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EDUCATIONAL EVALUATION AND POLICY ANALYSIS 2006 28: 153
DOI: 10.3102/01623737028002153

Educational Evaluation and Policy Analysis
Summer 2006, Vol. 28, No. 2, pp. 153–179

Does the Age That Children Start Kindergarten Matter? Evidence of Long-Term Educational and Social Outcomes

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The appropriate age for students to begin school is an issue of debate for educators, administrators, and parents. Parents worry that young children may not be able to compete with older classmates; schools worry that young students will not be able to meet rigorous academic standards associated with school accountability. Past literature is inconclusive as to the overall effect of age at school entry. Some research suggests that younger students have lower average achievement in early elementary school, while others find that students with summer birthdates, who are assumed to be younger at school entry, gain more education on average. At present, little is known about the impact of age at school entry on education attainment as students transition from high school into college and the labor market. This study uses data from the National Education Longitudinal Survey to examine long-term effects of age at school entry on both educational and social outcomes, with special attention to those students who enter kindergarten a year later than their peers. The results of this study suggest that delaying kindergarten does not create any long-term advantages for students.

Keywords: *age at entry, economics of education, kindergarten policy*

The No Child Left Behind Act of 2002 and other education reforms emphasize the importance of early and frequent standardized testing to ensure that children meet academic expectations. While the objective of these reforms is long-term academic success and high school completion, testing occurs as early as third grade to make sure children are on track with grade-level requirements (U.S. Department of Education, 2003). Using early testing as an accountability tool puts pressure on schools to ensure that all third graders meet national expectations. Early testing puts downward pressure on second grade, first grade, and even kindergarten to meet high academic standards (Meisels, 1992; Shepard & Smith, 1986). The result is an unprecedented level of academic rigor for very young children (Crosser, 1998; Karweit, 1988).

A relatively simple strategy to improve achievement in early grades may be to increase the average age of kindergartners (Stipek, 2002). This can be achieved across the board by moving the state cutoff date for kindergarten entry, or more locally by advising parents to keep young children out of kindergarten for an extra year. Administrators and teachers may believe that older students have greater maturity and ability to succeed in school (Uphoff & Gilmore,

The authors appreciate helpful comments from David I. Levine and seminar participants at the University of Southern California and the Association for Public Policy and Management for improving previous versions of this paper. We are especially grateful to Ken Frank for conversations concerning the sensitivity analysis in this paper. Remaining errors are our own.

1986). Parents may believe that delaying kindergarten will give a child an academic edge, by making him or her the oldest student next year instead of the youngest student this year (Bracey, 1989). This practice is nicknamed "redshirting" after the practice of holding college athletes back a year to develop physical strength and improve athletic skills (Katz, 2000). A key difference is that redshirted athletes participate in practice and training, while redshirted kindergartners may receive no school services unless a preschool class is available.

While redshirting offers students the potential advantage of being the oldest in kindergarten, it is unclear if age at school entry affects long-term academic success, high school completion, and college enrollment. If older students continue to perform well through high school and beyond, delayed kindergarten entry may be an effective way to improve educational outcomes across the board. Alternately, older students may encounter difficulties as a result of reaching puberty before their classmates, being able to drop out of school a grade early (Angrist & Krueger, 1991), or losing a year of workforce participation (Mayer & Knutson, 1999).

Although numerous studies document short-term benefits of redshirting, few studies have examined the long-term effects. This study uses the National Educational Longitudinal Survey (NELS) of 1988 (National Center for Education Statistics, 2002) to examine the long-term effects of age at kindergarten entry and the practice of redshirting on a group of students who entered kindergarten in the late 1970s and early 1980s. Regression analysis confirms that young children are more likely to repeat early grades, which does have negative academic consequences. However, controlling for grade retention and interactions with age at entry, starting school young does have modest advantages in terms of lifetime accumulation of human capital. In addition, we use semiparametric matching techniques to compare students who were redshirted to similar students who were not. The results confirm that younger students perform at least as well as similar older students throughout high school and college.

Theoretical Perspectives on Redshirting

Child development specialists have debated the advantages and disadvantages of redshirting for many years. Advocates of redshirting believe that children reach specific states of development based on an internal biological clock; there is little that can be done by schools or parents to accelerate this maturation process (Elkind, 1987). It follows that the way to improve kindergarten achievement is to delay school entry for an extra year. The natural growth process or "gift of time" is expected to bring an immature child to the skill and maturity level needed to succeed in kindergarten (Ilg, Ames, Haines, & Gillepspie, 1978). Students who start kindergarten too young will have an academic disadvantage because they are developmentally unready for kindergarten curricula. Younger students may be unmotivated, underachieving, and anxious throughout elementary and secondary school as a response to negative experiences in kindergarten (Uphoff & Gilmore, 1986). These disadvantages can result in early grade retention for students who start too young. Research shows that grade retention has consistently negative effects for students in terms of attitudes about school, self-esteem, and increased probability of dropping out (Hauser, 2000; Holmes, 1989; Shepard & Smith, 1987). Thus, redshirting is a potential strategy for giving students an extra year to mature before school, without risking the negative effects of grade retention (Jones & Sutherland, 1981). School districts can increase the maturity level of kindergarten classrooms either by recommending redshirting to parents or by increasing the minimum age for kindergarten.

A second approach to child development argues that maturity and school readiness can be influenced by school experiences (Piaget, 1970; Vygotsky, 1978). In this approach, immaturity is the result of environmental or genetic factors that cannot be cured by an additional year of growth. Instead, schools should provide developmentally appropriate instruction for young children with diverse backgrounds and experiences (Meisels, 1992). If young children benefit from a stimulating school environment, it is hypothesized that children who start school younger actually gain a valuable head start in cognitive development. Some authors believe that this head start has lifelong benefits (Mayer & Knutson, 1999). Children who start school older may miss out on beneficial early childhood experiences and services provided by schools (Karweit, 1988; May et al., 1994; May & Kundert, 1997). Opponents of redshirting argue that older children may be treated as if they are less capable than younger students in the

same grade by teachers or classmates (Crosser, 1998). In addition, older students may feel awkward about reaching puberty before their classmates (Byrd, Weitzman, & Auinger, 1997; Katz, 2000). In high school, older students may be more likely to drop out because compulsory attendance laws dictate a minimum age at which students can leave school (Angrist & Krueger, 1991).

Empirical Evidence on Redshirting

Past studies of age at school entry typically follow an age or grade cohort and compare outcomes for younger and older students (Stipek, 2002). Most studies focus solely on early elementary school or follow a grade cohort through fourth or sixth grade. A more recent literature explores the effects of age at school entry on wages later in life. There is surprisingly little research on the period in between, when students attend high school and transition to college and careers.

One group of studies found that age had no effect on achievement, even in early primary grades (Dietz & Wilson, 1985; Graue & DiPerna, 2000; Kundert, May, & Brent, 1995; May & Welch, 1986; Reinherz & Kinard, 1986; Spitzer, Cupp, & Parke, 1995), but the majority of studies show a small academic advantage for older students (Bickel, Zigmond, & Strayhorn, 1991; Cameron & Wilson, 1990; Carter, 1956; Crosser, 1991; Datar, 2006; Davis, Trimble, & Vincent, 1980; Dickinson & Larson, 1963; Green & Simmons, 1962; Hall, 1963; Jones & Mandeville, 1990; Langer, Kalk, & Searls, 1984; McClelland, Morrison, & Holmes, 2000; Miller, 1957; Shepard & Smith, 1987; Stipek & Byler, 2001; Sweetland & De Simone, 1987). These studies measure academic progress through cognitive tests and achievement tests and show that older students have higher test scores during early elementary school.

Our study is concerned with whether this advantage persists over time. Past studies that follow students over time have mixed results. Some of these studies show that older students have an advantage that lasts through elementary school (Breznitz & Teltsch, 1989; Cameron & Wilson, 1990; Carter, 1956; Hall, 1963; Sweetland & De Simone, 1987). But many studies show the academic gap between older and younger students fading by the time students leave elementary school (Bickel et al., 1991; Crosser, 1991; Davis et al., 1980; Jones & Mandeville, 1990; Langer et al., 1984; Miller, 1957), and possibly as early as second or third grade (McClelland et al., 2000; Stipek, 2002: Stipek & Byler, 2001). Following students through high school, Baer (1958) finds that younger students perform slightly worse than older students but still achieve appropriate grade-level acquisition of reading and math skills. A recent major review of the literature on age at school entry concludes that any academic advantages for older students disappear by third grade (Stipek, 2002). Overall, research suggests that the maturity advantage of older students in early grades does not translate into a lasting academic advantage.

Theories of child development argue that age at school entry is also related to students' emotional well-being and behavior. Empirical evidence provides no clear conclusions about whether older or younger students are the ones to suffer emotionally. Some research documents emotional problems for younger students resulting from low self-esteem, stress, and negative attitudes toward school (Alexander, Entwisle, & Horsey, 1997). One study of fourth graders in Israel found that self-image and anxiety problems among younger students continue at least through fourth grade (Breznitz & Teltsch, 1989). Uphoff and Gilmore (1986) cite evidence that younger students are more likely to be poorly adjusted and lack leadership skills when they reach high school. In these studies, socioemotional problems, depression, and even suicide were also more prevalent among younger high school students, although the samples were small and came from single school districts. Conversely, Byrd, Weitzman, and Auinger (1997) found that it was older students who suffer more behavioral problems up to age 17. Importantly, these results were independent of grade retention, meaning that being older was problematic for students who delayed school entry, as well as for students who repeated a grade. Most studies of age at school entry that looked at emotional and behavioral outcomes found no long-term effects on behavioral problems, peer adjustment, and attitudes about school (Baer, 1958; Bickel et al., 1991; Miller, 1957; Reinherz & Kinard, 1986; Stipek & Byler, 2001).

