What Makes a Leader?
Relative Age and High School Leadership

Elizabeth Dhuey
Stephen Lipscomb

Department of Economics
University of California, Santa Barbara
93106-9210 U.S.A.
dhuey@econ.ucsb.edu
Fax: + 1 805 893 8830

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Abstract

Economists have identified a substantial adult wage premium attached to high school leadership activity. Unresolved is the extent to which it constitutes human capital acquisition or proxies for an "innate" unobserved skill. We document a determinant of high school leadership activity that is associated purely with school structure, rather than genetics or family background. That determinant is a student's relative age. State-specific school entry cut-offs induce systematic within-grade variation in student maturity, which in turn generate differences in leadership activity. We find that the relatively oldest students are four to eleven percent more likely to be high school leaders.

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1. Introduction

The organization of labor within firms is in the process of fundamental changes.[1] There is a growing demand in the workforce for "soft skills" such as sociability, teamwork, and leadership. Similarly, university admissions standards increasingly require broader skill sets. Schools evaluate applicants not only by quantifiable cognitive measures but also on the ability to demonstrate skills such as leadership. There is little academic research devoted to measuring how these skills are acquired or how they are valued in the labor market despite constituting a large proportion of most wage regression residuals.

Among the most important qualitative skills in the labor market is leadership. In a recent article, Kuhn and Weinberger (2005) show that high school students with leadership experience as either a sports team captain or club president earn substantially higher adult wages and are more likely to become managers. They estimate a "leadership wage effect" between four and twenty-four percent depending on the specification and data used. They interpret this premium as the return to a leadership skill, but have some difficulty measuring the extent to which this skill is either acquired in high school as a result of participating in leadership activities or determined (either by genetics, family environment, or earlier school activities) before high school entry. The distinction is important because it has implications for education policy.

In this paper, we shed light on the above debate as follows: we present evidence that a component of the variation in high school leadership activity is driven by a factor that is influenced by the (primary and secondary) school environment, not by genetics or family background. This factor is a child's relative age among her cohort. Unless children

[1] See: Autor, Levy, & Murnane, 2003; Borghans, Weel, & Weinberg, 2005; Lindbeck & Snower, 2000.

born in different quarters of the year are genetically different or treated differently, or families with different unobserved socioeconomic status give birth in different months, the relative age effect shows how early differences in the school environment produce variation in high school leadership.

Almost all states have a standardized cut-off date that dictates whether a child is old enough to begin formal schooling. For example, if children need to be five years old by a particular date to enter kindergarten, the cut-off causes students to be up to twenty percent older than others at school entry. This introduces systematic differences in average maturity levels within each cohort. Although initial age effects may be large, they should dissipate over time unless there is a mechanism that perpetuates them. This mechanism arises from the difficulty in separating innate ability and maturity (Allen & Barnsley, 1993; Bedard & Dhuey, 2006). Teachers and parents may perceive that relatively older children are more able because the children are more mature compared to younger children that possess the same innate ability. As a result, older children may be selected disproportionately to serve as hall monitors or for similar positions of "authority" due to their relative maturity rather than ability. Cuhna, Heckman, Lochner, and Masterov (2005) show that skills accumulated in early childhood are complementary to later learning. The initial difficulty in distinguishing between ability and maturity may lead to different experiences and skill accumulation that perpetuates into the teenage years and beyond.

Several recent papers investigate the persistence of early differences in maturity on academic achievement. Allen and Barnsley (1993) argue that the inability to separate maturity from innate ability when streaming young children into different school "tracks" cause the relatively oldest to outperform the relatively youngest through secondary school in a sample of British students. Fredriksson and Öckert (2005) show that Swedish children with birthdays just after the cut-off perform better in school and are more likely to acquire post-secondary education. Bedard and Dhuey (2006) demonstrate that relative age effects exist across a wide range of countries and persist through adolescence into adulthood. The relatively oldest students score significantly higher on standardized math and science tests in the fourth and eighth grade compared to the relatively youngest. They are also about eight percent more likely to take college entrance exams and about ten percent more likely to attend college immediately.

An inherent selection problem exists in measuring the direct effect of relative age on later outcomes. In the United States, large fractions of the relatively youngest children defer school entry by a year. This switches them from being the youngest to being the oldest in their class and introduces a selection problem because these children predominately come from higher socioeconomic backgrounds. In addition, even if entry rules were strictly followed, relatively younger children are more likely to repeat a grade. This, once again, switches them from being the youngest to the oldest.

