0.013)	-0.030 <sup>*</sup> (0.012)
2016	-0.042 <sup>**</sup> (0.014)	-0.038 <sup>**</sup> (0.014)	-0.039 <sup>**</sup> (0.013)
2017	-0.045 <sup>**</sup> (0.016)	-0.041 <sup>*</sup> (0.016)	-0.042 <sup>**</sup> (0.013)
2018	-0.060 <sup>***</sup> (0.017)	-0.055 <sup>**</sup> (0.017)	-0.056 <sup>***</sup> (0.013)
Maternal education			
Compulsory	Ref.	Ref.	Ref.
High School	0.238 <sup>***</sup> (0.011)	0.229 <sup>***</sup> (0.010)	0.202 <sup>***</sup> (0.006)
Any college	0.499 <sup>***</sup> (0.017)	0.485 <sup>***</sup> (0.018)	0.447 <sup>***</sup> (0.007)
Paternal education			
Compulsory	Ref.	Ref.	Ref.
High School	0.170 <sup>***</sup> (0.007)	0.165 <sup>***</sup> (0.007)	0.148 <sup>***</sup> (0.005)
Any college	0.402 <sup>***</sup> (0.009)	0.393 <sup>***</sup> (0.008)	0.366 <sup>***</sup> (0.006)
Mother, disposable income (1k €)	0.001 <sup>**</sup> (0.000)	0.001 <sup>**</sup> (0.000)	0.001 <sup>**</sup> (0.000)
Father, disposable income (1k €)	0.000 <sup>***</sup> (0.000)	0.000 <sup>***</sup> (0.000)	0.000 <sup>***</sup> (0.000)
Age, mother	0.006 <sup>***</sup> (0.001)	0.006 <sup>***</sup> (0.001)	0.004 <sup>***</sup> (0.000)

Age, father	-0.003** (0.001)	-0.003** (0.001)	-0.002*** (0.000)
Child female	0.254*** (0.004)	0.253*** (0.004)	0.251*** (0.004)
Union dissolution	-0.067*** (0.006)	-0.060*** (0.006)	-0.055*** (0.004)
Intercept	-5.058*** (0.229)	-4.929*** (0.183)	-4.912*** (0.150)
Control variables	YES	YES	YES
Municipality FE	NO	YES	NO
School FE	NO	NO	YES
<i>N</i>	362440	362440	362441

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A4:** The effect of aging and schooling in grade 4

	Model 1	Model 2	Model 3
Schooling in years	0.599 <sup>***</sup> (0.058)	0.598 <sup>***</sup> (0.058)	0.545 <sup>***</sup> (0.043)
Aging in years	0.172 <sup>***</sup> (0.006)	0.173 <sup>***</sup> (0.006)	0.175 <sup>***</sup> (0.006)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.010)	0.016 (0.010)	0.019 (0.010)
2012	0.003 (0.012)	0.003 (0.011)	0.008 (0.009)
2013	-0.028 <sup>*</sup> (0.014)	-0.033 <sup>*</sup> (0.013)	-0.022 (0.012)
2014	-0.030 <sup>*</sup> (0.013)	-0.029 <sup>*</sup> (0.013)	-0.020 <sup>*</sup> (0.010)
2015	-0.043 <sup>**</sup> (0.014)	-0.041 <sup>**</sup> (0.013)	-0.033 <sup>***</sup> (0.010)
2016	-0.050 <sup>***</sup> (0.013)	-0.049 <sup>***</sup> (0.013)	-0.040 <sup>***</sup> (0.010)
2017	-0.057 <sup>***</sup> (0.016)	-0.055 <sup>***</sup> (0.015)	-0.045 <sup>***</sup> (0.010)
2018	-0.074 <sup>***</sup> (0.013)	-0.073 <sup>***</sup> (0.013)	-0.062 <sup>***</sup> (0.010)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.229 <sup>***</sup> (0.010)	0.225 <sup>***</sup> (0.010)	0.200 <sup>***</sup> (0.006)
Any college	0.518 <sup>***</sup> (0.018)	0.507 <sup>***</sup> (0.018)	0.468 <sup>***</sup> (0.008)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.162 <sup>***</sup> (0.006)	0.159 <sup>***</sup> (0.005)	0.142 <sup>***</sup> (0.005)
Any college	0.434 <sup>***</sup> (0.008)	0.419 <sup>***</sup> (0.007)	0.389 <sup>***</sup> (0.006)
Mother, disposable income (1k €)	0.002 <sup>**</sup> (0.001)	0.001 <sup>**</sup> (0.000)	0.001 <sup>**</sup> (0.000)
Father, disposable income (1k €)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age, mother	0.009 <sup>***</sup> (0.001)	0.008 <sup>***</sup> (0.001)	0.007 <sup>***</sup> (0.001)

Age, father	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)
Child female	0.192*** (0.004)	0.192*** (0.004)	0.186*** (0.003)
Union dissolution	-0.058*** (0.005)	-0.057*** (0.004)	-0.052*** (0.004)
Intercept	-5.596*** (0.264)	-5.540*** (0.256)	-5.234*** (0.202)
Control variables	YES	YES	YES
Municipality FE	NO	YES	NO
School FE	NO	NO	YES
<i>N</i>	355435	355435	355438

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A5:** The effect of aging and schooling in grade 6

	Model 1	Model 2	Model 3
Schooling in years	0.671*** (0.049)	0.636*** (0.051)	0.539*** (0.045)
Aging in years	0.111*** (0.007)	0.112*** (0.007)	0.115*** (0.006)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.011)	0.017 (0.010)	0.015 (0.009)
2012	-0.010 (0.010)	-0.008 (0.009)	-0.007 (0.010)
2013	-0.051*** (0.012)	-0.049*** (0.012)	-0.045*** (0.012)
2014	-0.035** (0.012)	-0.033** (0.011)	-0.031** (0.011)
2015	-0.043*** (0.012)	-0.041*** (0.012)	-0.037*** (0.010)
2016	-0.069*** (0.012)	-0.066*** (0.011)	-0.061*** (0.010)
2017	-0.076*** (0.014)	-0.071*** (0.013)	-0.065*** (0.010)
2018	-0.095*** (0.014)	-0.090*** (0.013)	-0.082*** (0.010)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.250*** (0.011)	0.244*** (0.010)	0.216*** (0.006)
Any college	0.521*** (0.018)	0.511*** (0.018)	0.470*** (0.009)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.177*** (0.006)	0.172*** (0.006)	0.152*** (0.005)
Any college	0.443*** (0.008)	0.431*** (0.007)	0.401*** (0.006)
Mother, disposable income (1k €)	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)
Father, disposable income (1k €)	0.000* (0.000)	0.000* (0.000)	0.000* (0.000)
Age, mother	0.010***	0.009***	0.007***

	(0.001)	(0.001)	(0.000)
Age, father	0.001	0.001	0.001**
	(0.001)	(0.001)	(0.000)
Child female	0.197***	0.197***	0.187***
	(0.004)	(0.004)	(0.003)
Union dissolution	-0.063***	-0.058***	-0.051***
	(0.007)	(0.006)	(0.004)
Intercept	-6.926***	-6.658***	-5.952***
	(0.341)	(0.346)	(0.301)
Control variables	YES	YES	YES
Municipality FE	NO	YES	NO
School FE	NO	NO	YES
<i>N</i>	342265	342265	342268