Previous studies of age at school entry typically rely on data from a single classroom, school, or school district. More recent studies have explored the influence of age at school entry on lifetime earnings using national datasets, by

using season of birth as an instrumental variable. Using census data, Angrist and Krueger (1991) and Mayer and Knutson (1999) found that adults who started school at a younger age have higher wages later in life. Angrist and Krueger attribute this result to compulsory attendance laws that are designed so students can drop out of school when they reach a certain age—typically 16 or 17 years. Students who start school younger are likely to gain more years of education before they can legally drop out. Students who start older are able to drop out sooner, resulting in lower average wages throughout life. Mayer and Knutson (1999) argue that early entry actually increases cognitive skills by exposing children to a formal learning environment. These superior cognitive skills may translate into higher wages later in life. These authors found that students with summer birthdates have higher average earnings later in life than students with winter birthdates.[1]

Overall, the literature on age at school entry provides mixed evidence. Older students may have higher achievement in early primary grades, but this gap appears to decrease as students progress through elementary school. However, adults who started school younger have higher wages. This suggests that somewhere in between, younger students gain an advantage over older students. This study seeks to fill this gap by examining the effects of age at school entry during high school and the transition to adulthood.

Data

Data for this study are drawn from the National Educational Longitudinal Study of 1988 (NELS), which tracks a cohort of eighth graders through high school and young adulthood. Unfortunately, longitudinal data do not exist at present that track students from kindergarten through young adulthood. The NELS dataset was selected because it follows a national sample of students through junior high, high school, college, and young adulthood—allowing for a rich selection of outcomes during this time frame. In addition, it provides retrospective histories of students' careers sufficient to identify age at entry and any grade repetitions or skips that may have occurred.

The NELS is sponsored by the National Center for Education Statistics (NCES) and carried out by the National Opinion Research Center. The data were drawn from a sample of 1,000 schools (800 public schools and 200 private schools, including parochial institutions). From this school sample, 25,000 eighth-grade students were selected for the initial survey. Two follow-up surveys revisited the majority of the sampled students in 1990 and 1992, when the students were typically in 10th grade and 12th grade. A third follow-up in 1994 included a randomized sample of 15,964 of the original student participants. A fourth follow-up was conducted in 2000 and included 15,273 students from the third follow-up. At the time of the fourth follow-up, the participants were approximately 26 years old and had been participating in the study for 12 years.

For each NELS participant, base year data were collected from students, parents, and schools to provide a rich variety of information about individual characteristics, school experiences, and family environments. Educational histories provide background data on school experiences leading up to eighth grade, such as repeating or skipping grades, and changing schools due to a move or other reason. School, parent, and student surveys from the first and second follow-ups provide rich data about student experiences during junior high and high school. However, other variables, such as family characteristics, are only available beginning in eighth grade. The problems associated with this data limitation are discussed later.

Long-Term Outcomes

Our goal is to examine a small set of long-term outcomes that reflect students' progressive accumulation of human capital as they transition from adolescence to young adulthood. We selected eighth-grade achievement test scores, having a child out of wedlock, dropping out of high school, entering college, and wages in 1999. These five outcomes represent important benchmarks toward labor market participation and address theoretical concerns about the pros and cons of redshirting.

Eighth-grade achievement is measured as a composite score of reading and math tests administered to all NELS participants (see Levine and Painter, 1999, for a full description of NELS cognitive tests). The composite score is standardized with a mean equal to 0 and standard deviation equal to 1. Child out of wedlock is measured for females only, if a birth occurred during a student's high school years. Dropout is measured as not having a diploma or GED by age 20, and college enrollment is measured as entering a 2- or 4-year college by age 20. Wage data are available for the

year 1999, when survey participants are approximately 25 years old. Wages were estimated for individuals who were working full-time and not enrolled in school, so the effects of graduate and professional school are partially excluded.

Additional variables were also tested based on theories of the influence of age at school entry on student outcomes to confirm the results on the main outcome variables. Additional academic outcomes include 10th- and 12th-grade test scores, college graduation, and repeating a grade in kindergarten or later elementary school. Social experiences at school were measured by student- and school-reported experiences. Survey items reported whether students felt put down by teachers and other students in 10th grade. Social interaction was also measured by variables representing participation in varsity sports and other school activities. Finally, behavior inside and outside school was measured by whether the student was reported by teachers to have a behavioral problem in high school and whether the student was ever arrested during high school. Variables relating to in-school experiences are not available for students who dropped out of school, so some observations are lost for these additional outcome variables.

Independent Variables

We assume that educational outcomes are correlated with age at school entry, observable characteristics, and unobservable characteristics such as skills, motivation, and intelligence. Compared with most past studies, this study employs far more detailed measures of family background and family involvement in education to control for observable characteristics. Family variables enable us to identify factors related to educational and social success that are also correlated with parent and school decisions about when a child enters kindergarten. Variables were selected because theories of redshirting indicate that these variables are correlated with redshirting and with long-term educational outcomes.

In their study of the effect of early school experience on dropout rates, Alexander, Entwisle, and Horsey (1997) provide a useful framework for organizing child and family variables that may affect redshirting and long-term outcomes. These authors examine how the original transition from home to school eventually influences the decision to drop out in terms of four factors: (1) socioeconomic status and background including income, race, and family structure; (2) family context including family stresses, parents' values, and parents' socialization; (3) personal resources including the child's attitudes and behaviors toward school; and (4) school experiences including achievement, tracking, and retention. Following this framework, we selected a rich set of control variables similar to those used by Alexander, Entwisle, and Horsey (1997). Variables representing a student's attitude in kindergarten were not available in the NELS data, so the personal resources category was excluded.[2]

Socioeconomic status and background variables describe the student's economic and family environment, which can influence readiness for kindergarten and future educational achievement. This set of variables includes occupational status (using Duncan's index), parental education, and family income. These variables were converted into *z*-scores with mean 0 and standard deviation equal to 1. When there were missing values for parental education because of an absent parent, these were given a *z*-score of 0 and categorical variables were included to note these important missing values.[3]

With limited information about student abilities, parents and teachers use demographic characteristics to make decisions about redshirting and grade retention (Hauser, 2000; Stipek, 2002). Socioeconomic variables include demographic characteristics: region, rural or urban-suburban, and a categorical variable for gender. Also included are categorical variables for whether the student, mother, and father were born in the United States. The student's position in a family is measured by the number of siblings and whether the student is the oldest child.

Family structure can also influence redshirting and achievement. Ideally, we would have information about family structure at kindergarten when parents chose to enroll or delay kindergarten. These data are not available because the NELS began in eighth grade. We use eighth-grade characteristics as the closest proxy for kindergarten characteristics. The six family structures were: intact families; single-parent families with either the biological mother present or the father present; step-families with either the biological mother or father present; and those families with no biological parent present. The other family structures can tell us something about whether a student experienced a divorce or remarriage, but

not the number of such transitions. Finally, a categorical variable indicating whether the student was the child of a teenage mother was included.

Family context variables identify stresses, attitudes, and family socialization process that influence educational attainment (Alexander et al., 1997). From the parent questionnaire, indicators were obtained for whether the family was one of five religions and any of four levels of religious observance. These variables may proxy for the social capital available to the children (Coleman, 1990). Two variables represent parents' involvement and expectations for the child's future. The parent involvement variable is equal to 1 if the parent belonged to a parent–teacher association or related organization or volunteered at school. The second variable is a measure of the parents' expectations for the child. It takes the value 1 if parents expected the student to obtain education beyond high school. To measure the learning environment at home, variables are also included that indicate whether the home had a library card, magazines, and many books. Finally, a variable for changing school during junior high or high school is added to represent the effect of discontinuity in education.

The effect of age at school entry is sometimes believed to be largely a result of its effect on student attitudes about school (Uphoff & Gilmore, 1986). We included three variables—repeating kindergarten, repeating Grades 1 through 8, and participating in an English as a Second Language (ESL) program—to reflect school experiences that may positively or negatively affect student attitudes.[4] Research shows that repeating a grade has strong negative effects on achievement and socialization (Hauser, 2000; Holmes, 1989). The effect of ESL is unknown, but the need for special language assistance may increase the likelihood of repeating a grade.

One drawback of the NELS data is that many background characteristics are only recorded from eighth grade forward. We are limited to using family histories from eighth grade as a proxy for family characteristics when children entered kindergarten. This influences variables representing socioeconomic status and background. Family income, parents' education and occupational status, location of residence, and family structure are all measured during the time the child is in eighth grade. Similarly, variables measuring parent expectations and participation in and support for children's education were measured during eighth grade. For many families, especially those families that experience no change in family structure, family characteristics in eighth grade are likely a good proxy for the characteristics of households when the child entered kindergarten. In addition, we are able to identify certain experiences—such as changing schools, repeating a grade, and participating in ESL programs—from historical information gathered in the 1988 survey.

Determining Age at School Entry

The variable of interest in this study is age at school entry. These data were constructed by tracing students' lives backward to identify the age a student began kindergarten. Month and year of birth give the students' age in eighth grade. Combined with data about the number of grade retentions, we can identify children by their season of birth and age at school entry.[5]

All students in the NELS were in eighth grade in 1988. We identified three groups of students for analysis. State cutoff dates for kindergarten vary, but most states require students to turn 5 between September and December of the year they enter kindergarten (Saluja, Scott-Little, & Clifford, 2000). Because of the variation across states, there is ambiguity about whether children born in autumn were held back due to redshirting or state cutoff dates. To avoid this problem, we limited our analysis to comparison of students with summer birthdates and winter birthdates. Research shows that of these students, children with summer birthdates are more likely to be redshirted (Brent, May, & Kundert, 1996).

