The Persistent Effect of Being Old for Grade on Social-Emotional Skills*

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Abstract

I examine the persistence of old-for-grade effects on social-emotional skills during secondary education, measured by self-esteem, friendships, learning approaches, and goal-setting mindsets. Students who are older at school entry often exhibit better skills than their younger peers at that time, but how these gaps evolve through secondary education remains less understood. Exploiting a fuzzy regression discontinuity design and the unique context of Seoul Education Longitudinal Study 2010 (SELS), I uncover different patterns in how these effects persist for girls and boys. Old-for-grade girls consistently show higher self-esteem compared to their younger counterparts throughout both middle and high school. There is also suggestive evidence that these girls maintain more effective learning approaches and closer friendships. In contrast, boys do not experience significant effects from being old for grade. Furthermore, I investigate whether the effects are driven by age at the time of the survey. The results indicate that relative age compared to grade peers is more likely the primary factor influencing these outcomes.

Keywords: School Starting Age, Social-Emotional Skills, Gender Differences, Seoul Education Longitudinal Study 2010 (SELS 2010)

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1 Introduction

Researchers have demonstrated that cognitive skills alone cannot fully explain disparities in labor market outcomes (Heckman et al., 2006; Lindqvist and Vestman, 2011). Social-emotional skills are a crucial component of human capital, predicting individual prospects in the labor market, such as employment, wages, and occupational choices.[1] While there is growing literature in economics on the impact of schools (Jackson et al., 2020), teachers (Gong et al., 2018; Kraft, 2019), and peers (Gong et al., 2021) on social-emotional skills, considerable gaps remain in understanding the factors that shape these skills.

Students who start school at an older age often have advantages in cognitive, physical, social, and emotional development.[2] However, it is unclear how these "old-for-grade" effects evolve as students progress into later adolescence. Early advantages may fade if they stem from age differences in the early school years, but they could also persist, influencing skill development throughout a student's education. Older students may benefit more from educational environments that build on initial skill advantages, namely dynamic complementarity (Cunha and Heckman, 2007). If this is the case, younger students may face disadvantages in later educational attainment and labor market outcomes.

In this study, I examine whether the effects of being "old-for-grade" on social-emotional skills persist through middle and high school. "Old-for-grade" students start school at an older age and remain older than their peers throughout their schooling. I use data from the

[1]Examples include noncognitive measures combining locus of control and self-esteem (Heckman et al., 2006), social skills (Deming, 2017; Weinberger, 2014), interpersonal skills (Borghans et al., 2008).

[2]Students who start at an older age are more ready for kindergarten (Dhuey et al., 2019), perform better on tests (Datar, 2006; Elder and Lubotsky, 2009; Cascio and Schanzenbach, 2016), and show fewer behavioral problems and better pro-social skills (Datar and Gottfried, 2015; Lubotsky and Kaestner, 2016) in early schooling.

Seoul Education Longitudinal Study 2010 (SELS 2010) and leverage several unique features of the South Korean educational context. First, Korea's rare grade repetition and nine years of compulsory schooling ensure that old-for-grade effects are not confounded by varying lengths of schooling. Second, random assignment to middle schools in Seoul minimizes biases that might arise from selection into higher-quality schools. This allows me to isolate the impact of relative age.

To estimate the old-for-grade effects, I employ a fuzzy regression discontinuity design, exploiting variations in birth dates around the school starting age cutoff. Since some parents delayed their children's school entry, making the starting age decision endogenous during the survey period, I instrument for being old-for-grade using birthdates around the cutoff. This approach follows prior studies that use similar methods for identification.[3] The fuzzy regression discontinuity design requires the standard assumptions of regression discontinuity and instrumental variable design to be satisfied. In addition, the monotonicity assumption must hold to interpret the estimates as local average treatment effects. Monotonicity implies that individuals who are affected should be affected in the same direction. However, the assigned entry age instrument potentially violates the monotonicity assumption (Barua and Lang, 2016; Fiorini and Stevens, 2021). In the context of my study, students born around the cutoff are expected to become old for grade if they are affected, a condition likely to hold.

I find that old-for-grade students have higher levels of social-emotional skills compared to their younger peers throughout middle and high school, with effects concentrated among girls. Old-for-grade girls exhibit higher self-esteem with suggestive evidence of stronger friendships

[3] Elder (2010), Evans et al. (2010), Landersø et al. (2017, 2020), and Johansen (2021).

and learning approaches compared to their younger counterparts. This indicates that old-for-grade girls have better social and interpersonal skills as well as enhanced motivation and engagement in academic achievement. The magnitude of these effects remains consistent from middle to high school, suggesting persistence over time. In contrast, old-for-grade boys show little difference in social-emotional skills compared to their younger peers, except for suggestive evidence of stronger friendships in middle school. Notably, these gender-specific effects cannot be attributed to differences in contemporaneous test scores or physical advantages.

Compared to other studies on similar outcomes, the old-for-grade effects I observe on social-emotional skills are larger. These substantial effect sizes may reflect the local nature of estimates from both regression discontinuity and instrumental variable designs. Although these effects may not be extrapolated outside the bandwidths or to non-compliers, I compare the reduced-form estimates with other studies. For example, the effects on girls' friendships, which range from 0.683 to 0.964 standard deviations, are similar to the impact of increasing the proportion of female peers in a classroom by 33.5 to 48.5 percentage points (Gong et al., 2021).

Next, I explore whether absolute age differences account for the observed effects. If younger students show lower levels of social-emotional skills because they are absolutely one year younger at the time of the survey, these effects might disappear if surveyed at the same age. To investigate this possibility, I reconstruct outcome variables measured at the same age using the annual panel data. Young-for-grade students are then the same age as old-for-grade students but have one more year of education. If the age at the survey is the primary driver of the effect, or if the extra year of schooling compensates for the advantages of being one year older at the time of the survey, then the effect should be close to zero. The results show that the effects are slightly smaller but remain positive and statistically significant, suggesting that the old-for-grade effects are more likely driven by relative age rather than absolute age differences.

This paper contributes to the literature on school starting age in several ways. First, I provide clean causal evidence of old-for-grade effects on social-emotional skills and decompose these effects into absolute and relative age components. One way of decomposition is the instrumental variable approach using assigned relative age and own assigned school starting age (Bedard and Dhuey, 2006). Peña and Duckworth (2018) and Peña (2020) apply this approach to grit, empathy, and decision-coping skills. However, this method may be problematic due to potential violations of monotonicity. Another approach is to compare estimates using outcomes measured at the same age and those measured at the same grade. Landersø et al. (2017, 2020) and Johansen (2021) compare the effects on health, crime, and parental outcomes. To the best of my knowledge, this is the first paper to decompose absolute and relative age components on social-emotional skills using this approach and show that these effects are more likely to be driven by relative age. Furthermore, I find that the positive old-for-grade effects on girls' social-emotional skills persist into high school, covering mid-to-late adolescence. Finally, I uncover gender differences in the development of social-emotional skills. While it is commonly believed that boys benefit more from attending school at an older age, young-for-grade girls may face disadvantages in social-emotional skill development as they advance to higher grades.

This study has important implications for post-secondary education and the labor market prospects, particularly for old-for-grade girls. While I cannot directly observe students after high school, previous studies indicate that enhanced social-emotional skills are crucial for labor market outcomes. For example, a one standard deviation increase in self-esteem is associated with a 25.06 percent increase in wages for females (de Araujo and Lagos, 2013), and a one standard deviation increase in social skills is linked to a 3 percentage point increase in full-time employment of males and females (Deming, 2017). Additionally, higher levels of learning approaches can enhance post-secondary educational attainment. Given the importance of social-emotional skills, this study highlights the need to address the unique challenges faced by young-for-grade girls when designing programs for social-emotional development.

The remainder of this paper is organized as follows. Section 2 describes the educational system in South Korea and the data I use. Section 3 explains the identification strategy, and Section 4 presents the results and interpretation. Section 5 presents robustness checks. Section 6 concludes.

2 Educational System and Data

Educational System in South Korea

Education in South Korea consists of six years of primary school, three years of middle school, and three years of high school. The academic year begins in March, and the school starting age cutoff date was March 1st until 2008.[4] Children become eligible to enter primary school in March following their 6th birthday. Consequently, if children enter school on time,

[4]The school starting age cutoff moved from March 1st to January 1st in 2008, and the January 1st cutoff was enforced starting in 2009. Children who turn six years old by January 1st are eligible to enter primary school in March of that year, effectively starting school in the calendar year of their 7th birthday. The sample utilized in this paper entered school when March 1st was the school starting age cutoff.

March-born children turn seven years old, while February-born children are six years old at school entry. Although early school entry or delayed entry is possible, early entry is relatively rare, with only about 0.3 - 0.6 percent of children in Seoul entering school early each year. In population-level data in Seoul, 779 out of 124,209 children entered school early in 2004, and 377 out of 111,496 students entered early in 2007. The share of early entrants remained relatively stable until the school entry cutoff moved to January 1st.[5] On the other hand, delayed school entry is more common, with approximately 5.4 percent in 2004 and about 8.7 percent in 2007 delaying their school entry in Seoul.[6] [7]

Before entering primary school, children in South Korea typically attend either kindergarten or daycare centers. Kindergarten is not entirely free when the children in my sample are aged three to five, and kindergarten and daycare centers did not have national curriculum before 2012. The share of children attending either kindergarten or daycare centers at age five was 76.3 percent in 2004 and 87.9 percent in 2007 in Korea. Most children are enrolled in one of these programs, which indicates that many old-for-grade children have one more year of experience in pre-primary education before school entry. This also indicates that old-for-grade and young-for-grade children experience different education cycles at the same age.[8]

[5]Source: Statistical yearbook of Seoul education 2005, 2008

[6]To delay school entry, parents need to file an application for reason such as child development, and the primary school headmaster decide whether to accept the application following the deliberation of the compulsory education management committee.

[7]Nationwide delayed entry rates in the United States are similar to those in Korea. In the United States, delayed entry rates range from 5 percent to 7 percent in recent years (Datar, 2006; Bassok and Reardon, 2013; Snyder and Dillow, 2013). Delayed entry in the United States was more prevalent in the 1970s and 1980s, with an average of 12 percent, but has declined over time (Huang, 2015).

[8]Kindergarten provides care for children from age three until they transition to primary school, while daycare centers provide care for children aged zero to six. These two types of early childhood education and care facilities operate under different laws and government supervision. Among children aged five in South Korea who attend kindergarten or daycare centers, approximately 60 percent attended kindergarten, while the remaining attended daycare centers.

Grade repetition is infrequent in South Korea. In 2010, only a small number of students, 12 in primary school and 45 in middle school, repeated grades.[9] Grade repetition may have differential impacts on the development of social-emotional skills compared to students advancing to higher grades. Additionally, young-for-grade students are more likely to have lower test scores, leading to a higher likelihood of repeating a grade (Dhuey et al., 2019). This suggests that grade repetition may result in differential social-emotional development trajectories for young-for-grade students. In my setting, the infrequency of grade repetition ensures unbiased estimates.

South Korea mandates six years of primary school and three years of middle school. 99.7 percent of middle school graduates advance to high school with an annual high school dropout rate of only one percent.[9] While the minimum school leaving age can potentially influence the length of schooling based on when students start school (Barua and Lang, 2016), the combination of nine years of compulsory education and a substantial advancement rate to high school reduces concerns related to dropout and its impact on social-emotional development.

In Seoul, middle school assignments are random within 11 school districts. High school assignments are based on student preferences. Most students choose between academic and vocational high schools. Within academic high schools, students submit preferences. Random school assignments in middle schools prevent my estimates from being confounded by school quality effects as old-for-grade students are more likely to outperform young-for-grade students in primary school.[10]

[9] Source: Statistical yearbook of education

[10] Although high school assignments in Seoul are based on student preferences, the consistency of the effects observed across both middle and high school suggests that preference-based assignments do not significantly alter the impact of being old-for-grade. The estimates are also robust to the inclusion of school fixed effects.

Data

I use the Seoul Educational Longitudinal Survey 2010 (henceforth SELS 2010) for this study. SELS 2010 sampled fourth-, seventh-, and tenth-grade students in 2010 and conducted annual surveys until their high school graduation.[11] I utilize data from the fourth-grade and seventh-grade cohorts to analyze the effects in both their high school years (grades 10 to 12) and middle school years (grades 7 to 9). After dropping students with missing dates of birth, there are 3,834 students in the fourth-grade cohort and 4,515 students in the seventh-grade cohort.[12] To address potential concerns regarding non-random attrition in the panel survey, I investigate whether attrition is correlated to being born after March 1st or being old-for-grade. However, the correlation between attrition and being born after the cutoff or being old for grade is close to zero, suggesting that attrition is unlikely to significantly bias the results.

One limitation of this data set is that it is not possible to directly observe the school starting age. Instead, I use the observed age in the first survey wave as a proxy for the school starting age. If students have repeated a grade or experienced grade retention, the observed age may not perfectly align with the actual school starting age. However, this is less problematic due to the infrequency of repetition or retention in South Korea. Retention typically occurs when a student's attendance rate falls below two-thirds of the total school days. In 2007, only 9 primary school and 23 middle school students repeated grades in

[11] SELS 2010 utilized a stratified two-stage cluster sampling approach. In the first stage, schools were randomly selected based on the number of schools within each school district. In the second stage, two classes were randomly chosen within each school.

[12] Some students are added in survey waves 6 and 7. 164 students in the fourth-grade cohort and 33 students in the seventh-grade cohort are added for a new policy evaluation in the sixth survey wave. 75 students are additionally added for the fourth-grade cohort in the seventh survey wave.

Seoul. Furthermore, students can postpone school enrollment, but this is only allowed for reasons such as illness or other extenuating circumstances.[13] In this sample, the majority of students in the seventh-grade cohort were born in 1997 and 1998, while the majority in the fourth-grade cohort were born in 2000 and 2001. Only a small number of students are older or younger than their assigned school age, which reassures that the observed age in the fourth or seventh grade likely reflects the actual school starting age.

The main outcomes of interest are self-esteem, friendship, learning approaches, and goal-setting mindsets. These social-emotional skills have been demonstrated to have an effect on academic attainment and labor market outcomes in previous studies. For instance, studies have shown that self-esteem affects educational attainment, wage, employment, and occupational choices (Heckman et al., 2006; de Araujo and Lagos, 2013). The friendship index measures a student's social and interpersonal skills, which predict later employment and occupational choices (Deming, 2017; Lindqvist and Vestman, 2011; Borghans et al., 2008). The learning approaches index measures students' learning strategies, effort, and motivations, all of which can positively affect their educational attainment. Finally, the goal-setting mindsets index measures whether students have clear goals, know how to achieve them, and work hard to attain them, indicating a connection to motivation.

The self-esteem index includes five questions from the Rosenberg Self-Esteem scale, which is widely used in Economics research. These questions are: *I feel that I have a number of good qualities. I am able to do things as well as most other people. I feel that I'm a person of worth. I take a positive attitude toward myself. On the whole, I am satisfied with myself.*

[13] Elementary and Secondary Education Act Article 28 Paragraph (4): The head of an elementary school or a middle school shall grant the exemption or postponement of the obligation of school enrollment pursuant to paragraph (2) or (3) only where the application thereof is filed because of illness or any extenuating circumstances determined by the superintendent of education.

The friendship index includes four questions of the following: *I have a friend whom I can trust and talk to. Rather than being alone during breaks or lunchtime, I spend time with my friends. Even if I have arguments with my friends, we make up quickly. I help my friends who need assistance.*[14]

The self-directed learning approach index includes nine questions based on the motivated strategies for learning questionnaire (MSLQ) (Pintrich et al., 1993), which include: *I think about how to connect newly learned information with what I already know. I study important materials by summarizing key points or organizing them in tables or mind maps. I check myself to see if I understand the class materials well. I try my best to fully understand the school materials. I try to stick to the study schedule I planned as much as possible. If there is anything I don't understand while studying or doing assignments, I look it up in books or online. I believe I will eventually understand any difficult material. I find studying enjoyable. I can handle my own work well without anyone telling me what to do.*[15]

The goal-setting mindset index includes five questions: *I have a clear goal that I want to achieve. I know what I need to do to achieve my goals. I am working hard to achieve my goals. The study I am doing now will help me achieve my future goals. If I achieve my future goals, I believe I can also contribute to society.*

Students respond to each question using a 5-point Likert scale, ranging from 1 being 'strongly disagree' to 5 being 'strongly agree.'[16] A higher score means better social-emotional skills. I present summary statistics for outcome indices by gender and cutoff among students

[14]Some of these questions are similar to the interpersonal skill survey questions in Jackson et al. (2020) and Datar and Gottfried (2015); Lubotsky and Kaestner (2016).