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A6:** The effect of aging and schooling in grade 8

	Model 1	Model 2	Model 3
Schooling in years	0.442 <sup>***</sup> (0.051)	0.422 <sup>***</sup> (0.049)	0.344 <sup>***</sup> (0.042)
Aging in years	0.016 <sup>*</sup> (0.007)	0.015 <sup>*</sup> (0.006)	0.019 <sup>**</sup> (0.006)
2010	0.000	0.000	0.000
2011	0.013 (0.010)	0.013 (0.010)	0.014 (0.010)
2012	0.002 (0.012)	0.001 (0.012)	0.002 (0.010)
2013	-0.019 (0.014)	-0.019 (0.014)	-0.017 (0.013)
2014	-0.031 <sup>**</sup> (0.011)	-0.030 <sup>**</sup> (0.011)	-0.029 <sup>*</sup> (0.011)
2015	-0.054 <sup>***</sup> (0.012)	-0.053 <sup>***</sup> (0.012)	-0.051 <sup>***</sup> (0.011)
2016	-0.056 <sup>***</sup> (0.014)	-0.054 <sup>***</sup> (0.014)	-0.051 <sup>***</sup> (0.011)
2017	-0.068 <sup>***</sup> (0.014)	-0.065 <sup>***</sup> (0.014)	-0.060 <sup>***</sup> (0.012)
2018	-0.101 <sup>***</sup> (0.014)	-0.098 <sup>***</sup> (0.014)	-0.091 <sup>***</sup> (0.011)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.225 <sup>***</sup> (0.009)	0.221 <sup>***</sup> (0.008)	0.195 <sup>***</sup> (0.006)
Any college	0.476 <sup>***</sup> (0.014)	0.467 <sup>***</sup> (0.014)	0.430 <sup>***</sup> (0.007)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.165 <sup>***</sup> (0.005)	0.161 <sup>***</sup> (0.005)	0.142 <sup>***</sup> (0.005)
Any college	0.418 <sup>***</sup> (0.008)	0.400 <sup>***</sup> (0.007)	0.369 <sup>***</sup> (0.006)
Mother, disposable income (1k €)	0.003 <sup>***</sup> (0.000)	0.003 <sup>***</sup> (0.000)	0.002 <sup>***</sup> (0.000)
Father, disposable income (1k €)	0.000 <sup>*</sup> (0.000)	0.000 <sup>*</sup> (0.000)	0.000 <sup>*</sup> (0.000)
Age, mother	0.010 <sup>***</sup>	0.009 <sup>***</sup>	0.008 <sup>***</sup>

	(0.001)	(0.001)	(0.000)
Age, father	0.002*	0.002*	0.002***
	(0.001)	(0.001)	(0.000)
Child female	0.153***	0.153***	0.143***
	(0.006)	(0.006)	(0.004)
Union dissolution	-0.056***	-0.053***	-0.047***
	(0.004)	(0.004)	(0.003)
Intercept	-5.151***	-4.894***	-4.166***
	(0.432)	(0.415)	(0.364)
Control variables	YES	YES	YES
Municipality FE	NO	YES	NO
School FE	NO	NO	YES
<i>N</i>	312187	312187	312189

Standard errors in parentheses \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A7:** Effects across aging and schooling dependent on parental union dissolution in grade 2

	Clustered SE	Muni. FE	School FE
Schooling	0.739*** (0.083)	0.717*** (0.065)	0.751*** (0.056)
Aging	0.263*** (0.008)	0.262*** (0.008)	0.260*** (0.007)
Schooling * Dissolution	0.109 (0.069)	0.090 (0.066)	0.036 (0.067)
Aging * Dissolution	-0.028* (0.012)	-0.027* (0.012)	-0.021 (0.013)
2010	0.000	0.000	0.000
2011	0.030* (0.014)	0.031* (0.014)	0.030* (0.012)
2012	-0.001 (0.012)	0.001 (0.012)	-0.001 (0.012)
2013	-0.039* (0.018)	-0.038* (0.018)	-0.045** (0.015)
2014	-0.029* (0.013)	-0.025 (0.013)	-0.024* (0.012)
2015	-0.033* (0.013)	-0.029* (0.013)	-0.030* (0.012)
2016	-0.042** (0.014)	-0.038** (0.014)	-0.039** (0.013)
2017	-0.045** (0.016)	-0.041* (0.016)	-0.042** (0.013)
2018	-0.060*** (0.017)	-0.055** (0.017)	-0.056*** (0.013)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.238*** (0.011)	0.228*** (0.010)	0.202*** (0.006)
Any college	0.499*** (0.017)	0.485*** (0.018)	0.447*** (0.007)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.170*** (0.007)	0.165*** (0.007)	0.148*** (0.005)
Any college	0.402*** (0.009)	0.393*** (0.008)	0.366*** (0.006)
Mother, disposable	0.001**	0.001**	0.001**

income (1k €)	(0.000)	(0.000)	(0.000)
Father, disposable	0.000***	0.000***	0.000***
income (1k €)	(0.000)	(0.000)	(0.000)
Age, mother	0.006***	0.006***	0.004***
	(0.001)	(0.001)	(0.000)
Age, father	-0.003**	-0.003**	-0.002***
	(0.001)	(0.001)	(0.000)
Child female	0.254***	0.253***	0.251***
	(0.004)	(0.004)	(0.004)
Union dissolution	-0.114	-0.059	0.032
	(0.204)	(0.200)	(0.192)
Intercept	-5.047***	-4.930***	-4.938***
	(0.243)	(0.197)	(0.158)
<hr/> <i>N</i>	<hr/> 362440	<hr/> 362440	<hr/> 362441

**Table A8:** Effects across aging and schooling dependent on parental union dissolution in grade 4

	Clustered SE	Muni. FE	School FE
Schooling	0.549 <sup>***</sup> (0.059)	0.553 <sup>***</sup> (0.060)	0.515 <sup>***</sup> (0.046)
Aging	0.190 <sup>***</sup> (0.007)	0.191 <sup>***</sup> (0.007)	0.191 <sup>***</sup> (0.007)
Schooling * Dissolution	0.157 <sup>*</sup> (0.061)	0.141 <sup>*</sup> (0.060)	0.096 (0.059)
Aging * Dissolution	-0.057 <sup>***</sup> (0.012)	-0.056 <sup>***</sup> (0.012)	-0.049 <sup>***</sup> (0.012)
2010	0.000	0.000	0.000
2011	0.017 (0.010)	0.016 (0.010)	0.019 (0.010)
2012	0.003 (0.012)	0.003 (0.011)	0.008 (0.009)
2013	-0.028 <sup>*</sup> (0.014)	-0.033 <sup>*</sup> (0.013)	-0.022 (0.012)
2014	-0.029 <sup>*</sup> (0.013)	-0.029 <sup>*</sup> (0.013)	-0.020 <sup>*</sup> (0.010)
2015	-0.043 <sup>**</sup> (0.014)	-0.041 <sup>**</sup> (0.013)	-0.033 <sup>***</sup> (0.010)
2016	-0.050 <sup>***</sup> (0.013)	-0.048 <sup>***</sup> (0.013)	-0.039 <sup>***</sup> (0.010)
2017	-0.057 <sup>***</sup> (0.016)	-0.055 <sup>***</sup> (0.015)	-0.045 <sup>***</sup> (0.010)
2018	-0.074 <sup>***</sup> (0.013)	-0.073 <sup>***</sup> (0.013)	-0.062 <sup>***</sup> (0.010)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.229 <sup>***</sup> (0.010)	0.225 <sup>***</sup> (0.010)	0.200 <sup>***</sup> (0.006)
Any college	0.518 <sup>***</sup> (0.018)	0.507 <sup>***</sup> (0.018)	0.468 <sup>***</sup> (0.008)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.162 <sup>***</sup> (0.006)	0.159 <sup>***</sup> (0.005)	0.141 <sup>***</sup> (0.005)
Any college	0.434 <sup>***</sup> (0.008)	0.419 <sup>***</sup> (0.007)	0.389 <sup>***</sup> (0.006)
Mother, disposable	0.002 <sup>**</sup>	0.001 <sup>**</sup>	0.001 <sup>**</sup>