To overcome the selection problem, we follow Bedard and Dhuey (2006) and calculate a child's "assigned relative age." This measure is based solely on an individual's birthday relative to the statewide school entry cut-off date.[2] For example, if the cut-off is September 1, children born in August will be in the youngest assigned relative age group while children born in September will be in the oldest. Since cut-off dates differ by state, students born in the same month do not necessarily have the same

[2] Datar (2006) uses similar measures of assigned relative age to estimate short-run models of age effects in kindergarten and first grade.

value of assigned relative age. This is important to avoid confounding assigned relative age with possible season of birth effects (Bound, Jaeger, & Baker, 2000).[3]

In their paper, Bedard and Dhuey (2006) use assigned relative age as an instrument for the child's actual age measured in months. With such a framework, the resulting coefficient estimates pertain to the population of children entering and progressing through school on time. Since a large fraction of students in the United States delays school entry or is retained a grade, and hence is not on time, we share their opinion that this does not provide the most policy relevant estimate. Instead, the policy relevant estimate measures the relative age effect at a specific point in time. They obtain these estimates through a reduced form specification, which we adopt in this paper. This specification allows assigned relative age to affect the outcomes we measure via a number of channels, including retention, delayed entry, and entry/grade acceleration.

Assigned relative age is exogenously determined so long as births are not targeted at certain points in the year by particular groups. For example, if the highest ability parents target births for the months just after the cut-off, our estimates may be biased upward. There is some evidence that highly educated women target births in summer months (Bedard & Dhuey, 2006). However, since almost all cut-off dates occur during autumn and winter, these children tend to be relatively younger, not older. This attenuates our point estimates.

The relative age effect in a specific grade tends to be smaller than a comparable one pertaining only to on-time children for a couple reasons. First, assuming that both retention and delayed entry are effective policies, they raise the human capital of affected children. This may increase the average skill level of young assigned relative age groups,

[3] Bedard and Dhuey (2006) use pooled cross-country regressions and found no season of birth effect.

because these children are the most likely to be retained or delayed. Second, accelerated children forgo a year of development to begin schooling earlier. This may decrease the average skill level among the oldest assigned relative age groups because these children are the most likely to be accelerated. Each of these policies attenuates our point estimates.

The conventional wisdom is that leadership skill has both innate and learned components. Our results suggest that school entrance rules exogenously determine a portion of what we typically call innate leadership ability. Specifically, using three nationally representative surveys, we find that the relatively oldest students in each cohort are between four and eleven percent more likely to lead a varsity sports team or club before graduating high school than the relatively youngest. We also find that the relatively oldest students participate as a leader about five percent more often and believe they possess more leadership skill than their youngest peers.

2. Data and Descriptive Statistics

A. Data Sources

Our empirical analysis uses samples from three nationally-representative surveys: *Project Talent* (1960), the *National Longitudinal Study of the High School Class of 1972,* and *High School and Beyond* (1980-82). Each of these surveys contains questions about leadership experience and provides birth date information. We identify leaders as individuals that have served either as a sports team captain or club president. Questions asked to *Project Talent* respondents pertain to leadership experience over the previous three years whereas the scope of questions asked in the subsequent two studies is limited to the previous year only. These surveys allow us to examine high school students and their leadership activities over a span of three decades.

Our main data set is *Project Talent* (*Talent*), a nearly five percent sample of 9th through 12th grade students in 1960. We restrict our attention to 10th through 12th graders because they were all attending a high school in 1960. The original sample size is 273,123 students. We exclude individuals who have missing values for sex, state of residence, or birthday. These exclusions decrease our sample by 3,874 students. Actual sample sizes differ by dependent variable. There are 10,262 students with missing information for club president and 19,180 students with missing information for team captain.

Talent also contains an index of self-reported leadership skill that we use as an alternative dependent variable to support our results. Survey designers constructed this categorical measure based on student responses to a bank of questions aimed toward understanding how students perceived themselves in terms of several psychological characteristics. The index is the number of questions that students say describes them "quite well" or "extremely well". We standardize this variable so that its empirical moments match a standard normal random variable within each grade level.

The *National Longitudinal Study of the High School Class of 1972* (*NLS-72*) surveyed high school seniors in 1972. The main difference from *Talent* besides surveying only one high school class is that the sample size is less than ten percent as large. We restrict our sample in the same ways as *Talent* and have a remaining sample size of about 16,000 students.

Our third data set is *High School and Beyond* (*HS&B*). It is also a nationally-representative sample of high school students. *HS&B* includes two cohorts: the 1980 senior class, and the 1980 sophomore class. In this study, we use seniors from the 1980 senior class and seniors from the two-year follow-up of the 1980 sophomore class. We restrict our sample in the same ways as the previous datasets and have a remaining sample size of about 18,000 students.

