Online Appendices and Glossary
Chapter 2

Lessons from Neuroscience Research for Understanding Causal Links between Family and Neighborhood Characteristics and Educational Outcomes

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A temporary stress reaction brought on by a challenging or mildly stressful situation will enhance synaptic efficacy and improve learning and memory (Arnsten, 1998). This happens via activation of the sympathetic nervous system (Cahill, Prins, Weber, & McGaugh, 1994; McGaugh, 1989). The sympathetic response refers to the fast activation of a set of brain areas that coordinate the release of neurotransmitters (like adrenaline) that increase heart rate, improve memory, and sharpen mental focus. These neurotransmitters increase quickly to even mild stressors and decrease just as rapidly when stress ends. However, if a stressor is sufficiently strong or elicits feelings of social threat, that is a threat to the physical or social self, a full stress response is elicited (Kemeny, 2009). Social threat is a concept based on the idea that humans are social animals, who function best in groups. Thus, quite strong stress reactions can be achieved simply by making an individual perceive themselves as low status, and displeasing to a higher status other. This experience can be created in a laboratory setting for a few minutes, eliciting a full stress response for a short period of time (Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004). When this happens, a second pathway—the limbic hypothalamic pituitary adrenal (LHPA) axis—is also put into play.

Activation of the LHPA axis produces a longer-term response to a stressor than the sympathetic nervous system (hours rather than seconds to minutes). The LHPA response to threat or challenge begins in the central nervous system (the brain). Signals from the ventromedial prefrontal cortex and amygdala stimulate the release of a hormone (Corticotropin-releasing hormone or CRH) in the hypothalamus. CRH is part of a cascade that begins in the brain and moves to the adrenal glands (located on top of the kidneys) via the vascular system. Eventually glucocorticoids (another set of hormones) produced by the adrenal glands make their way back to the brain, again via system-wide circulation in the blood. This circuitous route is quite slow, and

system wide increases in glucocorticoids are not common until 20 to 45 minutes after the experience of a traumatic or socially threatening stressor. The amygdala, hippocampus, and ventromedial prefrontal cortex are regions in the brain with a high density of receptors for glucocorticoids, and therefore are highly susceptible to the effects of stress. Chronic exposure to stress, and therefore high levels of glucocorticoids, results in a variety of neural sequelae that shape how the brain responds to stressful situations. This feedback loop can modify future responses to stress, resulting in a negative cascade. As is likely clear from the earlier description of neurodevelopment, these sequelae are most permanent and globally impairing if they are experienced during childhood. We describe in more detail in the body of the text how stress shapes the brain and subsequent behavior.

Appendix 2.A2

      The prefrontal cortex is a large expanse of tissue located in the front of the brain. When adults sustain damage to the prefrontal cortex they lose the ability to self- regulate, consequently, their behavior becomes impulsive, and they are unable to make and sustain goal-oriented plans. The ability to make plans and produce goal-oriented behavior is largely due to a form of cognition called executive functioning. Executive functions are often divided into three categories (Miyake, et al., 2000): working memory, inhibition, and shifting. *Working memory* is the ability to hold concepts, pictures, rules, or any other stimulus in mind and 'work' with it for a short period of time. *Inhibition* is the ability to not respond to distracting stimuli with a motor response or attention. *Shifting* is the ability to switch rapidly from one item or rule in working memory to another. When a large number of children are tested on a variety of tasks thought to assess executive functioning and their results are factor analyzed, these three main factors come out of the analysis. Tests of executive function, which are used in the laboratory represent simplified versions of the tasks required in daily life. Instead of attending to a teacher lecturing while ignoring students' whispering, children are asked to press a button to only one picture which is delineated as relevant and to ignore all other irrelevant pictures. In studies using neuroimaging, executive functions are associated with activation of the prefrontal cortex in children and adults (Rypma, Berger, & D'Esposito, 2002; Scherf, Sweeny, & Luna, 2006; Thomason, et al., 2009)

Appendix 2.A3

Details of the BEIP institutionalization intervention study

At the outset of the study, 136 institutionalized children (average age 22 months; range 6-30 months) were extensively studied in Bucharest, Romania. In addition to the institutionalized children, seventy-two community controls (never institutionalized group or NIG) were also studied; these were children living with their biological families in the greater Bucharest community, most of whom had been born at the same maternity hospitals as the institutionalized children (thereby providing some control over Socioeconomic Status or SES).

List of relevant citations for BEIP:

Ghera, et al., 2009; Marshall & Fox, 2004; Marshall, Reeb, Fox, Nelson, & Zeanah, 2008; Moulson, Fox, Zeanah, & Nelson, 2009; Moulson, Westerlund, Fox, Zeanah, & Nelson, 2009; Nelson, Parker, Guthrie, & the BEIP Core Group, 2006; Nelson, et al., 2007; Parker & Nelson, 2005; Smyke, et al., 2007; Smyke, Zeanah, Fox, Nelson, & Guthrie, in press; Smyke, Zeanah, Fox, & Nelson, 2009; Windsor, Glaze, & Koga, 2007; Zeanah, et al., 2009; Zeanah, et al., 2006a, 2006b; Zeanah, et al., 2003; Zeanah, Smyke, Koga, & Carlson, 2005)

Appendix 2.A4. Glossary Terms: (in order of appearance)

1. neural plasticity – a term generally taken to refer to how experience changes brain chemistry, anatomy or physiology

2. neurogenesis – the birth of neurons. Most neurogenesis occurs before birth, but in select areas of the brain (for example, the hippocampus, which is involved in memory) new neurons continue to be made through at least middle age

3. cell migration – the cerebral cortex, the outer folding of the brain visible to the naked eye, is created by immature neurons migrating from the area that lines the cerebral ventricles. Most migration occurs radially, although there is also some tangential migration (different types of neurons use different migratory patterns)

4. synapse – the connection between two neurons. The most common synapses is between a dendrite of one neuron and an axon of a neighboring neuron

5. teratogens – an agent that can cause harm to the developing fetus or child. For example, alcohol is a teratogen to the developing fetus

6. strabismus – a congenital disorder in which the eyes cannot converge on a distant object, which can interfere with binocular (two eyes) depth perception. Often the eyes are misaligned

7. Amblyopia – similar to strabismus, but in this case the eyes cannot converge because the muscles of one eye are weak. As a result, that eye cannot move in tandem with the other eye, which results in a lack of convergence which in turn results in a lose of binocular depth perception.

8. sensitive period – a time in development when it is essential for experience to occur in order to facilitate typical (normal) brain development

9. Bayley Mental Developmental Index – a standardized test used to evaluate a child's cognitive developmental status. From the Bayley one derives a "Developmental Quotient" (DQ), which in the eyes of many is a proxy for the Intelligence Quotient (IQ)

10. limbic hypothalamic pituitary adrenal axis – a circuit in the brain that involves portions of the limbic system (e.g., amygdala), the hypothalamus (a part of the brain dealing with the endocrine functions, thermal regulation, etc), the pituitary gland (which produces hormones) and the adrenal glands (which sit atop the kidneys and produce hormones). This "axis" is critically involved in the stress response.

11. Glucocorticoids – chemicals that serve many bodily functions, including facilitating the so-called "fight or flight" response, which is engaged under acute and profound stress (for example, being threatened)

12. working memory – the cognitive function that permits the storage of information for brief periods of time, just long enough to take action; for example, holding a telephone number "on line" until you dial the number.

13. Inhibition – being able to withhold a response; for example, to *not* say something, or to *not* push a button when you see a certain stimulus.

14. Set shifting – refers to a form of cognitive flexibility; for example, in a cognitive task that requires you to process color and shape information and you decide the correct decision is to focus on shape, the task changes and you must now focus on color.

15. white matter – refers to regions of the brain containing myelin

16. dendrite – one of the appendages that extend from the body (soma) of a neuron; in reality, most neurons have multiple dendrites, and each dendrite may have multiple spines. It is contact between a spine and an adjacent axon (the other appendage of a neuron) that can form a synapse

ONLINE APPENDICES on DATA SETS AND TABLES

for Chapter 3

The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems

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Appendix on ECLS-K

The Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) has followed a nationally representative sample of 21,260 children who were in kindergarten in the 1998-99 school year. The ECLS-K uses a multistage probability design. The primary sampling units were counties or groups of counties. The second sampling stage was public and private schools with kindergartens and the third stage sampled children of kindergarten age within each school. On average at baseline, there were six children per classroom. The study thus far has released six waves of data: fall of kindergarten and spring of kindergarten, first, third, fifth, and eighth grades. Data were collected from multiple sources, including direct cognitive assessments of children, interviews with parents and surveys of teachers and school administrators

Achievement. Achievement tests were administered in all study waves. The battery of achievement tests given in kindergarten covered language and literacy as well as early math skills. The children pointed to answers or gave verbal responses and were not asked to write or explain their reasoning. The tests were administered using a computer-assisted interviewing methodology. Not all children were given the same items. A set of "routing" items were used to assess whether children should subsequently receive more or less difficult items. For this reason, the cognitive assessment scores provided in the data are item response theory (IRT) scores. We reports results of analyses using standardized values of these latent ability scores. Reliabilities reported for the overall IRT scores in reading and mathematics are over .9.

In the fall of kindergarten the reading assessment evaluated children's ability to identify upper- and lower-case letters of the alphabet by name, associate letters with sounds at the beginning and end of words, and recognize common words by sight. The math skills measured include the ability to identify one and two digit numerals, recognize geometric shapes, count up to ten objects and recognize the next number in a sequence.

In fifth grade, children were again assessed on their mathematics and reading skills. These fifth grade assessments required students to complete workbooks and open-ended mathematics problems. Reading passages and questions were provided to children so that they could reference the passages when answering questions. However, all questions were read to the students in both reading and math. In math, all answer choices were read to the students; in reading, the students read the answer options.

The fifth grade mathematics assessment included items tapping the following areas: simple multiplication and division and recognizing complex number patterns; demonstrating an understanding of place value in integers to hundreds place; using knowledge of measurement and

rate to solve word problems; solving problems using fractions; and solving word problems involving area and volume. The fifth grade reading assessment included the following skill areas: making literal inferences, extrapolation, understanding homonyms, and evaluation. Skills measured exclusively in fifth grade tested students ability to evaluate nonfiction.

The ECLS-K also asked teachers to complete academic rating scales (ARS) on student reading and mathematics achievement in all survey waves. Teacher's rated children's proficiency in particular skills on a scale that ranges from ―not yet (1)" to ―proficient (5)." In kindergarten, the reading scale combined ratings of student's speaking, listening, early reading, writing, and computer literacy. The kindergarten math assessment asked about student's proficiency with five skills: number concepts, solving number problems, using math strategies, data analysis (graphing), and measurement.

In fifth grade, teacher ratings of proficiency in expressing ideas, use of strategies to gain information, reading on grade level, and writing were combined to measure reading skills. In mathematics, teachers' rating of student's understanding of number concepts (place value, fractions, and estimation), measurement, operations, geometry, application of mathematical strategies, and beginning algebraic thinking were combined.[1] At all time points, these measures had high levels of reliability (internal consistency).

Attention and Behavior Problems. Measures of children's attention and problem behavior were constructed from teacher responses to self-administered questionnaires. The responses categories for all items range 1 ―never" to 4 ―very often".

The ELCS-K's ―Approaches to Learning" scale, which we use as the measure of attention skills, includes six items that measure the child's attentiveness, task persistence, eagerness to learn, learning independence, flexibility and organization. This measure has a reliability of .89 in the fall of kindergarten.

The teacher-reported measure of externalizing problem behaviors consists of five items that rate the frequency with which a child argues, fights, gets angry, acts impulsively, and disturbs ongoing activities. The four items that make up the measure of internalizing behaviors ask about the apparent presence of anxiety, loneliness, low self-esteem, and sadness. The reliabilities for externalizing and internalizing problem behaviors are .90 and .80, respectively.

SES. The ECLS-K measured family SES by a combination of parents' education and occupation prestige, as well as household income. Each of the five measures were standardized to have a mean of 0 and standard deviation of 1. For families in which two parents were present, the composite SES variable was constructed by averaging of five measures (two measures of parental education and occupational prestige and one measure of household income). In cases where only one parent is present, an average of three measures was constructed (parent's education, occupational.

Missing Data. Although baseline data were collected from over 21,000 children, missing data reduced our analysis samples to approximately 17,600 in kindergarten fall and 11,265 children in the spring of fifth grade. Some of the missing data are deliberate, since the ECLS-K study randomly sampled half of children who changed schools and compensated for the losses

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[1] Reading ARS scores are available for the full sample, but only half of the teachers were asked to rate students in mathematics.

with adjustments to the sampling weights. We use pair-wise deletion in calculating the correlations in appendix tables 1-4. All analyses use appropriate weights to account for non-response and attrition.

Appendix on NLSY

The National Longitudinal Survey of Youth is a multi-stage stratified random sample of 12,686 individuals aged fourteen to twenty-one in 1979. Black, Hispanic, and low-income youth were over-represented in the sample. Annual (through 1994) and biennial (between 1994 and 2000) interviews with sample members, and very low cumulative attrition in the study, contribute to the quality of the study's data.

Beginning in 1986, the children born to NLSY female participants were tracked through biennial mother interview supplements and direct child assessments. Given the nature of the sample, it is important to note that early cohorts of the child sample were born disproportionately to young mothers. Our target sample consists of 3,893 children who were age 5 or 6 in 1986 (n=921), 1988 (n=1,160), 1990 (n=951) or 1992 (n=861). These children were ages 19 or 20 in 2000, 2002, 2004, and 2006 respectively. With its biennial measurement interval, the NLSY yields two independent samples of children (i.e., those observed at approximately 5, 7, 9, etc. and those observed at approximately 6, 8, 10, etc.).

Dependent variables. In our analyses, we use both measures of educational attainment and criminal activities as outcomes. Our primary measure of educational attainment is a dichotomous indicator of whether a child completed high school at age 19 or 20. We characterize students who are still enrolled in regular school at this age as having completed high school. We make this exception for students who because of the timing of the interview may be a few months shy of graduating. The rate of high school completion is between 77-79%. For the NLSY's three oldest cohorts, we used data collected at age 20 or 21 to measure whether the participant has ever attended college. Since it is taken early in adulthood, this is a dichotomous indicator of ―on time" college attendance, and available for only three of the four cohorts for which we have high school completion data. About 45-48% of the sample had attended college by this age.

To measure criminal activity we use a self-report indicator, taken at age 19 or 20, of whether the youth had ever been arrested for a crime. Some 22-24% of the NLSY sample reported that they had been arrested.

Key predictors. We use as key independent variables the assessments of academic skills, specifically reading and math achievement, as well as three dimensions of behavior – inattention and two aspects of problems behavior anxiety/depression and antisocial behavior. These are measured every two years in the NLSY data (ages 5/6, 7/8, 9/10, 11/12).

Reading and math achievement. Children's early academic skills are measured by standardized Peabody Individual Achievement Tests (PIAT, reading recognition and math). For the purposes of analysis, scores are standardized to have a mean of 0 and standard deviation of 1 (based on the full NLSY sample distribution).

Interviewers verbally administered the PIATs. Children were first given an age appropriate item, and a basal score was established when a child answered five consecutive questions correctly. Once a basal was established, interviewers continued to ask the child questions until the child answered 5 out of 7 consecutive items incorrectly. Subtracting the

number of incorrect scores between the basal and the ceiling score from the ceiling score produced a raw test score.

The reading recognition test consists of 84 items that measure word recognition and pronunciation ability. It tests children's skills at matching letters, naming names, and reading single words out loud. Dunn and Markwardt (1970) reported the one-month temporal reliability of a national sample, and the test-retest correlations ranged from a low of .81 for kindergarteners to a high of .94 for third grade students. Overall the test had an average temporal reliability of .89. Studies of the tests concurrent validity find that the test was moderately correlated with other tests of intelligence (e.g.,Wechsler Intelligence Scale for Children-Revised) and reading vocabulary (e.g., Metropolitan Achievement Test) (Davenport, 1976; Wikoff, 1978).

The PIAT math subscale consists of 84 multiple-choice items designed to measure mathematic concepts taught in mainstream classrooms. The problems were designed so that children are required to apply math concepts to questions rather than conduct increasingly complicated computations. The test starts with basic skills such as number recognition and counting. The test increases in difficulty to problems involving division, multiplication, and fractions. The most difficult questions involve advanced concepts from algebra and geometry. Dunn and Markwardt (1970) reported one-month test-retest reliabilities from a national sample. The reliabilities ranged from a low of .52 for kindergarteners to a high of .84 for high school seniors. On average the test-retest reliability was .74. Studies of the PIAT math test's concurrent validity found that the test correlated moderately with other tests of intelligence and math achievement (Davenport, 1976; Wikoff, 1978). The PIAT reading recognition and math test scores are highly correlated (r ranges from .36 at age 13 to .60 at age 8/9).

Antisocial behavior, inattention, and anxiety/depression. In the NLSY, behavior problems were assessed by mothers' responses to 28 items that asked how true statements were about a child's behavior during the past 3 months. These questions were created specifically for the NLSY, and consist of items derived from the Achenbach Behavior Problems Checklist as well as other established measures (Baker et al., 1993). The single item questions were recoded so that a response of "not true" corresponded to a score of 0, and "sometimes true" and "often" corresponded to a score of 1.

Six subscales were created by the NLSY staff based on a factor analysis of the items. The process for creating these subscales and the reliability of each is reported in Baker et al. (1993). Three of the 6 behavior problem subscales are used in this study—attention problems (hyperactivity), antisocial, and depression/anxiety. However, for the purposes of the analyses, the raw scores are translated into standardized scores with a mean of 0, and standard deviation of 1.

The attention problem scale is comprised of 5 items that ask about the following child behaviors: being restless and overactive, having difficulty concentrating or paying attention, being easily confused or in a fog, and having trouble with obsessions. The NLSY reports that this subscale has adequate reliability (alpha of .69).

The antisocial subscale is created from 6 items that measure whether the child cheats or tells lies, bullies or is cruel to others, does not feel sorry after misbehaving, breaks things deliberately, is disobedient at school, and has trouble getting along with teachers. The anti-social subscale has adequate reliability (alpha of .67).

The anxious/depressed scale consists of 5 items that indicate how often the child: has sudden changes in mood or feeling, feels or complains that no one loves him/her, is too fearful or anxious, feels worthless or inferior, and is unhappy, sad or depressed. The reliability of this scale is also adequate (alpha of .65). The attention and antisocial subscales are highly correlated, with correlations in the .45 -.55 range.[2]

Covariates. An important strength of the NLSY is the depth and range of longitudinal information collected about families. We take advantage of these data to construct a comprehensive set of covariates that capture potentially important confounds that may be correlated both with early skills and behavior as well as later attainment and crime.

Maternal and interviewer reports of two relevant dimensions of children's temperament – sociability and compliance – are drawn from the children's age 3 or 4 interviews.[3] The Peabody Picture Vocabulary Test- Revised (PPVT) is used to measure children's early receptive vocabulary at age 3/4. The PPVT consists of 175 vocabulary items which increase in difficulty. Nationally standardized scores are used in our analyses.

Data on children's family environments were coded to correspond to two intervals— between birth and age 5 and at age 5/6. Measures available at both times include: family income, family structure, and urban residence. Some information was only measured when children were age 5 or 6 including children's HOME environment and two measures of family structure (blended family and cohabitation). The highest grade a mother completed when the child was age 5/6 is also used as a control.

The NLSY measures an array of child and mother background characteristics, which are used as covariates in analyses. These variables include, for example, measures of the child's race (Black, Hispanic, or non-Hispanic white) and mothers' percentile scores on the Armed Forces Qualifying Test (AFQT, a measure of mothers' academic aptitude assessed in 1980). In addition, several variables that measure mothers' risk-taking behaviors (drug and alcohol use) and her adolescent experiences are also included as covariates.[4]

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[2] The antisocial and inattention/hyperactivity scale are both part of the larger externalizing scale created by NLSY staff. When we use the externalizing measure in analyses results parallel those found for the antisocial measure. The anxiety/depression scale is part of the larger internalizing scale.

[3] The compliance measure was created by summing maternal ratings of the frequency of children's behavior on a five-point scale from almost never (1) to almost always (5). Taken together, the seven items capture how well the child follows directions. For example, questions include how often ―the child obeys when told to go to bed" and ―turns off the TV when asked." This measure has adequate reliability, with NLSY reporting the alpha of .59 for children of all ages (Baker et al., 1993). Summing 3 interviewer ratings of the child's cooperation during the assessment created the sociability scale. Children were rated on a scale of poor (1) to excellent (5). Items include, for example, the observer's rating of how cooperative the child was in completing the assessment and of the child's attitude toward being tested. This measure has a high reliability; the NLSY reports an alpha of .93 (Baker et al., 1993). Children who were age 5 or 6 in 1986 do not have early childhood measures of PPVT or temperament because the maternal and child interview was not conducted at an earlier age for these children. In addition, NLSY's restriction of the measurement of sociability to children over age 4 in 1990, resulted in a large number of missing data on this measure for children in cohort 4 that were age 3 in 1990. These data are imputed for children with missing observations.

[4] Currie and Stabile's (2007) analysis takes advantage of the fact that the NLSY provides observations on siblings by estimating fixed-effect sibling models. They find very similar coefficients on early attention and anti-social behavior in their models of school enrollment. Given our lengthy time period between early-grade measurement of skills and behavior and eventual attainment, sibling models are not possible for our analyses.

Missing data. The longitudinal nature of data collection results in missing data. In the NLSY, between a quarter and a third of a particular age cohort of children is missing information on key outcome variable (ever arrested). Missing data on key predictors (achievement and behavior problems) is quite low during the early school years, with no more than 10% missing data on achievement or behavior at ages 5 or 6. Yet, as expected rates of missing data increase over time so that by age 13, about 30% of the sample has missing data on the predictor variables. We handle this missing data by using multiple imputation techniques to create and analyze five datasets in STATA. However, our estimation results are similar if we use only cases with complete data. This approach assumes that data were missing at random (conditional on observed characteristics).

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Appendix Table 3.A1: Bivariate Correlations Among Achievement, Attention and Behavior in Kindergarten and Fifth Grade, ECLS-K

	1	2	3	4	5
1. Reading	--	.75**	.38**	-.25**	-.20**
2. Math	.69**	--	.37**	-.22**	-.22**
3. Approaches to Learning	.29**	.41**	--	-.61**	-.40**
4. Externalizing Behavior	-.07**	-.14**	-.51**	--	.30**
5. Internalizing Behavior	-.12**	-.19**	-.36**	.25**	--

Note. Correlations below the diagonal are for kindergarten and above the diagonal are for fifth grade. **p<.01.

Appendix Table 3.A2: Bivariate Correlations Among Math and Reading Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--	.83**	.72**	.71**	.68**
2. Kindergarten-Spring	.80**	--	.79**	.76**	.73**
3. First Grade-Spring	.67**	.78**	--	.79**	.76**
4. Third Grade-Spring	.61**	.66**	.77**	--	.88**
5. Fifth Grade-Spring	.60**	.65**	.73**	.86**	--

Note. Correlations below the diagonal are for reading and above the diagonal
are for math. **p<.01.