[15]Questions used to measure the learning approach index are similar to academic effort (work hard index) in Jackson et al. (2020).

[16]Cronbach's α is reported for the reliability of these measures in the fourth survey wave. Most measures score above 0.7. See Appendix Table A15 for details.

born between January and April in Table 1. Across outcomes and grades, girls born in March or April, and thus more likely to be older, have higher average indices than those born in January or February. On the other hand, for boys, being born after March 1st does not consistently result in higher average indices. Between genders, girls have slightly lower self-esteem than boys, but there is no consistent pattern of girls scoring higher or lower than boys in other social-emotional skills.

To better interpret estimates, I standardize each survey response to mean zero and unit variance within each survey wave and sum relevant questions. I average each outcome over middle school years (grades 7 to 9), high school years (grades 10 to 12), across all grades (grades 7 to 12), and across all ages (ages 13 to 17) to reduce noise from the small sample size.[17] All outcomes are then standardized again. I use ages 13 to 17 when averaging across ages because data is unavailable for young-for-grade students at age 18 and old-for-grade students at age 12.[18] Young-for-grade students are in grade 8 at age 13 and grade 12 at age 17, while old-for-grade students are in grade 7 at age 13 and in grade 11 at age 17.

3 Identification Strategy

I use a fuzzy regression discontinuity design to investigate the old-for-grade effects on social-emotional skills. Despite the exogenous nature of dates of birth around the school entry cutoff, the timing of a child's school entry remains endogenous. Parents may choose to delay their child's school entry if they believe the child is not sufficiently ready for school.

[17] I also estimate the effects on outcomes at a specific grade or a specific age, but these estimates are consistent with those using pooled averages.

[18] The survey was conducted in July every year, so the age is calculated based on the survey time.

Therefore, I adopt being born after the school entry cutoff as an instrumental variable for the binary variable old-for-grade, similar to previous studies such as Evans et al. (2010) and Johansen (2021).

Old-for-grade is a binary variable, equal to one if the school starting age is 7 and zero if the school starting age is 6. Figure 1 illustrates the share of old-for-grade children by gender.[19] Children born in January and February are more inclined to delay their school entry as their dates of birth approach the cutoff. There is a jump in the share of old-for-grade children on March 1st, with the majority of children born in March and April being old for grade. Consistent with prior research (Fredriksson and Öckert, 2014; Landersø et al., 2017; Cook and Kang, 2020), boys are more likely to delay school entry compared to girls.

I estimate the following equations in the reduced form and in the first stage:

$$Y_{ic} = \beta_1 + \beta_2 cutoff_i + \beta_3 d_i + \beta_4 d_i * cutoff_i + \lambda_c + X_i' \gamma_1 + \epsilon_{ic}$$

$$oldforgrade_{ic} = \alpha_1 + \alpha_2 cutoff_i + \alpha_3 d_i + \alpha_4 d_i * cutoff_i + \delta_c + X_i' \gamma_2 + e_{ic}$$

where Y_{ic} is the outcome of interest, which includes self-esteem, friendship, learning approaches, and goal-setting mindsets in middle school and high school. d_i is the date of birth relative to the March 1st cutoff. It is equal to 0 when a child is born on March 1st, 1 if born on March 2nd, and -1 if born on February 28th. $cutoff_i$ is a binary variable equal to one if children are born after March 1st. I also include an interaction between d_i and $cutoff_i$. λ_c and δ_c are the survey cohort fixed effects in the reduced form and the first stage respectively. X_i is predetermined individual characteristics, including gender, firstborn,

[19]The share of old-for-grade students can be interpreted as old-for-grade within their respective grade cohorts in Seoul.

parents' educational attainment (categorized as less than high school, high school graduates, and more than high school), and indicators for missing covariates. I do not include individual controls in my main specification because the estimates remain robust to the inclusion of controls. The estimate of interest is hence $\hat{\beta}_2/\hat{\alpha}_2$.

I use a triangular kernel, which is optimal for boundary estimation, using local linear regression (Fan and Gijbels, 1996). In the main analysis, I choose 60-day bandwidths to ensure a comparison of the same sample across outcomes. Moreover, I conduct additional analyses using bias-corrected estimates and robust confidence intervals, utilizing bandwidths that minimize the mean squared errors (MSE) following Calonico et al. (2014). The results, shown in Appendix Table A10, remain robust. To further validate my approach, I investigate the optimal local polynomial order that minimizes asymptotic mean squared errors, following Pei et al. (2022). I find that local linear estimators consistently have lower asymptotic mean squared errors than local quadratic or cubic estimators. Results are shown in Appendix Tables A2 and A3.

I cluster the standard errors at the date of birth level. Additionally, I consider alternative clustering at the school level, given that SELS 2010 sampled students at the school level, and students within the same school might be exposed to common shock. The alternative clustering does not yield significantly different results compared to my main specification. Results are shown in Appendix Table 6. Notably, standard errors are larger when clustering at the date of birth level. This suggests that clustering at the date of birth level provides more conservative results. Therefore, in my main results, I present standard errors clustered at the date of birth level for robust and conservative estimates.

The validity of the regression discontinuity design relies on the assumption of continuous running variables and the smoothness of the regression functions for potential treatment and potential outcomes near the cutoff. One possible threat to identification is that parents may manipulate the date of birth around the school entry cutoff (Shigeoka, 2015). To address this, I first check whether the density of the running variable around the cutoff changes smoothly (McCrary, 2008). Figure 2 presents the density of births within 60-day bandwidths around the cutoff with two-day bins. The number of births is not significantly different before and after the cutoff. Second, I formally test the manipulation using the method proposed by Cattaneo et al. (2020). Results shown in Figure 3 do not reject that the density around the cutoff is smooth. I also do the same analysis separately for girls and boys in the Appendix Figures A1 and A2.[20] Lastly, I re-estimate the effects with the donut regression discontinuity design in the robustness check. I exclude one, four, and seven days around the cutoff. Results are shown in Appendix Figures A13 and A14. While the magnitudes become somewhat noisy, they remain largely consistent.

Another potential source of bias in the density of birth is the possibility of unique birth patterns in two specific school cohorts. If, for instance, time-specific events affect the two school cohorts in my data, my estimates would be biased. To mitigate this concern, I analyze whether residuals, obtained by regressing running variables on day-of-week and holiday fixed effects, are smooth around the cutoff. The estimates, shown in Appendix Figure A3, are robust to the inclusion of day-of-week fixed effects. Furthermore, Kim (2021) finds that adjustments in birth timing between February and March from 1997 to 2007 are small

[20]One possible concern related to my data is that the distribution of births around the cutoff date might differ from that at the population level since I use only a sample of students from these cohorts in my data. While I do not have access to the daily number of births at the population level in Seoul, I find that the share of births by month in my data is similar to that at the population level in Seoul. This evidence assures that the cohorts in my sample are not drastically different from the overall population in terms of birth patterns.

and not statistically significant, based on administrative birth certificates in Korea.[21] This evidence suggests that the birth patterns in my sample are not atypical compared to other cohorts and the population at large.

Another way to assess the validity of regression discontinuity design is to check whether individual predetermined characteristics are balanced around the cutoff. Figure 4 presents the distribution of females, firstborns, and parents' educational attainment for students born between January and April. The bin size is set to two days. Overall, the predetermined characteristics of children appear to be similar before and after the March 1st cutoff, suggesting no significant imbalance in these characteristics. One exception is that there is a slightly greater proportion of girls among January and February-born children compared to those born in March and April. I present the results separately for girls and boys, in addition to the entire sample.

Since I am using the instrument, standard instrumental variable assumptions, including the relevance of the instrumental variable and the exclusion restriction, must also be satisfied. Additionally, the monotonicity assumption is necessary to evaluate the local average treatment effect (LATE). Monotonicity implies that students born around the cutoff, if they are affected, should be affected in the same direction—specifically, they should become old-for-grade at school entry if affected in my setting. Instrument variables used in previous studies such as legal school entry age may violate the monotonicity assumption (Aliprantis, 2012; Barua and Lang, 2016; Fiorini and Stevens, 2021). Because I instrument a binary variable old-for-grade with being born after the cutoff, 'defiers' refer to parents and children

[21] One explanation provided by Kim (2021) is that school starting age enforcement is flexible, so parents can adjust the timing of their child's school entry when the child is eligible to enter school. This gives less incentive for parents to adjust birth timing.

who delay school entry when children are born before the cutoff and enter early when children are born after the cutoff. In other words, children will be seven years old when they are born before the cutoff and six years old when they are born after the cutoff. This seems implausible. For example, if children are not ready for school at age six, they may choose to be old-for-grade regardless of whether they are born before or after the cutoff. On the other hand, if children are already ready for school at age six, they will enter school on time if they are born before the cutoff. They may enter early or on time if they are born after the cutoff. Hence, it is not likely that the monotonicity assumption is violated.

4 Results

First Stage

I present the first-stage regression results in Table 2. All regressions include cohort fixed effects. Columns 1 and 2 show estimates for the entire sample, Columns 3 and 4 show estimates for girls, and Columns 5 and 6 show estimates for boys. The results show that children born after the cutoff are 32.3 percentage points more likely to be old for grade in their grade cohort. The effects are larger for girls with 37.6 percentage points compared to boys with 27.8 percentage points. Given that 44.6 percent of girls and 55.3 percent of boys born in January and February delay their entry, boys are more likely to be old for grade when they are born before cutoff. The estimates are significant in all regressions and remain consistent with and without individual controls. In the following results, I only present regression results without controls.

Main Results

Table 3 presents the main estimation results for social-emotional skills during middle school and high school. Odd columns present the effects during middle school (grades 7 to 9), while even columns present the effects during high school (grades 10 to 12). Panel A illustrates the results for girls, Panel B for boys, and Panel C for the entire sample. Columns 1 and 2 show the effects of being old for grade on self-esteem. Girls who are old for grade are more likely to exhibit higher self-esteem compared to young-for-grade girls in both middle school and high school. Magnitudes are similar in both periods as well, suggesting persistence of the effects. On the other hand, the effect on self-esteem for old-for-grade boys is relatively small and statistically insignificant. Panel C suggests that students who are old for grade generally exhibit higher self-esteem, and Panels A and B indicate these effects are primarily driven by girls.

The effects on friendships, in comparison to those on self-esteem, are generally less pronounced. On the whole, students who are old for grade tend to establish more positive relationships with their peers when compared to their young-for-grade counterparts within the entire sample. Old-for-grade girls, again, persistently enjoy closer friendships during both middle and high school. In the case of boys, the estimate on friendships is not statistically significant, despite the effect size resembling that observed in girls during middle school. Intriguingly, as students progress to high school, the distinction between old-for-grade and young-for-grade boys becomes notably diminished.

Columns 3 and 4 present the effects on friendships. In comparison to those on self-esteem, the effects are generally less pronounced. Overall, old-for-grade students tend to have better social and interpersonal skills in relationships with their peers compared to their young-for-grade counterparts within the entire sample. Old-for-grade girls persistently enjoy better friendships during both middle and high school. For boys, however, the estimate on friendships is not statistically significant, despite the similar effect size to girls during middle school. Interestingly, as students progress to high school, the difference between old-for-grade and young-for-grade boys fades out. Note that the evidence for the positive effect on friendships should be taken cautiously, given the sensitivity of the estimates to various specifications and bandwidth choices. Nonetheless, the findings imply that old-for-grade girls experience persistently better friendships, while the positive effects on old-for-grade boys tend to diminish.

Columns 5 and 6 present the effects of being old for grade on learning approaches. Girls who are old for grade tend to show more effective study habits, greater engagement in learning, and heightened dedication when compared to younger girls. Again, these effects persist throughout middle and high school. The estimate of 0.916 standard deviations in high school is slightly bigger than the estimate in middle school. One plausible explanation could be the higher perceived stakes associated with high school, as test scores in this period directly influence college admissions. Consequently, old-for-grade girls might exhibit enhanced self-control and study behaviors.

Panel A of Columns 7 and 8 suggests that old-for-grade girls tend to show a better ability to set goals. This implies that they are more likely to have clear goals and actively strive to achieve them. However, the estimates are somewhat smaller and statistically significant only at the 10 percent level during middle school, eventually losing their statistical significance in high school. In contrast, the effects of learning approaches and goal-setting mindsets for boys are relatively negligible during middle school, with a shift towards a negative direction in high school, albeit without statistical significance. Taken together, old-for-grade boys are not significantly more likely to have better learning approaches or goal-setting mindsets than young-for-grade boys.

In summary, the old-for-grade effects are more pronounced for girls. Old-for-grade girls show higher self-esteem, closer relationships with friends, and more effective learning approaches. Importantly, these findings suggest that the positive effects for old-for-grade girls persist over time rather than fade out as the students advance to higher grades. In contrast, old-for-grade boys do not show noticeable improvements in their social-emotional skill development.

To provide a broader context in terms of magnitudes, I first compare my estimates to other papers that study the effect of school starting age on similar outcomes. The effect size for self-esteem, ranging from 0.590 to 0.762 standard deviations for the entire sample, is larger than the 0.15 standard deviation identified by Datar and Gottfried (2015) for eighth graders. Notably, the impact on learning approaches for old-for-grade girls does not diminish over time, in contrast to the findings of Datar and Gottfried (2015) and Lubotsky and Kaestner (2016). The magnitude of the estimate in high school is comparable to the 0.63 standard deviation observed in Lubotsky and Kaestner (2016) or the 0.701 standard deviation identified in Datar and Gottfried (2015) during the Fall of kindergarten.

Then I compare my estimates with other interventions studying similar outcomes. This difference can potentially be attributed to variations in estimation methodologies and the local nature of both regression discontinuity and instrumental variable approaches. Despite potential limitations in terms of external validity beyond the specified bandwidths, reduced-form estimates could be employed for comparison with other interventions. Estimation results from reduced-form regressions are presented in Appendix Table A7. For instance, the effect on girls' friendships, ranging from 0.257 to 0.372 standard deviations, is comparable in magnitude to the effect of increasing the proportion of female peers in the classroom by 33.5 to 48.5 percentage points Gong et al. (2021). This increases students' social acclimation and general satisfaction index. Similarly, the effect on the learning approaches index of 0.353 standard deviation in high school aligns with the magnitude associated with an increase in teacher quality by 2 to 3 standard deviations on students' effort in class (Kraft, 2019).

Since there are multiple outcomes across middle school and high school, I also investigate the possibility of an increased number of significant results due to multiple hypothesis testing. I employ Bonferroni and Sidak corrections to adjust the p-values. I first adjust p-values across outcomes for girls. While the impact on friendship and learning approaches is not robust, the difference in self-esteem between old-for-grade girls and young-for-grade girls remains statistically significant. Furthermore, girls' self-esteem remains significant even after implementing corrections across both genders and outcomes. These findings further support that old-for-grade girls are more likely to exhibit higher self-esteem than young-for-grade girls, although the effects on other social-emotional skills might not be as robust.

Mechanisms and Interpretation

A crucial question in studying age effects is whether the observed old-for-grade effects are simply due to age differences within the same grade. When skills are measured at the same point of time, younger students might naturally exhibit lower skill levels because they have had less time to develop these skills. It is possible that these younger students would achieve the same skill levels if assessed one year later when they are the same age as their older peers.