To define assigned relative age, the cut-off date for children to enter kindergarten must be determined. For the *NLS-72* and *HS&B*, these dates were found using state statutes. Many states did not have explicit statutes about school cut-off dates during the late 1940's, when *Talent* respondents entered kindergarten. However, most schools followed the same cut-off date as the rest of the schools in their state. Therefore, we obtained state cut-off dates in our *Talent* sample by using the empirical distribution of birth months. The beginning of the first of the twelve consecutive months containing the largest percentage of student birth dates is defined as the cut-off date for each state.

Table 1 lists the cut-off dates used in our analysis. We determined that the majority of cut-off dates during the late 1940's occurred on January 1. This is consistent with Angrist and Kruegar (1991). During the late 1950's and 1960's, many states moved their cut-off earlier in the school year. This leads to more pronounced across-state variation in cut-offs during the later survey periods. In Table 1, the designation LEA, or local education authority, signifies that each school district has the power to determine its school cut-off date. We are unable to calculate an assigned relative age for these observations because we do not know the cut-off date for each local area. Similarly, the designation SSY, or start of school year, denotes that the start of the school year was the cut-off. Since we do not possess historical information on school starting dates, we are also unable to calculate the assigned relative age for observations from these states.

Using the cut-off date and date of birth, we construct each individual's assigned relative age (*Q*).[4] More specifically, *Q1* = 1 for students born in the last three eligible months prior to the cut-off and *Q1* = 0 otherwise. *Q2*, *Q3*, and *Q4* are similarly defined for each subsequent three-month interval. For example, using the September 1 cut-off, children born in June-August are the youngest (*Q1* = 1) and children born in September-November are the oldest (*Q4* = 1). This flexible approach allows for non-linearity in the way assigned relative age impacts the probability an individual takes a high school leadership role.

B. Descriptive Statistics

Table 2 illustrates each data set's descriptive statistics. A much larger fraction of students was a captain or president in the *Talent* dataset than in *NLS-72* or *HS&B*. This is reasonable since *Talent* variables refer to leadership over the previous three years instead of the previous year. Between *NLS-72* and *HS&B*, a greater fraction of students were captains and presidents in *HS&B*. Kuhn and Weinberger (2005) suggest that both actual and self-reported participation rates may have declined in the early 1970's due to the prevalent rift that existed between students and schools during the Vietnam War. *Talent* and *HS&B* also provide height and weight information. Because assigned relative age may simply reflect variation in physical maturity at the high school level, we use a flexible form that includes a quadratic in height in meters and body mass index (BMI).

[4] We thank Chau Do for providing us information on the state of residence for *HS&B,* which enabled us to calculate the assigned relative age for these data.

3. Econometric Model

In this study, we measure how relative age affects leadership experience at a specific grade. Our base empirical specification is the following reduced form equation, which we estimate separately for each dataset and leadership measure:

$$Leadership_i = \alpha + \beta_1 Q2_i + \beta_2 Q3_i + \beta_3 Q4_i + X_i \phi + School_i \lambda + \varepsilon_i \qquad (1)$$

where i denotes individuals and ε is the usual error term. *Leadership* is an indicator for a student being either a club president or sports team captain. *Q2*, *Q3*, and *Q4* are indicators for the student's assigned relative age with *Q1* (the youngest students) as the omitted group. The included covariates are an indicator for sex and controls for parental education. We also include grade level indicators in the *Talent* data and a cohort indicator for *HS&B*. Some specifications also control for race, height, and BMI. We include indicators for missing parental education, height, and BMI. Finally, specifications include school level fixed effects.

The coefficients of interest are the β's. For example, β_1 measures the impact of being one quarter older than the youngest student on serving as a team captain or club president. Similarly, β_2 and β_3 measure the impact of being two or three quarters, respectively, older than the youngest student on the probability of occupying either type of leadership position. Reduced form estimates do not permit a comparison of magnitudes across surveys because we allow assigned relative age to affect leadership through a variety of channels. Over the three decades we examine, patterns in retention, delayed entry, and grade acceleration may have changed. As previously explained, these changes only determine the extent to which the reduced form estimates are attenuated relative to comparable ones pertaining to on-time children only.