The first group of students have summer birthdates and entered kindergarten soon after they turned 5 years old. For simplicity, we call this group "young at school entry."[6] The second group of students have winter birthdates and entered kindergarten when they were approximately 5½ years old. This group is labeled "older at school entry."[7] The third group of students has summer birthdates and started school 1 year late. These students are labeled "redshirted" to reflect that kindergarten entry was intentionally delayed.[8] Redshirted students entered school soon after they turned 6 years old. Figure 1 illustrates how survey participants were placed in the young, older, and redshirted groups based on season and year of birth and school experiences.

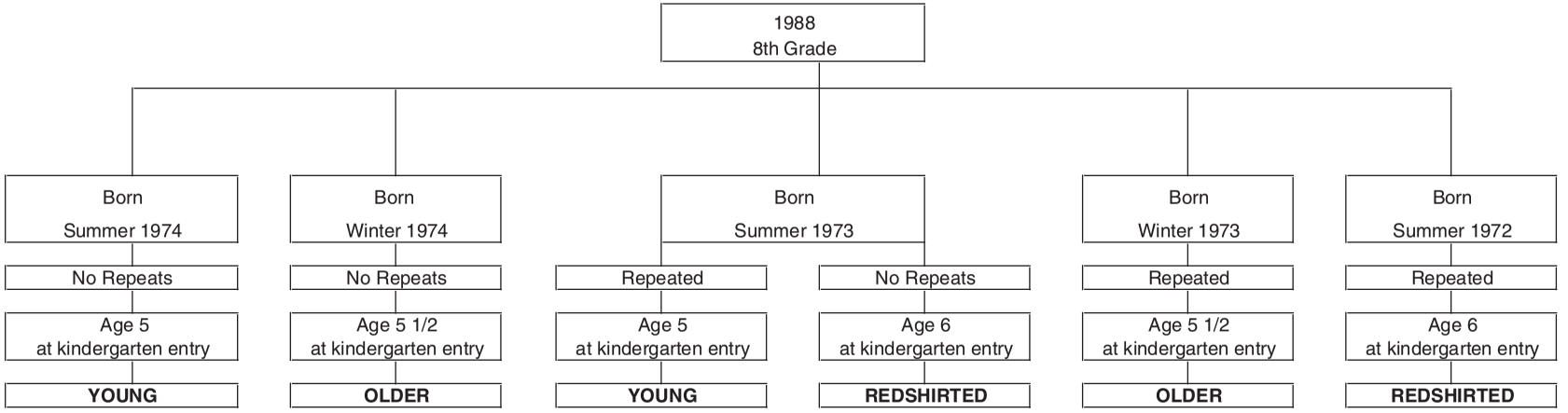

FIGURE 1. *Tracing age at kindergarten from NELS data.*

Methodology

A key concern in isolating the effect of age at school entry on long-term outcomes is that decisions about school entry may be correlated with unobservable family and child characteristics that also influence educational attainment. This is problematic if the same characteristics are associated with redshirting and educational outcomes. As Angrist and Krueger (1991) discuss, season of birth may be unrelated to factors that influence both outcomes and family background. If this assumption is correct, we can interpret an estimate of the effect of season of birth on student outcomes as strictly an age effect that is not contaminated by any correlation with unmeasured family background. Our first models make these assumptions.

Regression Analysis

First, we make a simple comparison of the younger and older groups. These students were not redshirted, but differ in age simply because of their season of birth. This provides an assessment of whether there are long-term effects of being younger at school entry due strictly to season of birth. The models used are estimated with a standard probit regression if the long-term outcomes are dichotomous (e.g., high school completion, out-of-wedlock fertility, college attendance, etc.) and with ordinary least squares (OLS) if the long-term outcomes are continuous (test scores and earnings).

Next, we estimate a second model to determine the effect of redshirting on long-term outcomes. Here, we compare children with summer birthdates who entered kindergarten at age 5 (the young group) and age 6 (the redshirted group). This provides an evaluation of the effects of being older in school because of delayed kindergarten entry.

Semiparametric Matching

The probit and OLS models are based on the assumption that the sample of students with summer birthdates that begin kindergarten at age 5 is not systematically different from the sample of students that begin kindergarten at age 6. This assumption is not likely to hold, as judgments about redshirting are typically endogenous to a child's individual characteristics (Marshall, 2003). There are two approaches in the literature to help overcome this selection problem. The first is to find an instrumental variable that is correlated with the likelihood of redshirting a student, but is not correlated with the outcome variable. In her study of the impact of age of kindergarten entry on early elementary achievement, Datar (2006) uses state laws concerning age at kindergarten entry as an instrumental variable that is endogenous to age at school entry but exogenous to achievement. This strategy did have an impact on the results of the study, but it cannot be replicated with NELS data because we do not know in what state participants lived during kindergarten. In addition, it is not clear that state cutoff dates are exogenous to achievement. States can purposely move up the cutoff date in an attempt to increase average elementary achievement (Stipek, 2002).

An alternative approach is to deal with selection on observables by employing a matching method. The matching method attempts to isolate the effect of the treatment on the treated by comparing the outcomes of redshirted students with the outcomes of similar students who were not redshirted. While this methodology does not adjust directly for selection on unobservable variables, we are able to control for some of these issues by placing restrictions on the matches. We apply a variant of the method proposed by Rosenbaum and Rubin (1983) that imposes weaker assumptions on the functional form of the estimated equation. In particular, the functional form of the probit equation places restrictions on the estimation that may smooth over important and potentially systematic differences between redshirted and young students. In this method, Rosenbaum and Rubin suggest using a propensity score to make matching feasible. The propensity score is a student's estimated probability of receiving the treatment—in this case being redshirted—given their observable characteristics. Rosenbaum and Rubin prove that matching on the propensity score provides as powerful a control as matching on all observable characteristics. This technique reduces the problem of matching on a large number of characteristics by matching on only one dimension—the propensity score for delayed kindergarten entry.[9]

In estimating the effect of delayed kindergarten entry, we permitted a single young student to match more than one redshirted student. This method minimizes the distance between treatments and their controls, but at the possible loss of some efficiency. Dehejia and Wahba (2002) find that in their sample this nearest-match algorithm performed better than algorithms that per-

mit several "fairly near" controls to match a single treatment. In our study, only 5% of control observations were used in multiple matches.

We are able to improve on the efficiency of the matching estimator by also matching within subgroups of the population to control for unobservable characteristics that may influence both redshirting and long-term outcomes. In the context of labor markets, Heckman, Ichimura, and Todd (1997) note the increased efficiency of matching within the same region, and Levine and Painter (2003) show a similar increase in efficiency when estimating the effect of out-of-wedlock fertility. In the estimations presented below, we match by gender, race, urban or rural residency, and intact or nontraditional family structure to capture some influences that are likely to be common across groups, but not an observable part of family background. To evaluate if redshirting is an effective way to prevent grade retention, we tested additional matches based on actual grade retention in kindergarten and grades one through eight, and also based on the predicted probability of repeating a grade.

Results

Family Characteristics

First, we examine the difference in characteristics between the young, older, and redshirted children. Young children were approximately 5 years old, older children were approximately 5½ years old, and redshirted children were approximately 6 years old when they entered kindergarten. By limiting the data set to summer and winter births, the number of observations is reduced. There are 2,535 observations in the older group of winter births. There are 3,021 observations with summer birthdates. Of the summer births, 2,794 are in the young group and 227 were redshirted. This translates to a 9% redshirting rate for students with summer birthdates, which is similar to redshirting rates in other studies (Stipek, 2002).

Table 1 displays the mean value of the independent variables for each group. The young and older groups have similar observable characteristics. They have similar family structure, religiosity, family size, gender, and rates of native U.S. birth. Parent education and family income are slightly higher for the young children, but these differences are less than 1 standard error. The redshirted group appears to be less advantaged than the young and older groups. These students are more likely to have nontraditional family structures and to have been born outside of the United States. They are also more likely to be male and either Latino or Asian. Redshirted students also are less likely to have parents who expect them to attend college and who participate at school.

This comparison indicates that in the NELS, students with fewer advantages were delayed presumably because they were considered less likely to succeed if they were the youngest in the class. This differs from some studies of individual school districts where relatively privileged students were more likely to be redshirted (Stipek, 2002). Students in the NELS may have been redshirted due primarily to perceived academic disadvantages. Thus, in this study redshirted students may be more likely to have low educational attainment.

Long-Term Outcomes

Table 2 tabulates the outcome variables for the young, older, and redshirted groups. With respect to long-term outcomes, young students have better outcomes on average than redshirted students. Young and older students are strikingly similar, with few significant differences in average outcomes. Redshirted students have slightly lower test scores, and are twice as likely to drop out as young students. Dropout is a particularly important issue for redshirted girls in this data set; one in five redshirted girls (not shown) ends up dropping out of school. Young and older students are more likely than redshirted students to attend college and graduate and earn higher salaries at age 25. Most social outcomes show no statistically significant differences by age at school entry. We do observe that young students are the least likely to have behavioral problems in high school, and that redshirted students are the most likely to be arrested.