To investigate this possibility, I re-create the outcome variables based on the age rather than the grade. For example, at age 17, old-for-grade students are typically in grade 11, whereas young-for-grade students are in grade 12. I take grade 11 responses for old-for-grade students and grade 12 responses for young-for-grade students to create outcome variables at the same age. Thus, old-for-grade students are the same age but have one less year of schooling compared to their young-for-grade peers. Estimates using these new outcome measures control age at the survey while also including the potentially negative effects of having one less year of schooling. In contrast, estimates using grade-based outcome measures combine the effects of school starting age, relative age compared to peers, and age at the time of the survey. If age at the time of the survey is the primary driver of these effects, the estimates based on outcomes measured at the same age should be smaller and not statistically significant. Ideally, using social-emotional skill measures in the later stages of life would fully control for years of schooling and differences in educational cycles. Although the data I use do not include information beyond high school, I can compare the estimates pooled across all grades (grades 7 to 12) and all ages (ages 13 to 17) to partially examine the influence of years of schooling.

Table 4 presents the results. For girls, the estimates at all ages are slightly attenuated compared to those at all grades. This suggests that age at the time of the survey contributes to some of the estimated effects in middle and high school years, or that having an additional year of schooling partially mitigates the impact of starting school at an older age. The effects for boys are generally consistent across all grades and ages.[22] This indicates that the old-for-grade effects do not completely disappear when young-for-grade students reach the same age as old-for-grade students and that an additional year of schooling does not fully compensate for starting school at an older age. Age at school entry and relative age compared to peers play a more significant role in social-emotional skill development.

Next, I investigate the potential mechanisms underlying these effects. First, I examine whether old-for-grade girls achieve higher test scores that could enhance their self-esteem.[23] The results, presented in Appendix Table A8, show that while the estimates are imprecise, old-for-grade girls perform better on Korean and math tests than their younger peers in middle school, though this advantage does not persist in high school. In contrast, old-for-grade boys consistently outperform their younger peers in English tests throughout middle and high school. This suggests that better test performance in middle school could be one factor contributing to higher self-esteem in girls, but test performance alone does not fully explain the disparities in girls' self-esteem.

Additionally, I compare estimates using test scores based on grade with those based on age. Recognizing that tests at each grade level reflect different educational cycles, I address this concern by utilizing the vertically scaled scores provided in SELS 2010, which align test scores across grade levels on a common vertical scale (Kim, 2015). The results, shown in Appendix Figure A7, indicate that the estimates are generally similar in size between grade-based and age-based test scores. As both girls and boys age or advance to higher grades, the estimates tend to become close to zero, following a pattern similar to that in Appendix

[22] These findings remain consistent when comparing the estimates of skills measured at a specific grade and those measured at a specific age. Results are shown in Appendix Figures A5 and A6.

[23] SELS 2010 developed Korean, math, and English tests based on the first-semester curriculum of each grade in the survey year.

Table A8.

The lack of significant effects on test scores, despite the positive impact on learning approaches, may seem counterintuitive. One plausible explanation is that the exams in the survey may not carry as high stakes. In fact, Kim (2011) finds that a one-month increase in school starting age increases the likelihood of entering a 4-year college by 0.42 percentage points within two years after high school graduation in Korea. This suggests that, although the direct influence on test scores may not be immediately evident, the effects of being old for grade on learning approaches could still play a role in later life.

Lastly, I explore whether old-for-grade students have physical advantages. Since height and weight were surveyed only in the first wave, I analyzed the height and weight of each cohort for grades 4 and 7. The results, as shown in Appendix Table A9, indicate that while the estimates for girls' height are positive, they are not statistically significant. The gaps between old- and young-for-grade boys are smaller and also not significant. In the seventh-grade cohort, the estimates are smaller compared to the fourth-grade. While old-for-grade girls may be taller than their younger peers in fourth grade, this difference fades by seventh grade. Additionally, the correlation between height and self-esteem is stronger for boys than for girls in the seventh-grade cohort, indicating that physical advantages are less likely to be the main driver of girls' higher self-esteem.

I use the Korean Children and Youth Panel Survey 2010 (KCYPS 2010) to complement the previous analysis for physical advantages and run a placebo test on age-based and grade-based estimates.[24] Since this dataset only provides birth month and year, not the exact date,

[24] I use the fourth- and seventh-grade cohorts in KCYPS 2010, who are in the same grades as my main sample from SELS 2010.

I apply an instrumental variable approach and focus on children born between January and April.[25] Appendix Figure A8 shows that old-for-grade girls are about 10 cm (4 inches) taller than young-for-grade girls in grade 5, significantly taller in grades 6 and 7, but the height difference diminishes by grade 8. Despite the height difference in age 11, the age-based estimates are mostly near zero. Boys' height results are noisier, but age-based estimates still trend closer to zero compared to grade-based estimates in grades 6 to 8. These findings confirm that the slight differences between age-based and grade-based estimates for social-emotional skills are not coincidental. Moreover, height differences are more pronounced in grades 5 to 7 for girls and grades 6 to 8 for boys. Thus, contemporaneous height differences are again less likely to be the primary factor behind girls' higher self-esteem.

Improved social-emotional skills for old-for-grade girls have crucial implications. Self-esteem has positively correlated with post-secondary education and later labor market outcomes, including employment and earnings (de Araujo and Lagos, 2013). Based on the estimates provided by de Araujo and Lagos (2013), a back-of-the-envelope calculation suggests that a one standard deviation increase in self-esteem could result in an approximately 25.06 percent wage increase for females, through an increase in years of schooling. Friendship, which is a combined index for social and interpersonal skills, can similarly impact employment. According to Deming (2017), a one standard deviation improvement in social skills predicts a 3.0 percentage point rise in full-time employment. Given the 0.964 standard deviation increase in friendship for girls, this could potentially translate into a 2.89 percentage point increase in female employment. While interpreting these findings, it is essential to be

[25] Using month of birth instead of exact birth date as the running variable, I instrument a born-after-cutoff indicator on the old-for-grade indicator. The model controls for the month of birth, the interaction between the month of birth and the born-after-cutoff indicator, and cohort fixed effects. Standard errors are clustered at the month-of-birth level.

cautious since most previous studies are based on US data, and some date back to the 1980s and early 2000s, which may differ from the current South Korean context. Nevertheless, it remains plausible that old-for-grade girls with enhanced social-emotional skills might attain more years of education and experience improved labor market outcomes in the future.

5 Robustness Check

In this section, I show the robustness of the results through a series of tests. First, I replicate the analyses with different bandwidths. Specifically, I employ mean squared error (MSE) optimal bandwidths for individual regressions and for the first stage, both computed following Calonico et al. (2014). I compare bias-corrected estimates and robust confidence intervals with the main estimates. Secondly, I explore the sensitivity of the results to different functional forms by estimating the effects using global linear and quadratic regressions, also utilizing various bandwidths (30, 60, and 90 days). Third, I assess whether a donut regression discontinuity approach, which excludes a small number of observations close to the cutoff, yields different results. Fourth, I examine whether including day-of-week and holiday fixed effects in the specification affects the main results.

To evaluate the sensitivity to bandwidth choices, I re-estimate the effects using MSE optimal bandwidths, following Calonico et al. (2014). I employ two approaches for computing MSE optimal bandwidths. The first minimizes the mean squared errors for fuzzy regression discontinuity design, generating different bandwidths for each regression—the MSE optimal bandwidths for fuzzy regression discontinuity range from 42 days to 78 days. The second uses the MSE optimal bandwidths computed in the first stage. Thus, I use the same bandwidths within each gender. The first-stage MSE optimal bandwidths are 38 days for girls and 40 days for boys. Results are presented in the Appendix Figures A9 and A10. The estimates maintain similar magnitudes across the different bandwidth choices. Estimates also remain statistically significant except for girls' friendships in high school and learning approaches in all grades. This indicates that the main results are robust and not sensitive to bandwidth choices.

Concerns might arise due to dates of birth being discrete variables, raising questions about the applicability of local linear regression discontinuity design. To address this concern, I replicate the main results using a parametric regression discontinuity design and cluster the standard errors at the date of birth level, following the approach proposed by Lee and Card (2008). The results obtained through global linear polynomials are largely consistent with my main specifications. To further check sensitivity to functional form, I compare estimates using linear and quadratic control functions and different bandwidth choices (30 days and 90 days). Results are shown in the Appendix Figures A11 and A12. Some estimates become noisy when using a smaller bandwidth of 30 days. This might be attributed to a smaller sample size due to narrower bandwidths. Although some estimates lose statistical significance, the magnitudes are consistent in general. Importantly, results for girls' self-esteem remain large and significant across different specifications. This reassures that the effects on girls' self-esteem are robust to changes in functional forms.

Next, I redo the same analyses using a donut regression discontinuity approach. Although manipulation testing does not reject the smoothness of the density of births, one might be worried about the randomness of births around the cutoff, especially considering March 1st is a holiday in Korea. To examine the robustness of the results, I exclude 1 day, 4 days, and 7 days before and after March 1st. Appendix Figures A13 and A14 indicate that the coefficients are robust to the donut approach. While the effects on girls' friendships and goal-setting mindsets become larger and statistically significant when excluding 7 days before/after the cutoff, the magnitudes of other outcomes generally remain similar.

Additionally, I investigate whether the results are sensitive to including day-of-week and holiday fixed effects. Results are shown in Appendix Tables A10 to A13. Columns 1 and 5 show estimates from my main specifications, and Columns 4 and 8 show estimates with day-of-week fixed effects. The estimates remain nearly unchanged across these different specifications. The results from the donut approach and the inclusion of day-of-week fixed effects help address concerns regarding potential birth manipulation around the cutoff.

6 Conclusion

In this study, I examine whether the effects of being old for grade on students' social-emotional skills fade out in late adolescence. By employing a fuzzy regression discontinuity design with a binary treatment of being old-for-grade and a binary assignment based on birth dates relative to the cutoff, I mitigate concerns about potential violations of the monotonicity assumption. Additionally, I leverage the unique educational context of Seoul, characterized by random middle school assignments, infrequent grade repetition and skipping, and a high rate of high school advancement, to control for confounding factors related to school sorting, repetition, and varying lengths of schooling.

I find that old-for-grade girls consistently exhibit higher self-esteem than their younger counterparts throughout both middle and high school. There is also suggestive evidence that they maintain closer friendships during adolescence and develop better learning approaches in high school. In contrast, the effects on boys' social-emotional skills are more limited. While old-for-grade boys experience slightly improved friendships in middle school, this effect fades out by high school. These results underscore the distinct trajectories of social-emotional skill development between girls and boys.

Lastly, I distinguish between relative and absolute age effects by comparing estimates from outcomes measured at the same age with those measured at the same grade. Even when controlling for absolute age at the time of the survey, old-for-grade girls continue to demonstrate higher social-emotional skills despite having one less year of schooling. This suggests that relative age is likely the more significant factor driving the old-for-grade effects on social-emotional skills.

This research has important implications for educators and policymakers, emphasizing the in-school program designs that support the development of social-emotional skills. In a school system with a defined cutoff date, there will always be age differences within the same grade, and younger girls may be at a disadvantage in terms of social-emotional skills. The persistent old-for-grade effects into late adolescence suggest that these disadvantages could have long-term consequences for young-for-grade students. Moreover, if, as the theory of dynamic complementarity suggests, skill begets skill, then old-for-grade students may derive greater benefits from interventions aimed at enhancing social-emotional skills. Therefore, it is crucial to consider these gaps when designing in-school programs to support skill development.

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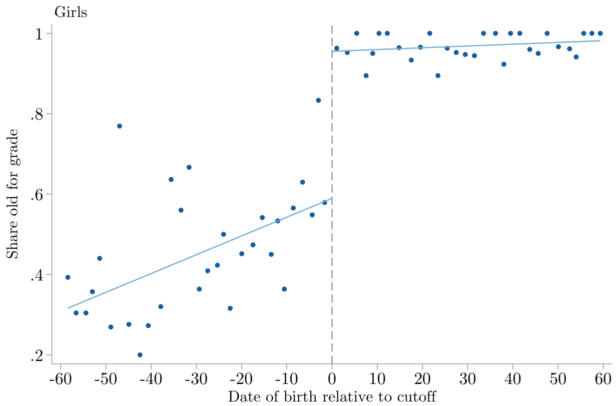
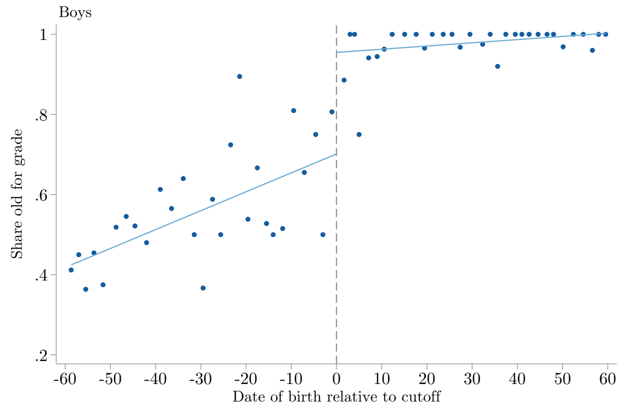
Figures

Figure 1: Share of Old-for-Grade Students among Girls (Left) and Boys (Right)



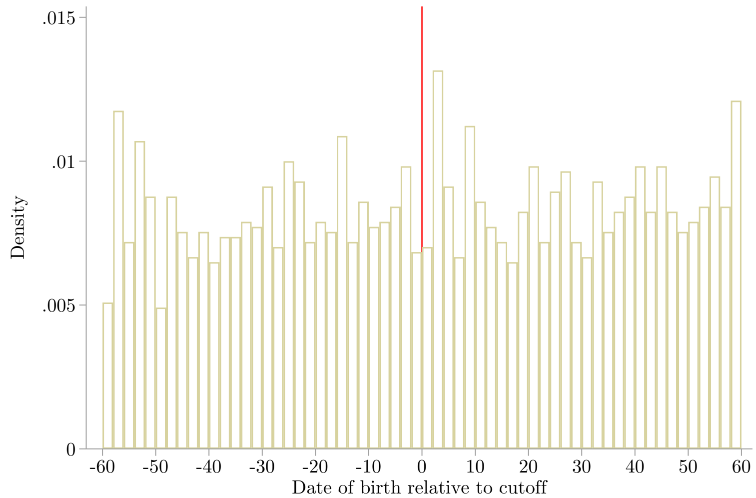
(a) Girls



(b) Boys

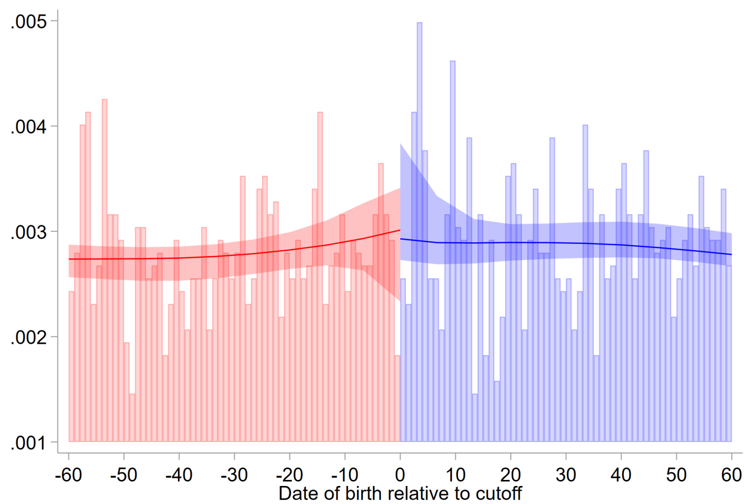
The share of old-for-grade students born between January and April is shown. The sample I use includes fourth-grade and seventh-grade cohorts in SELS 2010. The bin size is set to two days.