Appendix Table 3.A3: Bivariate Correlations Among Externalizing and
Internalizing Behavior Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--	.58**	.19**	.25**	.23**
2. Kindergarten-Spring	.72**	--	.25**	.28**	.21**
3. First Grade-Spring	.52**	.56**	--	.32**	.25**
4. Third Grade-Spring	.47**	.50**	.56**	--	.31**
5. Fifth Grade-Spring	.43**	.47**	.47**	.55**	--

Note. Correlations below the diagonal are for externalizing behavior and above
the diagonal are for internalizing behavior. **p<.01.

Appendix Table 3.A4: Bivariate Correlations Among Approaches to Learning
Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--				
2. Kindergarten-Spring	.71**	--			
3. First Grade-Spring	.48**	.53**	--		
4. Third Grade-Spring	.43**	.48**	.55**	--	
5. Fifth Grade-Spring	.38**	.41**	.48**	.55**	--

Note. **p<.01.

Appendix Table 3.A5: Gaps in Children's Academic and Behavior Skills in the Fall of Kindergarten, ECLS-K

	Reading		Math		Approaches to Learning		Lack of Externalizing Behavior[a]		Lack of Internalizing Behavior	
	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE
Boys/Girls	0.17	0.15	0.03	0.01	0.40	0.39	0.41	0.39	0.06	0.05
Black/White	0.43	0.30	0.62	0.40	0.36	0.30	0.31	0.28	0.06	0.04
Hispanic/White	0.53	0.29	0.77	0.36	0.22	0.14	-0.01	-0.07	0.05	0.03
SES: 1st quintile/5th quintile	1.26	0.85	1.34	0.85	0.63	0.63	0.26	0.17	0.30	0.31
SES: 1st quintile/3rd quintile	0.59	0.45	0.72	0.46	0.36	0.35	0.14	0.08	0.21	0.23
SES: 3rd quintile/5th quintile	0.67	0.47	0.62	0.40	0.27	0.27	0.12	0.13	0.09	0.08

Note: All positive numbers represent gaps in reference to the advantaged group indicated on the right hand side of the first column (e.g., girls, on average, score 0.17sd higher than boys in reading). Negative numbers indicate that the left hand group has better scores, on average.

[a]For both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 3.A6: Gaps in Children's Academic and Behavior Skills in the Spring of 5th Grade, ECLS-K

	Reading		Math		Approaches to Learning		Externalizing Behavior[a]		Internalizing Behavior	
	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE
Boys/Girls	0.13	0.06	-0.18	-0.26	0.58	0.51	0.48	0.41	0.12	0.07
Black/White	0.71	0.43	0.85	0.56	0.44	0.34	0.50	0.37	0.03	-0.08
Hispanic/White	0.58	0.21	0.50	0.23	0.06	0.15	-0.02	0.01	-0.05	-0.01
SES: 1st quintile/5th quintile	1.43	0.66	1.38	0.65	0.68	0.55	0.47	0.19	0.30	0.36
SES: 1st quintile/3rd quintile	0.80	0.27	0.71	0.21	0.18	0.21	0.11	0.06	0.08	0.16
SES: 3rd quintile/5th quintile	0.63	0.39	0.67	0.38	0.5	0.32	0.37	0.23	0.22	0.16

Note: In this table, all positive numbers represent gaps in reference to the advantaged group indicated on the right hand side of the first column (e.g., girls, on average, score 0.13 sd higher than boys in reading). Negative numbers indicate that the left hand group has better scores, on average. [a]For both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 3.A7. Summary of Probit Regressions of Ever Arrested, HS completion, and Attending College on Patterns of Childhood Antisocial Behavior, NLSY, Ages 8, 10, and 12

	Ever Arrested (N=1,466)			HS Completion (N=1,466)			Attending College (N=1,134)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
SES (ref: lowest quintile)									
SES quintile 2	.003	.005	.007	.058	.050	.042	.085†	.075	.060
	(.040)	(.040)	(.041)	(.037)	(.037)	(.037)	(.050)	(.052)	(.054)
SES quintile 3	-.075*	-.058	-.049	.153***	.126***	.106**	.210***	.164**	.131*
	(.034)	(.036)	(.038)	(.031)	(.034)	(.034)	(.048)	(.052)	(.053)
SES quintile 4	-.125***	-.098**	-.080*	.235***	.198***	.170***	.314***	.252***	.215***
	(.035)	(.038)	(.040)	(.031)	(.034)	(.035)	(.041)	(.046)	(.048)
SES quintile 5	-.150***	-.112**	-.090*	.312***	.268***	.236***	.398***	.337***	.285***
	(.033)	(.037)	(.039)	(.025)	(.028)	(.032)	(.036)	(.042)	(.046)
At age 6,									
Antisocial Problem		.054***	.011		-.040*	.001		-.044†	.000
		(.016)	(.018)		(.017)	(.020)		(.024)	(.026)
Attention Problem		.015	.014		-.026	-.001		-.032	.019
		(.017)	(.018)		(.018)	(.019)		(.028)	(.030)
Anxious Problem		-.006	-.003		-.006	-.012		-.019	-.033
		(.014)	(.015)		(.018)	(.020)		(.020)	(.024)
Achievement Composite		-.023	-.028		.067***	.022		.125***	.028
		(.016)	(.019)		(.017)	(.021)		(.022)	(.030)
Age 8-10-12									
<u>Antisocial Problems</u>									
Average age 8-10-12			.124***			-.095***			-.104***
			(.023)			(.024)			(.030)

Attention Problems									
Average age 8-10-12			-.020			-.035			-.071†
			(.023)			(.028)			(.041)
Anxious Problems									
Average age 8-10-12			-.023			.028			.037
			(.020)			(.026)			(.041)
Achievement Composite									
Average age 8-10-12			.016			.067**			.163***
			(.020)			(.024)			(.036)
Family & Child Characteristics	no	no	no	no	no	no	no	no	no

Notes: *** p<.001; ** p<.01; * p<.05; † p<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of ever being arrested associated with unit changes in the given independent variable.

Column 1 coefficients represent simple bivariate relationships between ses composite and dependent variable.

Column 2 adds antisocial, attention, anxiety, and achievement composite at age 6.

Column 3 adds averages of each measure at age 8, 10, and 12.

Appendix Table 3.A8: School-level Concentrations of Kindergarten Achievement, Attention and Behavior Problems

	All	Free Lunch Eligbility >50%	Free Lunch Eligbility <5%	Student Population ≥ 50% Minority	Urban School District	Suburban School District
			School Characteristics			
Percent of children with …						
Low math skills	25%	38%	10%	32%	28%	20%
Significant attention problems	24%	32%	17%	29%	26%	22%
Significant behavior problems	18%	24%	15%	23%	19%	17%
All three problems	5%	8%	2%	7%	6%	3%
Percent of full sample	100%	24%	15%	13%	39%	37%

Notes: ―Low math skills‖ are scoring in the bottom 25% of the math IRT distribution.
―Significant attention problems‖ are scoring in the bottom 25% of the attention scale
―Significant behavior problems‖ are scoring in the top 18% of the externalizing behavior problem scale

Appendix Table 3.A9. Summary of Results from Probit Regressions of High School Completion on Achievement and Behavior Problems across Middle Childhood, NLSY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	`(12)
	Age 5		Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 14
	Bivariate										Bivariate	
Antisocial	-.063***	-.030*	-.037*	-.021	-.048***	-.039**	-.058***	-.053***	-.061***	-.080***	-.158***	-.104***
	(.011)	(.014)	(.016)	(.014)	(.015)	(.015)	(.016)	(.015)	(.016)	(.016)	(.016)	(.024)
Inattention	-.050***	.005	-.001	.006	-.013	.017	-.007	-.005	-.037†	.014	-.111***	-.007
	(.011)	(.014)	(.016)	(.017)	(.019)	(.015)	(.017)	(.017)	(.020)	(.019)	(.013)	(.017)
Anxious	-.028*	.004	-.003	-.011	.003	-.014	.014	.009	.026	-.017	-.092***	-.001
	(.011)	(.014)	(.017)	(.015)	(.015)	(.015)	(.017)	(.015)	(.017)	(.017)	(.013)	(.021)
Reading	.090***	.027*	.032†	.046***	.065***	-.001	.032	.029*	.047†	.017	.036**	.044†
	(.011)	(.014)	(.017)	(.014)	(.018)	(.014)	(.021)	(.014)	(.026)	(.021)	(.012)	(.023)
Math	.080***	.019	.011	.026†	-.005	.056***	.056**	.033*	.030	.056***	.118***	.046*
	(.012)	(.015)	(.019)	(.015)	(.019)	(.015)	(.019)	(.015)	(.018)	(.015)	(.014)	(.019)
Antisocial	-.063***	-.030*	-.037*	-.021	-.049***	-.039*	-.058***	-.053***	-.061***	-.080***	-.158***	-.104***
	(.011)	(.014)	(.016)	(.014)	(.015)	(.015)	(.016)	(.016)	(.016)	(.016)	(.016)	(.024)
Inattention	-.050***	.005	-.001	.006	-.014	.017	-.007	-.005	-.037†	.015	-.111***	-.007
	(.011)	(.014)	(.016)	(.017)	(.019)	(.015)	(.017)	(.017)	(.020)	(.019)	(.013)	(.017)
Anxious	-.028*	.004	-.003	-.011	.005	-.013	.015	.008	.026	-.018	-.092***	-.001
	(.011)	(.014)	(.017)	(.015)	(.015)	(.015)	(.017)	(.015)	(.017)	(.017)	(.013)	(.021)
Achievement Composite	.114***	.047**	.042**	.072***	.061***	.054***	.088***	.063***	.076***	.080***	.108***	.091***
	(.013)	(.016)	(.016)	(.017)	(.018)	(.015)	(.019)	(.017)	(.023)	(.017)	(.016)	(.026)
Family & Child Char.	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
Sample Size	2005	2005	1888	1764	1832	1774	1756	1828	1658	1803	1667	1667

Notes: *** p<.001; **p<.01; *p<.05; †p<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of the high school completion associated with unit changes in the given independent variable

Results in columns (1) and (11) are based on bivariate probit regressions

Results in columns (2)-(10) and (12) are from a model with full controls and both behavior measures.
Results in the top panel are based on regressions that include separate measures of reading and math achievement. Results in the bottom panel are based on regressions that include a single composition measure of achievement.

Family and child controls include race; Hispanic ethnicity; gender; age 0-5: % years in poverty,% years with middle income, % years with middle high income, % urban residence, % years mother never married, % years mother divorced, % years resided with grandmother, ave # children; child: age 3/4: PPVT standardized score, age 4/5: compliance, age 4/5: sociability; household age5/6: urban residence, number of children, mother's education, poverty, child's father present in household, mother never married, mother divorced , mother cohabiting with partner, mother married to partner, total home; mother: age at birth, mother academic aptitude (AFQT) , ever use alcohol, mother fight, mother steal, age mother first tried smoking, mother never smoke, marijuana use: occasional, marijuana use: moderate, drug use: occasional, drug use: high, mother lived with two parents at age, mother us born, mother drank alcohol during pregnancy, used prenatal care , mother smoked during pregnancy.

Appendix Table 3.A10. Summary of Probit Regressions of High School Completion on Patterns of Childhood Antisocial Behavior, NLSY Ages 6, 8, and 10 (*N*=1,437 for high school completion and 1,081 for college attendance)

	(1)	(2)	(3)	(4)
	High School Completion		Ever Attended College by age 21/22	
	Bivariate	Adjusted	Bivariate	Adjusted
Antisocial Problems				
Intermittent	-.164***	-.056	-.189***	-.048
	(.032)	(.036)	(.041)	(.053)
Persistent	-.346***	-.162*	-.354***	-.165†
	(.055)	(.068)	(.061)	(.098)
Attention Problems				
Intermittent	-.159***	-.023	-.185***	-.045
	(.033)	(.032)	(.043)	(.054)
Persistent	-.268***	.033	-.313***	-.011
	(.060)	(.054)	(.057)	(.091)
Anxiety Problems				
Intermittent	-.089**	-.023	-.109**	-.047
	(.030)	(.034)	(.039)	(.051)
Persistent	-.229***	-.075	-.232***	-.114
	(.055)	(.070)	(.063)	(.088)
Reading Problems				
Intermittent	-.206***	-.077*	-.264***	-.114*
	(.031)	(.035)	(.037)	(.052)
Persistent	-.319***	-.076	-.358***	-.092
	(.055)	(.066)	(.063)	(.099)
Math Problems				
Intermittent	-.168***	-.058†	-.211***	-.101*
	(.032)	(.034)	(.042)	(.051)
Persistent	-.314***	-.133†	-.438***	-.338***
	(.060)	(.073)	(.047)	(.076)
Family & Child Characteristics	no	yes	no	yes

Notes: *** $p<.001$; ** $p<.01$; * $p<.05$; † $p<.1$

Probit model coefficients and standard errors are expressed as "marginal effects" -- percentage point changes in the probability of high school completion or college attendance associated with unit changes in the given independent variable

Columns 1 and 3 show bivariate coefficients between intermittent and persistent behavior problem groups and the no problem reference group

Columns 2 and 4 include all listed variables, plus child and family controls simultaneously.

"Persistent" reflects cases above the 75th percentile at Ages 6, 8, and 10.

"Intermittent" reflects cases above the 75th percentile for at least 1 but not all 3 time points
Controls are listed in Appendix Table 9

Appendix Table 3.A11. Summary of Results from Probit Regressions of "Ever Arrested" on Achievement and Behavior Problems across Middle Childhood, NLSY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13		Age 14	
	Bivariate										Bivariate	
Antisocial	.050***	.033**	.032*	.032*	.032*	.033*	.065***	.051***	.063***	.095***	.115***	.078***
	(.011)	(.012)	(.015)	(.015)	(.016)	(.014)	(.019)	(.013)	(.014)	(.013)	(.012)	(.015)
Inattention	.042***	.006	.007	.009	-.003	.011	-.016	.005	-.008	-.008	.082***	.007
	(.011)	(.014)	(.016)	(.015)	(.015)	(.015)	(.015)	(.015)	(.018)	(.016)	(.013)	(.017)
Anxious	.019†	-.005	-.011	-.008	-.008	-.009	-.008	-.002	-.003	-.018	.055***	-.006
	(.010)	(.013)	(.014)	(.014)	(.013)	(.015)	(.016)	(.014)	(.016)	(.016)	(.014)	(.015)
Reading	-.036***	-.008	-.016	-.004	-.005	-.003	-.007	.001	.007	-.023	-.049***	-.035
	(.011)	(.014)	(.015)	(.016)	(.017)	(.016)	(.017)	(.015)	(.019)	(.023)	(.012)	(.028)
Math	-.028*	-.010	.018	-.008	.003	-.001	.022	-.006	-.010	.010	-.039***	.014
	(.011)	(.014)	(.015)	(.016)	(.017)	(.015)	(.015)	(.015)	(.017)	(.014)	(.012)	(.017)
Antisocial	.050***	.033**	.032*	.032*	.032*	.033*	.065***	.051***	.062***	.095***	.115***	.079***
	(.011)	(.012)	(.015)	(.015)	(.016)	(.014)	(.019)	(.013)	(.014)	(.013)	(.012)	(.016)
Inattention	.042***	.006	.007	.009	-.003	.011	-.016	.005	-.008	-.007	.082***	.008
	(.011)	(.014)	(.016)	(.015)	(.015)	(.015)	(.015)	(.015)	(.018)	(.016)	(.013)	(.017)
Anxious	.019†	-.005	-.011	-.008	-.008	-.009	-.007	-.002	-.003	-.019	.055***	-.007
	(.010)	(.013)	(.014)	(.014)	(.013)	(.015)	(.016)	(.014)	(.016)	(.016)	(.014)	(.015)
Achievement Composite	-.043***	-.019	.003	-.011	-.002	-.004	.015	-.006	-.003	-.007	-.065***	-.011
	(.013)	(.017)	(.017)	(.016)	(.017)	(.015)	(.016)	(.018)	(.015)	(.018)	(.015)	(.024)
Family & Child Char.	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
Sample Size	2005	2005	1888	1764	1832	1774	1756	1828	1658	1803	1667	1667

Notes: *** p<.001; **p<.01; *p<.05; †p<.1
Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of ever being arrested associated with unit changes in the given independent variable.

Results in columns (1) and (11) are based on bivariate probit regressions
Results in columns (2)-(10) and (12) are from a model with full controls and both behavior measures.
Results in the top panel are based on regressions that include separate measures of reading and math achievement. Results in the bottom panel are based on regressions that include a single composition measure of achievement.

Appendix Table 3.A12. Summary of Probit Regressions of Ever Arrested on Patterns of Childhood Achievement, Attention and Behavior Problems at age 6, 8 and 10

NLSY (*N*=1,437 for All; 699 for Males only)

	(1)	(2)	(3)	(4)
	All		Males only	
	Bivariate	Adjusted	Bivariate	Adjusted
Antisocial Problems				
Intermittent	-.164***	-.056	-.212***	-.107†
	(.032)	(.036)	(.048)	(.057)
Persistent	-.346***	-.162*	-.395***	-.235**
	(.055)	(.068)	(.059)	(.083)
Attention Problems				
Intermittent	-.159***	-.023	-.180***	-.004
	(.033)	(.032)	(.042)	(.050)
Persistent	-.268***	.033	-.343***	-.007
	(.060)	(.054)	(.066)	(.088)
Anxious Problems				
Intermittent	-.089**	-.023	-.151***	-.061
	(.030)	(.034)	(.045)	(.059)
Persistent	-.229***	-.075	-.319***	-.115
	(.055)	(.070)	(.069)	(.103)
Reading Problems				
Intermittent	-.206***	-.077*	-.225***	-.079
	(.031)	(.035)	(.044)	(.058)
Persistent	-.319***	-.076	-.360***	-.111
	(.055)	(.066)	(.072)	(.104)
Math Problems				
Intermittent	-.168***	-.058†	-.198***	-.070
	(.032)	(.034)	(.045)	(.057)
Persistent	-.314***	-.133†	-.333***	-.097
	(.060)	(.073)	(.080)	(.114)
Family & Child Characteristics		yes		yes

Notes: *** p<.001; ** p<.01; * p<.05; † p<.1

Probit model coefficients and standard errors are expressed as "marginal effects" -- percentage point changes in the probability of ever being arrested associated with unit changes in the given independent variable

Columns 1 and 3 show bivariate coefficients between intermittent and persistent behavior problem groups and the no problem reference group

Columns 2 and 4 include all listed variables, plus child and family controls simultaneously.

"Persistent" reflects cases above the 75th percentile at Ages 6, 8, and 10.

"Intermittent" reflects cases above the 75th percentile for at least 1 but not all 3 timepoints
Controls are listed in Appendix Table 9.

Online Appendix

Chapter 4

Middle- and High School Skills, Behavior, Attitudes, and Curriculum Enrollment and Their Consequences

George Farkas

APPENDICES ON NELS DATA AND TABLES

I use data from the NELS, a nationally representative sample of eighth-graders, first surveyed in the spring of 1988. The study was sponsored by the National Center for Education Statistics (NCES), United States Department of Education. The base year NELS survey conducted in 1988 involved 25,000 eighth graders, from 1000 schools throughout the United States. A large proportion of this 1988 population was re-surveyed in 1990, 1992, 1994, and 2000. In 1990, many of the original participants were in the 10th Grade, while in 1992 they were in the 12th Grade. Data from the first 3 rounds included items about school (including some test scores), work, and home life.   In the 2000 sample, most of the participants were in their mid-20's and in the workforce or raising families. Approximately 12,100 people completed some portion of the survey at the 5 sample time points.

Sample

The analytic sample is restricted to respondents with complete data on the study variables. The N for the tables varies from 8,887 to 6,576 as various constraints were placed on the data.

Measures

Child Sex - Females were the reference category, with male children coded as 1.

Race/Ethnicity - Non-Hispanic White is the reference category and the other categories are as follows: 1) African American; 2) Hispanic; and 3) Asian.

Base Year Socio-Economic Status (SES) - The NELS staff constructed the SES using variables from the parent questionnaire data. The variables are father's education level, mother's education level, father's occupation, mother's occupation, and family income. These were Z-scored, averaged, and the result was Z-scored. For the few cases where all parent data components were missing, student data were used to compute the SES. The first four components from the student data are the same as the components used from parent data, educational-level data, and occupational data. The fifth component for SES from the student data consisted of summing the non-missing household items, calculating a simple mean of these items, and then standardizing this mean.

Test Scores/Test Achievement, 8th Grade – Standardized tests were given to study participants during the 8th Grade. Scores in English and Math were collected for the Base Year Survey. For our study, the two test scores were each Z-scored (mean = 0, STD = 1). In Tables 4.A4, 4.A6, 4.A8, and 4.A10, persistent and intermittent low test achievement were used. Intermittent low test achievement was defined as being in the lowest 25% of values in either the 8th or 10th grade wave, but not both. Persistent low test achievement was defined as being in the lowest 25% of values at both time points.

Learning Behaviors, 8th Grade – In the Base Year teacher's survey, teachers were asked to rate each participant in their class on their classroom characteristics. The questions dealt with absenteeism, tardiness, inattentiveness, and homework behaviors. For our study, we used the participant characteristics rated from two different teachers. The values were each Z-scored (mean = 0, STD = 1), summed, and then Z-scored. In Tables 4.A4, 4.A6, 4.A8, and 4.A10, persistent and intermittent learning behavior problems were used. Intermittent problem behavior was defined as being in the lowest 25% of values in either the 8th or 10th grade survey waves, but

not both. Persistent problem behavior was defined as being in the lowest 25% of values at both survey waves.

Externalizing Problem Behaviors, 8th Grade – In the Base Year teacher's survey, teachers were asked to rate each participant in their class on their classroom characteristics. One question dealt with disruptive behaviors. For our study, we used the participant characteristics rated from two different teachers. The values were each Z-scored (mean = 0, STD = 1), summed, and then Z-scored. For Tables 4.A1 and 4.A2, the values used represented a more positive behavior, while in the remaining tables the values were reverse coded so that a negative behavior was investigated. In Tables 4.A4, 4.A6, 4.A8, and 4.A10, persistent and intermittent externalizing were used. Intermittent externalizing was defined as being in the highest 25% of values on externalizing problem behaviors at either the 8th or 10th grade survey waves, but not both. Persistent externalizing behavior problems were defined as being in the highest 25% group of values on externalizing problem behaviors in both the 8th and 10th grade survey waves.

Internalizing, 8th Grade – In the Base Year teacher's survey, teachers were asked to rate each participant in their class on their classroom characteristics. One question dealt with exceptionally passive or withdrawn students. For our study, we used the participant characteristics rated from two different teachers. The values were each Z-scored (mean = 0, STD = 1), summed, and then Z-scored. For Table 4.A1, the values used represented a more positive behavior, while in the remaining tables the values were reverse coded so that a negative behavior was investigated.

In Tables 4.A4, 4.A6, 4.A8, and 4.A10, persistent and intermittent internalizing problem behaviors were used. Intermittent internalizing was defined as being in the highest 25% of values on internalizing behavior problems at either the 8th or 10th grade survey waves, but not

both. Persistent internalizing was defined as being in the highest 25% of values on internalizing problem behaviors in both the 8th and 10th grade survey waves.