income (1k €)	(0.001)	(0.000)	(0.000)
Father, disposable	0.000	0.000	0.000
income (1k €)	(0.000)	(0.000)	(0.000)
Age, mother	0.009***	0.008***	0.006***
	(0.001)	(0.001)	(0.001)
Age, father	-0.000	-0.000	0.000
	(0.001)	(0.001)	(0.000)
Child female	0.192***	0.192***	0.186***
	(0.004)	(0.004)	(0.003)
Union dissolution	-0.178	-0.114	0.027
	(0.319)	(0.319)	(0.286)
Intercept	-5.562***	-5.526***	-5.262***
	(0.264)	(0.263)	(0.218)
<hr/> <i>N</i>	<hr/> 355435	<hr/> 355435	<hr/> 355438

**Table A9:** Effects across aging and schooling dependent on parental union dissolution in grade 6

	Clustered SE	Muni. FE	School FE
Schooling	0.699*** (0.053)	0.661*** (0.056)	0.572*** (0.048)
Aging	0.121*** (0.007)	0.122*** (0.007)	0.123*** (0.007)
Schooling * Dissolution	-0.082 (0.048)	-0.073 (0.048)	-0.096 (0.054)
Aging * Dissolution	-0.030** (0.011)	-0.029** (0.011)	-0.025* (0.012)
2010	0.000	0.000	0.000
2011	0.017 (0.011)	0.017 (0.010)	0.015 (0.009)
2012	-0.010 (0.010)	-0.008 (0.009)	-0.007 (0.010)
2013	-0.051*** (0.012)	-0.049*** (0.012)	-0.045*** (0.012)
2014	-0.035** (0.012)	-0.033** (0.011)	-0.031** (0.011)
2015	-0.043*** (0.012)	-0.041*** (0.012)	-0.036*** (0.010)
2016	-0.069*** (0.012)	-0.066*** (0.011)	-0.061*** (0.010)
2017	-0.076*** (0.014)	-0.071*** (0.013)	-0.065*** (0.010)
2018	-0.095*** (0.014)	-0.090*** (0.013)	-0.082*** (0.010)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.250*** (0.011)	0.243*** (0.010)	0.215*** (0.006)
Any college	0.521*** (0.018)	0.511*** (0.018)	0.470*** (0.009)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.177*** (0.006)	0.172*** (0.006)	0.152*** (0.005)
Any college	0.443*** (0.008)	0.431*** (0.007)	0.401*** (0.006)
Mother, disposable	0.002**	0.002**	0.002**

income (1k €)	(0.001)	(0.001)	(0.001)
Father, disposable	0.000*	0.000*	0.000*
income (1k €)	(0.000)	(0.000)	(0.000)
Age, mother	0.010***	0.009***	0.007***
	(0.001)	(0.001)	(0.000)
Age, father	0.001	0.001	0.001**
	(0.001)	(0.001)	(0.000)
Child female	0.197***	0.197***	0.187***
	(0.004)	(0.004)	(0.003)
Union dissolution	0.865**	0.803*	0.902*
	(0.306)	(0.306)	(0.352)
Intercept	-7.246***	-6.956***	-6.283***
	(0.363)	(0.373)	(0.317)
<hr/> <i>N</i>	<hr/> 342265	<hr/> 342265	<hr/> 342268

**Table A10:** Effects across aging and schooling dependent on parental union dissolution in grade 8

	Clustered SE	Muni. FE	School FE
Schooling	0.438*** (0.050)	0.419*** (0.048)	0.344*** (0.047)
Aging	0.027** (0.008)	0.027** (0.008)	0.027*** (0.008)
Schooling * Dissolution	0.010 (0.048)	0.007 (0.049)	-0.001 (0.052)
Aging * Dissolution	-0.029* (0.012)	-0.029* (0.012)	-0.022 (0.012)
2010	0.000	0.000	0.000
2011	0.013 (0.010)	0.013 (0.010)	0.014 (0.010)
2012	0.002 (0.012)	0.001 (0.012)	0.002 (0.010)
2013	-0.019 (0.014)	-0.019 (0.014)	-0.017 (0.013)
2014	-0.031** (0.011)	-0.030** (0.011)	-0.029* (0.011)
2015	-0.054*** (0.012)	-0.053*** (0.012)	-0.051*** (0.011)
2016	-0.056*** (0.014)	-0.054*** (0.014)	-0.051*** (0.011)
2017	-0.067*** (0.014)	-0.064*** (0.014)	-0.060*** (0.012)
2018	-0.101*** (0.014)	-0.098*** (0.014)	-0.091*** (0.011)
Maternal education Compulsory	0.000	0.000	0.000
High School	0.225*** (0.009)	0.221*** (0.008)	0.195*** (0.006)
Any college	0.476*** (0.014)	0.467*** (0.014)	0.430*** (0.007)
Paternal education Compulsory	0.000	0.000	0.000
High School	0.165*** (0.005)	0.161*** (0.005)	0.142*** (0.005)
Any college	0.418*** (0.008)	0.400*** (0.007)	0.369*** (0.006)
Mother, disposable	0.003***	0.003***	0.002***

income (1k €)	(0.000)	(0.000)	(0.000)
Father, disposable	0.000*	0.000*	0.000*
income (1k €)	(0.000)	(0.000)	(0.000)
Age, mother	0.010***	0.009***	0.008***
	(0.001)	(0.001)	(0.000)
Age, father	0.002*	0.002*	0.002***
	(0.001)	(0.001)	(0.000)
Child female	0.153***	0.153***	0.143***
	(0.006)	(0.006)	(0.004)
Union dissolution	0.291	0.317	0.291
	(0.378)	(0.380)	(0.435)
Intercept	-5.280***	-5.032***	-4.292***
	(0.437)	(0.420)	(0.399)
<hr/> <i>N</i>	<hr/> 312187	<hr/> 312187	<hr/> 312189