Young students are most likely to repeat kindergarten, presumably as a remedy for being immature or unready for kindergarten the first time. Given equal achievement, teachers may be more willing to retain a young student in kindergarten due to the perception that she will benefit from an extra year of maturity, while a second year in kindergarten will not benefit a student who is already more mature than her classmates (Shepard & Smith, 1986). This finding supports previous studies showing an academic advantage for redshirted students in early grades. However, as in

TABLE 1
Mean Values of Family and Student Variables for Three Comparison Groups

Variable	Young[a] $n = 2{,}794$ Mean	*SE*	Older[b] $n = 2{,}535$ Mean	*SE*	Redshirted[c] $n = 227$ Mean	*SE*
Group 1: SES status and background						
Black	0.101	0.006	0.085	0.006	0.088	0.019
White	0.701	0.009	0.735	0.009	0.621	0.032
Asian	0.065	0.005	0.057	0.005	0.128	0.022
Hispanic	0.123	0.006	0.114	0.006	0.150	0.024
Single mother	0.142	0.007	0.149	0.007	0.198	0.027
Single father	0.003	0.001	0.004	0.001	0.009	0.006
Stepmother	0.097	0.006	0.103	0.006	0.066	0.017
Stepfather	0.024	0.003	0.016	0.002	0.018	0.009
Other family structure	0.033	0.003	0.029	0.003	0.044	0.014
Female	0.535	0.009	0.510	0.010	0.335	0.031
Native born	0.826	0.007	0.818	0.008	0.634	0.032
Mother foreign born	0.154	0.007	0.144	0.007	0.278	0.030
Father foreign born	0.157	0.007	0.141	0.007	0.308	0.031
South	0.355	0.009	0.339	0.009	0.344	0.032
West	0.200	0.008	0.187	0.008	0.229	0.028
Central	0.273	0.008	0.297	0.009	0.291	0.030
Urban	0.241	0.008	0.243	0.009	0.273	0.030
Rural	0.317	0.009	0.331	0.009	0.396	0.033
Mother was teen parent	0.124	0.006	0.131	0.007	0.084	0.018
Father's education	0.020	0.017	–0.033	0.018	–0.185	0.064
Mother's education	0.024	0.019	–0.024	0.019	–0.328	0.070
Father's occupation	0.007	0.017	–0.018	0.018	–0.088	0.057
Father unemployed	0.058	0.004	0.062	0.005	0.101	0.020
Mother's occupation	0.031	0.018	–0.022	0.019	–0.242	0.067
Mother unemployed	0.297	0.009	0.290	0.009	0.308	0.031
Oldest child	0.317	0.009	0.331	0.009	0.251	0.029
Number of siblings	2.197	0.029	2.253	0.031	2.638	0.113
Income in standard units	0.053	0.016	0.043	0.015	–0.340	0.074
Group 2: Family context						
Baptist	0.196	0.008	0.205	0.008	0.176	0.025
Catholic	0.322	0.009	0.327	0.009	0.344	0.032
Other religion	0.118	0.006	0.106	0.006	0.132	0.023
Missing religion	0.036	0.004	0.036	0.004	0.053	0.015
Number of siblings	2.198	0.029	2.253	0.031	2.639	0.113
Not religious	0.027	0.003	0.026	0.003	0.048	0.014
Very religious	0.416	0.009	0.390	0.010	0.322	0.031
Religious	0.149	0.007	0.148	0.007	0.137	0.023
Somewhat religious	0.167	0.007	0.166	0.007	0.141	0.023
Books in household	0.890	0.006	0.877	0.007	0.824	0.025
Magazines in household	0.749	0.008	0.743	0.009	0.634	0.032
Library card	0.815	0.007	0.800	0.008	0.731	0.029
Parents expect student to attend college	0.904	0.006	0.901	0.006	0.811	0.026
Parents involved at school	0.543	0.009	0.544	0.010	0.454	0.033
Changed school (other than normal transitions)[d]	0.224	0.008	0.247	0.009	0.273	0.030
Group 3: School experiences						
Repeated kindergarten	0.024	0.003	0.009	0.002	0.004	0.004
Repeated grades 1–8	0.142	0.007	0.101	0.006	0.185	0.026
ESL	0.034	0.003	0.039	0.004	0.084	0.018

[a]Students were age 5 at kindergarten entry. [b]Students were age 5½ at kindergarten entry. [c]Students were age 6 at kindergarten entry. [d]Missing values are imputed.

TABLE 2
Mean Values of Outcome Variables for Three Comparison Groups

Variable	Young[a] $n = 2,794$ Mean	Older[b] $n = 2,535$ Mean	Redshirted[c] $n = 227$ Mean
Key transitional outcomes			
8th-grade achievement test	0.142 (0.016)	0.160 (0.018)	–0.056 (0.061)
Behavior problems	0.111 (0.006)	0.117 (0.006)	0.154 (0.024)
Child out of wedlock[d]	0.115 (0.008)	0.128 (0.009)	0.157 (0.042)
Dropout	0.065 (0.005)	0.087 (0.006)	0.154 (0.024)
Attended college	0.713 (0.009)	0.675 (0.009)	0.573 (0.033)
Additional outcomes			
Early school experiences			
Repeated kindergarten	0.024 (0.003)	0.009 (0.002)	0.004 (0.004)
Repeated grades 1–8	0.142 (0.007)	0.101 (0.006)	0.185 (0.026)
High school—academic			
10th-grade achievement test[e]	0.006 (0.018)	–0.038 (0.019)	–0.139 (0.079)
12th-grade achievement test[e]	–0.048 (0.019)	–0.081 (0.020)	0.041 (0.085)
High school—social			
Felt put down by teachers	0.160 (0.008)	0.149 (0.008)	0.182 (0.031)
Felt put down by students	0.207 (0.009)	0.185 (0.009)	0.226 (0.033)
Varsity sports	0.490 (0.009)	0.500 (0.010)	0.493 (0.033)
School activities	0.688 (0.009)	0.675 (0.009)	0.634 (0.032)
Ever arrested	0.126 (0.006)	0.139 (0.007)	0.207 (0.027)
Postsecondary			
Earned a bachelor's degree	0.555 (0.011)	0.528 (0.012)	0.517 (0.045)
Income in 2000[f]	$29,591 (594)	$28,607 (562)	$26,914 (1,216)

[a]Students were age 5 at kindergarten entry.
[b]Students were age 5½ at kindergarten entry.
[c]Students were age 6 at kindergarten entry.
[d]Females only.
[e]Students who dropped out did not take the achievement test.
[f]If working and not in school.

previous studies, this advantage does not persist. Redshirted students are more likely to repeat Grades 1 through 8. Once again, this difference is most striking for redshirted girls (not shown), who are twice as likely to repeat as are girls in the young or older groups.

Regression Results

These observed differences in educational outcomes for students may be due to child and family characteristics, rather than age at school entry. The regression models control for observable child and family characteristics. In Model 1, we compare students in the young and older groups, controlling for family background, family context, and school experiences. These students were not redshirted and differ only in season of birth. The variable *young* is a categorical variable for students in the young group. Because grade retention is thought to cause future academic and social problems, young students may suffer in the long term because of the effects of retention rather than the effects of age differences. To control for this effect, we included repeating kindergarten and repeating grades one through eight as independent variables in the regressions on long-term outcomes. In addition, interaction terms were included to capture the combined effect of being younger and repeating a grade. The results for key variables are summarized in Table 3, with the full estimation results in Table A1 in the appendix. The control variables have the expected effect on education and social success. Higher socioeconomic status and a stable family context are positively associated with achievement. Negative school experiences, represented by variables for repeating kindergarten and Grades 1 through 8, have a negative effect on academic outcomes.

TABLE 3
Model 1 Results (Older vs. Young Students)

	8th-grade test		Child out of wedlock		Dropout		College		Wages	
Variables	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Young	–0.030	0.024	–0.012	0.011	–0.002	0.004	0.038	0.014***	1403.930	673.932**
Repeated kindergarten	–0.370	0.165**	0.089	0.109	0.048	0.043*	–0.113	0.093	–2011.167	1703.212
Young*repeat k	0.236	0.194	–0.009	0.070	–0.007	0.015	–0.006	0.100	–476.866	2102.039
Repeated grades 1–8	–0.242	0.059***	0.052	0.033*	0.033	0.011***	–0.140	0.037***	4812.656	4569.199
Young*repeat 1–8	0.116	0.073	–0.008	0.027	–0.013	0.004***	–0.009	0.041	–10225.060	5377.779*
R^{2c}	0.10		0.21		0.42		0.23		0.10	
Number of observations	4,483		2,788		5,329		5,329		4,145	

[a]Marginal effect estimated by OLS.
[b]Marginal effect (df/dx) estimated by probit with robust standard errors.
[c]For probit estimations, reported R^2 is the pseudo R^2 statistic.
*$p < .1$; **$p < .05$; ***$p < .01$

Controlling for grade retention, we found that young students have better opportunities to acquire human capital. The two groups were equally likely to drop out of school, but the interaction terms between repeating and being young show that young students who repeated a grade were significantly less likely to drop out than older students who repeated ($p < .01$), which may be due to compulsory attendance laws. Consistent with this finding, young students were more likely to attend college ($p < .05$) and have higher wages ($p < .05$). Age at school entry did not have the same effect on of out-of-wedlock births. Despite 6 months less fertility in school for young students, young and older students were equally likely to have an out-of-wedlock birth. Young and older students had similar eighth-grade achievement.

The second regression model (Model 2) tests the effect of being redshirted on students with summer birthdates. Here we compare students in the young and redshirted groups. Both groups were born in summer, but the redshirted group delayed kindergarten entry until age 6. Once again, the variable *young* reflects the effect of being in the youngest group. Overall, the results suggest no difference in outcomes between those who redshirt and those who begin kindergarten at age 5 across the five key outcomes (Table 4; Table A2 in the appendix). Controlling for child and family characteristics, young and redshirted students are equally likely to drop out, have a child out of wedlock, and attend college. Unlike estimates from Model 1, the variables that control for repeating a grade were not as consistently important.[10] The observed differences in average achievement for young and redshirted students disappear when we control for observable characteristics.