Locus of control, 8th Grade – In the Base Year Survey, participants were asked to answers questions from the Rotter locus of control scale.   Questions dealt with luck and the ability to attain one's goals. Some variables were recoded so that a higher value corresponded with a more positive outcome. The values were summed and Z-scored (mean = 0, STD = 1).

Self Esteem, 8th Grade – In the Base Year Survey, participants were questioned about their feelings of self-worth and satisfaction in their daily lives. The answers that were recorded for these questions were re-coded in some instances so that the direction of the variables all pointed in the same direction (value of 1 = low feeling, 5 high feeling). All variables were then Z-scored (mean = 0, STD = 1), then averaged. The result was then Z-scored.

Non-Academic Track, 10th Grade - In the first follow-up survey a question was asked about the student's present high school program. If the student had valid data and did not answer college preparatory, the student was given a value of 1 that corresponds to non-academic track.

Educational Expectations, 10th Grade – A group of questions in the first follow-up survey asked how far the participant thought they would go in school, their chances of high school graduation and whether they thought they would go to college in the future. The answers to these questions were Z-scored (mean = 0, STD = 1) and averaged. The result was then Z-scored.

Ever Arrested by 12th Grade - During the first and second follow-ups, participants were asked whether they had ever been arrested. If a participant answered yes to any one of these questions, the participant was given a value of 1 for being arrested.

High School Diploma – The variable F4UNI2E was used to determine whether or not a participant obtained a high school diploma by the fourth follow-up wave (2000). If the participant was classified as having a diploma, they were assigned the value of 1.

PSE Degree (Age 26) – During the fourth follow-up survey, participants were asked about their educational achievements after high-school. Participants listed what type, if any, of post secondary degree they have obtained.

Earnings (Age 26) – During the fourth follow-up survey, participants were asked the amount of income they earned in 1999 and how many weeks they worked in 1999. Our analysis was restricted to those that had income during 1999 and worked at least 1 week in 1999. This variable was Z-scored.

Database Set-up and Calculations

The NELS data was converted from raw data into SAS data set using SAS code included in the NELS CDROM. Variables listed above were created and simple means and STD were calculated using SAS as well. To calculate marginal effects, the dataset was converted into STATA using STAT Transfer. The mfx command in STATA was then used to calculate the marginal effects (dy/dx) and significance of the logistic regression models. Regressions shown in Tables 4.A1 and 4.A2 were run with school fixed effects, thereby eliminating the effects of any school level variables.

Appendix Table 4.A1. Marginal effects calculated from OLS or Logistic regression estimates of 8th Grade Outcomes. (N=7,815)

	Reading		Math		Learning Behaviors		Lack of Externalizing		Lack of Internalizing	
	Unadj.	School FE	Unadj.	School FE	Unadj.	School FE	Unadj.	School FE	Unadj.	School FE
Male	-.173 ***	-.209 ***	.108 ***	.068 **	-.151 ***	-.167 ***	-.322 ***	-.331 ***	.005	.002
	(.022)	(.024)	(.022)	(.022)	(.019)	(.021)	(.021)	(.022)	(.021)	(.023)
Black	-.586 ***	-.411 ***	-.717 ***	-.491 ***	-.192 ***	-.098 *	-.309 ***	-.345 ***	-.045	.004
	(.039)	(.047)	(.039)	(.041)	(.034)	(.043)	(.038)	(.059)	(.039)	(.055)
Hispanic	-.505 ***	-.226 ***	-.544 ***	-.240 ***	-.199 ***	-.051	-.116 ***	-.073	-.088 *	.033
	(.036)	(.049)	(.036)	(.043)	(.031)	(.042)	(.034)	(.042)	(.035)	(.056)
Asian	.089 *	.032	.377 ***	.275 ***	.183 ***	.221 ***	.178 ***	.210 ***	.068	.013
	(.043)	(.044)	(.043)	(.047)	(.037)	(.036)	(.041)	(.035)	(.042)	(.049)
SESQ2	.313 ***	.207 ***	.305 ***	.200 ***	.123 ***	.097 **	.057	.023	.118 ***	.111 **
	(.035)	(.034)	(.034)	(.031)	(.031)	(.036)	(.035)	(.036)	(.036)	(.042)
SESQ3	.510 ***	.390 ***	.493 ***	.367 ***	.194 ***	.166 ***	.057	.026	.214 ***	.204 ***
	(.034)	(.034)	(.033)	(.033)	(.031)	(.035)	(.034)	(.038)	(.035)	(.043)
SESQ4	.697 ***	.537 ***	.706 ***	.501 ***	.237 ***	.200 ***	.038	-.002	.206 ***	.198 ***
	(.034)	(.038)	(.033)	(.035)	(.031)	(.035)	(.034)	(.039)	(.035)	(.040)
SESQ5	1.13 ***	.875 ***	1.24 ***	.877 ***	.372 ***	.331 ***	.174 ***	.102 **	.272 ***	.277 ***
	(.033)	(.039)	(.033)	(.040)	(.030)	(.034)	(.034)	(.039)	(.034)	(.041)

These are calculated from bivariate regressions (of course race and SES are each represented by a set of dummy variables).

Significance, * < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A2. Marginal effects calculated from OLS or Logistic regression estimates of 12th Grade Outcomes. (N=7,924)

	Reading		Math		Learning Behaviors in High School		Lack of Externalizing	
	Unadj.	School FE	Unadj.	School FE	Unadj.	School FE	Unadj.	School FE
Male	-.185 ***	-.227 ***	.131 ***	.090 ***	-.187 ***	-.204 ***	-.255 ***	-.278 ***
	(.022)	(.023)	(.022)	(.0231)	(.022)	(.024)	(.022)	(.024)
Black	-.675 ***	-.486 ***	-.786 ***	-.500 ***	-.158 ***	-.167 **	-.398 ***	-.318 ***
	(.039)	(.048)	(.038)	(.041)	(.040)	(.060)	(.040)	(.057)
Hispanic	-.450 ***	-.194 ***	-.535 ***	-.235 ***	-.158 ***	-.068	-.127 ***	-.110 *
	(.035)	(.043)	(.034)	(.046)	(.036)	(.054)	(.035)	(.050)
Asian	.101 *	.077	.342 ***	.294 ***	.054	.083	.147 ***	.138 ***
	(.042)	(.048)	(.042)	(.046)	(.043)	(.048)	(.043)	(.035)
SESQ2	.345 ***	.256 ***	.370 ***	.281 ***	.122 ***	.113 **	.118 ***	.112 ***
	(.033)	(.034)	(.032)	(.032)	(.035)	(.045)	(.035)	(.045)
SESQ3	.556 ***	.421 ***	.601 ***	.467 ***	.159 ***	.138 ***	.164 ***	.159 ***
	(.033)	(.036)	(.032)	(.033)	(.035)	(.043)	(.035)	(.045)
SESQ4	.772 ***	.577 ***	.876 ***	.660 ***	.236 ***	.203 ***	.249 ***	.226 ***
	(.033)	(.037)	(.032)	(.036)	(.035)	(.043)	(.035)	(.043)
SESQ5	1.14 ***	.811 ***	1.31 ***	.930 ***	.327 ***	.289 ***	.326 ***	.278 ***
	(.033)	(.039)	(.032)	(.038)	(.035)	(.043)	(.035)	(.045)

These are calculated from bivariate regressions (of course race and SES are each represented by a set of dummy variables).

Significance, * < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A3. Marginal effects calculated from logistic regression estimates of Having a HS Diploma by Age 26. (N=8,198)

Male	-.003		-.009	.004	.001	.008
	(.007)		(.006)	(.005)	(.005)	(.004)
Black	-.069 ***		-.017	.011	.010	-.010
	(.015)		(.010)	(.006)	(.006)	(.007)
Hispanic	-.092 ***		-.024 **	.0003	.0001	-.010
	(.014)		(.009)	(.006)	(.006)	(.006)
Asian	.071 ***		.050 ***	.022 *	.024 **	.010
	(.011)		(.009)	(.009)	(.009)	(.010)
8th Grade SESQ2	.045 ***		.041 ***	.021 ***	.020 ***	.012 *
	(.005)		(.006)	(.005)	(.005)	(.005)
8th Grade SESQ3	.071 ***		.067 ***	.033 ***	.033 ***	.017 ***
	(.005)		(.005)	(.005)	(.005)	(.005)
8th Grade SESQ4	.093 ***		.089 ***	.045 ***	.044 ***	.023 ***
	(.005)		(.005)	(.005)	(.005)	(.005)
8th Grade SESQ5	.138 ***		.132 ***	.068 ***	.067 ***	.041 ***
	(.005)		(.005)	(.005)	(.005)	(.006)
8th Grade Externalizing Probs	-.039 ***			.001	.001	.001
	(.003)			(.002)	(.002)	(.002)
8th Grade Learning Behavior	.071 ***			.038 ***	.037 ***	.029 ***
	(.003)			(.003)	(.001)	(.004)
8th Grade Internalizing Probs	-.025 ***			-.002	-.001	.0004
	(.003)			(.002)	(.002)	(.002)
8th Grade Math Test Achievement	.085 ***			.035 ***	.034 ***	.021 ***
	(.003)			(.004)	(.004)	(.003)
8th Grade Reading Test Achievement	.073 ***			.007 *	.006	-.001
	(.003)			(.003)	(.003)	(.003)
8th Grade Self-Esteem	.031 ***				.002	-.001
	(.003)				(.003)	(.002)

8th Grade Locus of Control	.049 ***				.008 **	.003
	(.003)				(.003)	(.002)
10th Grade Non-Academic Track	-.140 ***					-.033 ***
	(.006)					(.005)
10th Grade Educational Expectations	.076 ***					.030 ***
	(.003)					(.002)

Results in column 1 are based on bivariate regressions

Significance, *   < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A4. Marginal effects calculated from logistic regression estimates of Having a HS Diploma by Age 26. (N=8,198)

Male	-.003		-.009	.008	.004	.010 *
	(.007)		(.006)	(.005)	(.005)	(.004)
Black	-.069 ***		-.017	.015 **	.014 *	-.005
	(.015)		(.010)	(.006)	(.006)	(.007)
Hispanic	-.092 ***		-.024 **	.0001	.0003	-.009
	(.014)		(.009)	(.006)	(.006)	(.006)
Asian	.071 ***		.050 ***	.024 **	.025 **	.011
	(.011)		(.009)	(.009)	(.009)	(.009)
8th Grade SESQ2	.045 ***		.041 ***	.019 ***	.019 ***	.011 *
	(.005)		(.006)	(.005)	(.005)	(.004)
8th Grade SESQ3	.071 ***		.067 ***	.031 ***	.030 ***	.015 **
	(.005)		(.005)	(.005)	(.005)	(.005)
8th Grade SESQ4	.093 ***		.089 ***	.044 ***	.043 ***	.023 ***
	(.005)		(.005)	(.005)	(.005)	(.005)
8th Grade SESQ5	.138 ***		.132 ***	.071 ***	.070 ***	.044 ***
	(.005)		(.005)	(.005)	(.005)	(.005)
Persistent Externalizing Probs	-.042 ***			-.003	-.003	-.001
	(.003)			(.002)	(.002)	(.002)
Intermittent Externalizing Probs	-.010 **			.001	.001	.002
	(.003)			(.002)	(.002)	(.002)
Persistent Learning Behavior Probs	-.078 ***			-.047 ***	-.046 ***	-.036 ***
	(.003)			(.003)	(.003)	(.002)
Intermittent Learning Behavior Probs	-.027 ***			-.012 ***	-.011 ***	-.009 ***
	(.003)			(.003)	(.003)	(.002)
Persistent Internalizing Probs	-.028 ***			-.004 *	-.004 *	-.001
	(.003)			(.002)	(.002)	(.002)
Intermittent Internalizing Probs	-.011 ***			-.003	-.003	-.001
	(.003)			(.002)	(.002)	(.002)

Persistent Low Math Test Achievement	-.273 ***			-.068 ***	-.063 ***	-.035 ***
	(.013)			(.010)	(.010)	(.008)
Intermittent Low Math Test Achievement	-.110 ***			-.013	-.012	.001
	(.016)			(.008)	(.008)	(.006)
Persistent Low Reading Test Achievement	-.234 ***			-.019 **	-.015 *	-.003
	(.013)			(.007)	(.007)	(.005)
Intermittent Low Reading Test Achievement	-.112 ***			-.009	-.007	.0002
	(.014)			(.007)	(.007)	(.006)
8th Grade Self-Esteem	.031 ***				.002	.00004
	(.003)				(.003)	(.002)
8th Grade Locus of Control	.049 ***				.008 **	.003
	(.003)				(.003)	(.002)
10th Grade Non-Academic Track	-.140 ***					--.033 ***
	(.006)					(.005)
10th Grade Educational Expectations	.076 ***					.027 ***
	(.003)					(.002)

Results in column 1 are based on bivariate regressions

Significance, *   < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A5. Marginal effects calculated from logistic regression estimates of being arrested by 1992. (N=8,198)

Male	.062 ***		.061 ***	.050 ***	.052 ***	.049 ***
	(.005)		(.005)	(.005)	(.005)	(.005)
Black	-.008		-.005	-.012 *	-.011 *	-.007
	(.008)		(.007)	(.005)	(.005)	(.006)
Hispanic	.005		.003	-.001	-.001	.001
	(.008)		(.007)	(.006)	(.006)	(.006)
Asian	-.022 **		-.017 *	-.011	-.012	-.009
	(.008)		(.007)	(.007)	(.007)	(.007)
8th Grade SESQ2	.009		.006	.012	.012	.014 *
	(.008)		(.007)	(.007)	(.007)	(.007)
8th Grade SESQ3	.006		.004	.013	.013	.019 *
	(.008)		(.007)	(.007)	(.007)	(.008)
8th Grade SESQ4	-.003		-.004	.008	.009	.016 *
	(.007)		(.006)	(.007)	(.007)	(.008)
8th Grade SESQ5	-.015 *		-.014 *	.005	.006	.016
	(.007)		(.006)	(.008)	(.007)	(.009)
8th Grade Externalizing Probs	.017 ***			.005 **	.004 **	.004 **
	(.002)			(.002)	(.002)	(.002)
8th Grade Learning Behavior	-.018 ***			-.010 ***	-.009 ***	-.007 ***
	(.002)			(.002)	(.002)	(.002)
8th Grade Internalizing Probs	.001			-.002	-.002	-.003
	(.002)			(.002)	(.002)	(.002)
8th Grade Math Test Achievement	-.014 ***			-.005	-.004	-.002
	(.002)			(.003)	(.003)	(.003)
8th Grade Reading Test Achievement	-.017 ***			-.004	-.003	-.001
	(.002)			(.003)	(.003)	(.003)
8th Grade Self-Esteem	-.005 *				-.002	-.001

	(.002)				(.002)	(.002)
8th Grade Locus of Control	-.013 ***				-.006 **	-.005 *
	(.002)				(.002)	(.002)
10th Grade Non-Academic Track	.029 ***					.007
	(.005)					(.004)
10th Grade Educational Expectations	-.019 ***					-.008 ***
	(.002)					(.002)

Results in column 1 are based on bivariate regressions

Significance, *   < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A6. Marginal effects calculated from logistic regression estimates of being arrested by 1992. (N=8,198)

Male	.062 ***		.061 ***	.043 ***	.044 ***	.042 ***
	(.005)		(.005)	(.004)	(.005)	(.004)
Black	-.008		-.005	-.012 *	-.011 *	-.008
	(.008)		(.007)	(.005)	(.005)	(.005)
Hispanic	.005		.003	-.001	-.001	.001
	(.008)		(.007)	(.005)	(.005)	(.005)
Asian	-.022 **		-.017 *	-.008	-.009	-.007
	(.008)		(.007)	(.007)	(.007)	(.007)
8th Grade SESQ2	.009		.006	.012	.012	.013 *
	(.008)		(.007)	(.006)	(.006)	(.006)
8th Grade SESQ3	.006		.004	.013 *	.013 *	.018 *
	(.008)		(.007)	(.007)	(.007)	(.007)
8th Grade SESQ4	-.003		-.004	.008	.009	.015 *
	(.007)		(.006)	(.007)	(.007)	(.007)
8th Grade SESQ5	-.015 *		-.014 *	.006	.007	.016
	(.007)		(.006)	(.007)	(.007)	(.008)
Persistent Externalizing Probs	.020 ***			.007 ***	.006 ***	.006 ***
	(.002)			(.002)	(.002)	(.002)
Intermittent Externalizing Probs	.014 ***			.006 ***	.006 **	.005 ***
	(.002)			(.002)	(.002)	(.002)
Persistent Learning Behavior Probs	.025 ***			.013 ***	.013 ***	.011 ***
	(.002)			(.002)	(.002)	(.002)
Intermittent Learning Behavior Probs	.016 ***			.009 ***	.008 ***	.008 ***
	(.002)			(.002)	(.002)	(.002)
Persistent Internalizing Probs	.002			-.001	-.001	-.002
	(.002)			(.002)	(.002)	(.002)
Intermittent Internalizing Probs	.001			-.001	-.001	-.001

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
	(.002)			(.002)	(.002)	(.002)
Persistent Low Math Test Achievement	.034 ***			.002	.0001	-.003
	(.008)			(.005)	(.005)	(.005)
Intermittent Low Math Test Achievement	.029 **			.002	.002	-.0002
	(.010)			(.006)	(.006)	(.005)
Persistent Low Reading Test Achievement	.053 ***			.017 **	.014 *	.011
	(.009)			(.007)	(.006)	(.006)
Intermittent Low Reading Test Achievement	.042 **			.017 *	.015 *	.013 *
	(.009)			(.007)	(.006)	(.006)
8th Grade Self-Esteem	-.005 *				-.001	-.001
	(.002)				(.002)	(.002)
8th Grade Locus of Control	-.013 ***				-.005 *	-.005 *
	(.002)				(.002)	(.002)
10th Grade Non-Academic Track	.029 ***					.005
	(.005)					(.004)
10th Grade Educational Expectations	-.019 ***					-.007 ***
	(.002)					(.002)

Results in column 1 are based on bivariate regressions

Significance, * < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A7. Marginal effects calculated from logistic regression estimates of having a Post Secondary Degree by Age 26.   (N=6,576)

Male	-.048 ***		-.067 ***	-.058 ***	-.063 ***	-.058 ***
	(.012)		(.012)	(.013)	(.013)	(.013)
Black	-.086 ***		-.043	.007	.002	-.014
	(.023)		(.023)	(.022)	(.023)	(.023)
Hispanic	-.167 ***		-.104 ***	-.063 **	-.064 **	-.074 ***
	(.020)		(.021)	(.021)	(.021)	(.021)
Asian	.076 ***		.049 *	.028	.031	.022
	(.022)		(.024)	(.025)	(.025)	(.025)
8th Grade SESQ2	.032		.021	-.007	-.007	-.014
	(.018)		(.018)	(.019)	(.019)	(.019)
8th Grade SESQ3	.067 ***		.055 **	.017	.016	.003
	(.017)		(.018)	(.019)	(.019)	(.019)
8th Grade SESQ4	.151 ***		.137***	.087 ***	.087 ***	.070 ***
	(.016)		(.017)	(.018)	(.018)	(.019)
8th Grade SESQ5	.301 ***		.289 ***	.225 ***	.224 ***	.207 ***
	(.013)		(.014)	(.017)	(.017)	(.018)
8th Grade Externalizing Probs	-.048 ***			.004	.004	.005
	(.006)			(.007)	(.007)	(.008)
8th Grade Learning Behavior	.107 ***			.071 ***	.068 ***	.062 ***
	(.007)			(.008)	(.008)	(.008)
8th Grade Internalizing Probs	-.032 ***			-.005	-.004	-.001
	(.006)			(.007)	(.007)	(.007)
8th Grade Math Test Achievement	.116 ***			.046 ***	.044 ***	.034 ***
	(.006)			(.009)	(.009)	(.009)
8th Grade Reading Test Achievement	.108 ***			.030 ***	.028 ***	.021 *
	(.006)			(.009)	(.009)	(.009)
8th Grade Self-Esteem	.033 ***				.011	.008

	(.006)				(.008)	(.008)
8th Grade Locus of Control	.055 ***				.011	.006
	(.006)				(.008)	(.008)
10th Grade Non-Academic Track	-.155 ***					-.059 ***
	(.012)					(.014)
10th Grade Educational Expectations	.118 ***					.034 ***
	(.007)					(.008)

Results in column 1 are based on bivariate regressions

Significance, * < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A8. Marginal effects calculated from logistic regression estimates of having a Post Secondary Degree by Age 26. (N=6,576)

Male	-.048 ***		-.067 ***	-.046 ***	-.052 ***	-.047 ***
	(.012)		(.012)	(.013)	(.013)	(.013)
Black	-.086 ***		-.043	.007	-.001	-.016
	(.025)		(.023)	(.023)	(.023)	(.024)
Hispanic	-.167 ***		-.104 ***	-.073 ***	-.073 ***	-.083 ***
	(.020)		(.021)	(.021)	(.021)	(.022)
Asian	.076 ***		.049 *	.028	.032	.018
	(.022)		(.024)	(.025)	(.025)	(.025)
8th Grade SESQ2	.032		.021	-.004	-.004	-.012
	(.018)		(.018)	(.019)	(.019)	(.019)
8th Grade SESQ3	.067 ***		.055 **	.023	.022	.009
	(.017)		(.018)	(.019)	(.019)	(.019)
8th Grade SESQ4	.151 ***		.137 ***	.097 ***	.096 ***	.078 ***
	(.016)		(.017)	(.018)	(.018)	(.019)
8th Grade SESQ5	.301 ***		.289 ***	.246 ***	.244 ***	.221 ***
	(.013)		(.014)	(.015)	(.016)	(.017)
Persistent Externalizing Probs	-.052 ***			-.009	-.008	-.006
	(.006)			(.007)	(.008)	(.007)
Intermittent Externalizing Probs	-.048 ***			-.026 ***	-.026 ***	-.023 ***
	(.006)			(.006)	(.006)	(.006)
Persistent Learning Behavior Probs	-.100 ***			-.063 ***	-.061 ***	-.055 ***
	(.007)			(.008)	(.008)	(.008)
Intermittent Learning Behavior Probs	-.070 ***			-.018 ***	-.043 ***	-.042 ***
	(.006)			(.006)	(.007)	(.007)
Persistent Internalizing Probs	-.033 ***			-.014 *	-.012	-.009
	(.006)			(.007)	(.007)	(.007)
Intermittent Internalizing Probs	-.028 ***			-.018 **	-.017 **	-.014 *
	(.006)			(.006)	(.006)	(.006)