**Table A9:** Effects across aging and schooling dependent on parental union dissolution in grade 2 for placebo group

	Clustered SE	Muni. FE	School FE
Schooling	0.752*** (0.082)	0.737*** (0.066)	0.777*** (0.058)
Aging	0.261*** (0.008)	0.259*** (0.008)	0.259*** (0.007)
Schooling * Not yet	-0.132 (0.113)	-0.135 (0.111)	-0.190 (0.118)
Aging * Not yet	0.027 (0.026)	0.032 (0.025)	0.028 (0.026)
Not yet	0.072 (0.312)	0.040 (0.309)	0.222 (0.342)
2010	0.000	0.000	0.000
2011	0.025 (0.013)	0.027* (0.013)	0.026* (0.013)
2012	-0.008 (0.012)	-0.005 (0.012)	-0.007 (0.012)
2013	-0.049* (0.019)	-0.047* (0.018)	-0.053*** (0.016)
2014	-0.025 (0.013)	-0.021 (0.013)	-0.021 (0.013)
2015	-0.040** (0.013)	-0.035* (0.013)	-0.034** (0.013)
2016	-0.053*** (0.015)	-0.048** (0.015)	-0.049*** (0.013)
2017	-0.061*** (0.017)	-0.056*** (0.016)	-0.057*** (0.013)
2018	-0.076*** (0.017)	-0.071*** (0.017)	-0.071*** (0.013)
Maternal education			
Compulsory	0.000	0.000	0.000
High School	0.265*** (0.014)	0.256*** (0.014)	0.230*** (0.007)
Any college	0.518*** (0.019)	0.504*** (0.020)	0.468*** (0.009)
Paternal education			
Compulsory	0.000	0.000	0.000
High School	0.186*** (0.009)	0.179*** (0.009)	0.163*** (0.007)
Any college	0.417***	0.406***	0.381***

	(0.012)	(0.010)	(0.007)
Mother, disposable income (1k €)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)
Father, disposable income (1k €)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Age, mother	0.007*** (0.001)	0.006*** (0.001)	0.005*** (0.001)
Age, father	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.000)
Child female	0.247*** (0.004)	0.246*** (0.004)	0.244*** (0.004)
Intercept	-5.101*** (0.242)	-4.994*** (0.203)	-5.024*** (0.163)
<hr/> <i>N</i>	<hr/> 263063	<hr/> 263063	<hr/> 263064

**Table A10:** Effects across aging and schooling dependent on parental union dissolution in grade 4 for placebo group

	Clustered SE	Muni. FE	School FE
Schooling	0.537*** (0.059)	0.541*** (0.058)	0.486*** (0.048)
Aging	0.191*** (0.007)	0.192*** (0.007)	0.193*** (0.007)
Schooling * Not yet	0.060 (0.113)	0.058 (0.111)	0.056 (0.127)
Aging * Not yet	-0.012 (0.031)	-0.012 (0.031)	-0.016 (0.030)
Not yet	-0.176 (0.571)	-0.168 (0.550)	-0.119 (0.608)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.019 (0.011)	0.018 (0.011)	0.018 (0.010)
2012	0.008 (0.011)	0.008 (0.011)	0.011 (0.010)
2013	-0.029* (0.014)	-0.035* (0.014)	-0.028* (0.013)
2014	-0.028* (0.014)	-0.029* (0.013)	-0.022* (0.011)
2015	-0.038** (0.013)	-0.036** (0.012)	-0.031** (0.010)
2016	-0.041** (0.013)	-0.041** (0.013)	-0.034** (0.011)
2017	-0.053** (0.016)	-0.053*** (0.015)	-0.045*** (0.011)
2018	-0.068*** (0.014)	-0.068*** (0.013)	-0.061*** (0.011)

Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.256*** (0.012)	0.251*** (0.013)	0.228*** (0.008)
Any college	0.541*** (0.019)	0.529*** (0.020)	0.494*** (0.010)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.179*** (0.008)	0.175*** (0.008)	0.160*** (0.007)
Any college	0.452*** (0.011)	0.436*** (0.010)	0.409*** (0.007)
Mother, disposable income (1k €)	0.001* (0.001)	0.001* (0.001)	0.001* (0.000)
Father, disposable income (1k €)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age, mother	0.010*** (0.001)	0.009*** (0.001)	0.008*** (0.001)
Age, father	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.000)
Child female	0.183*** (0.004)	0.183*** (0.004)	0.179*** (0.004)
Intercept	-5.555*** (0.264)	-5.511*** (0.257)	-5.193*** (0.227)
<i>N</i>	244758	244758	244760

**Table A11:** Effects across aging and schooling dependent on parental union dissolution in grade 6 for placebo group

	Clustered SE	Muni. FE	School FE
Schooling	0.714*** (0.052)	0.670*** (0.055)	0.566*** (0.049)
Aging	0.121*** (0.007)	0.121*** (0.007)	0.125*** (0.007)
Schooling * Not yet	-0.137 (0.197)	-0.127 (0.194)	-0.208 (0.178)
Aging * Not yet	0.022 (0.047)	0.018 (0.047)	0.017 (0.043)
Not yet	0.605 (1.227)	0.604 (1.217)	1.142 (1.180)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.022* (0.011)	0.022* (0.010)	0.019 (0.010)
2012	0.000 (0.010)	0.002 (0.010)	0.005 (0.011)
2013	-0.047*** (0.014)	-0.044** (0.014)	-0.040** (0.013)
2014	-0.026* (0.012)	-0.024* (0.012)	-0.021 (0.012)
2015	-0.039*** (0.011)	-0.037*** (0.011)	-0.031** (0.011)
2016	-0.068*** (0.012)	-0.065*** (0.012)	-0.058*** (0.011)
2017	-0.074*** (0.014)	-0.069*** (0.013)	-0.062*** (0.011)
2018	-0.096*** (0.014)	-0.091*** (0.014)	-0.082*** (0.011)

Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.261*** (0.013)	0.252*** (0.013)	0.228*** (0.008)
Any college	0.520*** (0.018)	0.508*** (0.018)	0.474*** (0.009)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.189*** (0.008)	0.182*** (0.007)	0.163*** (0.007)
Any college	0.454*** (0.009)	0.443*** (0.009)	0.415*** (0.007)
Mother, disposable income (1k €)	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.000)
Father, disposable income (1k €)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)
Age, mother	0.010*** (0.001)	0.009*** (0.001)	0.008*** (0.001)
Age, father	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)
Child female	0.186*** (0.005)	0.186*** (0.004)	0.181*** (0.004)
Intercept	-7.354*** (0.359)	-7.017*** (0.369)	-6.275*** (0.324)
<i>N</i>	224646	224646	224647