Additional Outcomes

Examining additional outcomes, there is evidence some that young students actually gain an academic advantage in high school (Table 5). When compared to the *older* group, even though there was no significant effect of *young* on eighth-grade test scores, young students had significantly higher test scores in 10th grade ($p < .001$) and 12th grade ($p < .05$). Consistent with the result for college enrollment, young students were also more likely to earn a bachelor's degree. Wages are greater for young students, but the difference is not statistically significant. There is no evidence that summer birth students have a social disadvantage compared with older students. The *young* variable was not a significant predictor of any social outcome variable.

At the same time, young students were significantly more likely to repeat kindergarten ($p < .001$) and grades one through eight ($p < .001$), indicating that being younger due to season of birth increases the likelihood of grade retention. This confirms findings from the literature that younger students have lower achievement in elementary school.

When comparing young and redshirted students on these additional outcomes, the only significant effect is that 10th-grade test scores are higher for younger students. The largest advantage for older students appears to be participation in varsity sports, but these results are not significant at the 10% level. As was the case when comparing the young students to the older ones, young students were significantly more likely to repeat kindergarten ($p < .01$) and Grades 1 through 8 ($p < .1$) than redshirted students. Finally, young students were significantly more likely to earn a bachelor's degree by age 26 than older students.

Semiparametric Matching

The regression results indicate that, controlling for observable characteristics, the only advantage of redshirted students compared with young students comes from the decreased likelihood of repeating kindergarten and subsequent grades. We next turn to semiparametric matching techniques to further compare young and redshirted students. This method controls for some of the selection bias introduced by voluntary redshirting by comparing students with similar predicted probabilities of being redshirted. More importantly, this method allows us to eliminate some of the observations that are drawn from a fundamentally different distribution than the redshirted students (see Levine and Painter, 2003, for a discussion of these issues). The outcomes of young students were then compared with the outcomes of redshirted students to identify if there are any circumstances that create an advantage for redshirted students.

In the first column of Table 6, we matched students based on multiple criteria, including gender, race, and urban or rural environment, in combination with a propensity score for redshirting. The results differ slightly from the regression re-

TABLE 4
Model 2 Results (Redshirted vs. Young Students)

	8th-grade test		Child out of wedlock		Dropout		College		Wages	
Variables	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Young	0.092	0.064	0.016	0.023	−0.008	0.010	0.039	0.038	1,559.627	1,898.658
Repeated kindergarten	0.155	0.18	0.095	0.151	0.027	0.028	−0.118	0.068*	−5,247.854	2,912.166*
Repeated grades 1–8	−0.302	0.15**	−0.020	0.055	0.017	0.022	−0.144	0.102	276.250	4,420.560
Young*repeat 1–8	0.169	0.155	0.050	0.100	−0.008	0.011	0.000	0.090	−2,474.823	4,571.584
R^{2c}	0.10		0.26		0.40		0.25		0.09	
Number of obs.	2,537		1,572		3,021		3,021		2,345	

[a]Marginal effect estimated by OLS.
[b]Marginal effect (df/dx) estimated by probit with robust standard errors.
[c]For probit estimations, reported R^2 is the pseudo R^2 statistic.
*$p < .1$; **$p < .05$; ***$p < .01$.

TABLE 5
Summary of Marginal Effects for Additional Outcomes

	Young vs. older		Young vs. redshirted	
Dependent variable	df/dx	*SE*	df/dx	*SE*
Early school experiences				
Repeat kindergarten	0.011	0.002***	0.013	0.003***
Repeat grades 1–8	0.049	0.008***	0.033	0.017*
High school—academic				
10th-grade achievement test	0.085	0.027***	0.172	0.075**
12th-grade achievement test	0.064	0.029**	0.042	0.08
High school—social				
Feel put down by teachers	0.009	0.012	–0.043	0.037
Feel put down by students	0.021	0.013	0	0.037
Varsity sports	–0.017	0.015	–0.063	0.04
School activities	0.012	0.014	–0.016	0.036
Behavior problems at school	0.002	0.009	–0.01	0.023
Ever arrested	0.005	0.008	–0.01	0.02
Postsecondary				
Earned a bachelor's degree	0.035	0.019*	–0.028	0.055

*$p < .1$; **$p < .05$; ***$p < .01$.

sults from Table 4. Young students have slightly higher test scores ($p < .01$) and higher rates of attending college, but also a slightly higher probability of an out-of-wedlock birth. Dropout rates and college attendance rates are almost equal. Redshirted students earn slightly higher wages. Consistent with the regression results in Table 4 is the result that most of the differences are not statistically significant. Only the difference in test scores is statistically significant.

Redshirting may be used as a strategy to prevent grade repetition, and based on the regression results, this strategy may be effective. To further examine outcomes following grade retention, we matched redshirted students with similar students who were not redshirted but who repeated a grade. This provides a direct comparison of redshirting and grade retention as two strategies to overcome immaturity. The results, displayed in Table 6 (column 2), are mixed. The younger students who repeated a grade have significantly higher dropout rates ($p < .10$) and are significantly less likely to attend college ($p < .10$), but have higher earnings. These results suggest that redshirting may increase the probability of high school graduation and college enrollment for students in a school district where grade retention is common. If retention is unlikely, redshirting will not have these benefits.

Since it is unlikely that parents and teachers have perfect information about which students entering kindergarten will eventually repeat a grade, it is more realistic to examine outcomes for students based on the probability of repeating as predicted from observable characteristics. Table 6, column 3, displays the results of matching based on an estimated probability of repeating a grade. This match provides insight into redshirting as a policy to prevent grade retention among students with similar characteristics and similar probabilities of grade retention. Here, the outcomes for young and redshirted students are very similar, with younger students having a slight advantage in test scores ($p < .10$), but almost equal probability of dropping out and attending college. So if decisions about redshirting are based only on the predicted probability of repeating, it is unlikely that redshirting creates any long-term advantages.

The final matching results in Table 6, column 4, test whether redshirting creates additional harm for students who later repeat a grade. Here, we matched young students who repeated and redshirted students who repeated to determine if repeating has greater negative effects on either group. This match restricts the sample size to 42 matches, making it less likely that differences will be statistically significant. The results, dis-

TABLE 6
Results of Semiparametric Matching (Young vs. Redshirted Students)

Variable	Column 1: Redshirted student matched with not-redshirted student, $N = 216$ pairs: Young mean value	Redshirted mean value	Difference = (young − redshirted)	N	Column 2: Matching a redshirted student with not-redshirted student who repeated grades K–8, $N = 205$ pairs: Young mean value	Redshirted mean value	Diff	N
8th-grade achievement test	–0.078	–0.304	0.226**	216	–0.302	–0.316	0.014	205
Dropout	0.153	0.144	0.009	216	0.205	0.146	0.059*	205
Child out of wedlock[a]	0.214	0.143	0.071	70	0.246	0.145	0.101	69
Attended college	0.597	0.583	0.014	216	0.493	0.571	–0.078*	205
Income in 2000[b]	$26,029	$26,204	–$175	114	$27,429	$23,783	$3,646*	100

Variable	Column 3: Matching based on similar probability of repeating a grade, $N = 125$ pairs: Young mean value	Redshirted mean value	Diff	N	Column 4: Matching a redshirted student who repeated with a Not-redshirted student who repeated, $N = 42$ pairs: Young mean value	Redshirted mean value	Diff	N
8th-grade achievement test	0.105	–0.138	0.243*	125	–0.329	–0.878	0.549***	42
Dropout	0.072	0.072	0.000	125	0.357	0.357	0.000	42
Child out of wedlock[a]	0.079	0.105	–0.026	38	0.364	0.182	0.182	11
Attended college	0.704	0.672	0.032	125	0.310	0.238	0.072	42
Income in 2000[b]	$27,844	$27,177	$667	64	$23,948	$21,737	$2,211	18

Note. All matches are based on probability of being redshirted, urban, race, two-parent households, and gender.
[a]Females only.
[b]Income is reported when both observations in a matched pair are working full-time and not in school.
*Difference is significant at 90% confidence level.
**Difference is significant at 95% confidence level.
***Difference is significant at 99% confidence level.

played in Table 6, column 4, suggest that younger students who repeat have higher test scores than redshirted students who repeat ($p < .10$). Younger students who repeat also had higher rates of college attendance and higher wages, but these results are not statistically significant. Thus, given that we cannot determine in advance who will repeat a grade, it appears that students have better outcomes on average if they begin kindergarten at age 5, even if grade repetition occurs later.

Sensitivity Analysis

While the matching method provides more efficient estimation based on observable variables, it is still possible that an unobservable variable confounds the relationship between redshirting and long-term outcomes (Hirano & Imbens, 2001). For example, parents of children who display maturity at age 5 may be less likely to delay kindergarten, and maturity may also contribute to student achievement in high school. If maturity has a sufficiently high correlation with both redshirting and long-term outcomes, the true effect of redshirting on student achievement could be significant even though the predicted effect is not significant. One may be able to ignore this problem if an instrument existed that predicted the propensity to redshirt, but not the outcome variable of interest. As mentioned previously, no such plausible instrument exists.

Frank (2000) offers a strategy to test the sensitivity of regression estimates by assessing the impact of either a confounding variable or a suppressor variable on the significance of regression coefficients. For purposes of this analysis, Frank's work demonstrates how to calculate the impact threshold of a suppressor variable (ITSV). We use the ITSV to identify the correlations necessary for an unobserved measure of maturity that would cause the results reported in Table 4 to be statistically significantly worse for the children who entered kindergarten at age 5. Specifically, the ITSV calculates a product of the correlation between an omitted variable and the dependent variable, and the correlation between the omitted variable and an independent variable.