Persistent Low Math Test Achievement	-.240 ***			-.083 ***	-.078 ***	-.054 *
	(.018)			(.022)	(.002)	(.022)
Intermittent Low Math Test Achievement	-.147 ***			-.037	-.034	-.016
	(.021)			(.022)	(.022)	(.022)
Persistent Low Reading Test Achievement	-.225 ***			-.060 **	-.052 *	-.033
	(.018)			(.022)	(.022)	(.022)
Intermittent Low Reading Test Achievement	-.147 ***			-.043 *	-.039 *	-.030
	(.019)			(.020)	(.020)	(.020)
8th Grade Self-Esteem	.033 ***				.010	.007
	(.006)				(.008)	(.008)
8th Grade Locus of Control	.055 ***				.015	.009
	(.006)				(.008)	(.008)
10th Grade Non-Academic Track	-.155 ***					-.066 ***
	(.012)					(.013)
10th Grade Educational Expectations	.118 ***					.035 ***
	(.007)					(.008)

Results in column 1 are based on bivariate regressions

Significance, *   < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A9. Marginal effects calculated from OLS regression estimates of Earnings per Week at Age 26.   (N=6,776)

Male	.293 ***		.285 ***	.278 ***	.264 ***	.271 ***
	(.024)		(.024)	(.025)	(.025)	(.025)
Black	-.211 ***		-.133 **	-.104 *	-.116 **	-.130 **
	(.044)		(.044)	(.045)	(.045)	(.045)
Hispanic	-.094 *		-.016	.010	.007	-.00001
	(.039)		(.039)	(.039)	(.039)	(.040)
Asian	.191 ***		.164 ***	.147 **	.159 **	.150 **
	(.052)		(.051)	(.051)	(.051)	(.051)
8th Grade SESQ2	.103 **		.086 *	.066	.063	.055
	(.038)		(.038)	(.038)	(.038)	(.038)
8th Grade SESQ3	.183 ***		.165 ***	.129 ***	.124 ***	.110 **
	(.038)		(.038)	(.039)	(.039)	(.039)
8th Grade SESQ4	.202 ***		.175 ***	.121 **	.114 **	.094 *
	(.038)		(.039)	(.040)	(.040)	(.041)
8th Grade SESQ5	.399 ***		.362 ***	.274 ***	.269 ***	.244 ***
	(.038)		(.039)	(.042)	(.042)	(.044)
8th Grade Externalizing Probs	.017			.029 *	.031 *	.031 *
	(.012)			(.014)	(.014)	(.014)
8th Grade Learning Behavior	.049 ***			.032 *	.026	.020
	(.012)			(.015)	(.015)	(.015)
8th Grade Internalizing Probs	-.049 ***			-.027 *	-.024	-.022
	(.012)			(.012)	(.012)	(.013)
8th Grade Math Test Achievement	.125 ***			.074 ***	.068 ***	.060 ***
	(.012)			(.018)	(.018)	(.018)
8th Grade Reading Test Achievement	.072 ***			-.011	-.019	-.024
	(.012)			(.017)	(.017)	(.017)
8th Grade Self-Esteem	.084 ***				.019	.017
	(.012)				(.015)	(.015)

8th Grade Locus of Control	.090 ***				.043 **	.039 *
	(.012)				(.016)	(.016)
10th Grade Non-Academic Track	-.137 ***					-.034
	(.025)					(.027)
10th Grade Educational Expectations	.087 ***					.027
	(.012)					(.015)

Results in column 1 are based on bivariate regressions

Significance, *   < 0.05, ** < 0.01, *** < 0.001

Appendix Table 4.A10. Marginal effects calculated from OLS regression estimates of Earnings per Week at Age 26. (N=6,776)

Male	.293 ***		.285 ***	.284 ***	.270 ***	.277 ***
	(.024)		(.024)	(.024)	(.025)	(.025)
Black	-.211 ***		-.133 **	-.113 *	-.126 **	-.143 **
	(.044)		(.044)	(.045)	(.045)	(.046)
Hispanic	-.094 *		-.016	.001	-.001	-.010
	(.039)		(.039)	(.039)	(.039)	(.040)
Asian	.191 ***		.164 ***	.155 **	.166 ***	.155 **
	(.052)		(.051)	(.051)	(.051)	(.038)
8th Grade SESQ2	.103 **		.086 *	.068	.064	.055
	(.038)		(.038)	(.038)	(.038)	(.038)
8th Grade SESQ3	.183 ***		.165 ***	.133 ***	.128 ***	.111 **
	(.038)		(.038)	(.039)	(.039)	(.039)
8th Grade SESQ4	.202 ***		.175 ***	.133 ***	.124 **	.099 *
	(.038)		(.039)	(.040)	(.040)	(.041)
8th Grade SESQ5	.399 ***		.362 ***	.307 ***	.297 ***	.263 ***
	(.038)		(.039)	(.041)	(.041)	(.043)
Persistent Externalizing Probs.	.020			.027 *	.030 *	.031 *
	(.012)			(.014)	(.014)	(.014)
Intermittent Externalizing Probs.	-.001			.003	.004	.005
	(.012)			(.013)	(.012)	(.013)
Persistent Learning Behavior Probs.	-.048 ***			-.034 *	-.029	-.022
	(.013)			(.015)	(.015)	(.015)
Intermittent Learning Behavior Probs	-.044 ***			-.035 **	-.030 *	-.029 *
	(.013)			(.013)	(.013)	(.013)
Persistent Internalizing Probs	-.046 ***			-.029 *	-.025 *	-.022
	(.013)			(.013)	(.013)	(.013)
Intermittent Internalizing Probs	-.041 ***			-.028 *	-.025 *	-.023
	(.012)			(.012)	(.012)	(.012)

Persistent Low Math Test Achievement	-.240 ***			-.133 ***	-.117 **	-.098 *
	(.032)			(.039)	(.040)	(.041)
Intermittent Low Math Test Achievement	-.128 **			-.055	-.049	-.036
	(.004)			(.041)	(.041)	(.041)
Persistent Low Reading Test Achievement	-.105 ***			.049	.070	.083 *
	(.033)			(.040)	(.040)	(.040)
Intermittent Low Reading Test Achievement	-.073 *			.016	.030	.038
	(.036)			(.037)	(.037)	(.037)
8th Grade Self-Esteem	.084 ***				.019	.016
	(.012)				(.015)	(.015)
8th Grade Locus of Control	.090 ***				.046 **	.041 *
	(.012)				(.016)	(.016)
10th Grade Non-Academic Track	-.137 ***					-.042
	(.025)					(.027)
10th Grade Educational Expectations	.087 ***					.032 *
	(.012)					(.015)

Results in column 1 are based on bivariate regressions

Significance, * < 0.05, ** < 0.01, *** < 0.001

Online Appendix 5

The Widening Academic-Achievement Gap between the Rich and the Poor:

New Evidence and Possible Explanations

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Section 5.A1. Studies Used

The studies used are listed in Table 5.A1.

Table 5.A1: Studies Used

Name of Study	Abbreviation	Year(s) Tested	Age(s) Tested	Grade(s) Tested	Test/ Subject(s)	Sample Size	Income Data Available
Early Childhood Longitudinal Study-Birth Cohort	ECLS-B	2001-2007	1-6	pre-k/k	reading, math	10,700	Yes
Early Childhood Longitudinal Survey-Kindergarten	ECLS-K	1998-2007	6-11	k-8	reading, math	24,500	Yes
Education Longitudinal Study	ELS	2002, 2004	16, 18	10, 12	reading, math	15,300	Yes
Equality of Educational Opportunity	EEO	1966	7,9,12,15,18	1,3,6,9,12	reading, math	76,000-134,000	No
High School and Beyond	HS&B	1980, 1982	16, 18	10, 12	reading, math	30,000	Yes
High School and Beyond	HS&B	1980	18	12	reading, math	28,000	Yes
Longitudinal Survey of American Youth	LSAY	1987-1992	13-18	7-12	math	3,100	No
Longitudinal Survey of American Youth	LSAY	1987-1990	16-18	10-12	math	2,800	No
NAEP-Long Term Trend	NAEP-LTT	1971-2004	9, 13, 17	3, 7, 11	reading, math	4,000-25,000	No
NAEP- MAIN	Main NAEP	1990-2007	10, 14, 18	4, 8, 12	reading, math	8,000-180,000	No
National Education Longitudinal Study	NELS	1988, 1990, 1992	14, 16, 18	8, 10, 12	reading, math	20,000-25,000	Yes
National Longitudinal Study	NLS	1972	18	12	reading, math	16,683	Yes
National Longitudinal Study of Adolescent Health	Add Health	1995	13-18	7-12	PPVT (vocabulary)	21,000	Yes
National Longitudinal Survey of Youth: 79	NLSY79	1981	16-18	10th-12th	ASVAB	12,000	Yes
National Longitudinal Survey of Youth: 97	NLSY97	1998	12-18	6-11	ASVAB	9,000	Yes
Program of International Student Assessment	PISA	2000, 2003, 2006	15	10	reading, math	3,800-5,600	No
Progress in International Reading Study	PIRLS	2001, 2006	9	4	reading	3,600-5,200	No
Project Talent	Talent	1960	14-18	9-12	reading, math	377,000	Yes
Prospects	Prospects	1991-1994	6-15	1-9	reading, math	12,000-20,000	Yes
Study of Early Child Care and Youth Development	SECCYD	1994-2006	3-15	pre-k - 9	Bayley, BBCS, WJ	1,000-1,300	Yes
Third International Mathematics and Science Study	TIMSS	1995	9, 13, 17	3, 8, 12	math	33,000	No
Third International Mathematics and Science Study-Repeat	TIMSS	1999	13	8	math	9,072	No
Trends in International Math and Science	TIMSS	2003, 2007	9, 13	4, 8	math	15,000-19,000	No

PPVT: Peabody Picture Vocabulary Test; ASVAB: Armed Services Vocational Aptitude Battery; BBCS: Bracken Basic Concept Scale; WJ: Woodcock Johnson

Note: family income is reported by students in Project Talent, NLS, and HS&B.

Section 5.A2. Computing Achievement Gaps

To standardize the test scores in each study used here, I first fit a regression model

$$Y_i = \beta_0 + \beta_1(AGE_i) + e_i, \quad e_i \sim N(0, \sigma^2),$$

using the appropriate sample weights. This yields an estimate of the age-adjusted variance in test scores, $\hat{\sigma}^2$, and an estimated residual, $\hat{e}_i$, for each student. Dividing the residual by the root mean squared error yields the age-adjusted standardized test score for each student

$$\hat{Y}_i^* = \frac{\hat{e}_i}{\hat{\sigma}}.$$

By construction, the $\hat{Y}_i^*$'s have a mean of 0 and a standard deviation of 1 (when weighted by the appropriate sample weight).

Although standardizing test scores solves the primary problems of the comparability of gaps measured with different tests and in non-interval-scale metrics, there are several potential problems. First, suppose we have some 'true' measure of cognitive ability, measured in a meaningful interval scale. If the variance of academic achievement, as measured in this metric, changes over time (either across cohorts, or within a cohort as it progresses through school), then standardizing the metric at each wave of testing confounds changes in the 'true' gap with changes in the variance of test scores. In this chapter, this will be a problem if the true variance of academic achievement varies over time. If the true variance of academic achievement grows over time, then the estimated trend in the achievement gaps will be underestimated, and vice versa. An examination of the standard deviations of LTT-NAEP scores from the 1970s through the 2000s, however, shows no trend in their magnitude, suggesting that the true variance of academic achievement has not changed appreciably over the last 40 years (Jencks, Owens, Shollenberger, & Zhu, 2010).

Second, measurement error in test scores will tend to inflate the variance of the test score distributions (thereby inflating $\hat{\sigma}^2$), meaning that the achievement gaps measured in standard deviation units will be biased toward zero. If the gaps at different grades, ages, or cohorts are measured with tests that have different amounts of measurement error, then the amount of bias will not be the same in each measure of the gap, leading to potentially erroneous inferences regarding patterns or trends in the magnitudes of the gaps over time.[1] Table 5.A2 provides information regarding the reliability of the tests used in each of the studies. In order to correct gap estimates for measurement error, I multiply the estimates by $\frac{1}{\sqrt{r}}$, where r is the reliability of the test. This yields estimates of the true gaps, and eliminates any bias in the trend that may arise from differential reliability of the tests.

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[1] This bias is not likely to be large, given that most standardized tests relatively high reliabilities, typically between 0.7 and 1.0. If two tests measure the same thing with different reliabilities, the ratio of the gaps estimated from the two different tests will be $\sqrt{r_1/r_2}$, where r_1 and r_2 are the reliabilities of the two tests. Thus, two tests with reliabilities of 0.7 and 1.0 would yield gap estimates that differed from one another by less than 20%.

Table 5.A2

Test Reliabilities in Math and Reading

	Math	Reading	Type	Source
Early Childhood Longitudinal Study-Birth Cohort (Pre-K)	0.89	0.84	IRT	http://nces.ed.gov/pubs2010/2010009.pdf
Early Childhood Longitudinal Study-Kindergarten (Fall-K)	0.91	0.92	IRT	User's Manual for the ECLS-K Eighth-Grade
Education Longitudinal Study (2002)	0.92	0.86	IRT	Ingels et al. 2006
Equality of Educational Opportunity Study	0.75	0.75	---	See note
High School & Beyond: 1980 Seniors	0.85	0.79	IC	Rock et al. 1985: Page 47-49
High School & Beyond: 1980 Sophomores	0.87	0.77	IC	Rock et al. 1985: Page 47-49
Longitudinal Survey of American Youth	0.96	NA	---	See note
NAEP-Long Term Trend (1996)	.85-.93	NF	IRT	http://nces.ed.gov/nationsreportcard/pdf/main1996/1999452d.pdf
NAEP-Long Term Trend (2003)	NF	.82-.86	IC	http://nces.ed.gov/nationsreportcard/pdf/main1998/2001509c.pdf
NAEP- MAIN (1996)	.95-.98	NF	IRT	http://nces.ed.gov/nationsreportcard/pdf/main1996/1999452d.pdf
NAEP-MAIN (1998)	NF	.70-.74	IC	http://nces.ed.gov/nationsreportcard/pdf/main1998/2001509c.pdf
NAEP- MAIN (2003)	NF	.72-.76	IC	http://nces.ed.gov/nationsreportcard/tdw/analysis/initial_classical.asp#table1
National Education Longitudinal Study (1988)	0.90	0.84	IC	Rock & Pollack 1991
National Longitudinal Study	0.86	0.79	IC	Rock et al. 1985: Page 47-49
National Longitudinal Study of Adolescent Health (PPVT)	NA	0.95	IC	
National Longitudinal Survey of Youth: 79	.84-.86	.75-.88	IRT	http://officialasvab.com/reliability_res.htm#table3
National Longitudinal Survey of Youth: 97	0.93	.86-.93	IRT	http://officialasvab.com/reliability_res.htm#table3
Program of International Student Assessment (2000)	0.81	0.89	IC	http://www.oecd.org/dataoecd/53/19/33688233.pdf
Program of International Student Assessment (2003)	0.85	0.80	IC	http://www.pisa.oecd.org/dataoecd/49/60/35188570.pdf
Program of International Student Assessment (2006)	0.78	0.78	IC	http://www.oecd.org/dataoecd/0/47/42025182.pdf
Progress in International Reading Study (2001)	NA	0.9	IC	Mullis et al. 2003, p. 298
Progress in International Reading Study (2006)	NA	0.88	IC	Mullis et al. 2007, p. 306
Project Talent	0.75	0.75	---	See note
Prospects (3rd Grade)	0.8	0.85	TR	http://epm.sagepub.com/cgi/reprint/61/5/841.pdf
Study of Early Child Care and Youth Development (WJ)	.86-.95	.88-.94	IC	http://www.iapsych.com/wj3ewok/LinkedDocuments/asb-2.pdf
Third International Mathematics and Science Study (2003, 4th Grad	0.88	NA	IC	Mullis et al. 2004, p. 368
Third International Mathematics and Science Study (2003, 8th Grad	0.9	NA	IC	Mullis et al. 2004, p. 368)
Third International Mathematics and Science Study (1999, 8th Grad	0.9	NA	IC	Mullis et al. 2000, p. 333
Third International Mathematics and Science Study (1995, 3rd Grad	0.83	NA	IC	Mullis et al. 1997, p. A-24
Third International Mathematics and Science Study (1995, 4th Grad	0.86	NA	IC	Mullis et al. 1997, p. A-24
Third International Mathematics and Science Study (1995, 7th Grad	0.89	NA	IC	Beaton et al. 1996, p. A-26
Third International Mathematics and Science Study (1995, 8th Grad	0.89	NA	IC	Beaton et al. 1996, p. A-26
Third International Mathematics and Science Study (1995, 12th Gra	0.8	NA	IC	Mullis et al. 1998, p. B-37

Note: NF = Not found; NA=not applicable; IC = internal consistency; TR = test-retest; IRT = reliability of IRT estimate. I was unable to locate reliabilities for all administrations of Main and Long-Term Trend NAEP. The ASVAB reliabilities were computed for 2005 military applicants as I was unable to locate reliabilities for the NLSY sample members. The reliabilities listed for NLSY 1979 refer to reliabilities for paper and pencil administrations of the test and the reliabilities listed for NLSY 1997 refer to reliabilities for comptuer adaptive administrations of the test. I was unable to find information on the reliability of the tests in Project Talent and EEO; for both I assumed a reliability of 0.75, which is slightly lower than the lowest-reported reliability of any of the other studies. I was unable to find reliabilities for the Longitudinal Survey of American Youth; this study's test was made up of NAEP items so I use a reliability of 0.96 which is the average (across grades) of the reliabilities of the 1996 administration of the math portion of the Main-NAEP.

Note that for some studies, estimates of the reliability of the tests was not available. In particular, I could find no information on the reliability of the tests in Project Talent and EEO; for both I assumed a reliability of 0.75, which is slightly lower than the lowest-reported reliability for any of the other studies. This is a conservative choice, as lower reliabilities will inflate the estimated gap for these studies, and will thereby attenuate the estimated trend in income achievement gaps.

Measuring socioeconomic achievement gaps

In general, we would like to estimate the association between student test scores and a measure of parental socioeconomic status (e.g., family income, parental education, or a composite SES score). We would like this measure to be comparable across studies conducted in different years and that collect information on income and parental education differently. Because dollars are not comparable across years, and because income inequality changes over time, we require a method that characterizes the relationship between income and children's achievement in a way that is comparable over time. I use the 90/10 income achievement gap—the difference in the average standardized test scores of children at the 90th percentile of children's family income and of children at the 10th percentile of family income.

Because income is generally measured categorically, in 5-15 ordered income categories, we cannot identify children's exact income or their exact percentile in the income distribution. Below I describe a method for estimating the average test score of children at any given percentile of the income distribution based on categorical income data. I begin with a general formulation of the problem and an approach to addressing it, and then describe the specific approach I take in this chapter.

Suppose there is a continuous latent family trait θ that is distributed according to the density function $\phi(\theta)$ (with cumulative density function $\Phi(\theta)$) in the population. We observe a crudely measured version of θ (crude in the sense that it is measured by a relatively small number of discrete categories rather than continuously). That is, we observe X, a discrete measure of θ, where $X \in \{1, 2, \ldots, K\}$. Let c_k be the proportion of the population with values of θ in category k or below (and where $c_0 = 0$, $c_K = 1$). Then $X = k$ if $\Phi^{-1}(c_{k-1}) < \theta \leq \Phi^{-1}(c_k)$. Note that here we have assumed no measurement error (no misclassification error).

We are interested in the relationship between some measure of student achievement, denoted Y, and θ. That is, if the relationship between Y and θ is described by the function $Y = f(\theta) + \epsilon$, where $E(\epsilon|\theta) = 0$, we would like to estimate the function f. However, because we do not observe θ, we must infer f from the observed mean values of Y in each category of X. For example, we would like to infer the strength of the relationship between family income and test scores, given the observed mean test scores among students in each category of family income.

First, note that we can write the average value of θ within each ordinal category k as

$$\bar{\theta}_k = \frac{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)} x\phi(x)dx}{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)} \phi(x)dx}$$

$$= \frac{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)} x\phi(x)dx}{c_k - c_{k-1}}.$$

(A1)

If $\phi(\theta)$ is the uniform density function, then (A1) becomes

$$\bar{\theta}_k = \frac{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)} x\phi(x)dx}{c_k - c_{k-1}}$$

$$= \frac{\int_{c_{k-1}}^{c_k} xdx}{c_k - c_{k-1}}$$

$$= \frac{c_k^2 - c_{k-1}^2}{2(c_k - c_{k-1})}$$

$$= \frac{c_k + c_{k-1}}{2}.$$

(A2)

Next, note that we can write the average value of Y within each ordinal category k as

$$\bar{Y}_k = \frac{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)} f(x)\phi(x)dx}{c_k - c_{k-1}}.$$

(A3)

Now suppose f can be approximated by a cubic polynomial function (one could allow a higher-order polynomial if inspection of the data suggests the need, but I find a cubic is more than sufficient for the income-achievement relationship—in many cases f is well-approximated by a line). That is,

$$Y = f(\theta) + \epsilon = a + b\theta + c\theta^2 + d\theta^3 + \epsilon, \qquad E(\epsilon|\theta) = 0.$$

(A4)

Now if $\phi(\theta)$ is the uniform density function, then we can express the average value of Y in category k as

$$\bar{Y}_k = \frac{\int_{\Phi^{-1}(c_{k-1})}^{\Phi^{-1}(c_k)}(a + bx + cx^2 + dx^3)dx}{c_k - c_{k-1}}$$

$$= \frac{a(c_k - c_{k-1}) + \frac{b}{2}(c_k^2 - c_{k-1}^2) + \frac{c}{3}(c_k^3 - c_{k-1}^3) + \frac{d}{4}(c_k^4 - c_{k-1}^4)}{c_k - c_{k-1}}$$

$$= a + b\frac{c_k + c_{k-1}}{2} + c\frac{c_k^2 + c_k c_{k-1} + c_{k-1}^2}{3} + d\frac{(c_k^2 + c_{k-1}^2)(c_k + c_{k-1})}{4}$$

$$= a + b\bar{\theta}_k + c\frac{4\bar{\theta}_k^2 - c_k c_{k-1}}{3} + d\frac{8\bar{\theta}_k^3 - 2(c_k^2 c_{k-1} + c_k c_{k-1}^2)}{4}$$

$$= a + b\bar{\theta}_k + c\frac{4\bar{\theta}_k^2 - \left(\bar{\theta}_k + \frac{c_k - c_{k-1}}{2}\right)\left(\bar{\theta}_k - \frac{c_k - c_{k-1}}{2}\right)}{3} + d\left(2\bar{\theta}_k^3 - \frac{(c_k + c_{k-1})(c_k c_{k-1})}{2}\right)$$

$$= a + b\bar{\theta}_k + c\left(\bar{\theta}_k^2 + \frac{(c_k - c_{k-1})^2}{12}\right) + d\left(\bar{\theta}_k^3 + \frac{(c_k - c_{k-1})^2}{4}\right)$$

<div align="right">(A5)</div>

We can compute the $\bar{\theta}_k$'s from (A2) and then can estimate $a, b, c,$ and d by regressing the observed $\bar{Y}_k$'s on the computed $\bar{\theta}_k$'s, the

$\left(\bar{\theta}_k^2 + \frac{(c_k - c_{k-1})^2}{12}\right)$'s, and the $\left(\bar{\theta}_k^3 + \frac{(c_k - c_{k-1})^2}{4}\right)$'s. The values of $\hat{a}, \hat{b}, \hat{c},$ and $\hat{d}$ describe the estimated relationship between the unobserved θ

and Y. Note that these will be different, in general, than what we would get by simply regressing the $\bar{Y}_k$'s on $\bar{\theta}_k, \bar{\theta}_k^2,$ and $\bar{\theta}_k^3$. The reason for

the difference is that, if f is not linear, then $f(\bar{\theta}_k) \neq E[\bar{Y}_k]$.