**Table A12:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 2

	Clustered SE	Muni. FE	School FE
Schooling	0.742*** (0.083)	0.720*** (0.065)	0.755*** (0.055)
Aging	0.266*** (0.008)	0.265*** (0.008)	0.263*** (0.007)
Schooling * Dissolution Dosage	0.178 (0.110)	0.144 (0.106)	0.046 (0.101)
Aging * Dissolution dosage	-0.076*** (0.018)	-0.076*** (0.017)	-0.062** (0.020)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.030* (0.014)	0.031* (0.014)	0.030* (0.012)
2012	-0.001 (0.012)	0.001 (0.012)	-0.001 (0.012)
2013	-0.039* (0.018)	-0.038* (0.018)	-0.044** (0.015)
2014	-0.029* (0.013)	-0.025 (0.013)	-0.024* (0.012)
2015	-0.033* (0.013)	-0.028* (0.013)	-0.029* (0.012)
2016	-0.042** (0.014)	-0.038** (0.014)	-0.039** (0.013)
2017	-0.045** (0.016)	-0.040* (0.016)	-0.042** (0.013)
2018	-0.060*** (0.017)	-0.055** (0.017)	-0.056*** (0.013)
Maternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)

High School	0.236*** (0.011)	0.227*** (0.010)	0.201*** (0.006)
Any college	0.497*** (0.017)	0.484*** (0.018)	0.447*** (0.007)
Paternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.169*** (0.007)	0.164*** (0.007)	0.147*** (0.005)
Any college	0.401*** (0.009)	0.392*** (0.008)	0.366*** (0.006)
Mother, disposable income (1k €)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)
Father, disposable income (1k €)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Age, mother	0.006*** (0.001)	0.005*** (0.001)	0.004*** (0.000)
Age, father	-0.003** (0.001)	-0.003** (0.001)	-0.002*** (0.000)
Child female	0.254*** (0.004)	0.253*** (0.004)	0.251*** (0.004)
Union dissolution	-0.046*** (0.008)	-0.041*** (0.008)	-0.046*** (0.007)
Union dissolution dosage	0.160 (0.307)	0.247 (0.302)	0.403 (0.296)
Intercept	-5.082*** (0.243)	-4.967*** (0.195)	-4.976*** (0.157)
<i>N</i>	362440	362440	362441

**Table A13:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 4

	Clustered SE	Muni. FE	School FE
Schooling	0.550*** (0.060)	0.553*** (0.060)	0.514*** (0.045)
Aging	0.190*** (0.007)	0.191*** (0.007)	0.191*** (0.007)
Schooling * Dissolution Dosage	0.265** (0.094)	0.246** (0.090)	0.162 (0.090)
Aging * Dissolution dosage	-0.094*** (0.020)	-0.093*** (0.020)	-0.077*** (0.018)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.010)	0.016 (0.010)	0.019 (0.010)
2012	0.003 (0.012)	0.003 (0.011)	0.008 (0.009)
2013	-0.028* (0.014)	-0.033* (0.013)	-0.021 (0.012)
2014	-0.029* (0.013)	-0.029* (0.013)	-0.020* (0.010)
2015	-0.043** (0.014)	-0.041** (0.013)	-0.033*** (0.010)
2016	-0.049*** (0.013)	-0.048*** (0.013)	-0.039*** (0.010)
2017	-0.057*** (0.016)	-0.055*** (0.015)	-0.045*** (0.010)
2018	-0.074*** (0.013)	-0.073*** (0.013)	-0.062*** (0.010)
Maternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)

High School	0.229 <sup>***</sup> (0.010)	0.225 <sup>***</sup> (0.010)	0.201 <sup>***</sup> (0.006)
Any college	0.518 <sup>***</sup> (0.018)	0.507 <sup>***</sup> (0.018)	0.468 <sup>***</sup> (0.008)
Paternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.162 <sup>***</sup> (0.006)	0.159 <sup>***</sup> (0.006)	0.142 <sup>***</sup> (0.005)
Any college	0.434 <sup>***</sup> (0.008)	0.419 <sup>***</sup> (0.007)	0.390 <sup>***</sup> (0.006)
Mother, disposable income (1k €)	0.002 <sup>**</sup> (0.001)	0.001 <sup>**</sup> (0.000)	0.001 <sup>**</sup> (0.000)
Father, disposable income (1k €)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age, mother	0.009 <sup>***</sup> (0.001)	0.008 <sup>***</sup> (0.001)	0.007 <sup>***</sup> (0.001)
Age, father	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)
Child female	0.192 <sup>***</sup> (0.004)	0.192 <sup>***</sup> (0.004)	0.186 <sup>***</sup> (0.003)
Union dissolution	-0.062 <sup>***</sup> (0.007)	-0.059 <sup>***</sup> (0.007)	-0.063 <sup>***</sup> (0.007)
Union dissolution dosage	-0.209 (0.479)	-0.147 (0.472)	0.092 (0.432)
Intercept	-5.563 <sup>***</sup> (0.269)	-5.518 <sup>***</sup> (0.264)	-5.256 <sup>***</sup> (0.215)
<i>N</i>	355435	355435	355438

**Table A14:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 6

	Clustered SE	Muni. FE	School FE
Schooling	0.685*** (0.051)	0.648*** (0.054)	0.562*** (0.047)
Aging	0.123*** (0.007)	0.124*** (0.007)	0.124*** (0.007)
Schooling * Dissolution dosage	-0.073 (0.072)	-0.061 (0.071)	-0.113 (0.082)
Aging * Dissolution dosage	-0.057*** (0.016)	-0.056*** (0.016)	-0.043* (0.017)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.011)	0.017 (0.010)	0.015 (0.009)
2012	-0.009 (0.010)	-0.008 (0.009)	-0.007 (0.010)
2013	-0.051*** (0.012)	-0.049*** (0.012)	-0.044*** (0.012)
2014	-0.035** (0.012)	-0.033** (0.011)	-0.031** (0.011)
2015	-0.043*** (0.012)	-0.041*** (0.012)	-0.036*** (0.010)
2016	-0.069*** (0.012)	-0.065*** (0.011)	-0.060*** (0.010)
2017	-0.076*** (0.014)	-0.071*** (0.013)	-0.065*** (0.010)
2018	-0.095*** (0.014)	-0.090*** (0.013)	-0.082*** (0.010)
Maternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)

High School	0.249*** (0.011)	0.243*** (0.010)	0.216*** (0.006)
Any college	0.521*** (0.017)	0.511*** (0.017)	0.470*** (0.009)
Paternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.177*** (0.006)	0.172*** (0.006)	0.153*** (0.005)
Any college	0.443*** (0.008)	0.431*** (0.007)	0.401*** (0.006)
Mother, disposable income (1k €)	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)
Father, disposable income (1k €)	0.000* (0.000)	0.000* (0.000)	0.000* (0.000)
Age, mother	0.010*** (0.001)	0.009*** (0.001)	0.008*** (0.000)
Age, father	0.001 (0.001)	0.001 (0.001)	0.001** (0.000)
Child female	0.197*** (0.004)	0.197*** (0.004)	0.187*** (0.003)
Union dissolution	-0.058*** (0.007)	-0.055*** (0.007)	-0.058*** (0.007)
Union dissolution dosage	1.208** (0.446)	1.115* (0.452)	1.311* (0.539)
Intercept	-7.173*** (0.352)	-6.886*** (0.360)	-6.223*** (0.315)
<i>N</i>	342265	342265	342268