Figure 2: Density of Births Born Around the Cutoff



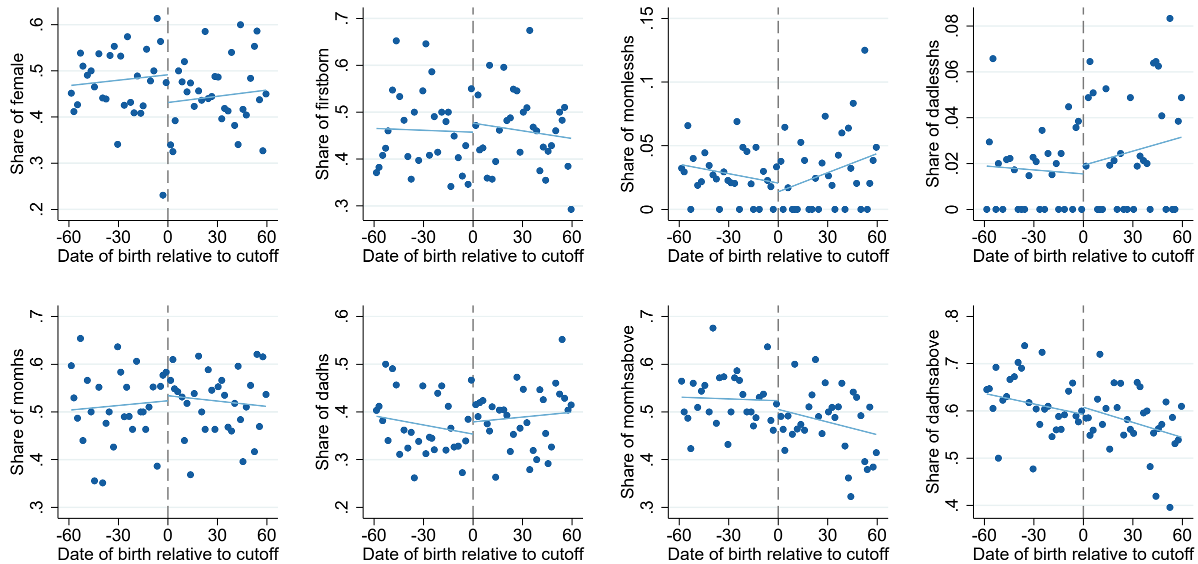
The density of births born between January and April is shown. The sample I use includes fourth-grade and seventh-grade cohorts in SELS 2010. The bin size is set to two days.

Figure 3: Manipulation Testing of Births



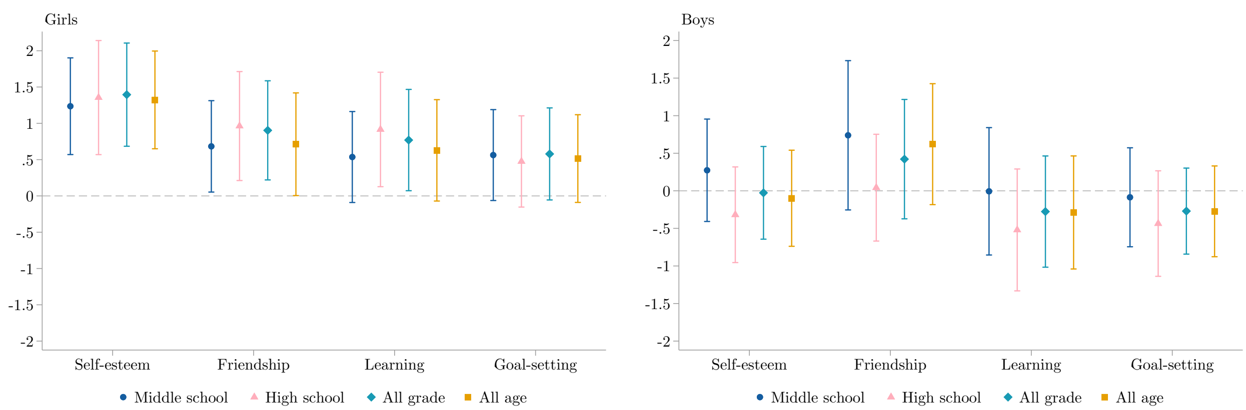
The figure presents manipulation testing of birth density around the cutoff following Cattaneo et al. (2020). The bandwidth is 60 days and the bin size is set to one day. The sample I use includes fourth-grade and seventh-grade cohorts in SELS 2010.

Figure 4: Comparison of Predetermined Characteristics Before and After the Cutoff



Each figure presents individual predetermined characteristics within 60-day bandwidths. Each dot represents the mean of each characteristic in a two-day bin. Predetermined characteristics include female, firstborn status, and parents' educational attainment. Parents' educational attainment is divided into three categories: less than high school, high school graduates, and some college or more. I also check for indicators of missing values in these characteristics, which are also balanced around the cutoff.

Figure 5: Effects of Being Old for Grade on Girls' and Boys' Social-Emotional Skills



(a) Girls (b) Boys

All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. Middle school (MS) outcomes are averaged across grades 7 to 9, high school (HS) outcomes are averaged across grades 10 to 12, and all grade outcomes are averaged across grades 7 to 12. All age outcomes are averaged across ages 13 to 17. All outcomes are standardized with a mean of zero and a unit variance.

Tables

Table 1: Summary Statistics of Outcome Indices by Cutoff and Gender: January to April Borns

	Girls		Boys	
	Before cutoff	After cutoff	Before cutoff	After cutoff
Panel A: Self-esteem				
Grades 7 to 9	3.597	3.699	3.728	3.718
	(0.707)	(0.735)	(0.683)	(0.666)
Grades 10 to 12	3.623	3.667	3.807	3.778
	(0.705)	(0.694)	(0.665)	(0.701)
Panel B: Friendship				
Grades 7 to 9	4.221	4.264	4.206	4.265
	(0.497)	(0.497)	(0.557)	(0.532)
Grades 10 to 12	4.185	4.209	4.231	4.212
	(0.508)	(0.528)	(0.525)	(0.536)
Panel C: Learning approaches				
Grades 7 to 9	3.275	3.342	3.333	3.339
	(0.635)	(0.622)	(0.650)	(0.622)
Grades 10 to 12	3.314	3.351	3.336	3.315
	(0.633)	(0.605)	(0.605)	(0.634)
Panel D: Goal-setting				
Grades 7 to 9	3.695	3.744	3.791	3.745
	(0.676)	(0.698)	(0.662)	(0.666)
Grades 10 to 12	3.704	3.748	3.731	3.693
	(0.625)	(0.630)	(0.631)	(0.701)
Observations	648	648	700	809

Average and standard deviation before standardization to mean zero and a unit variance are shown, with standard deviations in parentheses. The sample I use includes fourth-grade and seventh-grade cohorts born between January and April from SELS 2010 data. Grades 7 to 9 and grades 10 to 12 comprise middle school and high school, respectively. For each survey question, the student response is on a 5-point scale: *1 'strongly disagree,' 2 'disagree,' 3 'neutral,' 4 'agree,' 5 'strongly agree'*. A higher index indicates better social-emotional skills.

Table 2: First Stage: Effects of Being Born after the Cutoff on Being Old for Grade

	Entire sample		Girls		Boys	
	(1)	(2)	(3)	(4)	(5)	(6)
Born after cutoff	0.323***	0.315***	0.376***	0.372***	0.278***	0.277***
	(0.026)	(0.026)	(0.034)	(0.033)	(0.048)	(0.048)
Observations	2825	2825	1287	1287	1494	1494
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls		Yes		Yes		Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each cell reports the estimate of being born after the cutoff on being old for grade from a separate regression with a triangular kernel, linear polynomials, and 60-day bandwidths. All regressions include cohort fixed effects. Standard errors, in parentheses, are clustered at the date of birth level. Individual-level controls include a female indicator, a firstborn indicator, parents' educational attainment (categorized as less than high school, high school graduates, and some college or more), and indicators for missing values of these controls.

Table 3: RD Estimates of Social-Emotional Skills in Middle School and High School

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) MS	(2) HS	(3) MS	(4) HS	(5) MS	(6) HS	(7) MS	(8) HS
Panel A: Girls								
Old for grade	1.237***	1.356***	0.683**	0.964**	0.536*	0.916**	0.563*	0.475
	(0.340)	(0.401)	(0.321)	(0.383)	(0.320)	(0.403)	(0.320)	(0.321)
Observations	1216	1082	1216	1082	1214	1082	1217	1082
Panel B: Boys								
Old for grade	0.275	-0.320	0.743	0.042	-0.007	-0.523	-0.087	-0.438
	(0.349)	(0.326)	(0.510)	(0.364)	(0.435)	(0.415)	(0.338)	(0.360)
Observations	1416	1206	1417	1206	1417	1206	1417	1206
Panel C: Entire Sample								
Old for grade	0.823***	0.590*	0.667**	0.485*	0.239	0.164	0.251	-0.027
	(0.271)	(0.317)	(0.318)	(0.280)	(0.279)	(0.304)	(0.179)	(0.262)
Observations	2675	2324	2676	2324	2674	2324	2677	2324
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each cell reports the estimate of being old for grade on a social-emotional skill index from a separate regression with a triangular kernel, linear polynomials, and 60-day bandwidths. Standard errors, in parentheses, are clustered at the date of birth level. All regressions include cohort fixed effects. Middle school (MS) outcomes are averaged across grades 7 to 9, high school (HS) outcomes are averaged across grades 10 to 12. All outcomes are standardized with mean zero and unit variance.

Table 4: Comparison of RD Estimates: Social-Emotional Skills Measured at Same Grades vs. at Same Ages

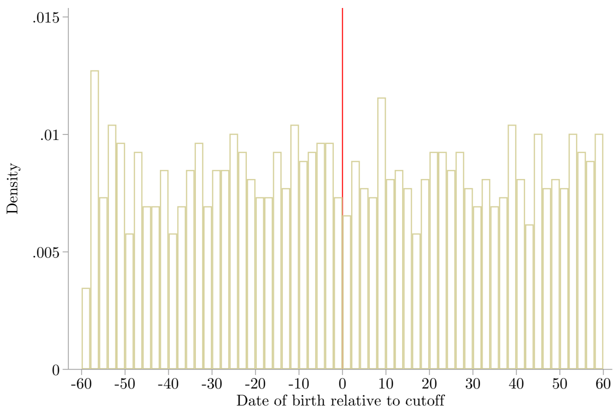
	Self-esteem		Friendship		Learning		Goal-setting	
	(1) Grade	(2) Age	(3) Grade	(4) Age	(5) Grade	(6) Age	(7) Grade	(8) Age
Panel A: Girls								
Old for grade	1.396***	1.324***	0.904***	0.712**	0.770**	0.628*	0.579*	0.515*
	(0.363)	(0.344)	(0.349)	(0.361)	(0.356)	(0.357)	(0.324)	(0.308)
Observations	1286	1274	1286	1274	1284	1273	1287	1274
Panel B: Boys								
Old for grade	-0.027	-0.099	0.423	0.624	-0.277	-0.289	-0.271	-0.274
	(0.316)	(0.328)	(0.407)	(0.413)	(0.379)	(0.385)	(0.293)	(0.310)
Observations	1493	1483	1494	1484	1494	1484	1494	1484
Panel C: Entire Sample								
Old for grade	0.762***	0.685**	0.635**	0.635**	0.217	0.131	0.130	0.0998
	(0.283)	(0.276)	(0.297)	(0.298)	(0.274)	(0.276)	(0.192)	(0.187)
Observations	2823	2801	2824	2802	2822	2801	2825	2802
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each cell reports the estimate of being old-for-grade on social-emotional skill indices from a separate regression with a triangular kernel, linear polynomials, and 60-day bandwidths. Standard errors, in parentheses, are clustered at the date of birth level. All regressions include cohort fixed effects. All grade outcome indices are averaged across grades 7 to 12, and all age outcome indices are averaged across ages 13 to 17. All outcomes are standardized with mean zero and unit variance.

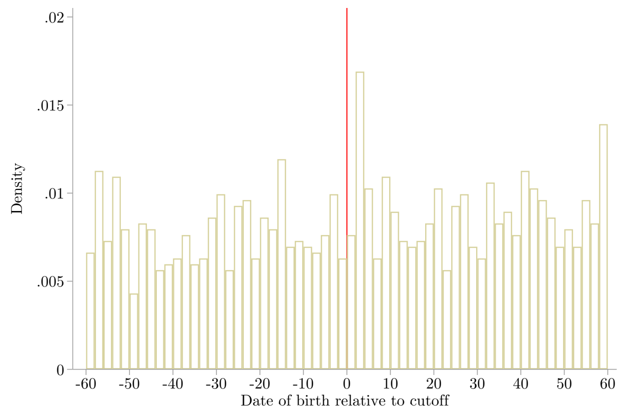
Appendix

Appendix Figures

Figure A1: Density of Births Born Around the Cutoff by Gender



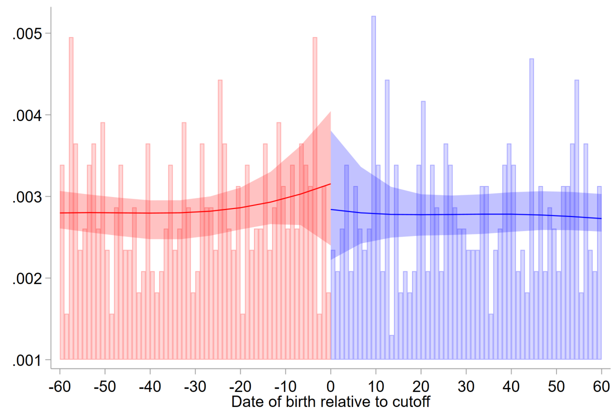
(a) Girls



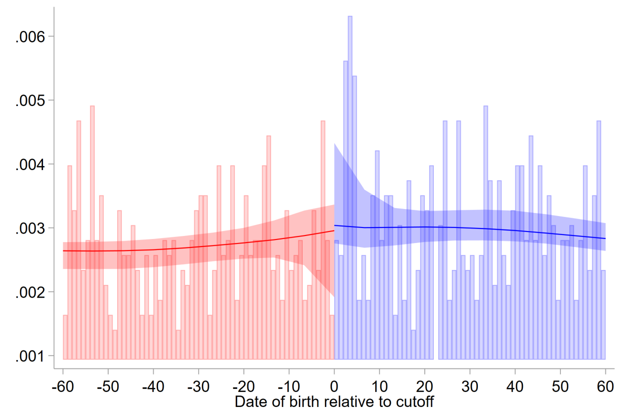
(b) Boys

The figure shows the density of births born between January and April by gender. The sample I use includes girls and boys in fourth-grade and seventh-grade cohorts in SELS 2010. The bin size is set to two days.

Figure A2: Manipulation Testing of Birth Density by Gender



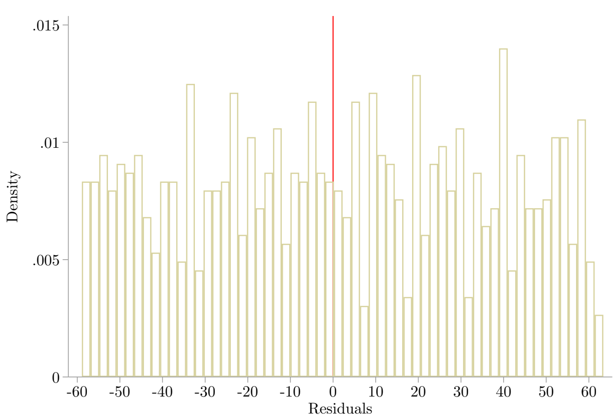
(a) Girls



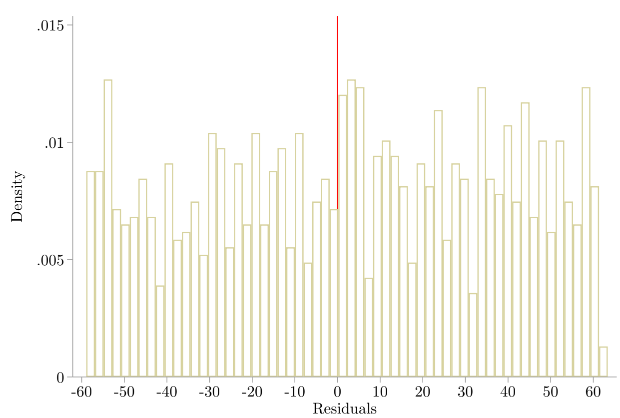
(b) Boys

The figure presents manipulation testing of birth density around the cutoff by gender following Cattaneo et al. (2020). The bandwidth is 60 days and the bin size is set to one day. The sample I use includes girls and boys fourth-grade and seventh-grade cohorts in SELS 2010.