     I apply the above method to estimate the association between student test scores and two measures of parental socioeconomic

status (family income and parental education).

Estimating the association between family income and achievement. In most of the studies that report income, income is reported in a set of discrete ordered categories.[2] I estimate the association between achievement and income percentile rank; this provides a comparable metric to compare income achievement gaps across time periods. Income percentile ranks have a uniform distribution, so the methods described above for uniformly distributed θ will apply. I fit cubic functions to estimate the association between achievement and income percentiles. I use weighted least squares for the estimation, weighting each observation by the inverse of the sampling variance of $\bar{Y}_k$, so that the fitted curve is influenced less by categories with small proportions of the population (and hence, large sampling variance). Below is an example of this method.

The data shown in Figure 5.A1 are from the 16-18 year-olds in the NLSY79 sample. Income is not reported categorically in NLSY; I divided reported income into 12 roughly equal sized categories here for illustration. The bars in the figure indicate the 95% confidence intervals for the mean income in a given income category; the red line represents the fitted cubic line through these data, using the method described above. Based on the fitted line, the estimated average standardized test score for a student at the 90th percentile is +0.48; the estimated average standardized test score for a student at the 10th percentile is -0.56, yielding an estimated 90/10 achievement gap of 1.04.

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[2] In NLSY79, NLSY97, and Add Health, parents report exact income. In NLSY97, a scatterplot of test scores against income shows a peculiar pattern: average test scores in the bottom decile are higher than in the second and third decile. Moreover, the distribution of family incomes in NLSY97 is much wider than the income distribution reported in CPS data for 1997 (in particular, there are far more families with very low income in the NLSY97 data then in the CPS data), suggesting that there may be some measurement error in the NLSY97 income data. To remedy this, I take the average family income over three years (1997-1999) for each student in the NLSY97 data in order to obtain a more reliable measure of family income. The distribution of this average income much more closely matches the CPS income distribution for 1997-1999. Moreover, the relationship between achievement and income is monotonic after this adjustment, and is similar in shape to the relationship in other samples (its first derivative is a positive, concave up function). Note that this adjustment has the effect of increasing the estimated NLSY97 income achievement gaps by roughly 10-15%, because it eliminates some attenuation bias due to measurement error, though this increase does not substantially affect the pattern of gap estimates.

Figure 5.A1

Association Between Reading Score and Family Income Percentile, NLSY79
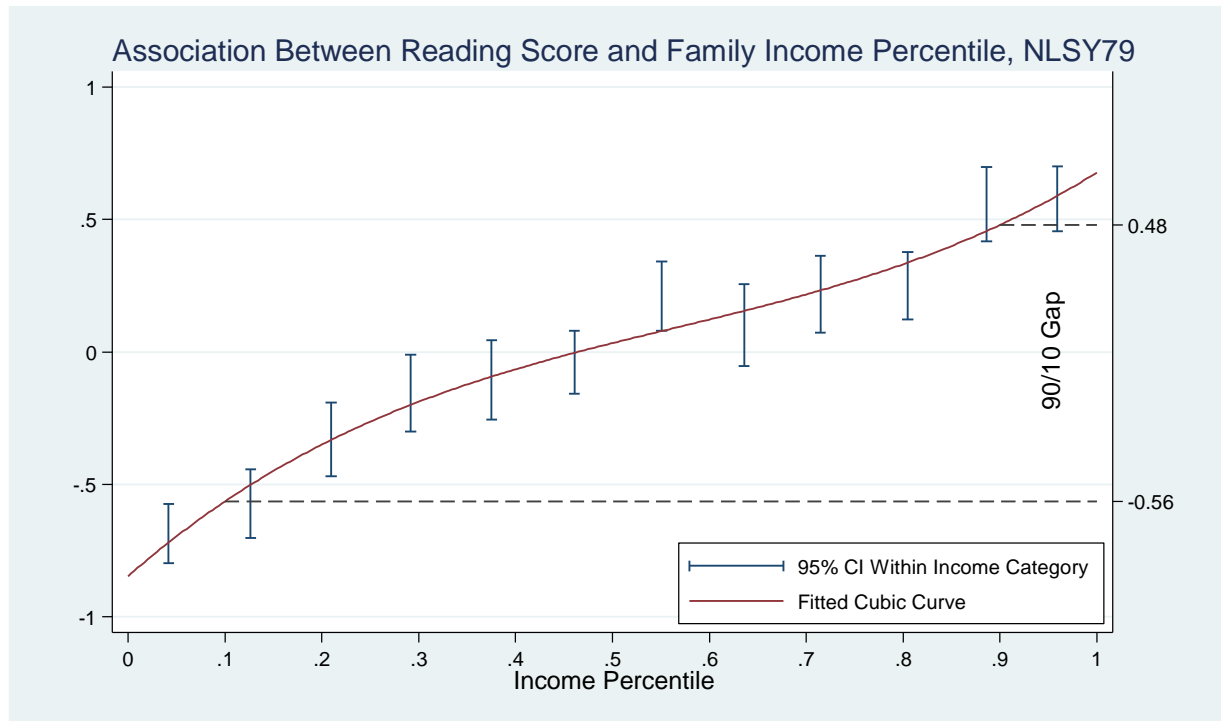
More generally, I compute the 90/10 income achievement gap (the average difference in scores between a student with family income at the 90th and the 10th percentiles) as:

$$\hat{\delta}^{90/10} = \left[\hat{Y}|\theta = .9\right] - \left[\hat{Y}|\theta = .1\right]$$

$$= \left[\hat{a} + \hat{b}(.9) + \hat{c}(.81) + \hat{d}(.729)\right] - \left[\hat{a} + \hat{b}(.1) + \hat{c}(.01) + \hat{d}(.001)\right]$$

$$= .8\hat{b} + .8\hat{c} + .728\hat{d}.$$

(A6)

Likewise, the 90/50 and 50/10 income achievement gaps are:

$$\hat{\delta}^{90/50} = \left[\hat{Y}|\theta = .9\right] - \left[\hat{Y}|\theta = .5\right]$$

$$= \left[\hat{a} + \hat{b}(.9) + \hat{c}(.81) + \hat{d}(.729)\right] - \left[\hat{a} + \hat{b}(.5) + \hat{c}(.25) + \hat{d}(.125)\right]$$

$$= .4\hat{b} + .56\hat{c} + .604\hat{d}.$$

(A7)

and

$$\hat{\delta}^{50/10} = \left[\hat{Y}|\theta = .5\right] - \left[\hat{Y}|\theta = .1\right]$$

$$= \left[\hat{a} + \hat{b}(.5) + \hat{c}(.25) + \hat{d}(.125)\right] - \left[\hat{a} + \hat{b}(.1) + \hat{c}(.01) + \hat{d}(.001)\right]$$

$$= .4\hat{b} + .24\hat{c} + .124\hat{d}.$$

(A8)

I compute the standard error of each of these gap estimates from the estimated variance-covariance matrix of the regression. That is

$$se\left(\hat{\delta}^{90/10}\right) = \left[Var\left(.8\hat{b} + .8\hat{c} + .728\hat{d}\right)\right]^{1/2}$$

$$= \left[\begin{array}{c} 0.64Var\left(\hat{b}\right) + 0.64Var\left(\hat{c}\right) + 0.53Var\left(\hat{d}\right) \\ +1.28Cov\left(\hat{b},\hat{c}\right) + 1.165Cov\left(\hat{b},\hat{d}\right) + 1.165Cov\left(\hat{c},\hat{d}\right) \end{array}\right]^{1/2}.$$

(A9)

Because parent-reported family income is not measured perfectly, the measured income achievement gaps will differ from the true income achievement gaps by a factor of $\sqrt{r}$, where r is the reliability of the income measure. The reliability of self-reported income is typically between 0.7-1.0, with an average of 0.86 (Marquis, Marquis, & Polich, 1986), implying that the income achievement gaps will be underestimated by as much as 15%. Some newer studies suggest that family income measures based on surveys have reliabilities of .70 to .78 when compared to tax or Social Security Administration records (Coder 1992, Angrist & Kreuger, 1991). For all parent-reported income measures, I assume income is measured with reliability of 0.86.

For the studies with student-reported family income, I estimate the reliability of student-reported income measures using data from HS&B. The HS&B study includes both student-reported family income and, for a roughly 15% subsample, parent-reported family income. The existence of both student- and family-reported family income enables us to estimate the reliability of measures of income.

Let i indicate true family income. We observe a student-report (s) and a parent-report (p) of family income, each measured with error. In addition, we observe y, an error-prone measure of true student achievement, a:

$$s = i + v$$

$$p = i + u$$

$$y = a + e$$

Assuming classical measurement error in s, p, and y, the following equalities hold:

$$corr(s, p) = \sqrt{r_s \cdot r_p}$$

$$corr(s, y) = corr(i, a) \cdot \sqrt{r_s \cdot r_y}$$

$$corr(p, y) = corr(i, a) \cdot \sqrt{r_p \cdot r_y}$$

where r_s, r_p, and r_y are the reliabilities of s, p, and y, respectively. Rearranging and substituting, it follows that

$$r_s = corr(s. p) \cdot \frac{corr(s, y)}{corr(p, y)}$$

$$r_p = corr(s. p) \cdot \frac{corr(p, y)}{corr(s, y)}$$

We can observe each of these correlations, and so can use them to estimate the reliabilities of both s and p.

In HS&B, parent-reported family income is measured using a set of survey questions, rather than a single question, as in other studies. The responding parent—usually the mother—was asked 1) how much wage income s/he received; 2) how much self-employment income s/he received; 3) how much wage income his/her spouse received; 4) how much self-employment income his/her spouse received; and then 5) a set of 15 questions asking how much the respondent and spouse together received from other sources, including dividends, interest, rent, alimony, AFDC, SSI, etc. For each of these questions, respondents indicated categorical ranges of

income (e.g., $1,000-$2,999 $3,000-$4,999, etc.) rather than exact dollar amounts. In order to estimate total family income, I assign a dollar amount equal to the midpoint of the category range (or $750,000 for the top-category, which is $500,000 or above), and then sum these amounts over all the items. Unfortunately, this results in an estimated income distribution that is much higher than the actual income distribution in 1980 (as estimated from CPS or NLSY79). For example, the 90th percentile of the income distribution computed this way is 33% higher than that reported in CPS. It may be that parents did not understand the questions well, and so double-reported some income. As a check on this, I compute a second measure of family income that is only the sum of the two wage income items (total wages of self and spouse). This yields a measure of income that is generally smaller than that computed from summing all the items, though the new measure has a much lower bottom tail (the 10th percentile of this distribution is $425, much lower than the $6900 10th percentile of CPS). The complexity of the parent-reported family income measure and the fact that total income must be estimated by summing the midpoints of categorical income ranges likely makes these parent-reported income measures less reliable than those in other studies, which simply ask parents their total family income.

The availability of two different parent-reported family income measures allows us to estimate the reliability of student-reported income using two different values for $corr(p, y)$. Likewise, the availability of both math and reading scores allows us to use two different outcome measures y to estimate the reliabilities of the measures. Moreover, we can estimate the reliabilities separately for 10th and 12th graders—while the reliability of the student reported measure may increase as students age, we don't expect the reliability of parent-reported income to depend on the age of the child in the sample.

The estimated reliabilities of the student- and parent-reported income measures from HS&B are reported in Table 5.A3 below. Note that the student-reported income measure has higher reliability, particularly in 12th grade, than either of the parent report measures. This is likely due to the abovementioned complexities in the HS&B parent-reported income items. Nonetheless, the reliabilities of the student-reported measures are not particularly high.

Table 5.A3

Estimated reliabilities of student- and parent-reported family income measures, HS&B

income measure	using all-item parent report		using wage only parent report		
	math	reading	math	reading	average
student-report, 10th grade	0.57	0.49	0.70	0.53	0.57
student-report, 12th grade	0.67	0.65	0.79	0.78	0.72

income measure	using 10th grade		using 12th grade		
	math	reading	math	reading	average
parent-report, all items	0.40	0.47	0.48	0.50	0.46
parent-report, wages only	0.31	0.42	0.35	0.36	0.36

Note that it is also possible to estimate the reliability of student-reported income using data from twins. HS&B oversampled twins, and so contains roughly 500 pairs of twins. The reliability of student-reported income from these twin pairs is 0.69 for 10th graders and 0.75 from 12th graders, slightly higher estimates than the values I estimate above (Fetters, Stowe, & Owings, 1984). In order to be conservative, I use the lower values, (0.57 for 10th graders and 0.72 for 12th graders).

Although we cannot estimate the reliability of the parent-reported family income measures in studies other than HS&B, other published studies estimate parent-reported income measures have reliabilities of roughly 0.86, on average (Marquis, et al., 1986).

I adopt the following strategy to disattenuate the estimated gaps for measurement error in the income measure. For studies with parent-reported family income, I assume a reliability of 0.86. For studies with student reported income, I assume a reliability of 0.50 for 9th grade reports, 0.57 for 10th grade, 0.65 for 11th grade, and 0.72 for 12th grade (the 10th and 12th grade reliabilities are estimated from HS&B above; the 9th and 11th are extrapolated/interpolated from these, assuming reliability of student reports increases linearly from 9th-12th grade). For HS&B, I use the gaps estimated from student-reported family income, both because these are more reliable than the parent-reports (see above), and because this allows me to use the full HS&B sample).

To adjust for the reliability of the income measure, I multiple the computed gaps by $1/\sqrt{r}$, where r is the estimated reliability.

Because some studies measure income using many more categories than other studies (e.g., Project Talent asked students to report their family income in 5 categories; NELS asked parents to report their income in 15 categories; all other studies used at least 9 categories), we may worry that income gaps are less well estimated (and possibly biased) when income is measured using fewer categories. To check this, estimate the 90/10 income achievement gap using the NLSY79 data, in which income is reported as a continuous variable (that is, I fit a cubic model through the individual-level data to estimate the gap). I then categorize income into 20, 10, or 5 categories, and estimate the gap again using each of these categorical measures of income using the methods described above. Table 5.A4 displays the results of this exercise.

Table 5.A4

Estimated 90/10 Income Achievement Gap, NLSY79, Using Different Categorizations of Income

Income Measure	Reading			Math		
	Age 16	Age 17	Age 18	Age 16	Age 17	Age 18
Continuous	0.995	1.079	1.040	1.080	1.176	1.223
	(0.114)	(0.080)	(0.082)	(0.110)	(0.086)	(0.082)
20 Categories	0.985	1.094	1.069	1.048	1.172	1.257
	(0.110)	(0.072)	(0.108)	(0.110)	(0.078)	(0.072)
10 Categories	0.982	1.065	1.045	1.039	1.158	1.231
	(0.100)	(0.050)	(0.096)	(0.096)	(0.062)	(0.076)
5 Categories	0.951	1.126	1.134	1.053	1.184	1.304
	(0.068)	(0.025)	(0.100)	(0.111)	(0.132)	(0.137)

Table 5.A4 shows that the estimated income achievement gap does not vary much regardless of whether it is estimated using continuously- or categorically-reported income. Moreover, the estimated gap does not vary systematically with the number of categories used. Estimates based on 5, 10, or 20 categories never differ by more than one-tenth of a standard deviation from one another; nor does there appear to be any systematic direction of the differences: sometimes the gap estimates are higher when using fewer categories; sometimes they are lower. This suggests that the fact that Project Talent has income reported in only 5 categories does not systematically

or substantially affect the size of the estimated gaps in Project Talent. As a result, it does not appear that differences across studies in the number of income categories used affect the estimated trend in the income achievement gap.

Estimating the association between parental education and achievement. I use two methods to estimate the association between parental education and student achievement. The first method is similar to the method used to estimate income achievement gaps. It treats the categorical measure of educational attainment as a measure of a continuous underlying latent characteristic, and then estimates the difference in average test scores between students at the 90th and 10th percentile of this distribution. This is done the same way as is described above, but uses a linear (rather than cubic) interpolation method. The second method fits a regression model predicting test scores using the categorical measure of parental education. The parental education categories reported in each study are collapsed to 4 categories (less than high school, high school diploma, some college, and BA or more) for comparability across studies. The adjusted R^2 from this regression model is used as a measure of the parental education achievement gradient.

The two approaches have different strengths; the first treats educational attainment categories as credentials. If the true distribution of human capital among parents were unchanged (other than a shift in mean human capital) and the relationship of human capital to children's achievement were also unchanged, but college degrees became more common (because of the expansion of higher education), the estimated association between parents' human capital (as measured by educational attainment) would be unchanged. That is, the linear interpolation method is unaffected by changes in credentialing rates. The R^2 method, in contrast, would be affected by changes in the proportions of parents in each credential/attainment category, because the R^2 statistic depends not only on the coefficients in the regression model but also the proportion of families in each category. On the other hand, the R^2 method treats educational

attainment as a set of meaningful categories that indicate real differences in human capital (or social class). If changes in educational attainment signify real changes in the distribution of human capital, then the R^2 measure of the association between parental education and achievement would be preferred.

All 19 studies have measures of parental education, but this measure is self-reported in a number of the studies. Examination of NAEP data (in which parental education is student-reported) shows that the estimated association between parental education and achievement is much weaker for younger children; this is certainly at least partly due to the unreliability of children's report of their parents' educational attainment. As a result, I use student-reported information on parental education only if the students are in high school when they report the information.

Section 5.A3. Estimating Income Inequality

I use CPS data to estimate the income inequality among the families of school-age children in each birth cohort. I do this as follows. Using CPS data, for each year from 1967-2008, I estimate the 90th and 10th percentiles of the income distribution of families with school-age children (ages 5-17). For these calculations, the family income distribution is weighted by the number of school-age children in a family, so the percentiles are relative to the distribution of school-age children's family incomes, rather than the distribution of family incomes (in practice, this weighting makes little appreciable difference in the estimated percentiles).

Section 5.A4. Estimating the Trend in Income Achievement Gaps

Figures 5.1 and 5.2 in the main chapter text display the estimated achievement gaps from each of the studies with income data. Two fitted trend lines are shown in each figure: a quartic fitted line spanning the full time period; and a quadratic fitted trend using only the cohorts born from 1974-2001. Although the figures are visually useful, I also fit a set of regression models to adjust the trend line for differences among the studies.

Because the studies differ in several potentially important ways (most notably whether or not income is reported by the parents or students; the age of the cohort when the test is administered; the reliability of the tests used, and the number of income categories used in reporting income), I fit a regression model through the 90/10 income achievement gap estimates to adjust for these factors in estimating the trend in the magnitude of the gaps. The results of these models are shown in Table 5.A5.

Table 5.A5

Estimated Trend in 90/10 Income Gap, Reading

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
Cohort Birth Year	0.010	**	0.011	*	0.010	+	0.015	**	0.010	**	0.011	*	0.010		0.017	**
	(0.001)		(0.004)		(0.005)		(0.003)		(0.001)		(0.005)		(0.007)		(0.004)	
Student-Reported			0.032								0.048					
Income			(0.180)								(0.207)					
Age at Test									0.000		0.002		0.001		0.007	
									(0.007)		(0.008)		(0.012)		(0.007)	
Intercept	0.951	**	0.941	**	0.951	**	0.882	**	0.951	**	0.939	**	0.950	**	0.866	**
	(0.024)		(0.065)		(0.072)		(0.036)		(0.025)		(0.072)		(0.089)		(0.039)	
Studies Included																
TALENT, NLS, HS&B	X		X						X		X					
NLSY79	X		X		X				X		X		X			
Post-1970 studies	X		X		X		X		X		X		X		X	
N (samples)	26		26		19		17		26		26		19		17	
N (studies)	12		12		9		8		12		12		9		8	
R-squared	0.911		0.912		0.396		0.720		0.911		0.912		0.396		0.736	

Note: Standard errors in parentheses, corrected for clustering of samples within studies. + p<.10; * p<.05; ** p<.01. Cohort birth year is centered at 1974; age is centered at 13, so intercept describes estimated 90/10 income achievment gap among 13-year-olds born in 1974. Observations are weighted by the inverse of their squared standard errors.

Estimated Trend in 90/10 Income Gap, Math

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
Cohort Birth Year	0.009	**	0.012	*	0.013	+	0.017	*	0.008	**	0.012	*	0.012		0.017	
	(0.002)		(0.005)		(0.006)		(0.007)		(0.001)		(0.005)		(0.009)		(0.009)	
Student-Reported			0.161								0.157					
Income			(0.205)								(0.216)					
Age at Test									-0.004		-0.001		-0.003		0.000	
									(0.012)		(0.012)		(0.018)		(0.016)	
Intercept	1.075	**	1.024	**	1.017	**	0.949	**	1.070	**	1.024	**	1.020	**	0.948	**
	(0.047)		(0.084)		(0.097)		(0.099)		(0.039)		(0.087)		(0.117)		(0.116)	
Studies Included																
TALENT, NLS, HS&B	X		X						X		X					
NLSY79	X		X		X				X		X		X			
Post-1970 studies	X		X		X		X		X		X		X		X	
N (samples)	20		20		13		11		20		20		13		11	
N (studies)	11		11		8		7		11		11		8		7	
R-squared	0.808		0.819		0.372		0.542		0.810		0.819		0.373		0.542	

Note: Standard errors in parentheses, corrected for clustering of samples within studies. + p<.10; * p<.05; ** p<.01. Cohort birth year is centered at 1974; age is centered at 13, so intercept describes estimated 90/10 income achievment gap among 13-year-olds born in 1974. Observations are weighted by the inverse of their squared standard errors.

The tables each show results from a set of regression models estimating the trend in the 90/10 income achievement gap based on the studies with data on family income. The regression is fit via weighted least squares, with each gap estimate weighted by the inverse of its estimated sampling variance. Standard errors are cluster-corrected for clustering of samples within studies (note that this substantially increases the size of the standard errors; without clustering, they are roughly half the size of the cluster-corrected standard errors, and the trend estimates are significant in all models except model 7).

Note that the models do not control for test reliability or for the number of categories used to measure income. Rather than control for reliability, the estimated gaps are adjusted to account for measurement error in the test (the gap estimate is multiplied by $1/\sqrt{r}$, where r is the reliability of the test). Second, because the analyses described above using NLSY data indicate that the estimated 90/10 gap is unaffected by the number of income categories used to measure income, the inclusion of a variable indicating the number of income categories used is not significant when included in the models, and so is excluded for parsimony. The gap estimates are adjusted for the estimated reliability of the family income measure, using the methods described above in section 5.A3.

Model 1 simply fits a linear trend through the data, without controls. For both reading and math, the estimated trend is roughly one-tenth of a standard deviation per decade ($p < .01$). However, this model does not control for any differences among the studies. Model 2 adds a control for whether or not family income is reported by parents or students. Because only the earliest studies—Project Talent, NLS, and HS&B—rely on student-reported income, the student-reported income dummy variable is highly correlated with the cohort variable ($r = -.72$). As a result, the inclusion of the student-report dummy variable substantially increases the standard errors. However, the student-report variable is never significant, and its inclusion does not appreciably change the trend coefficient.