Table 7 displays the results of Frank's test for suppressor variables for the five key outcome variables. The first column displays the partial correlation between the outcome variable and the *young* variable. We are looking for a suppressor variable that would reveal negative effects of being young. In the case of bad outcomes (dropout, behavior problems, and child out of wedlock), the ITSV is based on the correlations needed to make coefficients significant and positive (i.e., $t = +1.96$). In the case of good outcomes (eighth-grade test scores and college enrollment), the ITSV is based on the correlations needed to make coefficients negative and significant (i.e., $t = -1.96$). Table 7 also displays the partial correlations between an unobserved variable and the young and outcome variables that would imply that younger children have worse outcomes.

We focus our attention on eighth-grade achievement because it has the lowest ITSV in absolute value, and because it is easier to interpret the ITSV for continuous variables (see Harding, 2003). Assuming the impact of the suppressor is maximized, the impact of the suppressor variable would have to be .006 the induce suppression (to make the effect of starting kindergarten at age 5 statistically significant). Incorporating informa-

TABLE 7
Estimated Partial Correlations for a Suppressing Variable (SV)

Dependent variable	Partial correlation with "young"	Impact threshold (ITSV)	Critical *t*-value[a]	Partial correlation needed to reverse results	
				Correlation: "young" & SV	Correlation: outcome & SV
8th-grade achievement test	0.032	−0.006	−1.96	0.078	0.083
Behavior problems	−0.003	0.027	1.96	0.156	0.171
Dropout	−0.018	0.013	1.96	0.117	0.114
Child out of wedlock	0.013	0.053	1.96	0.224	0.235
Attended college	0.017	−0.014	−1.96	0.122	0.118

[a]*t*-value needed to show a statistically significant relationship between begin young at school entry and low achievement in the long run.

tion about covariates already in the model, a suppressor such as a measure of maturity would have to have a partial correlation with of .078 with starting kindergarten at age 5 and a partial correlation with eighth-grade test scores of .083 to induce suppression.

To explore whether these correlations are problematic, we looked for the best available measure of maturity at age 5 and its relationship to student achievement. To the best of our knowledge, there are no direct data on maturity. Instead, kindergarten readiness tests are one strategy to measure "maturity" and identify children at risk for academic and social problems (Graue & Shepard, 1989). These tests do not assess knowledge, but a child's capacity to learn, and are typically administered before a child enters kindergarten. Ideally, we would be able to calculate the true correlation between a readiness test, redshirting, and long-term outcomes for the NELS participants. Unfortunately, these data do not exist in the NELS or any other longitudinal dataset such as the Early Child Longitudinal Survey (ECLS). The relationship between readiness tests and student achievement in early elementary years has been studied by a number of authors (Bear & Modlin, 1987; May & Kundert, 1997; Meisels, 1987; Shepard, 1997), although most lack statistical rigor.

There is one study, in particular, that provides some insight into the correlation between readiness testing and early elementary school achievement, although not between readiness and redshirting. Graue and Shepard (1989) estimated simple correlations with no control variables between scores on the Gesell School Readiness Test (GSRT) and student achievement in kindergarten and first grade. The GSRT is designed to measure maturational level and to aid in kindergarten placement decisions. Simple correlations between GSRT scores and first-grade report card grades range from .13 and .24 for academic subjects. For a smaller subsample of students who were identified as needing developmental assistance, the simple correlations were much lower, ranging from .02 to .09 for academic subjects. While the simple correlations for the full sample are within the bounds that we would be concerned about, the ITSV calculation depends on partial correlations, controlling for all observable characteristics. It is unlikely that correlations would be this high after controlling for family and background characteristics. For example, in this study, the simple correlation between eighth-grade test scores and entering kindergarten at age 5 is .07, while the partial correlation controlling for family background is only .03. We would expect similar reductions in Graue and Shepard's reported correlations if controls for family characteristics were included. In addition, Graue and Shepard are reporting correlations for first-grade test scores when only 1 year has passed since kindergarten. It is likely that the large time gap between the determination of kindergarten readiness and eighth-grade testing will further reduce these correlations.

Robustness Checks

Because we discovered no significant differences between young and redshirted students, we conducted a series of robustness checks to determine if sampling affects the relationship between age at school entry and long-term outcomes. Because boys and girls mature at different rates, the effects of age at school entry may differ by gender. First, we tested the above results using samples of only boys and only girls. In general, these results confirm the conclusion that the only long-term effects of age at school entry come through the indirect effects of repeating a grade. There were no direct effects of age at school entry on long-term academic and social outcomes for boys or girls. We did find that young boys are more likely to repeat a grade than young girls. Thus, the negative effects of repeating a grade due to age at school entry are a greater concern for boys.

A second concern is that the NELS data on family characteristics in eighth grade may not reflect family characteristics when children entered kindergarten. Family structure variables may have changed during the time between kindergarten and eighth grade. However, intact two-parent families did not undergo family structure changes during this time. Limiting the sample to only two-parent households, there are no significant effects of age at school entry on behavior problems, out-of-wedlock births, dropout, or college enrollment. There was also no effect of age at school entry on repeating Grades 1 through 8. Also, young students in this restricted sample appear to have an academic advantage in high school. Tests scores in 8th grade, 10th grade, and 12th grade were significantly higher for young students versus redshirted students.

It is also possible that redshirting is beneficial for relatively privileged children, who are more likely to have access to stimulating learning experiences during the year of delayed kindergarten entry. We tested the above results on a sample of students from families with income above the sample mean and a sample of only White students. Again, there were no benefits of redshirting on long-term outcomes. Thus, redshirting by White and middle-class families does not appear to be any more effective than redshirting for students with low socioeconomic status.

An additional concern is that redshirting, retention, and student achievement may respond to school district policies. Frequent redshirting or redshirting of certain types of students may be an unofficial policy of school districts to increase the average achievement of kindergarteners. Thus, redshirting and achievement may be related through school policy. Ideally, we would have historical information to identify students who remained in the same school district from kindergarten through 12th grade and were therefore subject to one set of school district policies. Instead, we can identify students who attended the same junior high school, and students who changed schools between 8th and 12th grades. Students who changed schools were excluded from analysis of school effects. This eliminates approximately 25% of the sample. The regressions for young and redshirted students were replicated as fixed-effects models on this reduced sample to test the effect of endogeneity with school policies. Controlling for within-school effects, young students scored significantly higher on eighth-grade achievement tests ($p < .05$). There were no significant effects of age at entry for dropout, behavior problems, college enrollment, having a child out of wedlock, or wages.

Next, we compared outcomes of students who repeat kindergarten with those who redshirt. As noted in Table 6, students who start kindergarten at age 5 and then repeat a grade, perform worse than students who delayed kindergarten until age 6. At the same time, students in this sample could have educational or social problems that led them to repeat a grade but are not observed in the data. Perhaps a better comparison is to measure the differences in long-term outcomes between those who start kindergarten at age 5 and repeat kindergarten and those who start kindergarten at age 6. These two groups have similar ages in every grade after kindergarten and may be similar with respect to having a high probability of repeating kindergarten upon reaching age 5. The only difference is that the first group attended kindergarten twice, while the second group delayed kindergarten during the first year. We found that students who started kindergarten at age 5 and then repeated kindergarten at age 6, did as well or better than students who delayed kindergarten until age 6. The students who repeated kindergarten were less likely to be arrested and more likely to attend college. Rates of behavioral problems and out-of-wedlock births were similar for both groups.

Finally, a reduced form model was also estimated to explore the isolated effect of summer versus winter birth, regardless of age at kindergarten entry (Bedard & Dhuey, 2005). Ignoring year of birth, children with summer births are more likely to repeat a grade, but also more likely to attend college. There is no significant effect of summer birth on dropout or behavior problems.

Discussion

Because the NELS data reflect the experiences of students who entered kindergarten in the late 1970s and early 1980s, it is important to examine the applicability of these results to students and schools today. The first question is whether redshirting practices have changed in terms of who is redshirted. In the NELS data set, students who are male, White, and from low-income families are most likely to be redshirted. This is contrary to more recent perceptions of redshirting as a strategy used by wealthy parents to give children a competitive advantage. A NCES study of the National Household Education Survey looked at the incidence of redshirting for students entering kindergarten in 1992 and 1995. This study found that White males were more likely to be redshirted with no differences by poverty status (NCES, 1997). School district–level studies also confirm that White males are most likely to be redshirted, with mixed results regarding the influences of socioeconomic status (Stipek, 2002). There is no national evidence that redshirting is practiced more frequently by wealthy parents. Thus, from available data it does not appear that the demographic makeup of redshirted students in the NELS differs significantly from the situation today.

The second question is whether the prevalence of redshirting has changed. The rate of redshirt-

ing in the NELS was 9% for students with summer birthdates, which is identical to rates in the NHES in both 1992 and 1995 (NCES, 1997). There is evidence that redshirting was promoted as a strategy to prevent grade retention during the period when the NELS participants entered kindergarten. The maturationist theories of Ilg et al. (1978) were popular during this time, as were books such as *School Can Wait* (Moore, 1979) that advocate delaying school entry until children mature. Enthusiasm for redshirting was also expressed in professional education journals from this period, such as this excerpt from the journal *Education* (Jones & Sutherland, 1981):

> This remediation [redshirting] is a program that can be applied at any level of the educational system: nation-wide, state-wide, district-wide, or in an individual classroom; with minimal or no extra costs, and no disruption of things-as-they-are; and with benefit to everyone who is involved in educational systems.

Thus, redshirting was viewed during the period relevant to NELS participants as a positive alternative to grade retention. The new element for today's children is the added emphasis on early standardized testing and a more rigorous kindergarten curriculum (Stipek, 2002).