**Table A15:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 8

	Clustered SE	Muni. FE	School FE
Schooling	0.433*** (0.052)	0.415*** (0.049)	0.341*** (0.046)
Aging	0.030*** (0.008)	0.029*** (0.008)	0.029*** (0.007)
Schooling * Dissolution dosage	0.042 (0.074)	0.031 (0.073)	0.013 (0.078)
Aging * Dissolution dosage	-0.061*** (0.018)	-0.060*** (0.018)	-0.046** (0.017)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.014 (0.010)	0.013 (0.010)	0.014 (0.010)
2012	0.002 (0.012)	0.001 (0.012)	0.003 (0.010)
2013	-0.019 (0.014)	-0.019 (0.014)	-0.017 (0.013)
2014	-0.031** (0.011)	-0.030** (0.011)	-0.029* (0.011)
2015	-0.054*** (0.012)	-0.053*** (0.012)	-0.051*** (0.011)
2016	-0.056*** (0.014)	-0.054*** (0.014)	-0.051*** (0.011)
2017	-0.067*** (0.014)	-0.064*** (0.014)	-0.060*** (0.012)
2018	-0.101*** (0.014)	-0.098*** (0.014)	-0.090*** (0.011)
Maternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)

High School	0.224 <sup>***</sup> (0.009)	0.220 <sup>***</sup> (0.008)	0.195 <sup>***</sup> (0.006)
Any college	0.475 <sup>***</sup> (0.014)	0.466 <sup>***</sup> (0.014)	0.430 <sup>***</sup> (0.007)
Paternal education Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.164 <sup>***</sup> (0.005)	0.160 <sup>***</sup> (0.005)	0.142 <sup>***</sup> (0.005)
Any college	0.418 <sup>***</sup> (0.008)	0.399 <sup>***</sup> (0.006)	0.368 <sup>***</sup> (0.006)
Mother, disposable income (1k €)	0.003 <sup>***</sup> (0.000)	0.003 <sup>***</sup> (0.000)	0.002 <sup>***</sup> (0.000)
Father, disposable income (1k €)	0.000 <sup>*</sup> (0.000)	0.000 <sup>*</sup> (0.000)	0.000 <sup>*</sup> (0.000)
Age, mother	0.010 <sup>***</sup> (0.001)	0.009 <sup>***</sup> (0.001)	0.008 <sup>***</sup> (0.000)
Age, father	0.002 <sup>*</sup> (0.001)	0.002 <sup>*</sup> (0.001)	0.002 <sup>***</sup> (0.000)
Child female	0.153 <sup>***</sup> (0.006)	0.153 <sup>***</sup> (0.006)	0.143 <sup>***</sup> (0.004)
Union dissolution	-0.039 <sup>***</sup> (0.007)	-0.037 <sup>***</sup> (0.006)	-0.043 <sup>***</sup> (0.007)
Union dissolution dosage	0.516 (0.565)	0.589 (0.558)	0.568 (0.658)
Intercept	-5.268 <sup>***</sup> (0.445)	-5.027 <sup>***</sup> (0.417)	-4.295 <sup>***</sup> (0.395)
<i>N</i>	312187	312187	312189

**Table A16:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 2 across geographical closeness

	Clustered SE	Muni. FE	School FE
Same municipality	0.019 (0.023)	0.027 (0.022)	0.026 (0.018)
Schooling	0.742*** (0.083)	0.720*** (0.065)	0.755*** (0.055)
Aging	0.267*** (0.008)	0.265*** (0.008)	0.264*** (0.007)
Schooling * Dissolution dosage	0.111 (0.185)	0.090 (0.183)	-0.092 (0.158)
Schooling * Dissolution dosage * Same muni.	0.103 (0.182)	0.083 (0.180)	0.208 (0.183)
Aging * Dissolution dosage	-0.015 (0.028)	-0.027 (0.028)	-0.016 (0.032)
Aging * Dissolution dosage * Same muni.	-0.093** (0.033)	-0.072* (0.033)	-0.067 (0.036)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.030* (0.014)	0.031* (0.014)	0.030* (0.012)
2012	-0.001 (0.012)	0.001 (0.012)	-0.001 (0.012)
2013	-0.039* (0.018)	-0.038* (0.018)	-0.044** (0.015)
2014	-0.028* (0.013)	-0.025 (0.013)	-0.024* (0.012)
2015	-0.033* (0.013)	-0.028* (0.013)	-0.029* (0.012)
2016	-0.042** (0.014)	-0.038** (0.014)	-0.039** (0.013)

2017	-0.045** (0.016)	-0.040* (0.016)	-0.042** (0.013)
2018	-0.060*** (0.017)	-0.055** (0.017)	-0.056*** (0.013)
Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.236*** (0.011)	0.227*** (0.010)	0.201*** (0.006)
Any college	0.497*** (0.017)	0.484*** (0.018)	0.446*** (0.007)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.169*** (0.007)	0.164*** (0.007)	0.147*** (0.005)
Any college	0.401*** (0.009)	0.391*** (0.008)	0.366*** (0.006)
Mother, disposable income (1k €)	0.001** (0.000)	0.001** (0.000)	0.001** (0.000)
Father, disposable income (1k €)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Age, mother	0.006*** (0.001)	0.005*** (0.001)	0.004*** (0.000)
Age, father	-0.003** (0.001)	-0.003** (0.001)	-0.002*** (0.000)
Child female	0.254*** (0.004)	0.253*** (0.004)	0.251*** (0.004)
Union dissolution	-0.059** (0.018)	-0.061*** (0.017)	-0.065*** (0.016)
Union dissolution dosage	-0.176 (0.500)	-0.010 (0.494)	0.397 (0.482)

Union dissolution	0.505	0.379	-0.002
Dosage * Same muni.	(0.501)	(0.494)	(0.545)
Intercept	-5.083***	-4.968***	-4.976***
	(0.244)	(0.196)	(0.157)
<i>N</i>	362440	362440	362441

**Table A17:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 4 across geographical closeness

	Clustered SE	Muni. FE	School FE
Same municipality	0.015 (0.014)	0.024 (0.014)	0.018 (0.017)
Schooling	0.549*** (0.060)	0.553*** (0.060)	0.515*** (0.045)
Aging	0.191*** (0.007)	0.191*** (0.007)	0.191*** (0.007)
Schooling * Dissolution dosage	0.355* (0.151)	0.337* (0.143)	0.222 (0.139)
Schooling * Dissolution dosage * Same muni.	-0.137 (0.169)	-0.139 (0.166)	-0.091 (0.159)
Aging * Dissolution dosage	-0.072* (0.034)	-0.076* (0.034)	-0.063* (0.030)
Aging * Dissolution dosage * Same muni.	-0.036 (0.035)	-0.027 (0.034)	-0.024 (0.034)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.010)	0.016 (0.010)	0.019 (0.010)
2012	0.003 (0.012)	0.003 (0.011)	0.008 (0.009)
2013	-0.028* (0.014)	-0.033* (0.013)	-0.021 (0.012)
2014	-0.029* (0.013)	-0.029* (0.013)	-0.020* (0.010)
2015	-0.043** (0.014)	-0.041** (0.013)	-0.033*** (0.010)
2016	-0.049*** (0.013)	-0.048*** (0.013)	-0.039*** (0.010)