Because of the collinearity of the student-report variable and the cohort variable, Model 3 excludes the three studies with student-reported family income in order to estimate the trend among those studies with parent-reported income. In both the reading and math models, the estimated trend is unchanged and remains statistically significant. Finally, Model 4 estimates the trend using only data from studies with cohorts born from 1974-2001. In these models, the trend is estimated to be roughly one-sixth of a standard deviation per decade, and is statistically different from 0 in both cases.

Models 5-8 repeat models 1-4, but add a control for the age of the students when tested to the model. In none of these models does the age coefficient approach significance; nor does it have a consistent sign across the models. Nor does its inclusion substantially alter the magnitude of the estimated trend in any of the models. However, the age variable is relatively highly correlated with the cohort variable ($r = -.61$); as a result, its inclusion increases the standard errors on the trend, so that in some cases the trend is no longer statistically significant, though the point estimates are virtually identical to the models without age included.

In sum, the regression models suggest that the 90/10 income achievement gap in reading and math increased at a significant rate from the mid 1940s to 2001, and grew particularly rapidly from 1974-2001. The estimates from Model 4 imply that the 90/10 income achievement gap grew from 0.88 in reading and 0.95 in math for the 1974 cohort to 1.27 in reading and 1.41 in math for the cohort born in 2001, an increase of 40-50% over less than 3 decades.

Another way of examining the trend in the income achievement gap is to look at the gap as measured in studies with similar tests. There are six studies conducted by the National Center for Education Statistics in our sample (NLS, HS&B, NELS, ELS, ECLS-K, and ECLS-

B), spanning birth cohorts from 1954 to 2001. The tests used in these studies are similar to one another, using many overlapping items.[3]

Table 5.A6 shows the estimated 90/10 income achievement gaps from each of these NCES studies. The estimated gaps are relatively constant in size from the NLS through NELS cohorts (born 1954-1974), grow somewhat by the ELS cohort (born 1986) and then grow substantially by the two ECLS cohorts (born 1992-20019, increasing from roughly 0.9-1.0 standard deviations in the NLS, HS&B, and NELS cohorts to 1.2-1.4 standard deviations in the ECLS-K and ECLS-B cohorts.

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[3] The reading tests given in NLS and to the HS&B 1980 seniors were identical. Eighteen of 25 items that appeared in the NLS math test also appeared on the HS&B math test given to 1980s seniors. Eight of 19 items on the reading test given in NLS and to HS&B 1980 seniors were also given to HS&B 1982 seniors. Seventeen of 28 items on the math test given to HS&B 1982 seniors were also given to HS&B 1980 seniors (Rock, et al., 1985).

Some of the NELS items overlap with prior assessments, including those administered in HS&B, NAEP, SIMS, ETS test files from previous operational tests, and a pool of items written specifically for the NELS: 88 battery. The NELS math test contained 16 items in common with the HS&B test (out of 81 items on NELS) (Rock, Pollack, & Quinn, 1992). Some of the ELS test questions were selected from previous assessments, including those administered in NELS, NAEP, and PISA (Ingels, et al., 2005). The NELS and ELS math tests shared 44 common items.

The ECLS-K assessments included items that were specifically created for the study, items adapted from commercial assessments with copyright permission, and other NCES studies including items from NAEP (disclosed items), NELS, and ELS (Najarian, Pollack, Sorongon, & Hausken, 2009).

Table 5.A6

90/10 Income achievement gaps, by study and subject, all NCES studies and NLSY samples

Study Sample	Birth Year	Test Year	Reading	Math
NLS	1954	1972	0.919	1.006
			(0.060)	(0.043)
HS&B Grade 12	1962	1980	0.783	0.912
			(0.093)	(0.075)
HS&B Grade 10	1964	1980	0.938	1.023
			(0.102)	(0.102)
NELS	1974	1988	0.885	1.023
			(0.029)	(0.032)
ELS	1985	2002	1.094	1.111
			(0.039)	(0.041)
ECLSK	1993	1998	1.229	1.397
			(0.028)	(0.025)
ECLSB	2001	2006	1.198	1.280
			(0.037)	(0.045)
NLSY79	1963-65	1981	1.205	1.266
			(0.058)	(0.073)
NLSY97	1981-85	1997	1.198	1.241
			(0.040)	(0.048)

The other possible comparison of samples given similar tests are the NLSY79 and NLSY97 cohorts (born in the early 1960s and early 1980s). The estimated income achievement gaps in the two NLSY studies are essentially unchanged across this 20-year period (see Table 5.A6). This result is consistent with the trend in the NCES studies, at least through the mid 1970s cohorts. The NCES studies do show a rise in the gap between 1974 and the 1986 cohorts, while the NLSY studies show no rise through the early 1980s. It may be that most of the observed rise in the NCES studies occurs in the 1980s, which would not be observed in the NLSY studies. Or it may be that the content of the AFQT (the test used in the NLSY studies) is less responsive to the income or income-related factors that drive the upward trend in the NCES (and other studies). The NCES tests are designed to be tests of academic achievement—they deliberately measures content that is taught in schools. The AFQT, on the other hand, has been described by some as a measure of ability (latent cognitive skill, or fluid intelligence). Several studies, however, have demonstrated that AFQT scores are affected by schooling, and so at least partly are measures of achievement (Cascio & Lewis, 2005; Cordero-Guzman, 2001; Hansen, Heckman, & Mullen, 2004; Roberts, et al., 2000). A closer analysis of the differences in the content of the AFQT and the NCES tests might shed more light on whether the differences in trends in the income achievement gaps are partly due to differences in the content of the tests.

A final concern is the fact that some of the studies (Talent, NLS, HS&B, Add Health, and ELS) include school-based samples of high school students. Because some students dropout (and those who dropout have lower levels of academic achievement and come from lower-income families, on average, than those who complete high school), the exclusion of dropout from the early studies may bias the estimated achievement gaps downward. Moreover, because most of these studies are from the earlier cohorts, when dropout rates were higher, this may bias the estimated trend in the gaps. The NELS data, however, provide a method of testing how severe such bias may be. NELS sampled eighth-grade students and tested them in math and reading in 8th, 10th, and 12th grade. Because few students dropout

before the end of eighth grade, the full NELS sample is representative of its age cohort. Although some students in the NELS sample dropped out of school before the end of high school, a random subsample of these students was followed-up, surveyed, and tested in math and reading in the years when they would have been in 10th and 12th grade. Thus, we can compare the estimated income achievement gap in 12th grade based on the both the full NELS sample (by using the appropriate weights to adjust for the probability sampling of dropouts) and the NELS sample that was still in school in 12th grade. The latter mimics the type of sample we observe in Talent, NLS, HS&B, Add Health, and ELS (where we only observe test scores for students still in school); the former is what we would like to be able to estimate (the gap in the full cohort population). Likewise, we can compute the gaps in 8th grade from the full cohort sample and only among those who persisted in school through 12th grade. In both cases, the difference between the full cohort and persister estimates provides some guidance regarding the likely size of the bias in the early studies that do not include high school dropouts.

Table 5.A7

Achievement Gaps Among All Full Cohort (Including Dropouts) and Among Those Who Persist to 12th Grade (NELS)

	Income Achievement Gap			Race Achievement Gap	
	90/10	90/50	50/10	White-Black	White-Hispanic
Grade 12 Achievement Gaps					
Math					
Full Cohort Gap Estimate	1.05	0.63	0.42	0.86	0.61
Estimated Gap Among Students Who Persist to Grade 12	1.05	0.61	0.43	0.86	0.61
Reading					
Full Cohort Gap Estimate	0.91	0.48	0.42	0.73	0.60
Estimated Gap Among Students Who Persist to Grade 12	0.89	0.46	0.45	0.73	0.60
Grade 8 Achievement Gaps					
Math					
Full Cohort Gap Estimate	1.02	0.53	0.49	0.86	0.66
Estimated Gap Among Students Who Persist to Grade 12	1.02	0.51	0.51	0.90	0.66
Reading					
Full Cohort Gap Estimate	0.88	0.39	0.49	0.76	0.62
Estimated Gap Among Students Who Persist to Grade 12	0.87	0.38	0.51	0.79	0.62

Note: gaps are disattenuated to correct for measurement error in test or measurement error in reported family

The results of these exercises are shown in Table 5.A7. I compute the 90/10, 90/50, and 50/10 income achievement gaps as well as White-Black and White-Hispanic gaps. In no case do the estimated gaps in the full cohort and among the persister sample differ by more than .02 standard deviations. This suggests that there is no meaningful bias introduced into the school-based high school samples (Talent, NLS, HS&B, Add Health, and ELS).

Trends by race and gender

For most of the studies, it is possible to estimate the 90/10 income gap separately among the white, black, and Hispanic student populations, and separately by student gender. These are shown in Figures 5.A2-5.A11. Fitted trends, weighted by the inverse of the sampling variance of the estimated gaps, are shown. Note that the 90/10 gaps here are between students at the 90th and 10th percentiles of the income distribution of the full population, not the 90th and 10th percentiles of the specific (race or gender) group's family income distribution. Thus, the gaps here are comparable to those in the full population.

Figure 5.A2

Trend in 90/10 Income Gap in Reading, White Students, 1943-2001 Cohorts

Figure 5.A3

Trend in 90/10 Income Gap in Math, White Students, 1943-2001 Cohorts

Figure 5.A4

Trend in 90/10 Income Gap in Reading, Black Students, 1943-2001 Cohorts

Figure 5.A5

Trend in 90/10 Income Gap in Math, Black Students, 1943-2001 Cohorts

Figure 5.A6

Trend in 90/10 Income Gap in Reading, Hispanic Students, 1943-2001 Cohorts

Figure 5.A7

Trend in 90/10 Income Gap in Math, Hispanic Students, 1943-2001 Cohorts

Figure 5.A8

Trend in 90/10 Income Gap in Reading, Male Students, 1943-2001 Cohorts

Figure 5.A9

Trend in 90/10 Income Gap in Reading, Female Students, 1943-2001 Cohorts

Figure 5.A10

Trend in 90/10 Income Gap in Math, Male Students, 1943-2001 Cohorts

Figure 5.A11

Trend in 90/10 Income Gap in Math, Female Students, 1943-2001 Cohorts

Section 5.A5. Comparing income gaps to race gaps

The estimated race gap trends from the 12 studies with income shown in Figures 5.3 and 5.4 is a quadratic fitted trend line. The

estimated race gap trend from the NAEP studies is a polynomial fitted trend line (quartic for reading; cubic for math, because the quartic

term is not significant in the math models), adjusted for the age of the students when tested and controlling for whether the gaps come

from the Long-Term Trend NAEP or Main NAEP. The fitted lines show the estimated black-white gaps for 13-year-olds on the LTT-NAEP tests.

The black-white gap widens considerably in the early elementary grades, which explains why the black-white gap in the ECLS-K and ECLS-B is so much smaller than the contemporaneous NAEP gap (which is based on gaps at age 9 and 13).

Section 5.A6. Does rising inequality account for the growth of the income achievement gap?

Income inequality grew substantially in the U.S from the 1970s to the present. Figure 5.A12 displays the long-term trend in income inequality in the U.S., as measured by the share of total income accruing to the top 10% of earners. Note that inequality was relative low and stable from the mid 1940s into the 1970s, when it began to rise rapidly.

Figure 5.A12

Share of Income Accruing to 10% Highest Income Families, 1918-2007

Source: Piketty & Saez (2009): http://www.econ.berkeley.edu/~saez/TabFig2007.xls
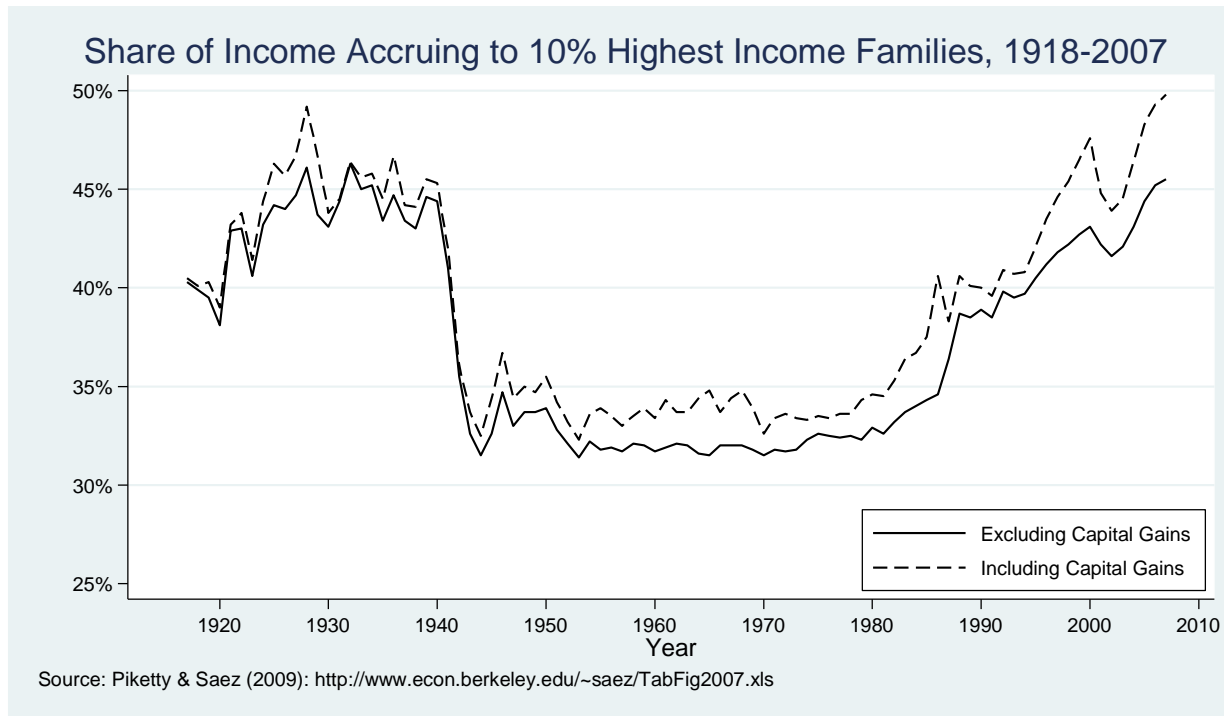
To formally test whether income inequality trends account for the income achievement gap trends, I fit a series of regression models of the form

$$\delta_i^{90/10} = \gamma_0 + \gamma_1(COH_i) + \gamma_2 \left(\log_2 \left(\frac{I_i^{90}}{I_i^{10}} \right) \right) + e_i$$

(A10)

where i indexes study cohorts, δ_i is the estimated 90/10 income achievement gap, COH_i is an indicator for the birth year of a given study cohort (centered on 1974), and where $R_i^{90/10}$ is the 90/10 income ratio of study cohort i. Rather than estimate the 90/10 income ratio from the specific sample, I use CPS data to estimate the 90/10 ratio. Because it is not immediately obvious whether it is income inequality in recent years, in the early years of one's life, or over the course of one's entire life that matter the most, I use different versions of the 90/10 ratio in the models. In some models $R^{90/10}$ is the 90/10 income ratio in the year the test is given; in some it is the average of the 90/10 ratios for the 5 prior years; in some it is the average 90/10 ratio for the first 5 years of a child's life (e.g., for the NELS sample—14 years olds born in 1974 and tested in 1988—this would be the average of the 90/10 ratio in 1974-1978); and in some I use the average of the 90/10 over the child's entire life. Because CPS income data are available only from 1967 forward, I do not include in these models cohorts born prior to 1963 (I exclude the NLS and Project Talent samples). For HS&B and NLSY79—cohorts born in the early/mid 1960s, I use the data for the years available.

I fit a second set of models, identical to those described above, but using the 90/50 and 50/10 income achievement gaps and income ratios in place of the 90/10 gaps and ratios. These models test whether the growing 50/10 income inequality accounts for the growing 50/10 income gaps (and likewise for the 90/50 models).

In general, these models suggest that income inequality does not explain the rising income achievement gap. The estimates are shown in Tables 5.A8 and 5.A9 below. In general, the coefficients on the logged income ratio are very unstable across the models, but also have large standard errors and so are significant in only one of 24 models. The income inequality measures are highly correlated ($r >$ 0.9) with the cohort birth year, making the estimated coefficients very imprecise due to multicollinearity. Nonetheless, the estimated trend in the 90/10 income achievement gap is as large or larger as in the models shown above that do not control for income inequality; the trend estimates range from 0.10 to 0.22 standard deviations per decade, net of income inequality trends. In reading, these 90/10 trend coefficients are statistically significant ($p < .10$) in each of models; in the math models they are never significant at $p < .05$ in only two of the models, but are of roughly the same magnitude as the reading coefficients.

Table 5.A8

Estimated Association Between Income Inequality and the Income Achievement Gap, Reading

		Measure of Income Inequality Used			
	Base Model	Current Year 90/10 Ratio	5 Year Average 90/10 Ratio	Average 90/10 Ratio When Ages 0-4	Average 90/10 Ratio Over Whole Life
90/10 Income Achievement Gap					
Cohort Birth Year	0.010 *	0.019 **	0.015 **	0.015 +	0.018 *
	(0.004)	(0.006)	(0.004)	(0.007)	(0.007)
$\log_2$(90/10 Ratio)		-1.339	-0.665	-0.202	-0.483
		(0.756)	(0.399)	(0.332)	(0.468)
R-squared	0.424	0.633	0.556	0.451	0.506
90/50 Income Achievement Gap					
Cohort Birth Year	0.011 **	0.011 +	0.015 +	0.031 +	0.028 *
	(0.002)	(0.005)	(0.007)	(0.015)	(0.009)
$\log_2$(90/50 Ratio)		-0.012	-0.562	-1.754	-1.946
		(0.824)	(1.268)	(1.277)	(1.165)
	0.573	0.579	0.590	0.634	0.642
50/10 Income Achievement Gap					
Cohort Birth Year	-0.001	-0.001	-0.001	-0.003 +	-0.002
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
$\log_2$(50/10 Ratio)		-0.214	-0.251	0.164	0.072
		(0.423)	(0.326)	(0.241)	(0.368)
	0.010	0.050	0.074	0.076	0.033
N (samples)	21	21	21	21	21
N (studies)	10	10	10	10	10

Note: Standard errors in parentheses, corrected for clustering of samples within studies. + p<.10; * p<.05; ** p<.01. Project Talent and NLS studies excluded for lack of income inequality data. Observations are weighted by the inverse of their squared standard errors.

Table 5.A9

Estimated Association Between Income Inequality and the Income Achievement Gap, Math

	Base Model	Measure of Income Inequality Used			
		Current Year 90/10 Ratio	5 Year Average 90/10 Ratio	Average 90/10 Ratio When Ages 0-4	Average 90/10 Ratio Over Whole Life
90/10 Income Achievement Gap					
Cohort Birth Year	0.012 *	0.018 +	0.016 +	0.022	0.022
	(0.005)	(0.009)	(0.008)	(0.015)	(0.016)
$\log_2$(90/10 Ratio)		-0.800	-0.327	-0.342	-0.551
		(1.003)	(0.803)	(0.451)	(0.738)
R-squared	0.402	0.459	0.420	0.449	0.454
90/50 Income Achievement Gap					
Cohort Birth Year	0.007 +	0.004	0.011	0.038 **	0.032
	(0.003)	(0.008)	(0.009)	(0.009)	(0.020)
$\log_2$(90/50 Ratio)		0.536	-0.577	-2.671 **	-2.782
		(0.872)	(1.289)	(0.616)	(2.226)
	0.257	0.278	0.268	0.366	0.352
50/10 Income Achievement Gap					
Cohort Birth Year	0.004	0.005	0.005	0.003	0.003
	(0.003)	(0.004)	(0.005)	(0.007)	(0.007)
$\log_2$(50/10 Ratio)		-0.303	0.049	0.147	0.176
		(0.628)	(0.686)	(0.366)	(0.613)
	0.143	0.173	0.149	0.166	0.159
N (samples)	15	15	15	15	15
N (studies)	9	9	9	9	9

Note: Standard errors in parentheses, corrected for clustering of samples within studies. + p<.10; * p<.05; ** p<.01. Project Talent and NLS studies excluded for lack of income inequality data. Observations are weighted by the inverse of their squared standard errors.

The bottom panels of Tables 5.A8 and 5.A9 show there is little or no evident trend in the 50/10 income achievement gap over this time period, particularly in reading. There is, however, evidence that the 90/50 income achievement gap has grown, particularly in reading (middle panel, Table 5.A7). Growing income inequality explains none of that growth; in fact the estimated trends are steeper, controlling for income inequality.

Section 5.A7. Does an Increasing Association Between Income and Achievement Explain the Growth of the Income Achievement Gap?

In this section I estimate the association between family income (in logged dollars) and child achievement. Although I refer to this association in some places as an estimate of the "achievement returns to income," this parameter should not be thought of as a causal parameter. I estimate the association between income and achievement indirectly. Suppose the relationship between income (I) and achievement (A) is given by

$$A = \beta_0 + \beta_1 \log_2(I) + e.$$

$$(A11)$$

Then the 90/10 income achievement gap can be written

$$\delta^{90/10} = E[\bar{A}|I = I^{90}] - E[\bar{A}|I = I^{10}]$$

$$= \beta_1 \log_2\left(\frac{I^{90}}{I^{10}}\right)$$

$$= \beta_1 \log_2\left(R^{90/10}\right),$$

$$(A12)$$

where I^{90} and I^{10} are the incomes at the 90th and 10th percentiles of the income distribution, respectively. Thus, the gap is a function of both the strength of the income coefficient (β_1) and the extent of income inequality ($R^{90/10} = I^{90}/I^{10}$). An increase in the achievement gap, therefore, might result from an increase in inequality, an increase in the strength of the association between income and

achievement, or some combination of the two. Rather than estimate β_1 from a regression of individual-level achievement on logged income, I note that

$$\beta_1 = \frac{\delta^{90/10}}{\log_2(R^{90/10})}.$$

(A13)

I use the estimated 90/10 income gap from each study, and divide it by the logged 90/10 income ratio (computed from CPS data, as described above) to estimate β_1. This has two advantages over using individual-level data and regressing achievement on income. First, it allows me to estimate the gap using a nonlinear (cubic) model, and it yields less noisy estimates of β_1 because the CPS income inequality estimates are much more precise than I obtain from each individual study.

I compute the β_1 for each of the samples in this way. I also compute the corresponding coefficient for the 50/10 and 90/50 regions of the income distribution. For example,

$$\hat{\beta}_1^{50/10} = \frac{\hat{\delta}^{50/10}}{\log_2(\hat{R}^{50/10})}$$

(A14)

is the estimated association between income and achievement for families with incomes below the median income. Likewise,

$$\hat{\beta}_1^{90/50} = \frac{\hat{\delta}^{90/50}}{\log_2(\hat{R}^{90/50})}$$

(A15)

is the estimated association between income and achievement for families with incomes above the median. Figures 5.A13-5.A18 below

display the estimated associations between income and achievement implied by the equations above. In these figures, I use the average

income inequality during the five years prior to the test year,[4] though the figures are very similar regardless of which income ratio I use.