4. Results

A. Linear Probability Results

The first and third columns of Table 3 present our base specification using the *Talent* data. The results indicate that assigned relative age is a statistically significant determinant of the probability an individual is a high school leader. The magnitude of the impact increases for relatively older students. In column 1, students in the relatively oldest quarter in each cohort are two percentage points more likely to be a team captain than students in the relatively youngest quarter. Similarly, these students are 2.7 percentage points more likely to be a club president.[5] This corresponds to a 4.9 percent and 5.9 percent increase in predicted probability, respectively. These results support the hypothesis that relative age effects persist in the development of soft skills in much the same way as others have shown they do for cognitive measures that directly affect academic performance and achievement.[6,7]Our estimates are similar in magnitude to results found by Bedard and Dhuey (2006) in their cross-country analysis on academic achievement.

Columns 1 and 3 also indicate that women are more likely to be either type of high school leader. That women are 7.3 percentage points more likely to be sports team captains in 1960 is a particularly puzzling feature of *Talent*. Reliable nationwide sports

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[5] Both linear and non-linear specifications such as probit and logit produced similar results throughout.
[6] See: Allen & Barnsley, 1993; Bedard & Dhuey, 2006; Fredriksson & Öckert, 2005; Puhani & Weber, 2005.
[7] Throughout the analysis, we try to present conservative estimates of relative age effects. In addition to including school fixed effects, each specification reports robust standard errors clustered at the state level.

participation data from 1960 is difficult to obtain from outside sources. The National Federation of State High School Associations began collecting this data in 1972 after the passage of Title IX. In that school year, women represented only 7.4 percent of high school athletes. The gender gap has steadily narrowed since 1972. This trend suggests that a large majority of 1960 high school athletes were male. Although it is unclear which teams these women were leading, including them appears only to reduce our point estimates. We include separate estimates by gender in the Appendix. Coefficients from the sample of *Talent* males are larger than those presented in Table 3.

We also use the self-assessed measure of leadership skill as a dependent variable in columns 5 and 6. Indeed, relative age is a significant predictor of self-reported leadership. The coefficient of .058 represents a 1.9 percentage point increase relative to the mean level of leadership skill reported by the youngest quarter of students.

The reduced form allows assigned relative age to affect leadership experience through a variety of channels. In columns 2, 4, and 6 we test whether the empirical relationships are driven by variation in teenage physical development by adding a quadratic in height and body mass index. Persico, Postlewaite, and Silverman (2004) find that taller individuals at age sixteen enjoy a significant adult wage premium. About half of this wage premium is attributable to variation in participation on sports teams and clubs. Since older students are taller and more physically developed on average, they are more likely to be the "best" team or club members. If we select leaders disproportionately from this group, assigned relative age may be uncorrelated with leadership experience once we control for physical characteristics.

The addition of these variables barely attenuates our coefficient estimates. This result is common to our entire analysis using *Talent* and *HS&B* data.[8] Importantly, we can only control for teenage physical maturity. Variation in physical maturity at much younger ages remains a plausible channel to explain the relationships we observe in Table 3. Nevertheless, that high school age physical characteristics only minimally attenuate the coefficients of interest supports our belief that members are choosing their leaders in part based on skills that do not directly relate to current physical development.

One concern is the possibility of bias due to non-random sample selection. Since relatively older children reach the end of compulsory schooling earlier, they may constitute a disproportionately high fraction of dropouts. This could bias the coefficients of interest upward since the lower tail of the ability distribution would be truncated for older assigned relative ages. In another potential scenario, the relatively youngest students may drop out of high school more frequently. This could bias the coefficients of interest downward due to the truncation of the ability distribution of the relatively youngest. Solving this selection problem poses many difficulties. In Table 4, we present evidence suggesting that, although the sample selection concerns are valid, they do not appear to bias our results upward. The top panel reveals that the two relatively oldest quarters are statistically underrepresented in the 12^{th} grade sample. Each of these two quarters makes up only twenty-three percent of the 12^{th} grade sample. To gauge the impact on our results, we repeated the specifications from columns 2 and 4 in Table 3 for each dependent variable on (1) just the 10^{th} grade sample and (2) the 10^{th} and 11^{th} grade samples combined. Importantly, point estimates are largely similar.

[8] Height and body mass index information is not available in *NLS-72*.

To supplement our analysis, we include similar specifications for samples from *NLS-72* and *HS&B*, two surveys conducted approximately ten and twenty years, respectively, after *Talent*. We present these estimates in Table 5. Our empirical specifications differ only in that the sole variable of interest is assigned relative quarter 4. We do this because the considerable reduction in sample sizes makes it difficult to estimate precisely the effects of discrete changes in a series of indicator variables on a binary dependent variable.[9] Our specification therefore measures the impact of assigned relative quarter 4 compared to the other three quarters.