2017	-0.057*** (0.016)	-0.055*** (0.015)	-0.045*** (0.010)
2018	-0.074*** (0.013)	-0.073*** (0.013)	-0.062*** (0.010)
Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.229*** (0.010)	0.225*** (0.010)	0.201*** (0.006)
Any college	0.518*** (0.018)	0.507*** (0.018)	0.468*** (0.008)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.162*** (0.006)	0.159*** (0.006)	0.142*** (0.005)
Any college	0.434*** (0.008)	0.419*** (0.007)	0.390*** (0.006)
Mother, disposable income (1k €)	0.002** (0.001)	0.001** (0.000)	0.001** (0.000)
Father, disposable income (1k €)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Age, mother	0.009*** (0.001)	0.008*** (0.001)	0.007*** (0.001)
Age, father	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)
Child female	0.192*** (0.004)	0.192*** (0.004)	0.186*** (0.003)
Union dissolution	-0.072*** (0.013)	-0.077*** (0.012)	-0.076*** (0.015)
Union dissolution dosage	-0.845 (0.673)	-0.725 (0.643)	-0.307 (0.651)

Union dissolution	0.994	0.905	0.638
Dosage * Same muni.	(0.731)	(0.712)	(0.739)
Intercept	-5.568***	-5.523***	-5.261***
	(0.269)	(0.264)	(0.214)
<i>N</i>	355435	355435	355438

**Table A18:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 6 across geographical closeness

	Clustered SE	Muni. FE	School FE
Same municipality	0.042* (0.019)	0.049** (0.018)	0.049** (0.016)
Schooling	0.685*** (0.051)	0.648*** (0.054)	0.561*** (0.047)
Aging	0.123*** (0.007)	0.124*** (0.007)	0.124*** (0.007)
Schooling * Dissolution dosage	-0.063 (0.110)	-0.036 (0.113)	-0.170 (0.119)
Schooling * Dissolution dosage * Same muni.	-0.015 (0.138)	-0.040 (0.136)	0.090 (0.136)
Aging * Dissolution dosage	-0.042 (0.026)	-0.045 (0.026)	-0.032 (0.027)
Aging * Dissolution dosage * Same muni.	-0.026 (0.034)	-0.017 (0.033)	-0.020 (0.031)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.017 (0.011)	0.017 (0.010)	0.015 (0.009)
2012	-0.010 (0.010)	-0.008 (0.009)	-0.008 (0.010)
2013	-0.051*** (0.012)	-0.049*** (0.012)	-0.045*** (0.012)
2014	-0.035** (0.012)	-0.033** (0.011)	-0.031** (0.011)
2015	-0.043*** (0.012)	-0.041*** (0.012)	-0.037*** (0.010)
2016	-0.069*** (0.012)	-0.066*** (0.011)	-0.061*** (0.010)

2017	-0.076*** (0.014)	-0.071*** (0.013)	-0.065*** (0.010)
2018	-0.095*** (0.014)	-0.090*** (0.013)	-0.082*** (0.010)
Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.249*** (0.011)	0.243*** (0.010)	0.216*** (0.006)
Any college	0.521*** (0.018)	0.511*** (0.017)	0.470*** (0.009)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.177*** (0.006)	0.172*** (0.006)	0.153*** (0.005)
Any college	0.443*** (0.008)	0.431*** (0.007)	0.401*** (0.006)
Mother, disposable income (1k €)	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)
Father, disposable income (1k €)	0.000* (0.000)	0.000* (0.000)	0.000* (0.000)
Age, mother	0.010*** (0.001)	0.009*** (0.001)	0.008*** (0.000)
Age, father	0.001 (0.001)	0.001 (0.001)	0.001** (0.000)
Child female	0.197*** (0.004)	0.197*** (0.004)	0.187*** (0.003)
Union dissolution	-0.091*** (0.016)	-0.094*** (0.015)	-0.096*** (0.014)
Union dissolution dosage	1.000 (0.778)	0.869 (0.790)	1.611* (0.807)

Union dissolution	0.364	0.417	-0.419
Dosage * Same muni.	(0.937)	(0.932)	(0.922)
Intercept	-7.178***	-6.892***	-6.226***
	(0.352)	(0.360)	(0.314)
<i>N</i>	342265	342265	342268

**Table A19:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 8 across geographical closeness

	Clustered SE	Muni. FE	School FE
Same municipality	0.021 (0.016)	0.028 (0.015)	0.035* (0.016)
Schooling	0.432*** (0.052)	0.415*** (0.049)	0.340*** (0.046)
Aging	0.030*** (0.008)	0.029*** (0.008)	0.030*** (0.007)
Schooling * Dissolution dosage	-0.106 (0.118)	-0.106 (0.117)	-0.139 (0.117)
Schooling * Dissolution dosage * Same muni.	0.226 (0.132)	0.209 (0.131)	0.235 (0.130)
Aging * Dissolution dosage	-0.053 (0.028)	-0.053 (0.028)	-0.042 (0.028)
Aging * Dissolution dosage * Same muni.	-0.010 (0.034)	-0.006 (0.034)	-0.008 (0.031)
2010	0.000 (.)	0.000 (.)	0.000 (.)
2011	0.013 (0.010)	0.013 (0.010)	0.014 (0.010)
2012	0.002 (0.012)	0.001 (0.012)	0.002 (0.010)
2013	-0.019 (0.014)	-0.019 (0.014)	-0.017 (0.013)
2014	-0.031** (0.011)	-0.030** (0.011)	-0.029* (0.011)
2015	-0.054*** (0.012)	-0.053*** (0.012)	-0.051*** (0.011)
2016	-0.056***	-0.054***	-0.051***

	(0.014)	(0.014)	(0.011)
2017	-0.067*** (0.014)	-0.064*** (0.014)	-0.060*** (0.012)
2018	-0.101*** (0.014)	-0.098*** (0.014)	-0.091*** (0.011)
Maternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.224*** (0.009)	0.220*** (0.008)	0.195*** (0.006)
Any college	0.475*** (0.014)	0.466*** (0.014)	0.430*** (0.007)
Paternal education			
Compulsory	0.000 (.)	0.000 (.)	0.000 (.)
High School	0.164*** (0.005)	0.160*** (0.005)	0.142*** (0.005)
Any college	0.417*** (0.008)	0.399*** (0.006)	0.368*** (0.006)
Mother, disposable income (1k €)	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.000)
Father, disposable income (1k €)	0.000* (0.000)	0.000* (0.000)	0.000* (0.000)
Age, mother	0.010*** (0.001)	0.009*** (0.001)	0.008*** (0.000)
Age, father	0.002* (0.001)	0.002* (0.001)	0.002*** (0.000)
Child female	0.153*** (0.006)	0.153*** (0.006)	0.143*** (0.004)
Union dissolution	-0.056*** (0.014)	-0.060*** (0.013)	-0.070*** (0.014)
Union dissolution	1.677	1.691	1.848

dosage	(0.935)	(0.933)	(0.985)
Union dissolution	-1.818	-1.728	-1.954
Dosage * Same muni.	(1.094)	(1.081)	(1.100)
Intercept	-5.262*** (0.445)	-5.021*** (0.417)	-4.291*** (0.394)
<i>N</i>	312187	312187	312189