The figures show very little change in the income-achievement association when we consider the full income distribution (Figures 5.A13

and 5.A14). However, when we consider the association among families with incomes above the median, it appears that the "returns to

income" have grown considerably over the last several decades, particularly in reading, where the coefficient has increased by 50-60% in

the last 25 years (Figures 5.A15 and 5.A16). This is not true when we examine the trend in the estimated association between income and

achievement for families below the median income (Figures 5.A17 and 5.A18). Among these families, the "returns to income" have been

the same—or even declining—for 50 years.

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[4] For Project Talent I use the 90/10 ratio estimated from the sample, as there is no CPS data for this cohort. For NLS, I use the 90/10 ratio from the CPS averaged over the years 1967-1972, the only years for which this cohort has CPS data.

Figure 5.A13

Trend in Association Between Income and Reading Achievement,
All Families, 1940-2001 Cohorts

Study
- TALENT
- NLS
- HS&B
- NLSY79
- NELS
- Add Health
- Prospects
- NLSY97
- ELS
- SECCYD
- ECLS-K
- ECLS-B
- Fitted Trend 1943-2001

Cohort Birth Year

Figure 5.A14

Trend in Association Between Income and Math Achievement,
All Families, 1940-2001 Cohorts

Figure 5.A15

Trend in Association Between Income and Reading Achievement,
Families Above Median Income, 1940-2001 Cohorts

Figure 5.A16

Trend in Association Between Income and Math Achievement,
Families Above Median Income, 1940-2001 Cohorts

Study
- ● TALENT
- ● NLS
- ● HS&B
- ◆ NLSY79
- ◆ NELS
- ◆ Add Health
- ▲ Prospects
- ▲ NLSY97
- ▲ ELS
- ■ SECCYD
- ■ ECLS-K
- ■ ECLS-B
- — Fitted Trend 1943-2001

Cohort Birth Year

Figure 5.A17

Trend in Association Between Income and Reading Achievement,
Families Below Median Income, 1940-2001 Cohorts

Figure 5.A18

Trend in Association Between Income and Math Achievement,
Families Below Median Income, 1940-2001 Cohorts

Section 5.A8. Estimating Trends in Parental Education Gaps

Figures 5.A19 and 5.A20 display the association between parental educational attainment and math and reading scores from all available studies. Studies where parental educational attainment is student-reported are included only if the students were in high school at the time of the report (this means, for example, that only age 17 NAEP-LTT and grade 12 Main NAEP estimates are included here). A reliability of 0.90 is assumed for high-school student reports of parental educational attainment, consistent with twin-based estimates obtained from the HS&B data (Fetters, et al., 1984) Each figure includes three fitted trend lines: i) a trend line based on the high school NAEP data; ii) a trend line based on the estimated parental education gap from 16 non-NAEP studies; and iii) a fitted cubic trend line based on all estimates, but adjusted for the age of the students when tested and whether parental education was reported by students or parents. Each of these fitted trends suggests a slightly different story.

Figure 5.A19: Parental Education Gap in Reading, 1940-2001 Cohorts

Trend in Parental Education Gap in Reading, 1943-2001 Cohorts

Study
○ Non-NAEP Studies
△ NAEP-LTT
◇ Main NAEP
– – NAEP Trend
– – Observed Trend, Non-NAEP Studies
── Adjusted Trend, All studies

Cohort Birth Year
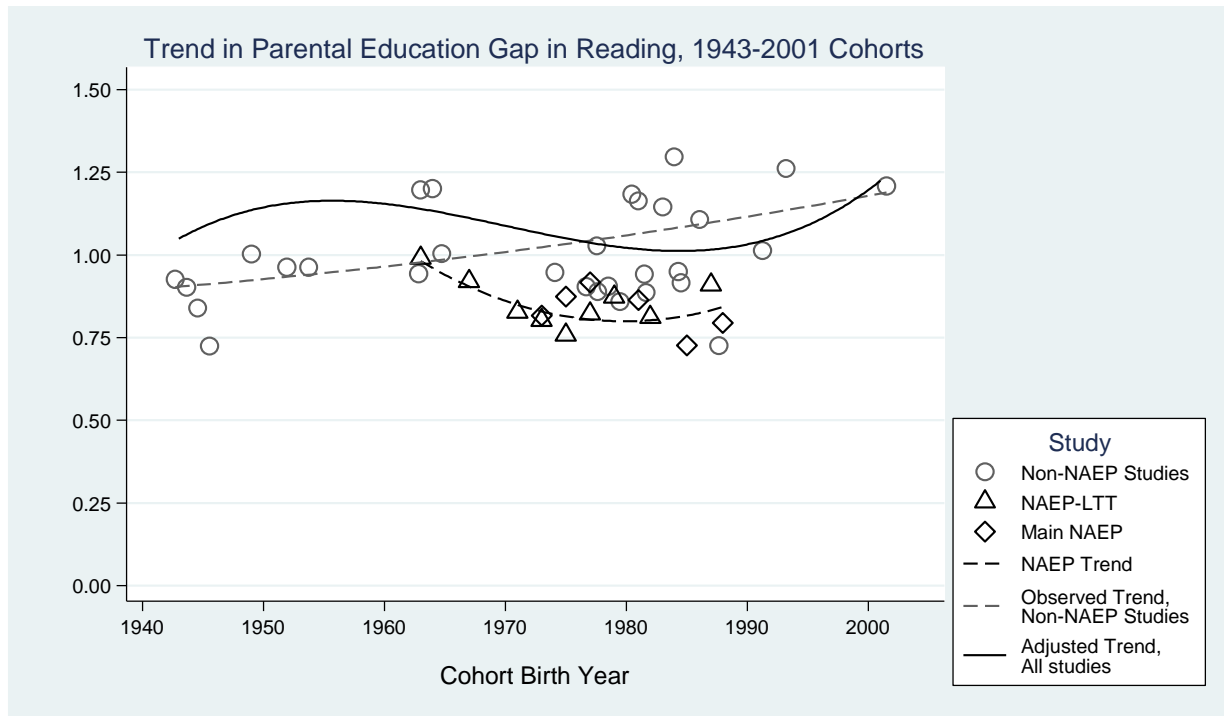
Figure 5.A20: Parental Education Gap in Math, 1940-2001 Cohorts

Trend in Parental Education Gap in Math, 1943-2001 Cohorts

Study
○ Non-NAEP Studies
△ NAEP-LTT
◇ Main NAEP
– – NAEP Trend
– – Observed Trend, Non-NAEP Studies
—— Adjusted Trend, All studies

Cohort Birth Year
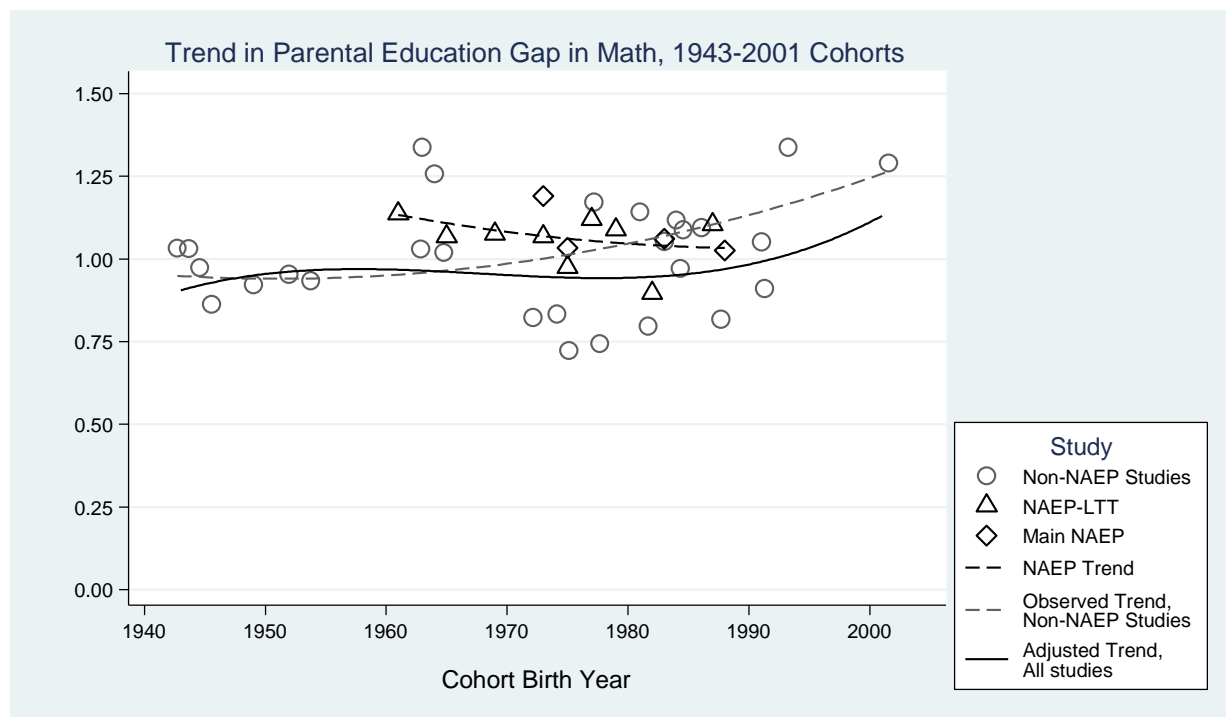
Note: Figures 5.A19 and 5.A20 display estimated 90/10 parental education gaps from each sample.   See Appendix Section 5.A2 for details on the computation of these gaps.

NAEP data suggest that the parental education gap changed little or declined slightly across cohorts born from 1960 to 1990. The non-NAEP studies, in contrast, suggest that the parental education achievement gap grew by roughly 30% among cohorts born from the 1940s to 2001. This trend, however, may be confounded by the fact that early studies relied on student-reported parental education and that later studies had a wider age range of students. The adjusted trend line is based on a regression model that controls the age at which

students were tested, and for whether or not parental education was student- or parent-reported. The fitted line displays the estimated trend in the parental education gap for 14-year-old students in studies with parent-reported educational attainment. For both math and reading, these trends show little change from the 1940s through the 1990s; while there is some suggestion that the parental education gap may have increased among the most recent cohorts, there are too few data points in the last decade to be sure of this.

On the whole, the data suggest that the association between parental educational attainment and student achievement has not changed dramatically over the last 50 years, though there is some evidence that it may be increasing in recent decades.

To estimate the partial associations between income, parental education, and achievement, I fit regression models of the form

$$Y_i = \beta_0 + \beta_1(INC_i) + \beta_2(PARED_i) + \mathbf{R}_i\mathbf{\Gamma} + \epsilon_i$$

$$(A16)$$

where INC_i is family income measured in percentiles; $PARED_i$ is parental educational attainment measured in percentiles;[5] and $\mathbf{R}_i$ is a vector of race dummy variables. I multiple both $\hat{\beta}_1$ and $\hat{\beta}_2$ by 0.8 so that they can be interpreted as the average difference in achievement between students at the 90th and 10th percentiles of the income (or parental education) distributions, controlling for parental education (or income) and race. This makes them comparable to the income gaps reported in Figures 5.1 and 5.2. I then plot the estimated coefficients $0.8 \cdot \hat{\beta}_1$ and $0.8 \cdot \hat{\beta}_2$ from each study and wave across cohorts in Figures 5.10 and 5.11.

---

[5] I measure both income and parental education in percentiles so that the coefficients can be compared to one another. To measure income in percentiles, I assign each student the income percentile corresponding to the middle percentile of the income category of his family income (for example, if 30% of students are in income categories $1, 2, \ldots k - 1$, and if 10% of students are income category k, then all students in income category k are assigned income percentile of $\left(0.30 + \frac{1}{2} \cdot 0.10\right) = 0.35$). To measure parental education in percentiles, I assign each student the maximum of his or her father's and mother's educational attainment category, and convert these ordered categories into percentiles in the same was as I do for income categories.

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Data Appendix

Chapter 6

Gains and Gaps:
A Historical Perspective on
Inequality in College Entry and Completion

Martha J. Bailey and Susan M. Dynarski

Census and ACS: Sample

We use the U.S. decennial censuses from 1940 to 2000 and the American Community Surveys (ACS) for 2006 and 2007 (Ruggles et al. 2009). Our census sample includes residents of "group quarters" such as dormitories, barracks, and prisons. We include only native-born U.S. residents, so that we can clearly distinguish the effect of social and economic conditions in the United States from shifts in immigration. We use the census weights in our calculations.

Census and ACS: Variable Definitions

From 1940 to 1980, the census obtained information about the highest grade of school a person had *attended* and *completed*, allowing us to identify those who have entered

college, even if they completed no years of college. By contrast, the post-1980 censuses and the ACS record whether a person has "some college" or completed a degree. We define a college entrant as someone who at age nineteen has attended college or is enrolled in college (1940–80 censuses) or has "some college" or is enrolled in college (1990–2000 census and ACS). We define a college completer as someone who at age twenty-five has completed sixteen years of schooling (1940–80 censuses) or who has completed a BA or higher (1990–2000 census and ACS).

The coding of race has changed across census years. Until 1970, race coding depended upon an enumerator's visual inspection and recording of each person's race. From 1970 forward, race was reported by someone in the household. As the meaning of race has changed to include ethnicity, more recent censuses allow coding of mixed race. These changes are especially important as they relate to historical descriptions of outcomes among "Hispanic/Latinos," which is not considered a race by the Census Bureau.[i] Beginning in 1980, the census explicitly asked about "Hispanic origin" on the enumeration form and did *not* recode "Hispanic/Latino" and "other race" responses as white. Nevertheless, even sophisticated attempts to impute changes in the "Hispanic origin" population before 1980 misses many members of this group (Gratton and Gutmann 2000). There is no simple way to deal with this important data limitation. Our compromise is to present series for whites and blacks (which include Hispanics of those races) until 1970, and present separate series for non-Hispanic whites, non-Hispanic blacks, and Hispanics for the 1980–2000 census and the ACS.

NLSY: Sample

We focus on NLSY79 cohorts born 1961–64 and NLSY97 cohorts born 1979–82. We limit the sample to native-born respondents who responded to questions about their completed education at both age nineteen and twenty-five. We use the baseline survey weights to generate our means.

NLSY: Variable Definitions

A person is coded as a college entrant if they were enrolled in college at any survey between baseline and age nineteen. A person is coded as a college completer if they had completed a BA by age twenty-five.

Notes

[i] Prior to 1970, Hispanics/Latinos were mostly classified as white by enumerators. This was explicit in the instructions in 1940 and 1950, and "Mexican" and "Puerto Rican" write-ins were recoded as "White" by the census in 1970. See IPUMS: http://usa.ipums.org/usa-action/variableDescription.do?mnemonic=HISPAN (accessed November 15, 2009).

Figure 7.A1: Students Expecting At Least Some College by Grade and Year
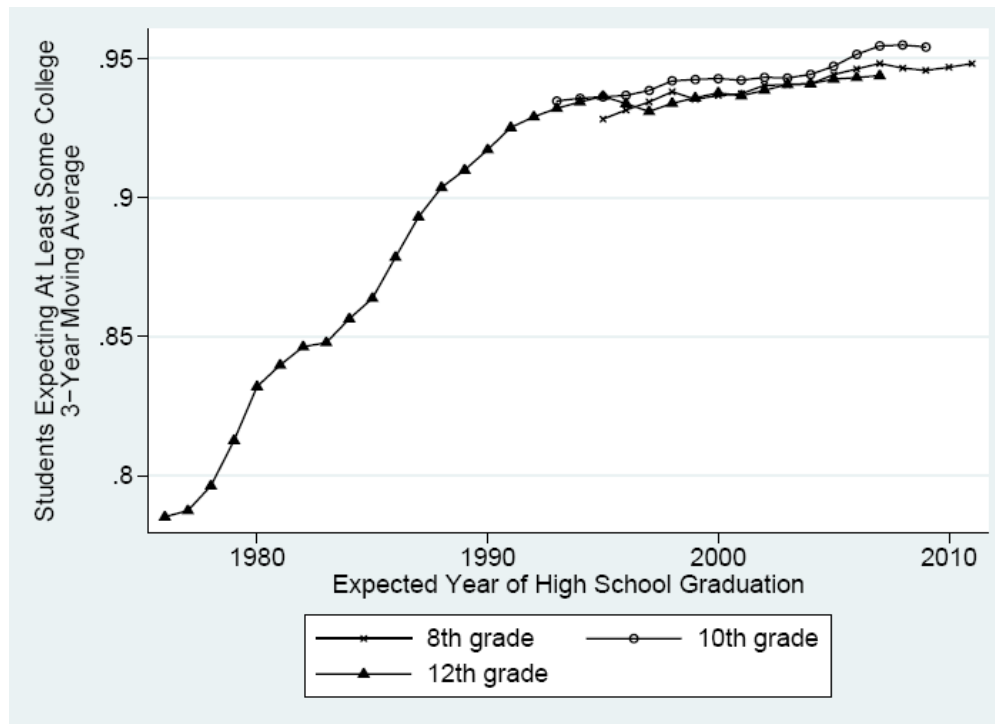
Figure 7.A2: Twelfth Graders Expecting At Least Some College by SES and Gender
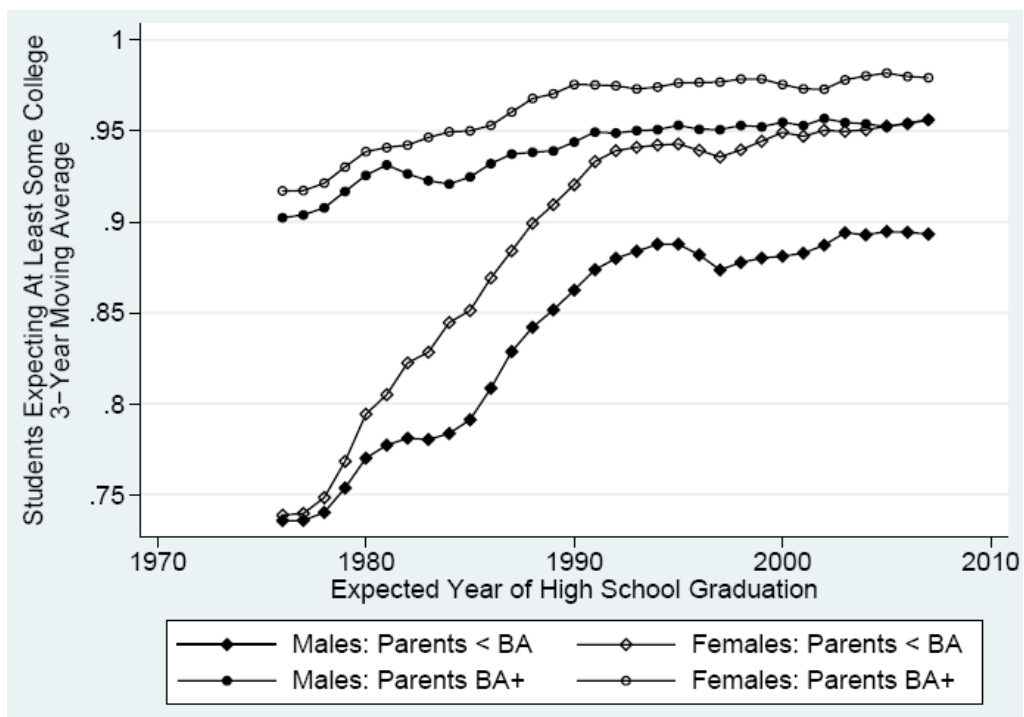
Figure 7.A3: Expectations and Attainment of At Least Some College
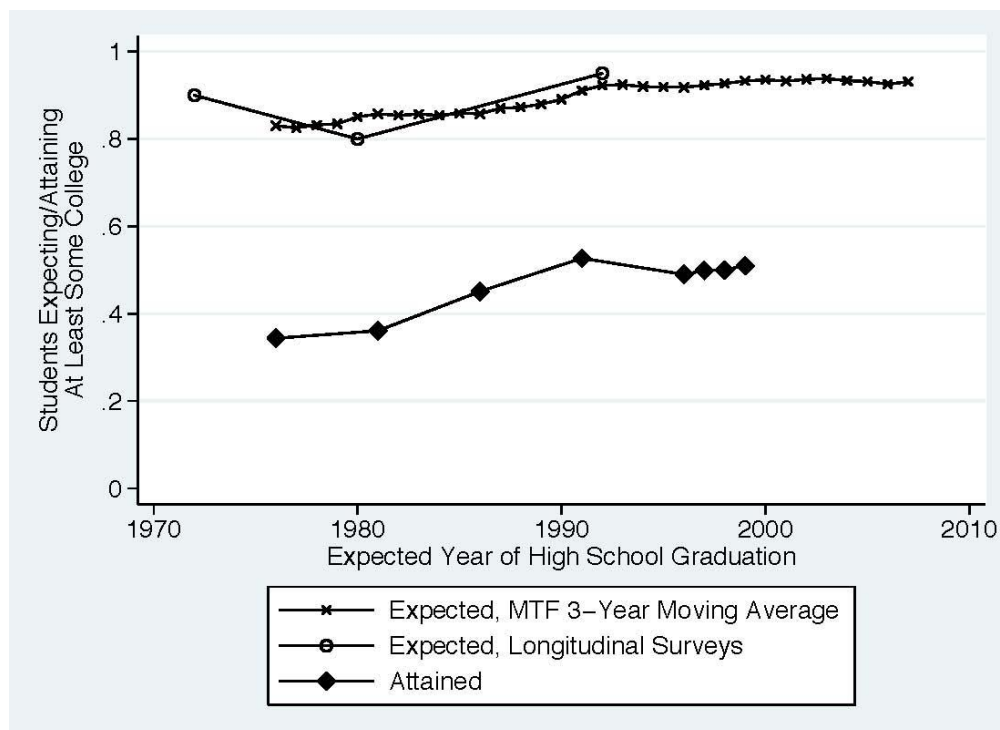
(a) Blacks