These point estimates should underestimate the impact of assigned relative quarter 4 when assigned relative quarter 1 is the only omitted category as in Table 3. To illustrate this point, columns 1 and 4 of Table 5 repeat the base specification from Table 3 using assigned relative quarter 4 as the only variable of interest. Relative to their younger peers, the relatively oldest twenty-five percent of students are 1.4 percentage points more likely to be team captains and 1.6 percentage points more likely to be club presidents. These point estimates are 30 and 40 percent, respectively, lower than in Table 3. Although significant at only the ten percent level for our *HS&B* sample, *NLS-72* and *HS&B* produce estimates that are similar to *Project Talent* for team captains. The oldest students in each cohort are between 1.3 and 1.6 percentage points more likely to be high school team captains.[10] These estimates convert to 10.6 and 7.6 percent changes, respectively. The impact of assigned relative age on the probability of becoming a club president is less clear in *NLS-72* and *HS&B*. Since we estimate the coefficient of interest very

[9] *NLS-72* and *HS&B* samples are each less than ten percent of our *Talent* samples.
[10] See the Appendix for separate specifications by gender. As with *Talent*, the *NLS-72* sample presents evidence that relative age affects the probability of becoming a team captain more strongly for men.

imprecisely in both cases, it is difficult to conclude anything based on these regressions. Despite this, the statistically significant results from the team captain regressions suggest that, were the samples larger, we would see similar patterns in fully specified models that include quarters 2 through 4 for this type of high school leadership.

B. Estimates Conditional on Membership

In the previous two tables, we have estimated how assigned relative age affects the probability of holding a leadership position using samples that included both activity members and non-members. Since members choose captains and presidents from their ranks, it makes sense to condition on team and club membership. We present these results in Table 6. These models are similar to those estimated in columns 2 and 4 of Table 3. Table 6 reveals that, conditional on team membership, the relatively oldest students are 1.6 percentage points more likely to be elected captain. Although strongly significant, this coefficient is twenty percent smaller than the coefficient from the full sample. This suggests that relatively older students are also slightly more likely to participate in sports. Coefficients in the club president regression in column 2 are essentially unchanged from Table 3 column 4. Although this is evidence that the effect of assigned relative age on club leadership is independent of its effect on club membership, 85 percent of *Talent* respondents report having been club members over the previous three years so the samples are largely similar.

C. Do Relatively Older Students Have More Leadership Experience?

The analysis so far demonstrates that within-cohort age variation results in statistically significant differences in the probability that individuals become high school leaders. In this section, we ask a related question by exploring whether relatively older students have *more* high school leadership experience. To do this we take advantage of the categorical nature of the questions *Talent* respondents answered regarding their leadership activities. In particular, students listed the number of times they had served as a sports team captain or club president over the previous three years. Answer choices ranged from zero to five, with five being the top-coded category.

In Table 7a, we report these results using a Poisson regression model. Unlike the linear probability specifications, these coefficients are interpreted as percentage changes. According to the results, being among the relatively oldest students increases the expected number of leadership experiences by 5.2-5.8 percent. The Poisson regression model relies on the assumption that the $E[y|x] = V[y|x]$. Below the regression output, we report the Chi-squared statistic from a goodness-of-fit test of the model to the data. These statistics far exceed the critical level needed to reject at the one percent level, signifying that the mean-variance equality assumption is violated in the data. As a result, we also include a negative binomial regression model that instead relies on the weaker assumption that $E[y|x] = \sigma^2 V[y|x]$, where $\sigma^2 > 1$ is the overdispersion factor. Coefficient and standard error estimates are largely similar across models.[11]

Based on these estimates, Table 7b illustrates the expected number of times we predict individuals to be captains or presidents by relative quarter. The expected amount of leadership experience increases with relative age. These models reveal that relative age does more than simply increasing the probability that an individual becomes a high

[11] Estimates of the overdispersion factor in columns 2 and 4 are positive and statistically significant.

school leader. Table 7 shows that relatively older students will accumulate approximately five percent more leadership experience.

5. Conclusion

Although leadership is an important job skill, economists know very little about how it is acquired. In this paper, we demonstrate that a student's relative age exogenously determines a portion of the variation in high school leadership activity. This factor is due to differences in school structure rather than genetics or family background. In our analysis using three nationally-representative surveys, we estimate that the relatively oldest twenty-five percent of students are between four and eleven percent more likely to hold a leadership position than the relatively youngest. We also present evidence that the relatively oldest students accumulate about five percent more leadership experience before graduating, compared to the relatively youngest. Although many factors could explain these relationships, assigned relative age appears to be largely unrelated to differences in teenage physical development.