Figure A3: Density of Birth Born Around the Cutoff Conditional on Day-of-Week Fixed Effects



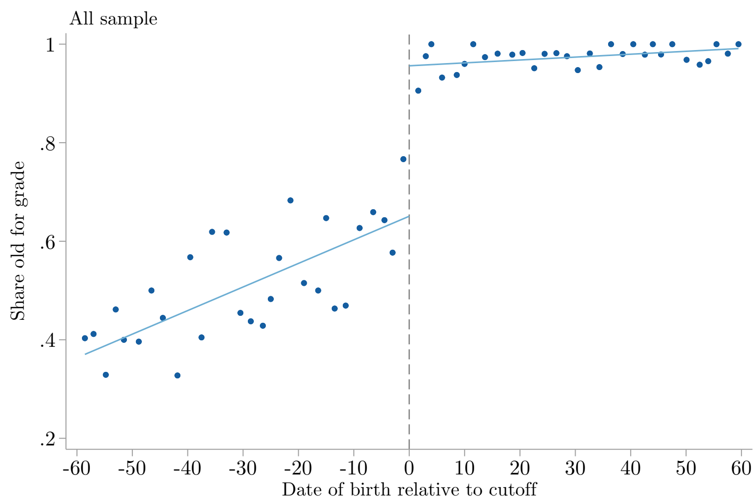
(a) Girls



(b) Boys

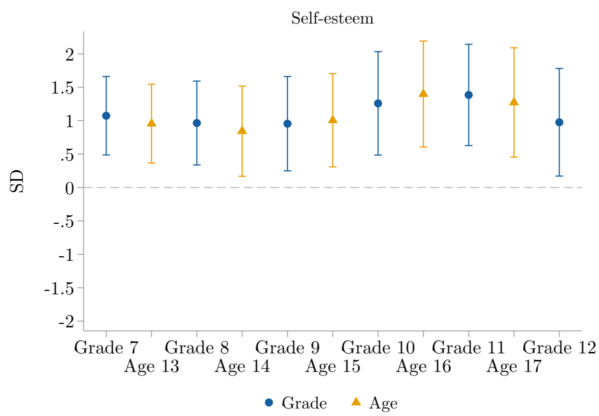
The figure shows the density of births born between January and April, using residuals from regressions conditioning on day-of-week fixed effects and holidays. Panel A shows the birth patterns of girls and Panel B shows the birth patterns of boys. The sample I use includes fourth-grade and seventh-grade cohorts in SELS 2010. The bin size is set to two days.

Figure A4: Share of Old-for-Grade Students

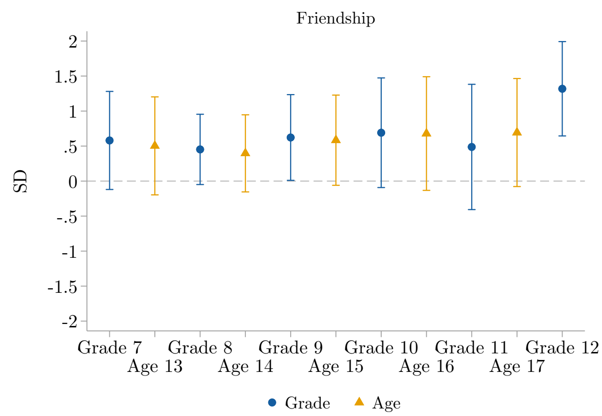


The share of old-for-grade students born between January and April is shown. The sample I use includes fourth-grade and seventh-grade cohorts in SELS 2010. The bin size is set to two days.

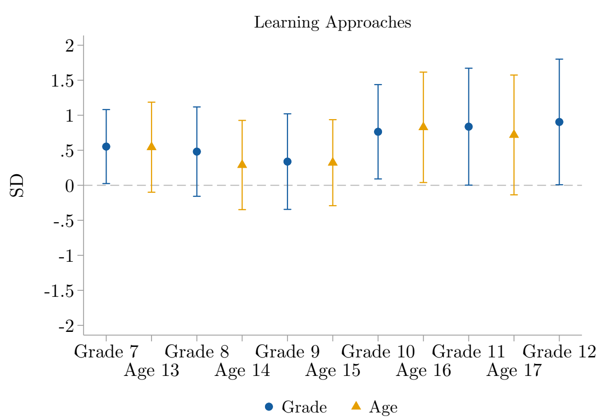
Figure A5: Comparison of Old-for-grade Effects in Grades 7–12 and Ages 13–17 (Girls)



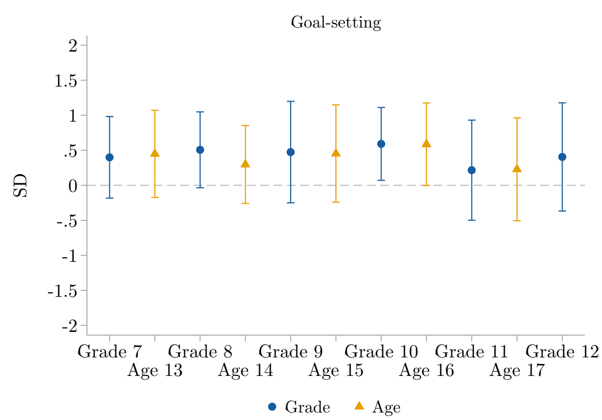
(a) Self-esteem



(b) Friendship



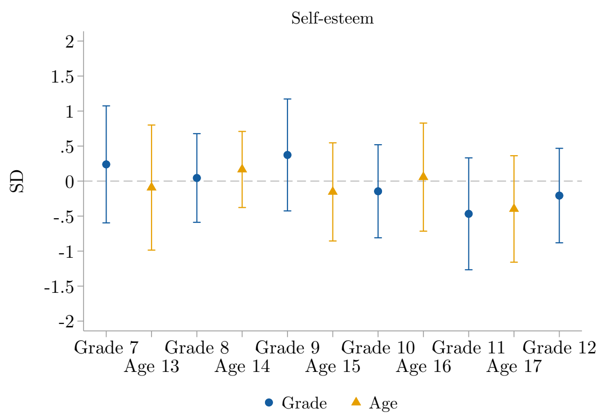
(c) Learning approaches



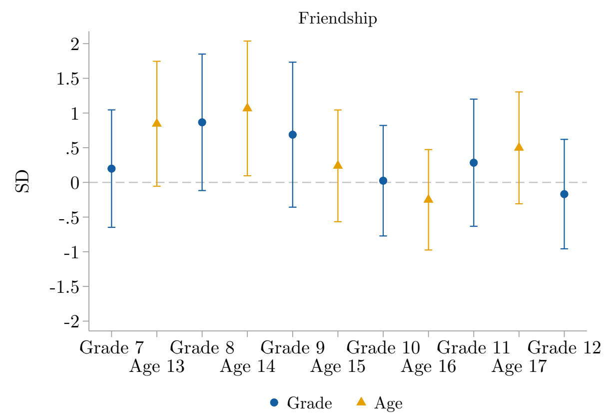
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

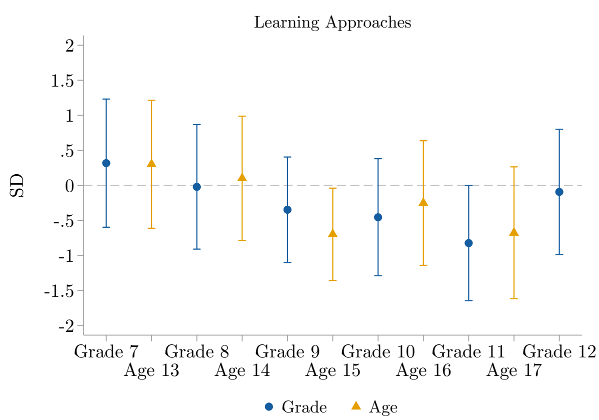
Figure A6: Comparison of Old-for-grade Effects in Grades 7–12 and Ages 13–17 (Boys)



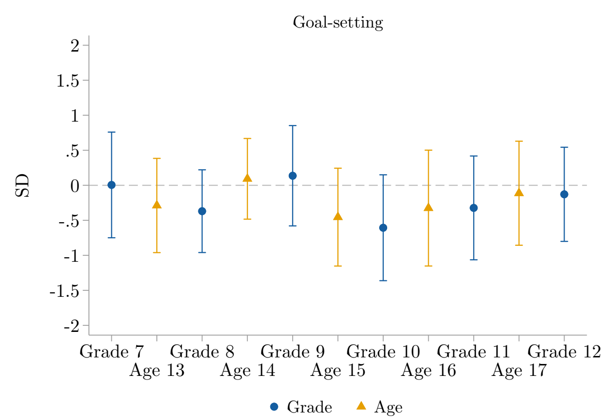
(a) Self-esteem



(b) Friendship



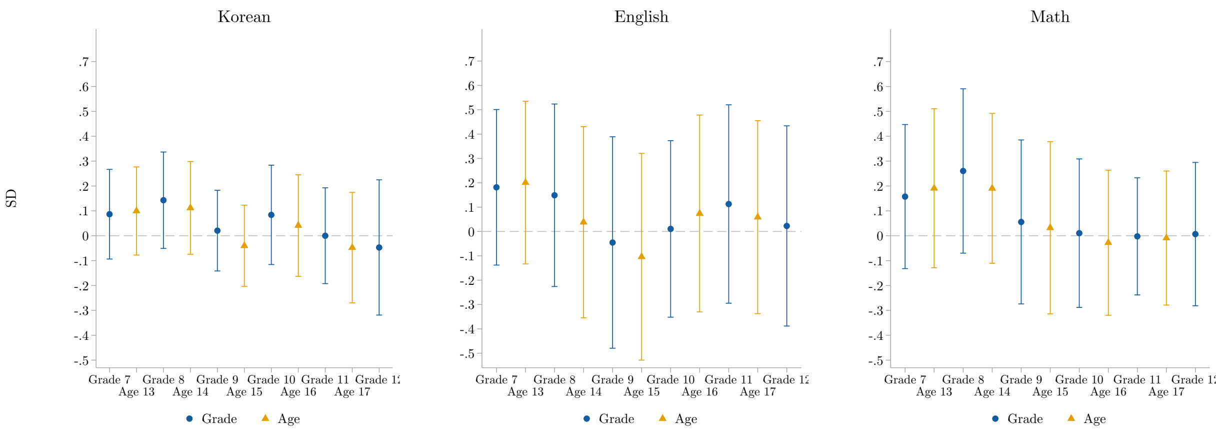
(c) Learning approaches



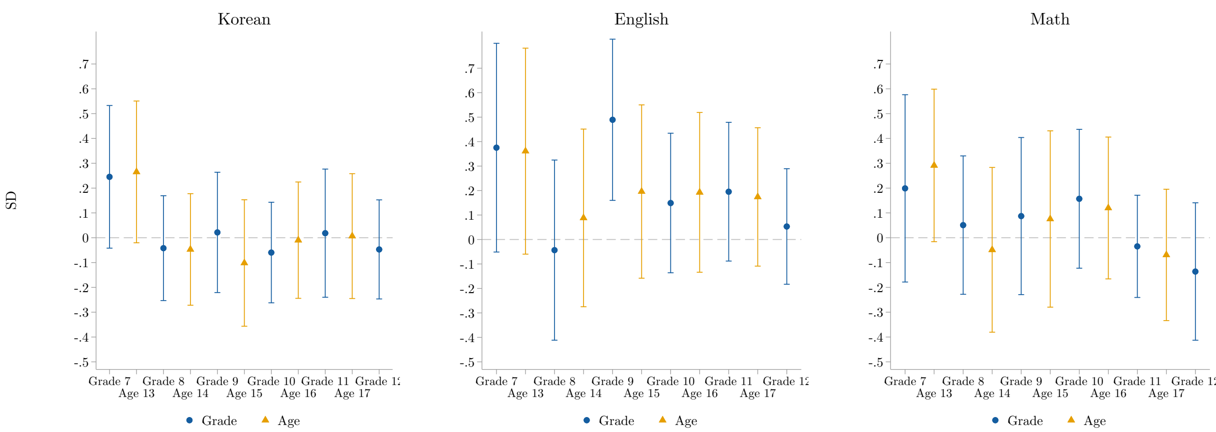
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

Figure A7: Old-for-grade Effects on Test Scores in Grades 7–12 and Ages 13–17



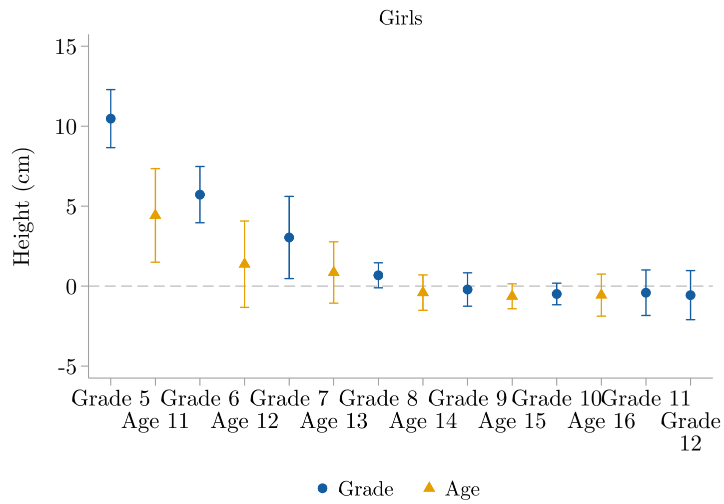
(a) Girls



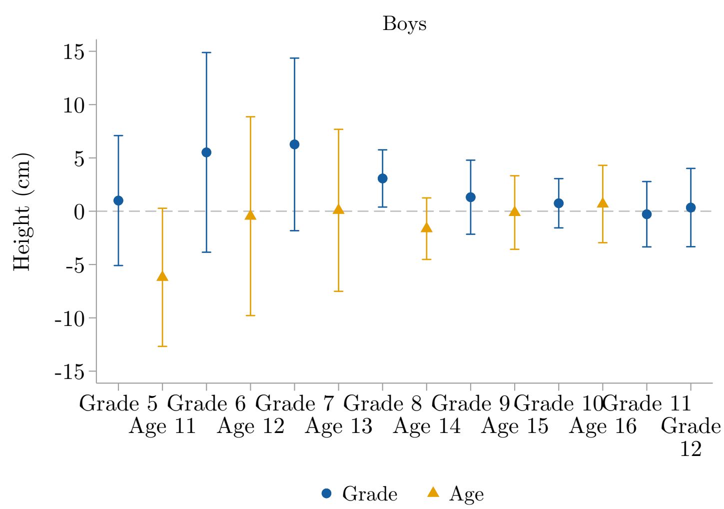
(b) Boys

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent estimates using outcomes measured at the same grade. Triangles represent estimates using outcomes measured at the same age. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. Test scores are vertically scaled and standardized with mean zero and unit variance.