Overall, the results in this analysis suggest that redshirting is not an effective way to improve student outcomes, and in the long run, age has little effect on academic and social success in high school and young adulthood. These results generally agree with the limited previous research on long-term outcomes of age at school entry. Like Angrist and Krueger (1991), we find that young students with summer birthdates have higher wages than students with winter birthdates. However, we find no significant differences in wages based on redshirting, suggesting that this is not an effective strategy to give students a competitive edge on the job market. Our study finds no differences in behavioral outcomes for redshirted students. Using a more complex measure of parents' perception of behavior problems, Byrd et al. (1997) found that redshirted students have more behavioral problems in high school. However, the results in this study confirm the conclusion of Byrd et al. that younger students do not have behavioral problems associated with immaturity.

We do find that older students—whether due to redshirting or season at birth—are less likely to repeat kindergarten and subsequent grades, although this result was no longer significant in a sample of only married households. Knowing the profound negative effects of grade retention (Hauser, 2000; Holmes, 1989), parents and school administrators may still prefer to redshirt students who demonstrate a high probability of grade retention. There are two potential problems with this approach. First, our results indicate that the negative effects of retention are independent of age. Unless an extra year before kindergarten is guaranteed to prevent grade retention, which is impossible to predict accurately, the student may still be retained after redshirting. Further, our results indicate that when students are matched based on their probability of repeating a grade, young students perform as well as older students. A nationwide review of readiness policy demonstrates that educators and policymakers have no clear idea of what makes a student ready for kindergarten (Saluja et al., 2000). Age appears to be an inadequate predictor, and no readiness tests have satisfactory validity and reliability (Gredler, 1997; Shepard, 1997).

Concluding Remarks

This study addresses the issue of whether there are long-term advantages to delaying kindergarten entry until age 6. Specifically, the analysis focuses on the effects of age at school entry during a youth's high school years and the transition to adulthood, rather than focusing on the impact during elementary school or on an adult's wages. This research represents an important first step in understanding the role of age at school entry on these important transitional outcomes, while future research that contains more precise data on the early elementary experiences of youths will provide important insights into some factors that are unobservable in this analysis. The forthcoming ECLS birth cohort data will begin to solve this problem by gathering data from birth through first grade. These data should provide insight into the developmental and socioeconomic factors that lead to redshirting.

Shepard and Smith (1986, 1987) argue that the challenge is for elementary schools to accommodate the diverse achievement and maturity levels of young children, rather than for young children to meet expectations for kindergarten readiness. The clear policy implication for schools is that both redshirting and grade retention based solely on age should avoided. However, the situation

for parents is more complex. While parents can choose when their child should enter kindergarten, they have less control over grade retention decisions. Parents who elect to send a young child to kindergarten may regret the decision, if the school later elects to hold the child back because of his or her age. Therefore, the implication for parents is that they must consider school policies concerning both age at kindergarten and grade retention before making a decision about redshirting. If schools have a high propensity for retaining young students, parents may elect to redshirt as a prevention strategy. Alternately, parents who enroll a young child in kindergarten should continue to advocate for their child regarding any future retention decisions.

Despite evidence that older students have an academic advantage in elementary school, our results suggest that redshirting by parent preference or school recommendation is not an effective strategy for improving high school achievement, graduation rates, or college enrollment. Combined with the work of Angrist and Krueger (1991), this suggests that the most important effect of age at school entry may be that older students lose a year of participation in the workforce rather than that younger students are disadvantaged in early elementary years. Thus, the true competitive advantage may favor students who enter school at a young age.

Notes

[1]However, Bound and Jaeger (1996) warn that season of birth is not a good instrumental variable. They cite a set of studies that links season of birth somewhat inexplicably to individual characteristics including race, mental retardation, depression, and schizophrenia.

[2]Alexander, Entwisle, and Horsey (1997) found student attitudes in kindergarten to be a weak predictor of dropping out. Instead of controlling for early attitudes toward school, we examine whether early experiences in school (age at school entry) influence students' attitudes toward school later in life.

[3]For father's education, this procedure is far from perfect. Most of these missing values are in female-headed households. Furthermore, it may be the case that these values are missing in precisely those families that are the most disadvantaged because of the least connection to the father. This will cause the coefficient on single parent to be biased upward. In addition, it is not clear in the NELS whether the value for a stepfamily is taken from the stepfather or the biological father. For these reasons, the analysis was replicated without the variable father's education, and the differences in the results were small and not statistically significant.

[4]Another potentially relevant school experience is attending preschool. However, the decision to send a child to preschool is similar to the decision about when to enroll a child in kindergarten. In addition, the NELS data do not provide specific information about preschool quality or quantity.

[5]Students who skipped a grade were excluded because there were too few of these students in the NELS sample to conduct a systematic analysis.

[6]"Young at school entry" students were born in June, July, or August, 1975, if they did not repeat a grade, and June, July, or August, 1974, if they did repeat a grade.

[7]"Older at school entry" students were born in December, 1973, or January or February, 1974, if they did not repeat a grade, and December, 1972, or January or February, 1973, if they did repeat a grade.

[8]"Redshirted" students were born in June, July, or August, 1974, if they did not repeat a grade, and June, July, or August, 1973, if they did repeat a grade. Strictly speaking, not all students born in June, July, or August, 1974, were redshirted, because Indiana, Alaska, and Missouri have cutoff dates before August 31.

[9]Dehejia and Wahba (2002) provide an important example of where matching techniques closely estimate the true effects of a training program. Importantly, they find that the results from the matching method are closer to the actual experimental results than are the estimates predicted by a standard regression method.

[10]An interaction term for repeating kindergarten and entering kindergarten at age 5 was tested and omitted because of the fact that no girls were redshirted and repeated kindergarten.

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Manuscript received July 18, 2005
Final revision received March 22, 2006
Accepted April 14, 2006

Appendix

TABLE A1
Model 1 Results (Older vs. Young Students)

Variables	8th-grade test		Dropout		Behavior		Child out of wedlock		College	
	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Young	–0.030	0.024	–0.002	0.004	0.002	0.009	–0.012	0.011	0.038	0.014***
Group 1: SES status and background										
Black	–0.227	0.046***	0.019	0.008***	0.046	0.018***	0.117	0.028***	0.007	0.024
White (omitted)										
Asian	0.085	0.058	–0.017	0.004***	–0.010	0.020	–0.053	0.018**	0.119	0.034***
Hispanic	–0.101	0.045**	–0.007	0.005	0.011	0.016	0.040	0.024*	0.031	0.025
Single mother	0.019	0.037	0.017	0.007***	0.046	0.015***	0.065	0.020***	–0.024	0.021
Single father (omitted due to multicollinearity)										
Stepmother	–0.019	0.041	0.005	0.006	0.036	0.016**	0.045	0.021**	–0.021	0.023
Stepfather	–0.085	0.083	0.021	0.017	0.093	0.040***	–0.042	0.022	–0.017	0.048
Other family structure	–0.103	0.069	0.007	0.009	0.057	0.028**	0.051	0.034*	–0.012	0.039
Female	0.017	0.023	0.002	0.003	–0.072	0.008***			0.037	0.013***
Native born	–0.008	0.038	–0.211	0.021***	–0.049	0.015***	–0.116	0.023***	0.200	0.025***
Mother foreign born	–0.009	0.051	–0.016	0.005**	0.003	0.019	–0.026	0.020	0.102	0.027***
Father foreign born	0.064	0.050	–0.002	0.008	–0.025	0.016	–0.021	0.020	0.075	0.026***
South	–0.077	0.035**	0.000	0.005	–0.006	0.013	–0.040	0.015**	–0.001	0.021
West	–0.046	0.039	0.005	0.006	0.064	0.017***	0.002	0.018	–0.016	0.024
Central	–0.105	0.034***	0.000	0.005	0.013	0.013	0.007	0.017	–0.039	0.021
Urban	0.010	0.029	–0.004	0.004	0.004	0.010	0.007	0.014	0.002	0.018
Rural	–0.034	0.028	–0.006	0.004	–0.014	0.009	0.001	0.012	–0.029	0.016*
Mother was teen parent	–0.006	0.038	0.000	0.004	0.032	0.015**	0.043	0.018***	–0.042	0.022**
Father's education	0.075	0.018***	–0.004	0.003	0.000	0.007	–0.016	0.008*	0.058	0.011***
Mother's education	0.049	0.016***	–0.004	0.002	0.004	0.006	–0.004	0.008	0.035	0.010***
Father's occupation	0.038	0.016**	–0.007	0.002***	0.012	0.006**	–0.006	0.007	0.030	0.009***
Father unemployed	0.017	0.051	0.000	0.006	–0.016	0.016	0.012	0.021	0.088	0.024***
Mother's occupation	0.003	0.014	–0.001	0.002	0.006	0.005	–0.010	0.006*	0.017	0.008**
Mother unemployed	0.021	0.026	0.001	0.004	–0.013	0.009	0.001	0.011	0.016	0.015
Oldest child	0.005	0.025	–0.001	0.004	–0.033	0.008***	–0.005	0.011	0.032	0.015**
Number of siblings	–0.002	0.008	0.002	0.001*	0.001	0.003	0.011	0.003***	–0.015	0.005***
Group 2: Family context										
Baptist	–0.062	0.035*	0.012	0.006**	0.009	0.013	0.021	0.017	–0.018	0.020
Catholic	–0.070	0.030**	–0.005	0.005	–0.005	0.011	–0.011	0.014	0.033	0.018*
Other religion	–0.015	0.042	0.001	0.006	–0.027	0.012**	0.024	0.021	–0.034	0.026
Missing religion	0.080	0.066	–0.007	0.006	–0.058	0.013***	–0.005	0.026	0.025	0.034
Not religious	–0.110	0.074	0.010	0.013	0.023	0.027	0.052	0.041	–0.046	0.044
Very religious	0.000	0.030	–0.022	0.004***	–0.023	0.010**	–0.028	0.013**	0.095	0.016***
Religious	–0.023	0.037	–0.007	0.004	–0.013	0.012	–0.011	0.015	0.073	0.018***
Somewhat religious	–0.053	0.036	–0.012	0.003***	–0.016	0.011	–0.004	0.015	0.054	0.019***