On their own, the magnitude of our estimates does not seem to warrant a serious reconsideration of statewide school cut-off dates. From an administrative standpoint, there are significant advantages to the current system. Yet the more we uncover about the scope of outcomes relative age affects, the closer we move in that direction. Previous research focuses on relative age as a strong predictor of academic outcomes such as test scores and college attendance. Our estimates on a very distinct set of outcomes are similar in size to these studies.[12] Taken into context with the rest of the literature, we believe economists are only beginning to understand the total extent of relative age effects. In our opinion, we have only scratched the surface of potential outcomes to be investigated. In future research, we plan to examine how relative age influences other soft skills and behaviors. We also plan to investigate whether relative age effects differ across socioeconomic categories. Parents from low socioeconomic classes are less likely to delay their children's entrance into school. As a result, these children make up a larger share of relatively young students. The cumulative disadvantage of both coming from a low socioeconomic background and being relatively young may be very large.

Based on the current state of the research, we believe the most appropriate policy recommendation is to better inform parents of the effects associated with being relatively young. In addition, to the extent possible, educators should pay closer attention to the difference between perceived ability and maturity when placing children in ability-specific groupings. Both may help attenuate the negative effects related to being relatively young.

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[12] Kuhn & Weinberger (2005) show that the leadership wage effect is identical for students above and below the median math score. They infer that quantitative skills as measured by math tests are very different from leadership ability.

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Table 1

State cut-off dates for kindergarten entrance

State	Project talent 1947-1949	NLS-72 1959	HS&B 1967, 1969	State	Project talent 1947-1949	NLS-72 1959	HS&B 1967, 1969
AL	1-Nov	1-Oct	1-Oct	MT	1-Nov	None	SSY
AK	1-Jan	2-Nov	2-Nov	NE	1-Jan	15-Oct	15-Oct
AZ	1-Jan	None	1-Jan	NV	1-Jan	31-Dec	31-Dec
AR	1-Jan	1-Oct	1-Oct	NH	1-Jan	30-Sep	30-Sep
CA	1-Jan	1-Dec	1-Dec	NJ	1-Jan	LEA	LEA
CO	1-Jan	LEA	LEA	NM	1-Jan	1-Jan	1-Jan
CT	1-Jan	1-Jan	1-Jan	NY	1-May	1-Dec	1-Dec
DE *	1-Jan	1-Sep	1-Sep, 31-Dec	NC	1-Oct	1-Oct	1-Oct
FL	1-Jan	1-Feb	1-Feb	ND	1-Jan	31-Oct	31-Oct
GA	1-Jan	None	None	OH	1-Jan	None	None
HI	1-Jan	31-Dec	31-Dec	OK	1-Jan	1-Nov	1-Nov
ID	1-Nov	None	16-Oct	OR	1-Dec	15-Nov	15-Nov
IL	1-Jan	1-Dec	1-Dec	PA	1-Feb	1-Feb	1-Feb
IN	1-Jan	None	None	RI	1-Jan	None	31-Dec
IA	1-Nov	15-Nov	15-Oct	SC	1-Jan	None	None
KS	1-Jan	1-Sep	1-Sep	SD	1-Nov	1-Nov	1-Nov
KY	1-Jan	30-Dec	31-Dec	TN	1-Jan	31-Dec	31-Oct
LA	1-Jan	31-Dec	31-Dec	TX	1-Oct	1-Sep	1-Sep
ME	1-Nov	15-Oct	15-Oct	UT	1-Nov	SSY	SSY
MD	1-Jan	31-Dec	31-Dec	VT	1-Jan	1-Jan	1-Jan
MA	1-Jan	LEA	LEA	VA	1-Nov	30-Sep	30-Sep
MI	1-Jan	1-Dec	1-Dec	WA	1-Nov	SSY	SSY
MN	1-Jan	1-Sep	1-Sep	WV	1-Jan	None	None
MS	1-Jan	1-Jan	1-Jan	WI	1-Dec	1-Dec	1-Dec
MO	1-Jan	1-Oct	1-Oct	WY	1-Oct	15-Sep	15-Sep

Note: LEA: Cut-off date at the discretion of the Local Education Authority; None: Cut-off date not designated in state statutes; SSY: Cut-off date is the start of the school year

* Delaware cut-off changed to December 31st in 1969.