Figure A8: Old-for-grade Effects on Height in Grades 5–12 and Ages 11–16 Using IV



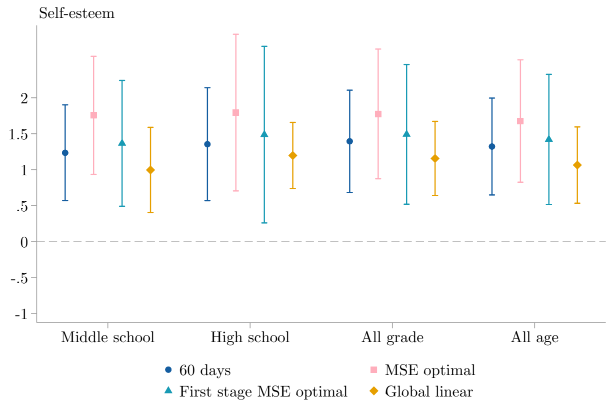
(a) Girls



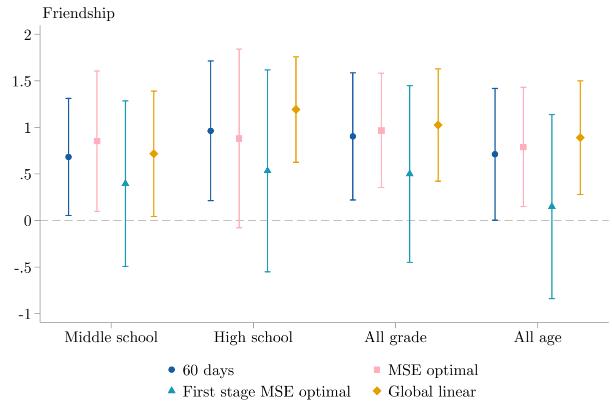
(b) Boys

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent estimates using outcomes measured at the same grade. Triangles represent estimates using outcomes measured at the same age. The sample includes January- to April-born children among fourth-grade and seventh-grade cohorts in KCYPS 2010. All regressions include cohort fixed effects. Standard errors are clustered at the month of birth level.

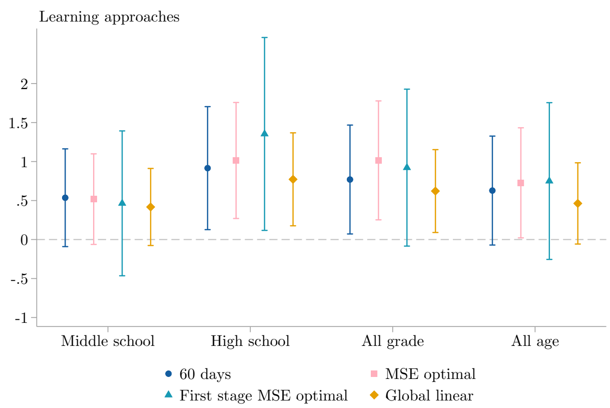
Figure A9: Sensitivity of RD Estimates to Bandwidth Choices: Being Old for Grade on Social-Emotional Skills (Girls)



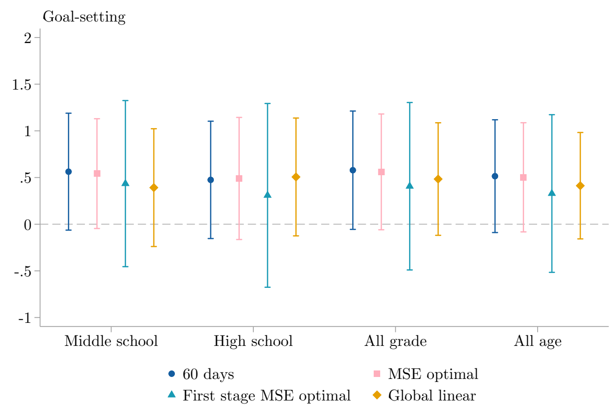
(a) Self-esteem



(b) Friendship



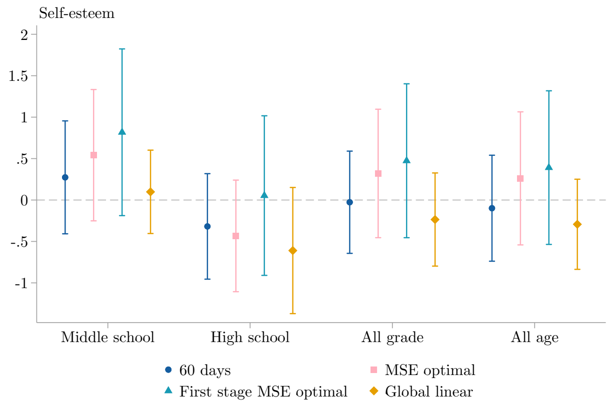
(c) Learning approaches



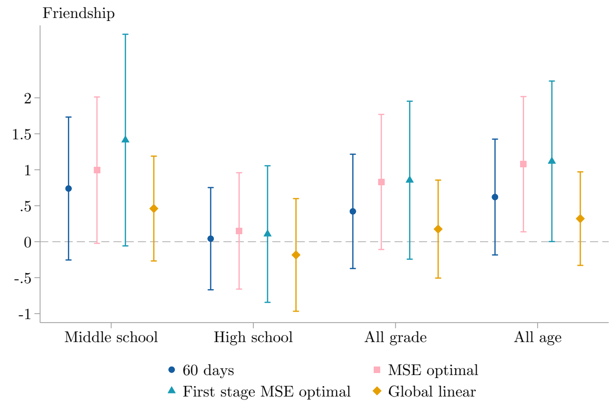
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent estimates from the main regression using 60-day bandwidths. Squares represent bias-corrected estimates and robust confidence intervals from the regression with mean squared error (MSE) optimal bandwidths following Calonico et al. (2014). Triangles represent bias-corrected estimates and robust confidence intervals from the regression with first-stage MSE optimal bandwidths. Lastly, diamonds represent estimates using global linear polynomials with 60-day bandwidths. All estimates use a triangular kernel and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

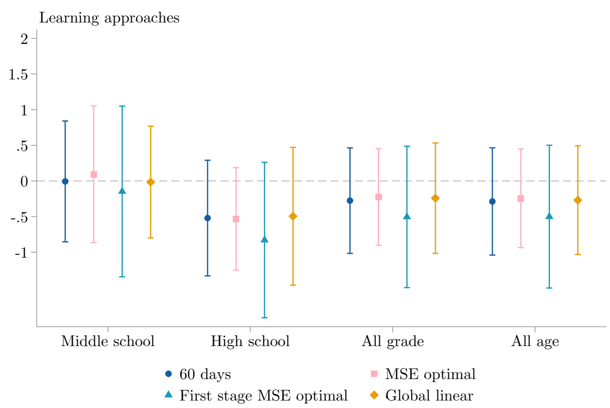
Figure A10: Sensitivity of RD Estimates to Bandwidth Choices: Being Old for Grade on Social-Emotional Skills (Boys)



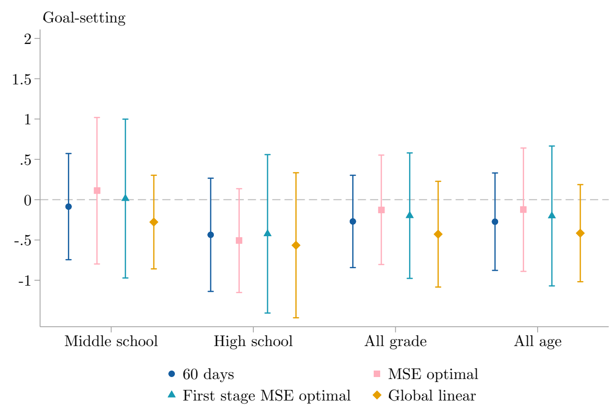
(a) Self-esteem



(b) Friendship



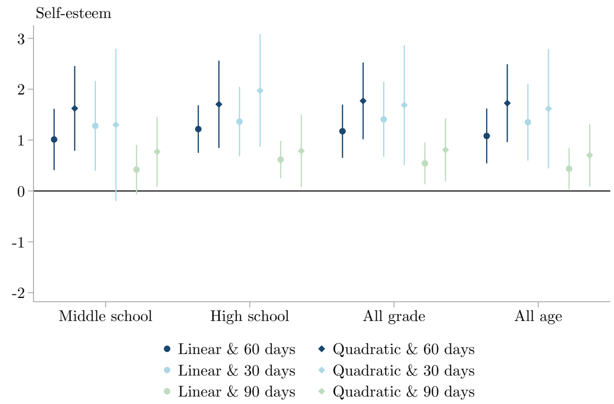
(c) Learning apprаches



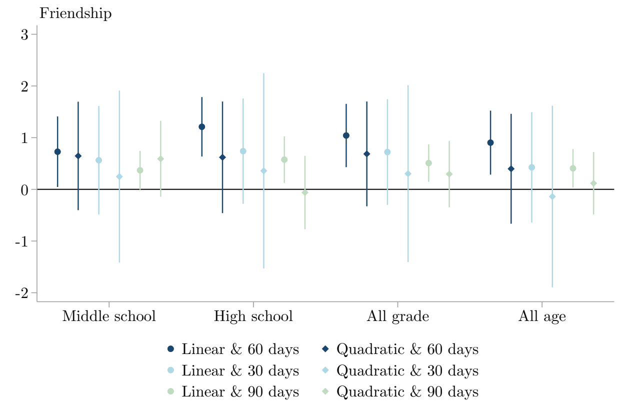
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent estimates from the main regression using 60-day bandwidths. Squares represent bias-corrected estimates and robust confidence intervals from the regression with mean squared error (MSE) optimal bandwidths following Calonico et al. (2014). Triangles represent bias-corrected estimates and robust confidence intervals from the regression with first-stage MSE optimal bandwidths. Lastly, diamonds represent estimates using global linear polynomials with 60-day bandwidths. All estimates use a triangular kernel and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

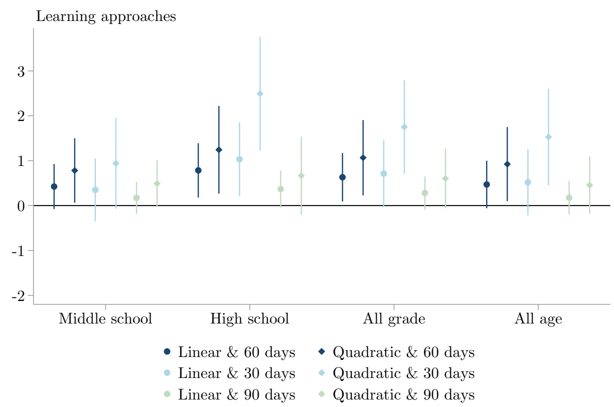
Figure A11: Sensitivity of RD Estimates to Polynomial and Bandwidth Choices: Being Old for Grade on Social-Emotional Skills (Girls)



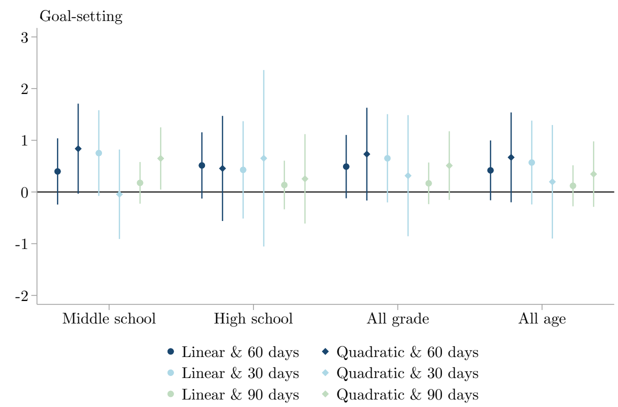
(a) Self-esteem



(b) friendship



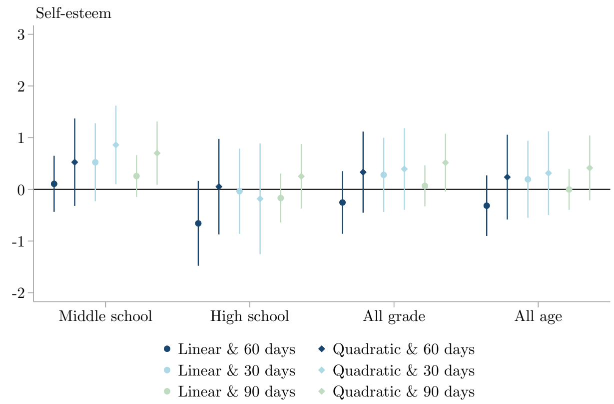
(c) Learning



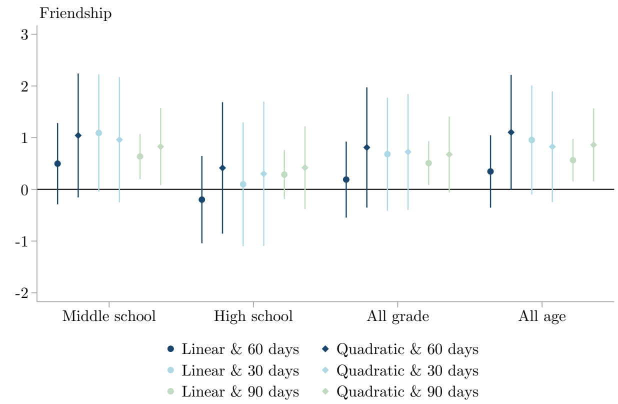
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent the estimates using global linear polynomials. Diamonds represent the estimates using global quadratic polynomials. All estimates include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

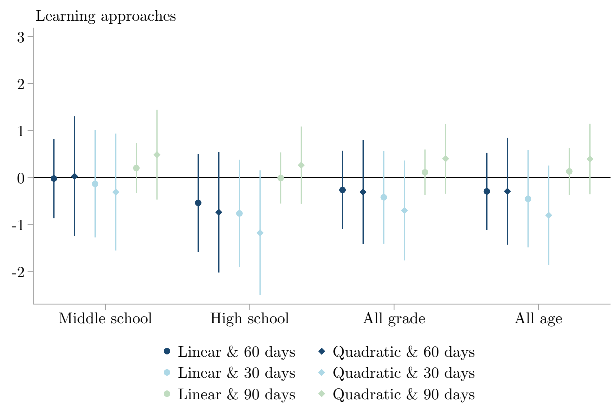
Figure A12: Sensitivity of RD Estimates to Polynomial and Bandwidth Choices: Being Old for Grade on Social-Emotional Skills (Boys)



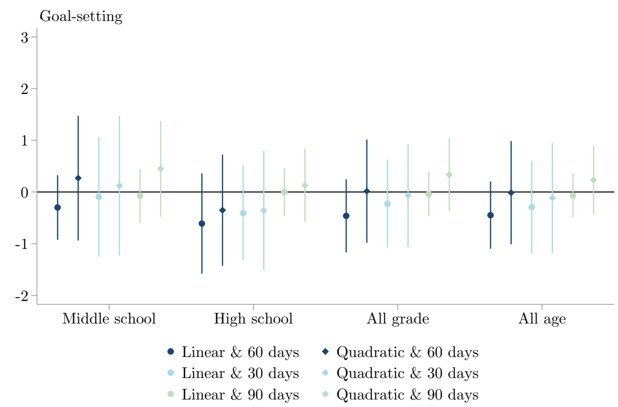
(a) Self-esteem



(b) friendship



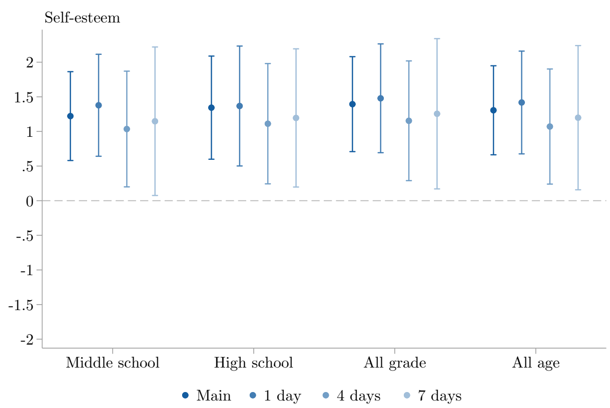
(c) Learning



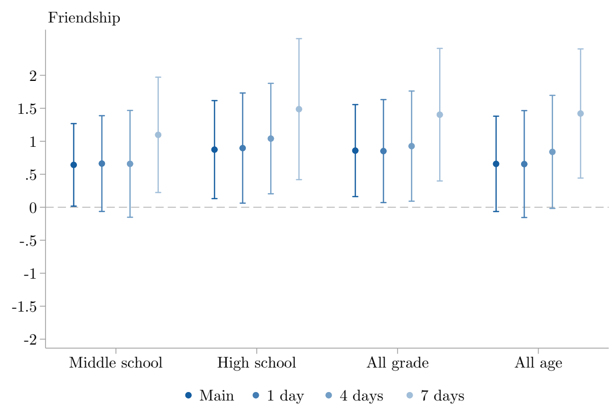
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Circles represent the estimates using global linear polynomials. Diamonds represent the estimates using global quadratic polynomials. All estimates include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