(*continued*)

TABLE A1
(Continued)

Variables	8th-grade test		Dropout		Behavior		Child out of wedlock		College	
	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Books in household	0.032	0.039	–0.007	0.005	0.011	0.012	–0.001	0.015	0.010	0.021
Magazines in household	0.058	0.029**	–0.001	0.004	0.014	0.009	–0.026	0.013**	0.030	0.017*
Library card	0.073	0.030**	–0.014	0.005***	–0.041	0.012***	–0.035	0.016**	0.046	0.018***
Income in standard units	0.050	0.019***	–0.001	0.002	–0.010	0.007	–0.007	0.007	0.060	0.012***
Parents expect student to attend college	0.160	0.042***	–0.029	0.008***	–0.056	0.017***	–0.004	0.016	0.252	0.028***
Parents involved at school	0.011	0.024	–0.003	0.003	–0.002	0.008	–0.007	0.011	0.047	0.014***
Changed schools (other than normal transitions)[c]	–0.121	0.037***	0.023	0.007***	0.047	0.014***	0.039	0.017**	–0.061	0.022***
Imputed changed schools[c]	0.067	0.048	–0.012	0.004***	–0.036	0.012***	–0.020	0.016	0.026	0.025
Group 3: School Experience										
Repeated kindergarten	–0.370	0.165**	0.048	0.043*	–0.013	0.052	0.089	0.109	–0.113	0.093
Young*repeat kindergarten	0.236	0.194	–0.007	0.015	0.017	0.076	–0.009	0.070	–0.006	0.100
Repeated Grades 1–8	–0.242	0.059***	0.033	0.011***	0.107	0.026***	0.052	0.033*	–0.140	0.037***
Young*repeat 1–8	0.116	0.073	–0.013	0.004***	–0.039	0.015**	–0.008	0.027	–0.009	0.041
ESL student	0.090	0.061	–0.004	0.007	0.028	0.025	–0.029	0.020	0.032	0.035
Constant (for OLS only)	0.048	0.080								
Log-likelihood function (for probit only)			–826.315		–1,694.377		–812.143		–2,524.217	
R^{2d}	0.10		0.42		.10		0.21		0.23	
Number of observations	4,483		5,329		5,329		2,788		5,329	

[a]Marginal effect estimated by OLS.
[b]Marginal effect (df/dx) estimated by probit with robust standard errors.
[c]Missing values are imputed; dummy variable is included to represent that value was imputed.
[d]For probit estimations, reported R^2 is the pseudo R^2 statistic.
*$p < .1$; **$p < .05$; ***$p < .01$.

TABLE A2
Model 2 Results (Redshirted vs. Young Students)

Variables	8th-grade test		Dropout		Behavior		Child out of wedlock		College	
	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Young	0.092	0.064	–0.010	0.023	0.016	0.023	–0.008	0.010	0.039	0.038
Group 1: SES status and background										
Black	–0.191	0.058*	0.033	0.022	–0.060	0.014*	0.004	0.008	0.036	0.030
White (omitted)										
Asian	0.123	0.074	–0.035	0.022	0.022	0.026	–0.017	0.005*	0.125	0.039***
Hispanic	–0.081	0.058	0.002	0.020	–0.001	0.007	–0.003	0.007	0.029	0.032
Single mother	0.033	0.048	0.041	0.020**	0.071	0.026***	0.015	0.009**	–0.022	0.028
Single father	0.247	0.302	0.045	0.095	omitted		0.054	0.056	–0.018	0.134
Stepmother	0.008	0.056	0.033	0.022	0.034	0.024*	0.004	0.008	–0.013	0.031
Stepfather	–0.093	0.1	0.123	0.054***	–0.049	0.017	0.015	0.017	–0.078	0.063
Other family structure	–0.094	0.088	0.089	0.039***	0.041	0.038	0.019	0.015	–0.109	0.056**
Female	0.016	0.03	–0.074	0.011***	–0.119	0.029***	0.006	0.004	0.041	0.018**
Native born	0.017	0.049	–0.048	0.020***	–0.044	0.019*	–0.182	0.024***	0.178	0.032***
Mother foreign born	–0.023	0.069	0.044	0.031	–0.018	0.024	–0.015	0.007	0.082	0.037**
Father foreign born	0.078	0.065	–0.041	0.020*	0.001	0.014	–0.009	0.009	0.104	0.033***
South	–0.04	0.046	–0.021	0.016	0.005	0.021	–0.002	0.006	0.027	0.027
West	–0.08	0.05	0.048	0.022**	0.003	0.019	0.008	0.008	0.027	0.029
Central	–0.052	0.046**	0.002	0.017	–0.009	0.015	–0.003	0.006	–0.025	0.027
Urban	–0.089	0.039*	0.015	0.014	0.010	0.015	–0.009	0.005*	0.017	0.023
Rural	–0.063	0.036	–0.010	0.013	0.044	0.024**	–0.008	0.004*	–0.003	0.021
Mother was teen parent	–0.063	0.052***	0.066	0.022***	–0.012	0.009	0.008	0.007	–0.002	0.028
Father's education	0.076	0.024**	0.002	0.009	0.006	0.009	–0.001	0.004	0.072	0.015***
Mother's education	0.05	0.021	0.005	0.008	–0.015	0.009*	–0.003	0.003	0.020	0.013
Father's occupation	0.023	0.021	0.001	0.007	0.035	0.030	–0.006	0.003*	0.033	0.012***
Father unemployed	–0.035	0.066	–0.023	0.020	0.024	0.022	0.010	0.010	0.061	0.032*
Mother's occupation	0.006	0.018	–0.001	0.007	0.008	0.013	–0.004	0.003*	0.035	0.010***
Mother unemployed	0.009	0.034***	–0.012	0.012	0.081	0.031***	–0.008	0.004*	0.010	0.020
Oldest child	0.012	0.033	–0.028	0.011**	–0.022	0.018	–0.005	0.005	0.031	0.020
Number of siblings	0.008	0.011	0.002	0.004	–0.022	0.020	0.002	0.001*	–0.021	0.006***
Income in standard units	0.033	0.023	–0.015	0.008*	–0.022	0.022	–0.003	0.003	0.054	0.014***
Group 2: Family context										
Baptist	–0.05	0.046**	0.006	0.017	0.004	0.019	0.009	0.008	–0.016	0.027
Catholic	–0.082	0.039	–0.009	0.014	0.024	0.027	–0.010	0.006	0.024	0.023
Other religion	0.019	0.053	–0.040	0.015**	0.048	0.043	–0.007	0.006	–0.054	0.035
Missing religion	0.092	0.086	–0.057	0.017**	0.012	0.038	–0.009	0.007	0.014	0.046
Not religious	–0.067	0.094	0.051	0.039	–0.025	0.016*	0.004	0.013	–0.042	0.057
Very religious	0.024	0.039	–0.007	0.013	–0.022	0.015	–0.017	0.005***	0.089	0.022***
Religious	–0.007	0.049	–0.013	0.016	–0.015	0.015	–0.005	0.005	0.083	0.023***
Somewhat religious	–0.028	0.047	0.003	0.016	0.011	0.004***	–0.012	0.004**	0.038	0.025

(*continued*)

TABLE A2
(Continued)

Variables	8th-grade test		Dropout		Behavior		Child out of wedlock		College	
	Effect size[a]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*	Effect size[b]	*SE*
Books in household	0.044	0.052*	0.004	0.016	–0.036	0.016**	–0.004	0.007	0.038	0.030
Magazines in household	0.069	0.038***	0.005	0.013	–0.037	0.018**	–0.006	0.005	0.053	0.022**
Library card	0.103	0.04	–0.035	0.015**	–0.013	0.007*	–0.014	0.007***	0.050	0.023**
Parents expect student to attend college	0.132	0.053	–0.066	0.023***	–0.003	0.012	–0.036	0.012***	0.225	0.036***
Parents involved at school	0.004	0.032***	0.024	0.011**	0.045	0.021**	0.003	0.004	0.032	0.018*
Changed schools (other than normal transitions)****	–0.138	0.049	0.044	0.018***	–0.029	0.015	0.029	0.010***	–0.065	0.031**
Imputed changed schools****	0.069	0.062	–0.044	0.015**			–0.016	0.004***	0.060	0.032*
Group 3: School experience										
Repeated kindergarten	0.155	0.18**	–0.035	0.039	0.095	0.151	0.027	0.028	–0.118	0.068*
Repeated Grades 1–8	–0.302	0.15	0.039	0.051	–0.020	0.055	0.017	0.022	–0.144	0.102
Young*repeat 1–8	0.169	0.155	0.003	0.045	0.050	0.100	–0.008	0.011	0.000	0.090
ESL student	0.12	0.079**	0.018	0.031	–0.003	0.018	0.000	0.011	0.055	0.041
Constant (for OLS only)	–0.139	0.119								
Log-likelihood function (for probit only)			–958.490		–419.191		–464.667		–1,380.576	
R^{2d}	0.10		0.11		0.26		0.40		0.25	
Number of obs.	2,537		3,021		1,572		3,021		3,021	

[a]Marginal effect estimated by OLS.
[b]Marginal effect (df/dx) estimated by probit with robust standard errors.
[c]Missing values are imputed, dummy variable is included to represent that value was imputed.
[d]For probit estimations, reported R^2 is the pseudo R^2 statistic.
*$p < .1$; **$p < .05$; ***$p < .01$.