**Table A20:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 8 by gender

	Male	Male	Male	Female	Female	Female
<b>Grade 2</b>						
Schooling	0.807*** (0.093)	0.785*** (0.080)	0.813*** (0.070)	0.690*** (0.084)	0.666*** (0.065)	0.701*** (0.062)
Aging	0.249*** (0.010)	0.245*** (0.010)	0.245*** (0.010)	0.283*** (0.008)	0.283*** (0.008)	0.281*** (0.009)
Schooling * Dissolution dosage	0.045 (0.121)	0.013 (0.120)	-0.099 (0.154)	0.275 (0.148)	0.238 (0.145)	0.171 (0.125)
Aging * Dissolution dosage	-0.074* (0.028)	-0.072* (0.028)	-0.064* (0.030)	-0.072** (0.023)	-0.071** (0.023)	-0.056* (0.025)
<i>N</i>	177288	177288	177289	185152	185152	185152
<b>Grade 4</b>						
Schooling	0.504*** (0.079)	0.501*** (0.079)	0.463*** (0.062)	0.596*** (0.059)	0.604*** (0.060)	0.574*** (0.052)
Aging	0.173*** (0.010)	0.173*** (0.010)	0.172*** (0.010)	0.204*** (0.009)	0.205*** (0.009)	0.205*** (0.009)
Schooling * Dissolution dosage	0.299* (0.134)	0.294* (0.134)	0.211 (0.136)	0.223 (0.122)	0.199 (0.119)	0.113 (0.112)
Aging * Dissolution dosage	-0.100*** (0.028)	-0.098*** (0.029)	-0.085** (0.028)	-0.081** (0.025)	-0.079** (0.025)	-0.068** (0.023)
<i>N</i>	172109	172109	172111	183326	183326	183327
<b>Grade 6</b>						
Schooling	0.695*** (0.065)	0.658*** (0.066)	0.576*** (0.062)	0.685*** (0.054)	0.646*** (0.058)	0.560*** (0.054)
Aging	0.088*** (0.010)	0.089*** (0.010)	0.089*** (0.010)	0.151*** (0.009)	0.151*** (0.009)	0.153*** (0.009)
Schooling * Dissolution dosage	-0.094 (0.117)	-0.084 (0.118)	-0.164 (0.125)	-0.065 (0.090)	-0.052 (0.087)	-0.050 (0.103)
Aging * Dissolution dosage	-0.040 (0.028)	-0.039 (0.028)	-0.032 (0.028)	-0.063** (0.019)	-0.060** (0.019)	-0.056* (0.022)
<i>N</i>	164286	164286	164288	177979	177979	177980
<b>Grade 8</b>						
Schooling	0.423*** (0.066)	0.407*** (0.062)	0.319*** (0.058)	0.444*** (0.062)	0.425*** (0.061)	0.362*** (0.056)
Aging	0.028** (0.010)	0.025* (0.010)	0.025* (0.011)	0.031** (0.010)	0.030** (0.010)	0.031*** (0.009)
Schooling * Dissolution Dosage	-0.033 (0.119)	-0.048 (0.120)	-0.027 (0.117)	0.098 (0.108)	0.094 (0.105)	0.051 (0.098)
Aging * Dissolution dosage	-0.049 (0.029)	-0.047 (0.029)	-0.036 (0.028)	-0.064** (0.019)	-0.063** (0.019)	-0.053* (0.021)
<i>N</i>	150425	150425	150425	161762	161762	161764
Control variables	YES	YES	YES	YES	YES	YES

Municipality FE	NO	YES	NO	NO	YES	NO
School FE	NO	NO	YES	NO	NO	YES

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Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table A21:** Effects across aging and schooling dependent on parental union dissolution as dosage in grade 8 by maternal education

	< College	< College	< College	College	College	College
<b>Grade 2</b>						
Schooling	0.882*** (0.097)	0.815*** (0.076)	0.825*** (0.069)	0.611*** (0.086)	0.640*** (0.076)	0.685*** (0.064)
Aging	0.234*** (0.010)	0.230*** (0.010)	0.226*** (0.009)	0.302*** (0.010)	0.304*** (0.010)	0.305*** (0.009)
Schooling * Dissolution dosage	0.016 (0.132)	-0.031 (0.131)	-0.149 (0.128)	0.286* (0.140)	0.291* (0.141)	0.232 (0.165)
Aging * Dissolution dosage	-0.045 (0.024)	-0.046 (0.024)	-0.028 (0.025)	-0.091** (0.033)	-0.089** (0.032)	-0.078* (0.031)
<i>N</i>	191202	191202	191202	171238	171238	171239
<b>Grade 4</b>						
Schooling	0.598*** (0.067)	0.564*** (0.067)	0.520*** (0.057)	0.489*** (0.067)	0.536*** (0.065)	0.504*** (0.056)
Aging	0.164*** (0.010)	0.164*** (0.010)	0.161*** (0.009)	0.220*** (0.010)	0.222*** (0.009)	0.225*** (0.009)
Schooling * Dissolution dosage	0.254 (0.133)	0.249 (0.132)	0.151 (0.117)	0.244* (0.116)	0.221 (0.118)	0.206 (0.129)
Aging * Dissolution dosage	-0.074** (0.026)	-0.073** (0.026)	-0.053* (0.023)	-0.099*** (0.026)	-0.095*** (0.026)	-0.093** (0.029)
<i>N</i>	194066	194066	194068	161369	161369	161370
<b>Grade 6</b>						
Schooling	0.730*** (0.059)	0.660*** (0.059)	0.568*** (0.059)	0.627*** (0.064)	0.632*** (0.061)	0.553*** (0.056)
Aging	0.105*** (0.010)	0.105*** (0.010)	0.104*** (0.009)	0.146*** (0.009)	0.148*** (0.009)	0.151*** (0.010)
Schooling * Dissolution dosage	-0.060 (0.100)	-0.044 (0.098)	-0.092 (0.105)	-0.144 (0.147)	-0.130 (0.147)	-0.175 (0.130)
Aging * Dissolution dosage	-0.029 (0.023)	-0.029 (0.023)	-0.019 (0.023)	-0.087** (0.026)	-0.080** (0.026)	-0.078** (0.027)
<i>N</i>	196194	196194	196197	146071	146071	146071
<b>Grade 8</b>						
Schooling	0.442*** (0.059)	0.408*** (0.058)	0.336*** (0.053)	0.415*** (0.060)	0.426*** (0.054)	0.352*** (0.058)
Aging	0.014 (0.010)	0.013 (0.010)	0.013 (0.010)	0.053*** (0.010)	0.050*** (0.010)	0.052*** (0.010)
Schooling * Dissolution Dosage	-0.049 (0.093)	-0.054 (0.091)	-0.061 (0.095)	0.206 (0.108)	0.190 (0.109)	0.140 (0.118)
Aging * Dissolution dosage	-0.037 (0.021)	-0.036 (0.021)	-0.023 (0.022)	-0.092** (0.027)	-0.085** (0.027)	-0.077** (0.027)
<i>N</i>	186619	186619	186621	125568	125568	125568

Control variables	YES	YES	YES	YES	YES	YES
Municipality FE	NO	YES	NO	NO	YES	NO
School FE	NO	NO	YES	NO	NO	YES

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$