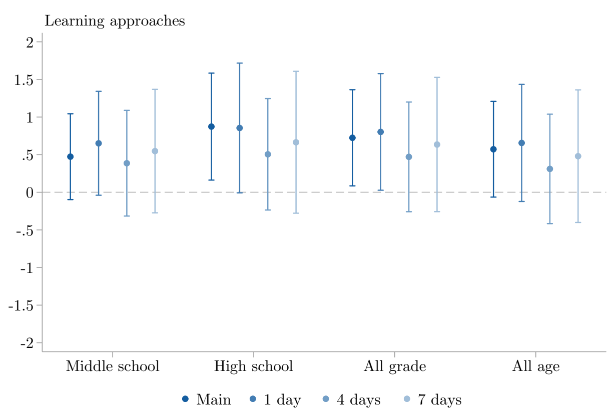
Figure A13: Comparison of Standard RD and Donut RD Estimates: Effects of Being Old for Grade on Social-Emotional Skills (Girls)



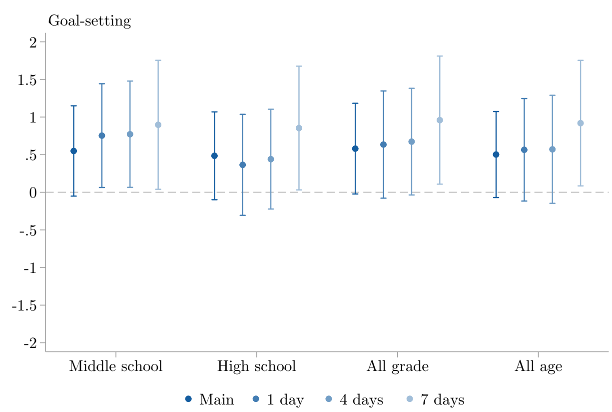
(a) Self-esteem



(b) Friendship



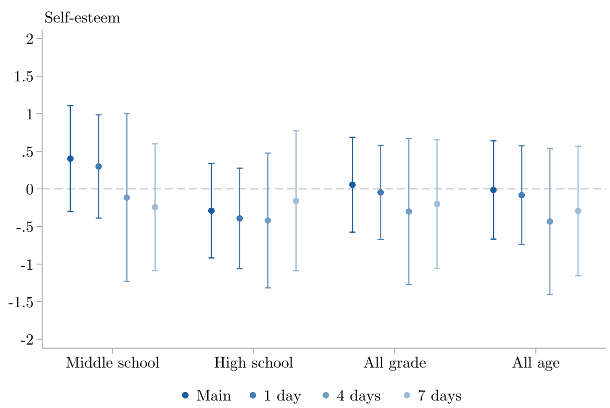
(c) Learning approaches



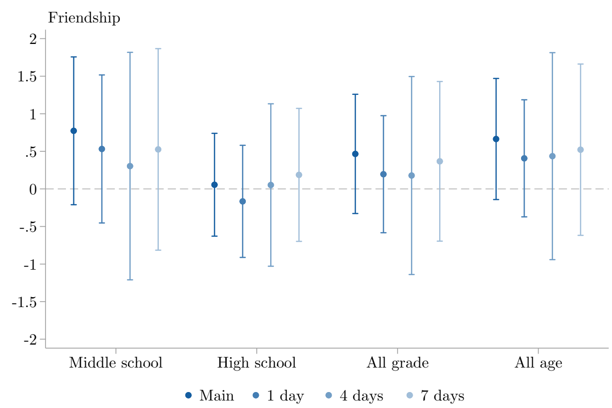
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Donut sizes are set to 1 day, 4 days, and 7 days before and after the cutoff. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

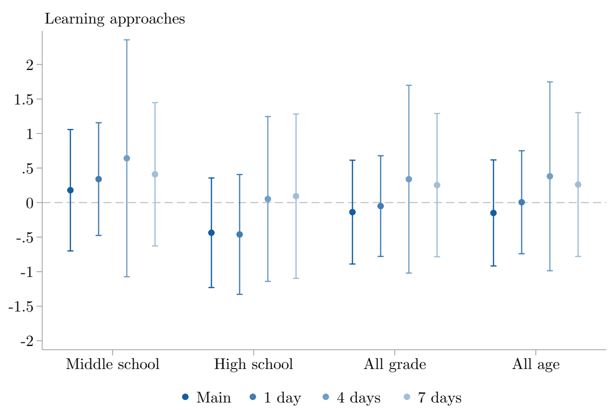
Figure A14: Comparison of Standard RD and Donut RD Estimates: Effects of Being Old for Grade on Social-Emotional Skills (Boys)



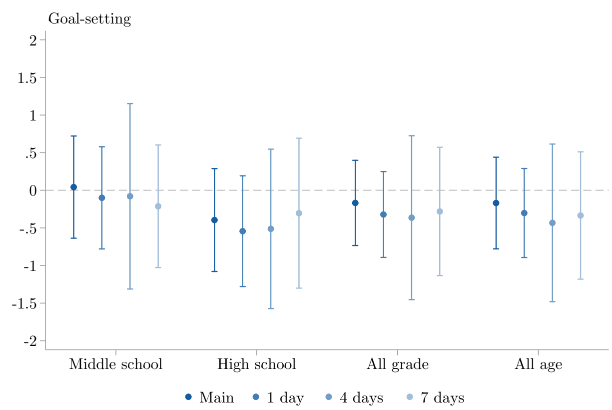
(a) Self-esteem



(b) Friendship



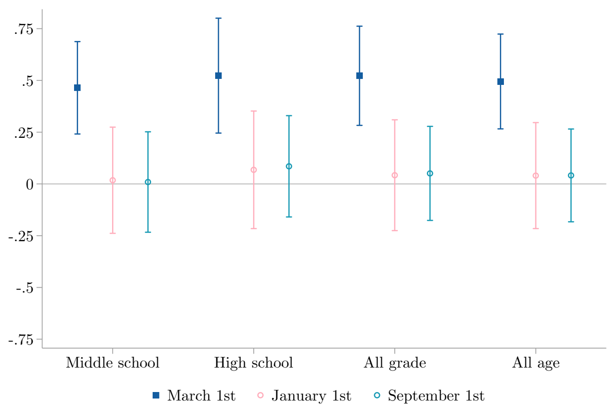
(c) Learning approaches



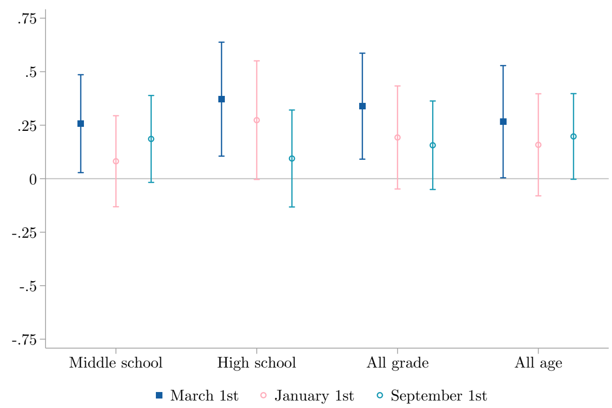
(d) Goal-setting mindsets

The estimates and corresponding 95 percent confidence intervals (CI) are shown. Donut sizes are set to 1 day, 4 days, and 7 days before and after the cutoff. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

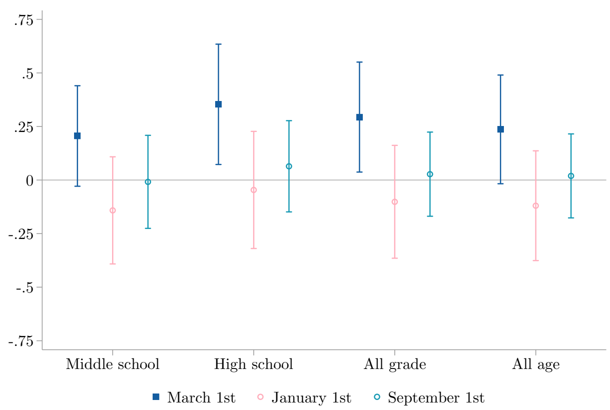
Figure A15: Comparison of Reduced-Form RD Estimates with Placebo Age Cutoffs: Effects of Being Born after the Cutoff on Social-Emotional Skills (Girls)



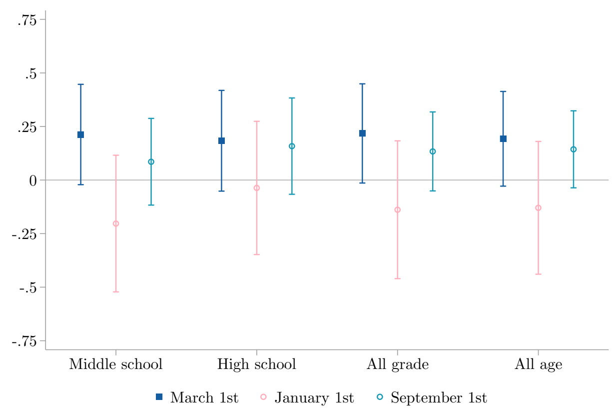
(a) Self-esteem



(b) Friendship



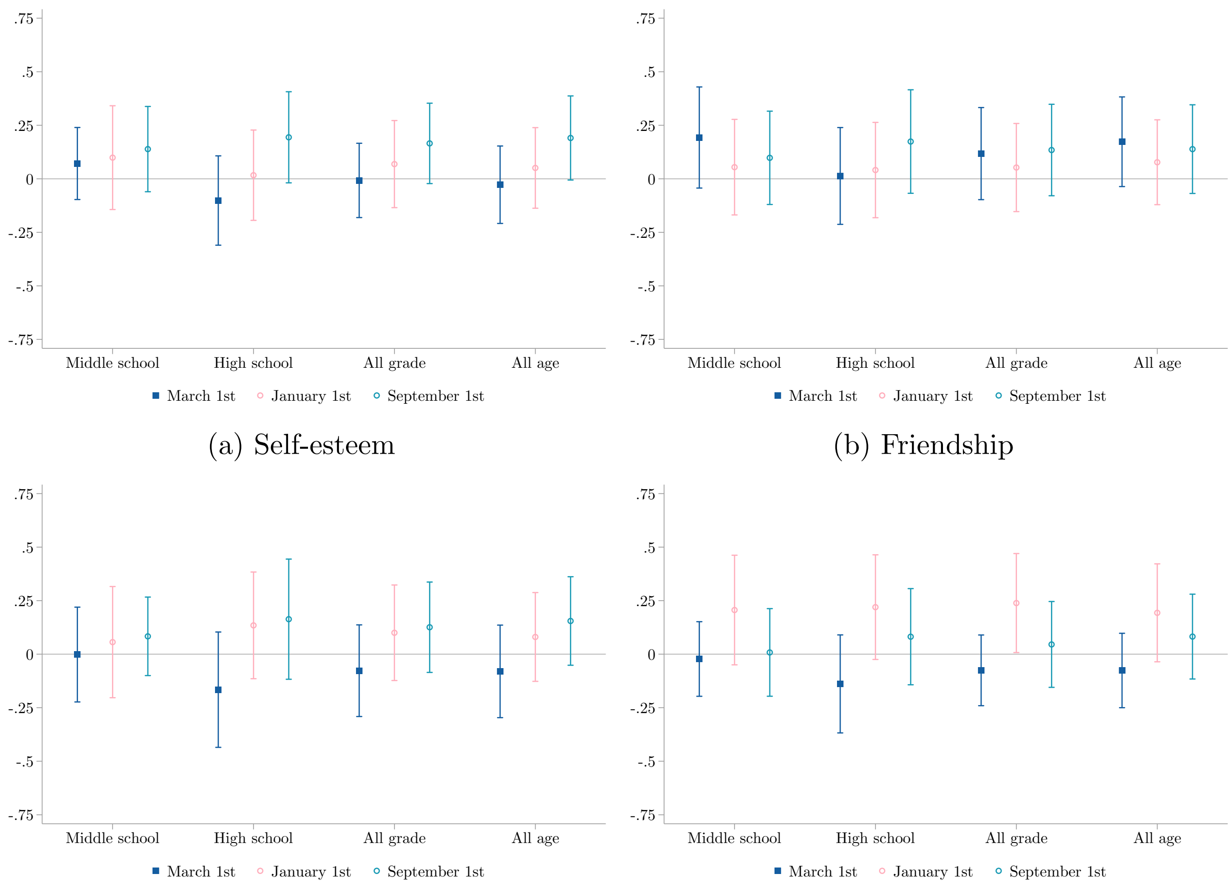
(c) Learning approaches



(d) Goal-setting mindsets

The reduced-form estimates and corresponding 95 percent confidence intervals (CI) are shown. Squares represent estimates from the main specification. Hollow circles represent estimates using January 1st and September 1st as a placebo cutoff. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

Figure A16: Comparison of Reduced-Form RD Estimates with Placebo Age Cutoffs: Effects of Being Born after the Cutoff on Social-Emotional Skills (Boys)



(a) Self-esteem

(b) Friendship

(c) Learning appraches

(d) Goal-setting mindsets

The reduced-form estimates and corresponding 95 percent confidence intervals (CI) are shown. Squares represent estimates from the main specification. Hollow circles represent estimates using January 1st and September 1st as a placebo cutoff. All regressions use a triangular kernel, linear polynomials, and 60-day bandwidths and include cohort fixed effects. Standard errors are clustered at the date of birth level. All outcomes are standardized with mean zero and unit variance.

Appendix Tables

Table A1: Average Outcome Indices by Cutoff and Gender: January to April Borns

	Girls		Boys	
	Before cutoff	After cutoff	Before cutoff	After cutoff
Panel A: Self-esteem				
Grades 7 to 12	3.611	3.686	3.749	3.744
	(0.658)	(0.664)	(0.637)	(0.636)
Ages 13 to 17	3.644	3.692	3.760	3.740
	(0.666)	(0.683)	(0.649)	(0.643)
Panel B: Friendship				
Grades 7 to 12	4.201	4.236	4.217	4.236
	(0.463)	(0.479)	(0.500)	(0.499)
Ages 13 to 17	4.211	4.244	4.226	4.251
	(0.476)	(0.479)	(0.505)	(0.499)
Panel C: Learning approaches				
Grades 7 to 12	3.296	3.355	3.329	3.325
	(0.606)	(0.575)	(0.591)	(0.587)
Ages 13 to 17	3.297	3.351	3.322	3.319
	(0.615)	(0.591)	(0.615)	(0.598)
Panel D: Goal-setting				
Grades 7 to 12	3.714	3.753	3.759	3.729
	(0.603)	(0.632)	(0.587)	(0.630)
Ages 13 to 17	3.706	3.743	3.739	3.723
	(0.617)	(0.647)	(0.616)	(0.636)
Observations	648	648	700	809

Average and standard deviation before standardization to mean zero and a unit variance are shown, with standard deviations in parentheses. The sample I use includes fourth-grade and seventh-grade cohorts born between January and April from SELS 2010 data. For each survey question, the student response is on a 5-point scale: *1 'strongly disagree,' 2 'disagree,' 3 'neutral,' 4 'agree,' 5 'strongly agree'*. A higher index indicates better social-emotional skills.

Table A2: Root Mean Squared Error for Each Outcome in Middle School and High School

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) MS	(2) HS	(3) MS	(4) HS	(5) MS	(6) HS	(7) MS	(8) HS
Panel A: Girls								
Linear	0.155	0.183	0.146	0.288	0.115	0.331	0.127	0.128
Quadratic	0.379	0.467	0.250	0.317	0.359	1.196	0.490	0.430
Cubic	1.095	1.229	1.170	0.934	1.734	2.299	1.017	1.228
Panel B: Boys								
Linear	0.425	0.277	0.583	0.168	0.215	0.217	0.229	0.168
Quadratic	0.503	0.405	0.510	0.321	0.783	0.961	0.443	0.441
Cubic	0.803	0.929	0.854	1.201	1.094	1.223	0.704	1.225

Each cell reports a result from a separate regression with a triangular kernel, linear polynomials, and 60-day bandwidths. Middle school (MS) outcomes are averaged across grades 7 to 9, high school (HS) outcomes are averaged across grades 10 to 12.