Table 2
Summary statistics

Variable	Project Talent	NLS-72	High School & Beyond
Captain	0.405	0.123	0.211
	(0.491)	(0.328)	(0.408)
President	0.456	0.229	0.345
	(0.498)	(0.420)	(0.475)
Team member	0.697	0.517	0.527
	(0.460)	(0.500)	(0.500)
Club member	0.852	0.718	0.803
	(0.355)	(0.450)	(0.400)
Quarter 1 (Youngest)	0.256	0.255	0.253
	(0.436)	(0.436)	(0.435)
Quarter 2	0.261	0.258	0.253
	(0.439)	(0.438)	(0.435)
Quarter 3	0.241	0.238	0.247
	(0.428)	0.426	(0.431)
Quarter 4 (Oldest)	0.242	0.244	0.247
	(0.429)	(0.429)	(0.431)
Female	0.501	0.497	0.509
	(0.500)	(0.500)	(0.500)
Black		0.092	0.117
		(0.290)	(0.321)
Hispanic		0.048	0.119
		(0.214)	(0.324)
Other		0.045	0.032
		(0.207)	(0.175)
Parental education			
High school	0.496	0.604	0.616
	(0.500)	(0.489)	(0.486)
B.A. or better	0.179	0.204	0.246
	(0.383)	(0.403)	(0.431)
Height (Meters)	1.686		1.701
	(0.115)		(0.107)
BMI	21.21		21.33
	(4.243)		(3.300)

Note: Summary statistics based on weighted data. Parental education refers to the highest degree attained among the respondent's parents.

Table 3
The impact of assigned relative age on high school leadership measures, Talent data

Dependent variable	Team captain		Club president		Self-reported leadership skill	
	(1)	(2)	(3)	(4)	(5)	(6)
Quarter 2	0.005	0.004	0.014	0.014	0.016	0.015
	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)
Quarter 3	0.012	0.011	0.021	0.021	0.052	0.049
	(0.003)	(0.003)	(0.004)	(0.004)	(0.007)	(0.007)
Quarter 4 (Oldest)	0.020	0.019	0.027	0.027	0.058	0.055
	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)
Female	0.073	0.102	0.019	0.039	0.064	0.141
	(0.012)	(0.011)	(0.003)	(0.005)	(0.007)	(0.010)
Parental education						
High school	0.026	0.026	0.084	0.084	0.167	0.164
	(0.003)	(0.003)	(0.004)	(0.004)	(0.008)	(0.008)
B.A. or better	0.033	0.032	0.126	0.125	0.326	0.322
	(0.004)	(0.004)	(0.006)	(0.006)	(0.010)	0.011
Height (Meters)		-0.768		-0.184		-1.008
		(0.178)		(0.197)		(0.432)
Height squared		0.281		0.077		0.423
		(0.054)		(0.059)		(0.129)
BMI*		-0.026		0.352		0.712
		(0.060)		(0.070)		(0.118)
BMI squared*		0.363		-0.888		-0.550
		(0.163)		(0.186)		(0.303)
Observations	250,069	250,069	258,987	258,987	264,986	264,986

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include a constant, an indicator for missing parental education, grade indicators, and school-level fixed effects. Specifications 2, 4 and 6 include an indicator for missing height and gender*grade interactions.

* Values for BMI are divided by 100.

Table 4a
Means of assigned relative age variables, by grade

	Grade 10	Grade 11	Grade 12	Z statistic	
	(1)	(2)	(3)	(10th-11th)	(11th-12th)
Quarter 1 (Youngest)	0.248	0.253	0.269	2.420	7.234
Quarter 2	0.262	0.257	0.263	2.392	2.717
Quarter 3	0.243	0.244	0.234	0.489	4.661
Quarter 4 (Oldest)	0.247	0.246	0.234	0.487	5.586
Observations	91,459	84,738	73,872		

Note: Z-statistic is from a test of difference in means between the 10th and 11th grade samples and 11th and 12th grade samples. Statistics based on weighted data. The sample used is from the team captain regressions.

Table 4b
Robustness check regressions using 10th and 11th graders only, Talent data

	Team captain		Club president	
Dependent variable	10th grade only	10th & 11th grades	10th grade only	10th & 11th grades
	(1)	(2)	(3)	(4)
Quarter 2	0.008	0.003	0.016	0.012
	(0.004)	(0.003)	(0.004)	(0.003)
Quarter 3	0.010	0.008	0.016	0.018
	(0.007)	(0.005)	(0.005)	(0.005)
Quarter 4 (Oldest)	0.024	0.020	0.027	0.027
	(0.006)	(0.004)	(0.004)	(0.004)
Observations	91,459	176,197	94,455	182,658

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include a constant, controls for gender, height, height squared, BMI, BMI squared, parental education, indicators for missing parental education and height, and school-level fixed effects. Specifications 2 and 4 include a control for the 11th grade cohort and a gender*grade interaction.