Table A3: Root Mean Squared Error for Each Outcome in All Grades and All Ages

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) Grade	(2) Age	(3) Grade	(4) Age	(5) Grade	(6) Age	(7) Grade	(8) Age
Panel A: Girls								
Linear	0.159	0.158	0.236	0.359	0.158	0.147	0.129	0.127
Quadratic	0.371	0.350	0.249	0.262	0.636	0.547	0.317	0.312
Cubic	1.085	0.993	0.981	0.870	1.989	1.886	0.871	0.784
Panel B: Boys								
Linear	0.353	0.354	0.349	0.411	0.188	0.191	0.171	0.171
Quadratic	0.370	0.356	0.394	0.406	0.880	1.011	0.406	0.378
Cubic	0.827	0.796	0.852	0.848	1.198	1.355	0.895	0.841

Each cell reports a result from a separate regression with a triangular kernel, linear polynomials, and 60-day bandwidths. All grade outcomes are averaged across grades 7 to 12. All age outcomes are averaged across ages 13 to 17.

Table A4: First Stage using MSE Optimal Bandwidths: Effects of Being Born after the Cutoff on Being Old for Grade

	Entire sample			Girls			Boys		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Born after cutoff	0.295	0.283	0.294	0.359	0.359	0.357	0.271	0.270	0.271
	[.23 ; .359]	[.217 ; .35]	[.229 ; .358]	[.274 ; .444]	[.28 ; .439]	[.271 ; .443]	[.127 ; .414]	[.129 ; .411]	[.129 ; .413]
Bandwidth	31	32	31	38	38	37	40	40	40
Observations	1,505	1,548	1,505	834	834	813	1,014	1,014	1,014
Cohort FE	Yes	Yes		Yes	Yes		Yes	Yes	
Individual controls		Yes			Yes			Yes	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. This table presents bias-corrected estimates of being born after the cutoff on being old for grade and robust 95 percent confidence intervals using the mean squared error optimal bandwidths. Each cell reports results from a separate regression with a triangular kernel and linear polynomials. Standard errors are clustered at the date of birth level. Individual-level controls include a female indicator, a firstborn indicator, parents' educational attainment (categorized as less than high school, high school graduates, and some college or more), and indicators for missing values of these controls.

Table A5: RD Estimates using MSE Optimal Bandwidths: Social-Emotional Skills in Middle School and High School

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) MS	(2) HS	(3) MS	(4) HS	(5) MS	(6) HS	(7) MS	(8) HS
Panel A: Girls								
Old for grade	1.721	1.785	0.817	1.003	0.545	1.055	0.571	0.511
	[.902 ; 2.54]	[.704 ; 2.865]	[.049 ; 1.584]	[.068 ; 1.938]	[-.054 ; 1.143]	[.293 ; 1.817]	[-.035 ; 1.177]	[-.159 ; 1.182]
Bandwidth	51	48	54	49	73	70	72	66
Observations	1,035	870	1,113	886	1,487	1,273	1,478	1,203
Panel B: Boys								
Old for grade	0.517	-0.492	1.055	0.147	0.097	-0.571	0.114	-0.547
	[-.264 ; 1.297]	[-1.167 ; .184]	[-.008 ; 2.119]	[-.666 ; .96]	[-.886 ; 1.08]	[-1.317 ; .175]	[-.793 ; 1.021]	[-1.215 ; .122]
Bandwidth	56	69	66	60	62	78	42	77
Observations	1,322	1,396	1,549	1,224	1,471	1,546	1,000	1,538
Panel C: Entire Sample								
Old for grade	1.246	0.904	0.981	0.537	0.369	0.199	0.343	-0.078
	[.573 ; 1.919]	[.083 ; 1.725]	[.207 ; 1.756]	[.004 ; 1.07]	[-.283 ; 1.022]	[-.358 ; .757]	[-.088 ; .774]	[-.575 ; .419]
Bandwidth	42	46	55	72	61	74	42	73
Observations	1,891	1,800	2,475	2,789	2,752	2,862	1,893	2,829
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each cell reports the estimate of being old for grade on a social-emotional skill index and robust 95 percent confidence intervals from a separate regression with a triangular kernel, linear polynomials, and mean squared error optimal bandwidths. Standard errors are clustered at the date of birth level. All regressions include cohort fixed effects. Middle school (MS) outcomes are averaged across grades 7 to 9, high school (HS) outcomes are averaged across grades 10 to 12. All outcomes are standardized with mean zero and unit variance.

Table A6: Comparison of RD Estimates using MSE Optimal Bandwidths: Social-Emotional Skills Measured in All Grades and All Ages

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) Grade	(2) Age	(3) Grade	(4) Age	(5) Grade	(6) Age	(7) Grade	(8) Age
Panel A: Girls								
Old for grade	1.742	1.643	1.013	0.829	1.083	0.860	0.589	0.528
	[.84 ; 2.644]	[.792 ; 2.493]	[.382 ; 1.645]	[.168 ; 1.491]	[.29 ; 1.875]	[.078 ; 1.642]	[-.05 ; 1.228]	[-.075 ; 1.132]
Bandwidth	47	47	75	75	62	63	70	70
Observations	1,016	1,007	1,628	1,616	1,353	1,354	1,521	1,508
Panel B: Boys								
Old for grade	0.247	0.214	0.813	1.063	-0.243	-0.264	-0.123	-0.120
	[-.498 ; .992]	[-.567 ; .996]	[-.123 ; 1.749]	[.127 ; 2]	[-.945 ; .458]	[-.983 ; .455]	[-.801 ; .554]	[-.885 ; .645]
Bandwidth	50	47	52	53	75	75	46	44
Observations	1,246	1,178	1,296	1,306	1,825	1,814	1,161	1,102
Panel C: Entire Sample								
Old for grade	1.132	1.042	0.806	0.811	0.301	0.220	0.235	0.189
	[.4 ; 1.864]	[.351 ; 1.734]	[.202 ; 1.411]	[.201 ; 1.421]	[-.233 ; .835]	[-.357 ; .797]	[-.205 ; .674]	[-.252 ; .629]
Bandwidth	41	41	68	68	71	68	51	49
Observations	1,965	1,952	3,210	3,188	3,324	3,187	2,407	2,304
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each cell reports the estimate of being old for grade on a social-emotional skill index and robust 95 percent confidence intervals from a separate regression with a triangular kernel, linear polynomials, and mean squared error optimal bandwidths. Standard errors are clustered at the date of birth level. All regressions include cohort fixed effects. All grade outcome indices are averaged across grades 7 to 12, and all age outcome indices are averaged across ages 13 to 17. All outcomes are standardized with mean zero and unit variance.

Table A7: Reduced-Form: Effects of Being Born after the Cutoff on Social-Emotional Skills in Middle School and High School

	Self-esteem		Friendship		Learning		Goal-setting	
	(1) MS	(2) HS	(3) MS	(4) HS	(5) MS	(6) HS	(7) MS	(8) HS
Panel A: Girls								
Born after cutoff	0.464***	0.523***	0.257**	0.372***	0.206*	0.353**	0.213*	0.183
	(0.114)	(0.142)	(0.117)	(0.136)	(0.120)	(0.143)	(0.119)	(0.120)
Observations	1,216	1,082	1,216	1,082	1,214	1,082	1,217	1,082
Panel B: Boys								
Born after cutoff	0.072	-0.101	0.193	0.013	-0.002	-0.166	-0.022	-0.139
	(0.086)	(0.106)	(0.120)	(0.115)	(0.113)	(0.137)	(0.089)	(0.117)
Observations	1,416	1,206	1,417	1,206	1,417	1,206	1,417	1,206
Panel C: Entire Sample								
Born after cutoff	0.261***	0.201*	0.214**	0.169*	0.079	0.055	0.083	-0.011
	(0.077)	(0.105)	(0.093)	(0.095)	(0.086)	(0.103)	(0.055)	(0.090)
Observations	2,675	2,324	2,676	2,324	2,674	2,324	2,677	2,324
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school (MS) outcomes are averaged across grades 7 to 9, high school (HS) outcomes are averaged across grades 10 to 12. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A8: Effects of Being Old for Grade on Test Scores in Middle and High School

	Korean		English		Math		
	(1) MS	(2) HS	(3) MS	(4) HS	(5) MS	(6) General	(7) Science
Panel A: Girls							
Old for grade	0.260	0.105	-0.099	-0.091	0.286	0.001	-0.500
	(0.261)	(0.321)	(0.313)	(0.398)	(0.305)	(0.359)	(0.611)
Observations	1,227	1,081	1,227	1,081	1,227	843	385
Panel B: Boys							
Old for grade	0.163	0.038	0.593	0.471*	0.125	-0.406	0.028
	(0.409)	(0.299)	(0.369)	(0.272)	(0.391)	(0.447)	(0.534)
Observations	1,441	1,203	1,441	1,202	1,441	738	678
Panel C: Entire Sample							
Old for grade	0.151	0.031	0.192	0.150	0.230	-0.127	-0.140
	(0.263)	(0.210)	(0.258)	(0.235)	(0.261)	(0.278)	(0.374)
Observations	2,712	2,320	2,712	2,319	2,712	1,610	1,081
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A9: Effects of Being Old for Grade on Height, Weight, and BMI

	Fourth-grade cohort			Seventh-grade cohort		
	(1) Height(cm)	(2) Weight(kg)	(3) BMI	(4) Height(cm)	(5) Weight(kg)	(6) BMI
Panel A: Girls						
Old for grade	7.047	-4.762	-4.041	1.237	3.231	1.013
	(4.502)	(6.878)	(2.582)	(1.623)	(2.709)	(0.851)
Baseline mean	137.335	33.913	17.871	156.410	46.057	18.786
Observations	584	584	584	624	580	580
Panel B: Boys						
Old for grade	4.588	3.067	0.478	0.325	2.005	0.455
	(3.346)	(4.099)	(1.428)	(5.019)	(10.253)	(3.226)
Baseline mean	137.119	35.499	18.781	156.805	48.921	19.769
Observations	621	621	621	788	768	768

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. 1cm = 0.3937in & 1kg = 2.205lb.

Table A10: RD Estimates Robust to Inclusion of Cohort Fixed Effects, Controls, and Day-of-Week Fixed Effects: Self-Esteem

	Middle school				High school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Girls								
Old for grade	1.236***	1.180***	1.229***	1.276***	1.355***	1.306***	1.311***	1.411***
	(0.340)	(0.327)	(0.334)	(0.338)	(0.401)	(0.382)	(0.386)	(0.386)
Observations	1216	1216	1216	1216	1082	1082	1082	1082
Panel B: Boys								
Old for grade	0.273	0.401	0.271	0.235	-0.319	-0.250	-0.315	-0.296
	(0.348)	(0.355)	(0.344)	(0.314)	(0.325)	(0.328)	(0.321)	(0.309)
Observations	1416	1416	1416	1416	1206	1206	1206	1206
Cohort FE	Yes	Yes		Yes	Yes	Yes		Yes
Individual controls		Yes				Yes		
Day-of-week FE				Yes				Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school outcomes are averaged across 7th-9th grades, and high school outcomes are averaged across 10th-12th grades. All outcomes are standardized with mean zero and unit variance.

Table A11: RD Estimates Robust to Inclusion of Cohort Fixed Effects, Controls, and Day-of-Week Fixed Effects: Friendship

	Middle school				High school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Girls								
Old for grade	0.683**	0.624*	0.686**	0.718**	0.963**	0.858**	0.967**	1.017***
	(0.321)	(0.319)	(0.316)	(0.323)	(0.383)	(0.380)	(0.377)	(0.386)
Observations	1216	1216	1216	1216	1082	1082	1082	1082
Panel B: Boys								
Old for grade	0.739	0.768	0.746	0.702	0.042	0.068	0.031	0.035
	(0.507)	(0.495)	(0.504)	(0.499)	(0.362)	(0.345)	(0.357)	(0.352)
Observations	1417	1417	1417	1417	1206	1206	1206	1206
Cohort FE	Yes	Yes		Yes	Yes	Yes		Yes
Individual controls		Yes				Yes		
Day-of-week FE				Yes				Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school outcomes are averaged across 7th-9th grades, and high school outcomes are averaged across 10th-12th grades. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A12: RD Estimates Robust to Inclusion of Cohort Fixed Effects, Controls, and Day-of-Week Fixed Effects: Learning Approaches

	Middle school				High school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Girls								
Old for grade	0.536*	0.431	0.551*	0.557*	0.915**	0.829**	0.899**	0.964**
	(0.320)	(0.284)	(0.316)	(0.312)	(0.402)	(0.356)	(0.393)	(0.396)
Observations	1214	1214	1214	1214	1082	1082	1082	1082
Panel B: Boys								
Old for grade	-0.007	0.181	-0.008	-0.033	-0.521	-0.407	-0.524	-0.504
	(0.432)	(0.436)	(0.428)	(0.419)	(0.414)	(0.397)	(0.409)	(0.377)
Observations	1417	1417	1417	1417	1206	1206	1206	1206
Cohort FE	Yes	Yes		Yes	Yes	Yes		Yes
Individual controls		Yes				Yes		
Day-of-week FE				Yes				Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school outcomes are averaged across 7th-9th grades, and high school outcomes are averaged across 10th-12th grades. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A13: RD Estimates Robust to Inclusion of Cohort Fixed Effects, Controls, and Day-of-Week Fixed Effects: Goal-Setting Mindsets

	Middle school				High school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Girls								
Old for grade	0.563*	0.510*	0.562*	0.581*	0.475	0.459	0.438	0.504
	(0.320)	(0.309)	(0.315)	(0.322)	(0.321)	(0.299)	(0.305)	(0.321)
Observations	1217	1217	1217	1217	1082	1082	1082	1082
Panel B: Boys								
Old for grade	-0.086	0.047	-0.069	-0.082	-0.436	-0.383	-0.421	-0.397
	(0.336)	(0.346)	(0.335)	(0.331)	(0.358)	(0.346)	(0.352)	(0.310)
Observations	1417	1417	1417	1417	1206	1206	1206	1206
Cohort FE	Yes	Yes		Yes	Yes	Yes		Yes
Individual controls		Yes				Yes		
Day-of-week FE				Yes				Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level. Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school outcomes are averaged across 7th-9th grades, and high school outcomes are averaged across 10th-12th grades. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A14: Robust to Inclusion of School Fixed Effects: Self-Esteem

	Middle school			High school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Girls							
Old for grade	1.237***	1.237***	1.105***	1.356***	1.357***	0.971***	1.300***
	(0.340)	(0.336)	(0.219)	(0.401)	(0.388)	(0.223)	(0.263)
Observations	1,216	1,216	1,216	1,082	1,012	1,012	1,077
Panel B: Boys							
Old for grade	0.275	0.275	0.474	-0.320	-0.175	-0.109	-0.531*
	(0.349)	(0.422)	(0.340)	(0.326)	(0.434)	(0.319)	(0.295)
Observations	1,416	1,416	1,416	1,206	1,129	1,129	1,204
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Middle school FE			Yes			Yes	
High school FE							Yes
Cluster	DOB	MS	MS	DOB	MS	MS	HS

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses are clustered at the date of birth level (DOB), middle school level (MS), and high school level (HS). Each cell reports results from a separate regression with local linear polynomials, a triangular kernel, and a 60-day bandwidth. Middle school outcomes are averaged across 7th-9th grades, and high school outcomes are averaged across 10th-12th grades. All outcomes are standardized with mean zero and unit variance. All regressions include cohort fixed effects.

Table A15: Reliability Measures: Cronbach's α

	Middle school	High school	
		Academic	Vocational
Self-esteem	0.941	0.911	0.907
Friendship	0.782	0.785	0.787
Learning method	0.835	0.760	0.723
Learning effort	0.823	0.767	0.721
Learning attitude	0.776	0.717	0.655
Goal-setting	0.902	0.861	0.858

Cronbach's α is measured in the fourth survey wave.