Table 5
The impact of assigned relative age on the probability of becoming a high school leader, Talent, NLS-72 and HS&B data

	Team captain			Club president		
Dependent variable	Project talent	NLS-72	HS&B	Project talent	NLS-72	HS&B
	(1)	(2)	(3)	(4)	(5)	(6)
Quarter 4 (Oldest)	0.014	0.013	0.016	0.016	-0.004	0.009
	(0.003)	(0.006)	(0.009)	(0.002)	(0.008)	(0.010)
Female	0.073	-0.027	-0.085	0.019	0.062	0.065
	(0.012)	(0.006)	(0.008)	(0.003)	(0.011)	(0.012)
Black		0.039	0.096		-0.016	-0.011
		(0.014)	(0.015)		(0.020)	(0.017)
Hispanic		0.007	0.015		-0.010	-0.032
		(0.012)	(0.013)		(0.018)	(0.016)
Parental education						
High school	0.026	0.049	0.054	0.084	0.070	0.082
	(0.003)	(0.006)	(0.018)	(0.004)	(0.013)	(0.015)
B.A. or better	0.033	0.091	0.143	0.126	0.175	0.209
	(0.004)	(0.007)	(0.022)	(0.006)	(0.020)	(0.018)
Observations	250,069	15,960	18,066	258,987	15,968	18,031

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include a constant, indicators for missing parental education, and school-level fixed effects. HSB specifications include a control for the sophomore cohort. NLS-72 and HSB specifications include an indicator for *other* race.

Table 6

LPM regression results on the sample of team or club members, Talent data

Dependent Variable	Team captain (1)	Club president (2)
Quarter 2	0.002	0.013
	(0.003)	(0.004)
Quarter 3	0.010	0.020
	(0.004)	(0.005)
Quarter 4 (Oldest)	0.016	0.027
	(0.004)	(0.004)
Female	0.150	0.023
	(0.011)	(0.006)
Parental education		
High school	0.014	0.071
	(0.004)	(0.004)
B.A. or better	0.014	0.104
	(0.005)	(0.006)
Observations	159,792	203,559

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include indicators for height, height squared, BMI, BMI squared, indicators for missing parental education and height, a constant, indicators for grade level, school, and gender*grade interactions.

Table 7
Count data models, Talent data

	Number of times team captain		Number of times club president	
Dependent variable	Poisson	Negative binomial	Poisson	Negative binomial
	(1)	(2)	(3)	(4)
Quarter 2	0.016	0.015	0.030	0.029
	(0.010)	(0.010)	(0.011)	(0.011)
Quarter 3	0.034	0.034	0.052	0.052
	(0.009)	(0.009)	(0.013)	(0.013)
Quarter 4 (Oldest)	0.052	0.053	0.058	0.059
	(0.010)	(0.010)	(0.011)	(0.011)
Observations	250,069	250,069	258,987	258,987
Chi-squared value*	1.25×10^8		1.08×10^8	
Overdispersion factor		2.278		1.402
		(0.183)		(0.060)

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include a constant, controls for gender, parental education, an indicator for missing parental education, height, height squared, BMI, BMI squared, an indicator for missing height, grade indicators, gender*grade interactions, and school-level fixed effects.
* There are 250,052 degrees of freedom in the team captain regression and 258,970 in the club president regression. The p-value for each test is 0.000.

Predicted probabilities for each dependent variable by relative quarter, Talent data

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Number of times captain	1.062	1.080	1.101	1.124
Number of times president	0.986	1.016	1.040	1.047

Appendix Table
LPM regression results separated by gender

Dependent variable	Team captain		Club president	
	Males	Females	Males	Females
	(1)	(2)	(3)	(4)
A. Project Talent				
Quarter 2	0.006	0.005	0.014	0.014
	(0.003)	(0.005)	(0.004)	(0.004)
Quarter 3	0.016	0.007	0.026	0.017
	(0.004)	(0.005)	(0.006)	(0.005)
Quarter 4 (Oldest)	0.024	0.013	0.035	0.019
	(0.004)	(0.006)	(0.004)	(0.005)
Observations	123,748	126,321	128,043	130,944
B. NLS-72				
Quarter 4 (Oldest)	0.022	0.004	-0.007	-0.001
	(0.012)	(0.010)	(0.010)	(0.012)
Observations	7,890	8,070	7,868	8,100
C. HS&B				
Quarter 4 (Oldest)	0.006	0.018	0.009	0.010
	(0.013)	(0.010)	(0.017)	(0.017)
Observations	8,643	9,423	8,589	9,442

Note: Statistics based on weighted data. Robust standard errors are reported in parentheses, clustered at the state level. All specifications include a constant, controls for height, height squared, BMI, BMI squared, parental education, indicators for missing parental education and height, grade indicators, and school-level fixed effects.