Figure 7.A3 cont'd.
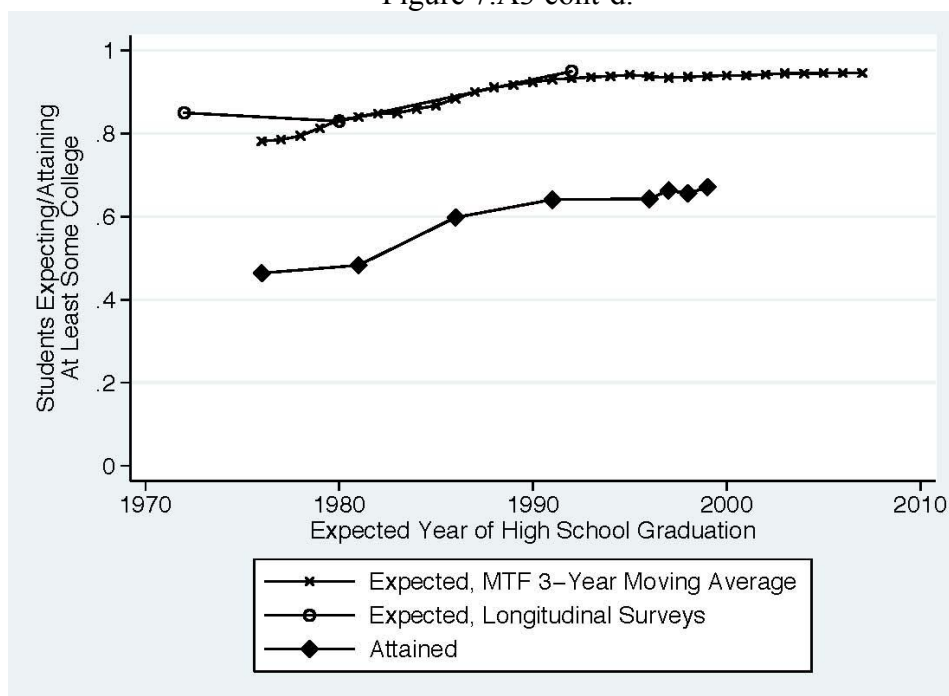
(b) Whites

Figure 7.A3 cont'd.
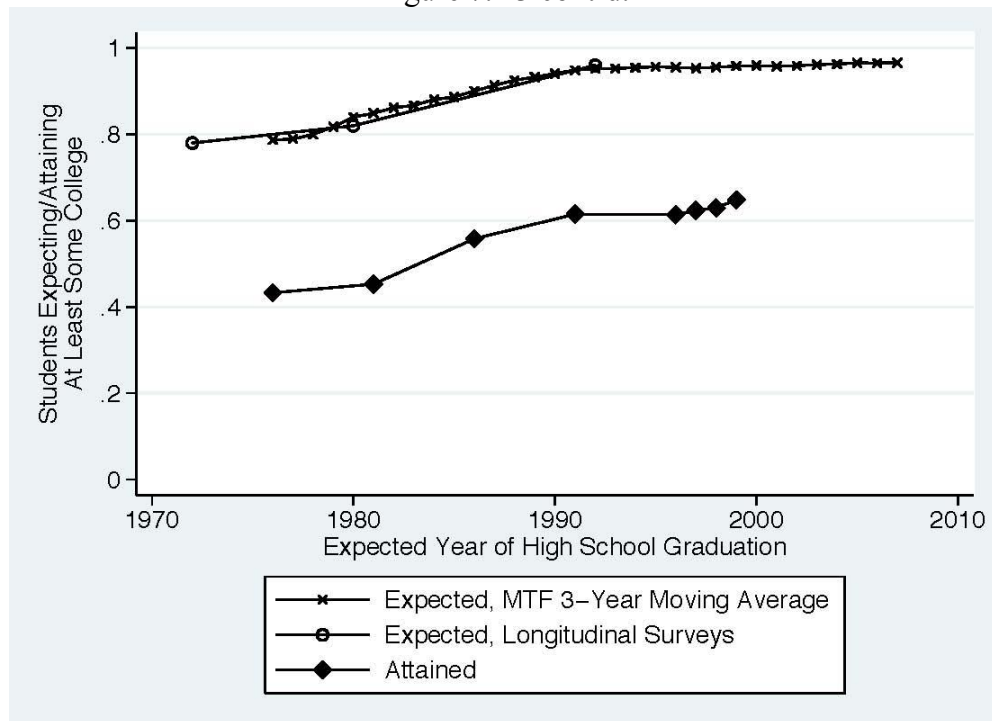
(c) Females

Figure 7.A3 cont'd.
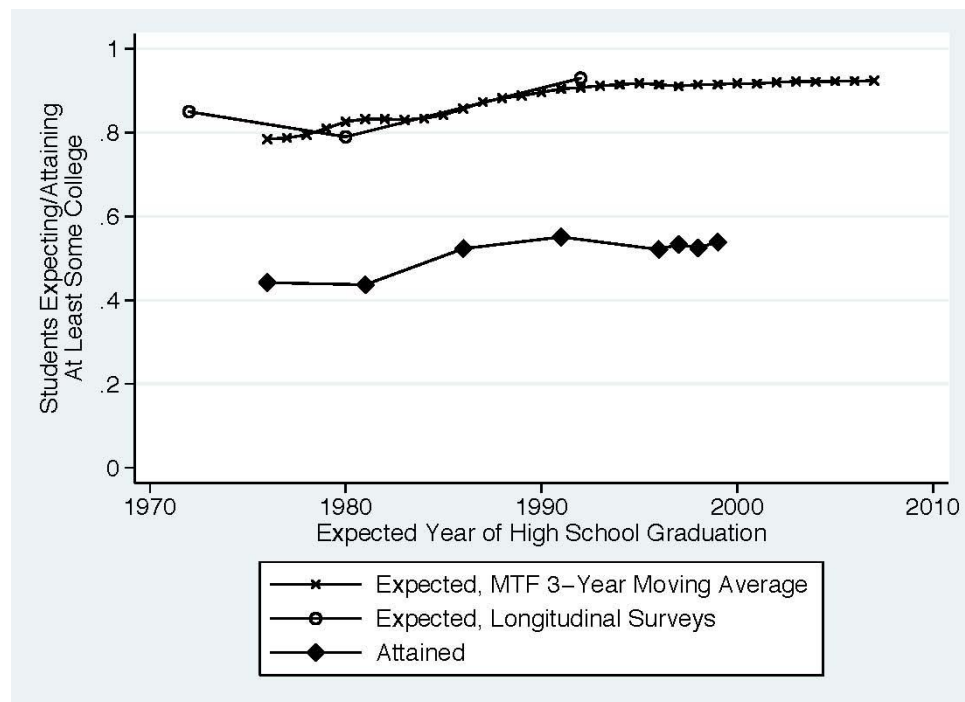
(d) Males

Table 7.A1 - Summary Statistics for Sophomore Cohorts in HSB, NELS and ELS			
	HSB	NELS	ELS
	(Sophomores in 1980, n=11,498)	(Sophomores in 1990, n= 11,857)	(Sophomores in 2002, n= 12,174)
Expectations			
Grade 10 Expectations			
Grade 10 Expect Less than HS	0.019	0.005	0.011
Grade 10 Expect HS	0.254	0.087	0.075
Grade 10 Expect at Least Some PSE	0.727	0.908	0.914
Grade 10 Expect BA or Higher	0.402	0.611	0.801
Grade 12 Expectations			
Grade 12 Expect Less than HS	0.025	0.002	0.003
Grade 12 Expect HS	0.188	0.052	0.058
Grade 12 Expect Some at Least PSE	0.787	0.946	0.938
Grade 12 Expect BA or Higher	0.401	0.697	0.745
2 Years Post-HS Expectations			
2 Years Post-HS Expect Less than HS	0.029	0.003	0.003
2 Years Post-HS Expect HS	0.202	0.073	0.072
2 Years Post-HS Expect at Least Some PSE	0.769	0.924	0.925
2 Years Post-HS Expect BA or Higher	0.392	0.722	0.727
Student Demographics			
Male	0.493	0.491	0.493
Race			
Hispanic	0.068	0.096	0.148
Black	0.120	0.117	0.142
White	0.788	0.741	0.615
Other	0.024	0.046	0.048
Parent's Highest Education			
Parent Complete HS or Less	0.412	0.282	0.264
Parent Completed Some PSE	0.428	0.415	0.346
Parent Completed a BA or More	0.160	0.302	0.390
SES Quintile			
Lowest SES Quintile	0.177	0.193	0.199
Second SES Quintile	0.204	0.204	0.208
Third SES Quintile	0.208	0.214	0.211
Fourth SES Quintile	0.214	0.213	0.205
Highest SES Quintile	0.197	0.177	0.177
Number of Siblings			
No Siblings	0.039	0.064	0.057
One Sibling	0.204	0.325	0.297
Two Siblings	0.256	0.273	0.289
Three or More Siblings	0.501	0.338	0.357
Student Achievement			
HS Program			
HS Academic Program	0.336	0.386	0.531
HS General Program	0.459	0.458	0.364
HS Vocational Program	0.206	0.157	0.105

See notes at end of table.

Table 7.A1 Cont'd - Summary Statistics for Sophomore Cohorts in HSB, NELS and ELS			
Student Achievement Cont'd			
Quartile of Combined Math and Reading Scores, Grade 10			
Lowest Quartile	0.234	0.235	0.250
Second Quartile	0.249	0.257	0.248
Third Quartile	0.256	0.265	0.245
Highest Quartile	0.261	0.243	0.257
Academic GPA, Grade 12	2.325	2.296	2.585
School Variables			
Students per Guidance Counselor, Grade 10, in Hundreds	3.662	4.051	3.472
Percent of Free- and Reduced- Price Lunch Eligible Students	0.149	0.192	0.230
Percent of Previous Year's Graduates in 4-Yr College	0.471	0.457	0.497
PSE Matriculation Variables			
Applied to PSE in Grade 12	0.649	0.666	0.757
Enrolled in PSE within 2 Years Post-HS	0.585	0.702	0.716
Type of PSE Enrolled in within 2 Years Post-HS			
Less than 2 Year Institution	0.087	0.171	0.016
2 Year Institution	0.172	0.170	0.243
4 Year Institution	0.317	0.362	0.457
Highest Degree Attained			
Less than HS	0.071	0.030	-
HS	0.473	0.460	-
Certificate	0.105	0.082	-
AA	0.084	0.076	-
BA	0.226	0.313	-
MA	0.029	0.035	-
PHD	0.011	0.006	-
Economic Variables			
Percent of County Population Unemployed	0.074	0.064	0.060
County Per Capita Income, in Thousands, 2007 Dollars	23.247	$21.887	$24.254
PSE Cost Variables			
County Mean PSE Tuition, In-State, in Thousands, 2007 Dollars	-	$7.051	$10.753
County Mean PSE Tuition, Out-of-State, in Thousands, 2007 Dollars	-	$9.068	$13.008
County Mean PSE Room and Board Costs, in Thousands, 2007 Dollars	-	$5.583	$7.972
County Minimum Tuition, In-State, in Thousands, 2007 Dollars	-	$3.17	$3.831
County Minimum Tuition, Out-of-State, in Thousands, 2007 Dollars	-	$5.763	$6.899
County Minimum PSE Room and Board Costs, in Thousands, 2007 Dollars	-	$3.835	$5.579

Notes:

SES is a composite measure of parents' education, parents' occupations, and family income.

PSE means post-secondary education.

Data are weighted to be nationally representative.

Table 7.A2 - Descriptive Statistics for NELS 1988-2000 Panel, 8th Grade Cohort					
	1988 Wave	1990 Wave	1992 Wave	1994 Wave	2000 Wave
Expectations					
Expect Less than HS	0.015	0.025	0.007	0.007	0.024
Expect HS	0.099	0.103	0.052	0.085	0.214
Expect Some PSE	0.886	0.873	0.940	0.908	0.762
Expect BA or Higher	0.666	0.578	0.688	0.695	0.562
Time-Invariant Student Characteristics					
Male		0.499			
Race					
Hispanic		0.106			
Black		0.119			
White		0.726			
Other		0.048			
SES Quintile					
Lowest SES Quintile	0.206				
Second SES Quintile	0.200				
Third SES Quintile	0.211				
Fourth SES Quintile	0.209				
Highest SES Quintile	0.175				
Number of Siblings					
No Siblings	0.062		0.061		
One Sibling	0.317		0.319		
Two Siblings	0.270		0.270		
Three of More Siblings	0.351		0.350		
LEP Status	0.023	-	-	-	-
Gifted Status	-	-	0.088	-	-
HS Program					
HS Academic Program			0.365		
HS General Program			0.470		
HS Vocational Program			0.165		
Time-Varying Family Characteristics					
Student had child	-	0.041	0.044	0.146	-
Hours of TV Watched During Week	3.515	3.181	2.734	-	-
Hours of Homework During Week	5.748	7.625	13.263	-	-
Parent(s) Notified of Behavior at School	0.290	0.150	0.213	-	-
Locus of Control (standardized)	0.013	0.021	0.028	-	-
Self-Concept (standardized)	0.004	-0.002	0.000	-	-
Parent(s) Unemployed	0.111	0.111	0.085	-	-
Suspended	-	0.089	0.083	-	-
Days Absent	-	9.893	11.291	-	-
Live with 2 Parents	0.666	-	0.616	-	-

See notes at end of table.

Table 7.A2 Cont'd - Descriptive Statistics for NELS 1988-2000 Panel, 8th Grade Cohort					
Time-Varying Measures of Student Academic Performance					
Academic GPA (scale 0-4)	2.923	2.750	2.288	-	-
School Size (in hundreds)	6.482	11.526	11.941	-	-
Quartile of Combined Math and Reading Scores					
Lowest Quartile	0.242	0.221	0.239	-	-
Second Quartile	0.263	0.255	0.256	-	-
Third Quartile	0.259	0.269	0.259	-	-
Highest Quartile	0.236	0.255	0.246	-	-
School Characteristics					
Students per Guidance Counselor, in Hundreds	-	4.100	-	-	-
Percent of Free- and Reduced- Price Lunch Eligible Students	0.241	0.199	-	-	-
Percent of Previous Year's Graduates in 4-Yr College	-	0.453	-	-	-
Private School	0.121	0.097	0.092		
PSE Matriculation Variables					
Applied to PSE	-	-	0.697	-	-
Enrolled in PSE				0.734	
Type of PSE Enrolled In					
Less than 2 Year Institution				0.170	
2 Year Institution				0.183	
4 Year Institution				0.381	
Highest Degree Attained					
Less than HS					0.068
HS					0.472
Certificate					0.085
AA					0.072
BA					0.273
MA					0.029
PHD					0.005
Economic Variables					
Percent of County Population Unemployed		0.064			
County Per Capita Income, in Thousands, 2007 Dollars		$21.892			
PSE Cost Variables					
County Mean PSE Tuition, In-State, in Thousands, 2007 Dollars			$7.040		
County Mean PSE Tuition, Out-of-State, in Thousands, 2007 Dollars			$9.051		
County Mean PSE Room and Board Costs, in Thousands, 2007 Dollars			$5.598		
County Minimum Tuition, In-State, in Thousands, 2007 Dollars			$3.102		
County Minimum Tuition, Out-of-State, in Thousands, 2007 Dollars			$5.678		
County Minimum PSE Room and Board Costs, in Thousands, 2007 Dollars			$3.803		

Notes: N= 10,677

SES is a composite measure of parents' education, parents' occupations, and family income.

PSE means post-secondary education.

Data are weighted to be nationally representative.

Table 7.A3 - Expectations and Student Outcomes in Grade 10, NELS Sophomores Cohort

	GPA	Hours of Homework per Week	Hours Watching TV per Week	Academic HS Program	Parent(s) Notified at Least Once of Behavior Problems at School	Suspended from School At Least Once	Days Absent	Self-Concept	Locus of Control
Expect Some College or More, Grade 8	0.049	0.439*	-0.077	0.026	-0.030	-0.035	0.122	-0.021	-0.005
	(0.037)	(0.209)	(0.077)	(0.014)	(0.018)	(0.019)	(0.376)	(0.023)	(0.023)
Expect BA or More, Grade 8	0.094***	0.389*	0.016	0.089***	-0.001	-0.003	-0.287	0.016	0.032*
	(0.022)	(0.172)	(0.049)	(0.011)	(0.011)	(0.011)	(0.213)	(0.017)	(0.016)
Low SES Quintile Female, Grade 8	-0.075	0.242	-0.107	-0.135***	-0.080***	-0.008	2.443***	-0.040	0.057*
	(0.040)	(0.337)	(0.087)	(0.022)	(0.017)	(0.015)	(0.422)	(0.031)	(0.028)
Second SES Quintile Female, Grade 8	-0.030	0.818*	-0.060	-0.090***	-0.065***	-0.003	1.530***	-0.055	0.072**
	(0.033)	(0.340)	(0.074)	(0.022)	(0.017)	(0.014)	(0.303)	(0.030)	(0.026)
Third SES Quintile Female, Grade 8	-0.037	0.781**	-0.049	-0.067**	-0.059***	-0.019	1.436***	-0.098***	0.086***
	(0.033)	(0.295)	(0.076)	(0.021)	(0.016)	(0.011)	(0.320)	(0.029)	(0.026)
Fourth SES Quintile Female, Grade 8	-0.012	0.548	-0.174*	-0.027	-0.069***	0.005	1.032***	-0.078*	0.071*
	(0.030)	(0.311)	(0.075)	(0.022)	(0.019)	(0.019)	(0.270)	(0.033)	(0.030)
Highest SES Quintile Female, Grade 8	0.040	0.770*	-0.199**	-0.001	-0.053***	-0.006	0.891**	-0.101**	0.074**
	(0.030)	(0.335)	(0.070)	(0.022)	(0.016)	(0.009)	(0.272)	(0.033)	(0.028)
Low SES Quintile Male, Grade 8	-0.163***	-0.258	0.020	-0.128***	0.031	0.058**	1.795***	0.018	0.027
	(0.048)	(0.307)	(0.090)	(0.023)	(0.019)	(0.020)	(0.444)	(0.032)	(0.029)
Second SES Quintile Male, Grade 8	-0.128***	-0.345	0.112	-0.084***	0.026	0.046**	0.236	0.023	0.031
	(0.033)	(0.285)	(0.082)	(0.021)	(0.019)	(0.015)	(0.291)	(0.028)	(0.028)
Third SES Quintile Male, Grade 8	-0.087**	-0.292	0.116	-0.069**	0.003	0.012	0.546	0.005	0.002
	(0.034)	(0.287)	(0.078)	(0.021)	(0.018)	(0.013)	(0.283)	(0.029)	(0.026)
Fourth SES Quintile Male, Grade 8	-0.070*	-0.010	0.067	-0.033	0.044*	-0.008	0.241	0.037	0.016
	(0.032)	(0.276)	(0.065)	(0.020)	(0.019)	(0.013)	(0.268)	(0.027)	(0.027)
Hispanic, Grade 8	-0.000	0.012	0.053	0.040*	0.013	-0.019	-0.387	0.034	0.022
	(0.036)	(0.253)	(0.070)	(0.018)	(0.017)	(0.017)	(0.349)	(0.027)	(0.024)
Black, Grade 8	-0.061	-0.318	0.392***	-0.008	0.025	0.003	-1.245***	0.212***	0.068*
	(0.041)	(0.268)	(0.089)	(0.020)	(0.019)	(0.023)	(0.355)	(0.031)	(0.030)
Other, Grade 8	0.037	0.609	-0.035	0.019	-0.005	0.009	-0.302	0.035	0.016
	(0.043)	(0.343)	(0.085)	(0.021)	(0.020)	(0.018)	(0.430)	(0.031)	(0.030)
One Sibling, Grade 8	0.001	-0.047	-0.149	-0.004	0.010	0.003	0.011	-0.042	-0.056*
	(0.030)	(0.245)	(0.077)	(0.019)	(0.015)	(0.015)	(0.347)	(0.028)	(0.026)
Two Siblings, Grade 8	-0.009	0.194	-0.106	-0.009	0.021	0.002	0.505	-0.025	-0.041
	(0.031)	(0.241)	(0.080)	(0.018)	(0.016)	(0.015)	(0.384)	(0.027)	(0.027)
Three of More Siblings, Grade 8	-0.012	0.100	-0.192*	-0.042*	0.021	0.014	0.536	-0.028	-0.044
	(0.032)	(0.243)	(0.082)	(0.018)	(0.016)	(0.016)	(0.347)	(0.029)	(0.027)
Living with 2 Parents, Grade 8	0.049**	0.131	0.092*	-0.010	-0.006	-0.014	-0.351*	-0.004	0.003
	(0.018)	(0.143)	(0.040)	(0.010)	(0.009)	(0.010)	(0.162)	(0.015)	(0.014)

See notes at end of table.

Table 7.A3 Cont'd - Expectations and Student Outcomes in Grade 10, NELS Sophomores Cohort

	GPA	Hours of Homework per Week	Hours Watching TV per Week	Academic HS Program	Parent(s) Notified at Least Once of Behavior Problems at School	Suspended from School At Least Once	Days Absent	Self-Concept	Locus of Control
Low Quartile Combined Math and Reading Test Score, Grade 8	-0.525***	-2.281***	0.045	-0.228***	0.037*	0.024	0.664*	-0.090***	-0.127***
	(0.032)	(0.272)	(0.069)	(0.016)	(0.015)	(0.016)	(0.296)	(0.026)	(0.025)
Second Quartile Combined Math and Reading Test Score, Grade 8	-0.379***	-1.577***	0.104	-0.176***	0.013	-0.005	-0.005	-0.058**	-0.060**
	(0.023)	(0.236)	(0.053)	(0.014)	(0.012)	(0.010)	(0.215)	(0.022)	(0.021)
Third Quartile Combined Math and Reading Test Score, Grade 8	-0.239***	-0.796***	0.116**	-0.086***	0.007	-0.007	0.041	-0.061**	-0.045*
	(0.019)	(0.198)	(0.043)	(0.013)	(0.011)	(0.008)	(0.196)	(0.021)	(0.019)
Academic GPA, Grade 8 (0-4 scale)	0.467***	0.859***	0.037	0.123***	-0.042***	-0.038***	-0.887***	0.053***	0.074***
	(0.017)	(0.123)	(0.032)	(0.008)	(0.007)	(0.008)	(0.179)	(0.012)	(0.012)
LEP Status, Grade 8	-0.072	0.098	-0.217	-0.017	-0.035	-0.031	0.238	0.025	0.001
	(0.077)	(0.688)	(0.167)	(0.028)	(0.027)	(0.035)	(0.850)	(0.049)	(0.051)
Locus of Control, Grade 8 (standardized)	0.053**	0.523***	-0.028	0.035***	-0.011	-0.020*	-0.009	0.094***	0.287***
	(0.017)	(0.132)	(0.037)	(0.008)	(0.008)	(0.009)	(0.153)	(0.013)	(0.014)
Self-Concept, Grade 8 (standardized)	0.020	-0.172	-0.023	-0.003	-0.008	0.010	0.212	0.404***	0.129***
	(0.014)	(0.128)	(0.033)	(0.007)	(0.008)	(0.010)	(0.143)	(0.013)	(0.013)
Parent(s) Notified of Behavior at School, Grade 8	-0.085***	0.026	-0.074	-0.011	0.109***	0.086***	0.387	-0.008	-0.016
	(0.018)	(0.144)	(0.047)	(0.010)	(0.011)	(0.012)	(0.199)	(0.017)	(0.015)
Hours of TV Watched During the Week, Grade 8	0.003	0.017	0.390***	-0.002	0.003	0.001	0.000	-0.004	-0.010*
	(0.006)	(0.041)	(0.013)	(0.003)	(0.002)	(0.003)	(0.051)	(0.004)	(0.005)
Hours of Homework per Week, Grade 8	0.004*	0.218***	-0.000	0.003***	-0.001	-0.001	0.007	-0.003	0.000
	(0.002)	(0.016)	(0.004)	(0.001)	(0.001)	(0.001)	(0.014)	(0.002)	(0.001)
N					15803				
R²	0.548	0.348	0.354	0.475	0.291	0.298	0.440	0.415	0.388
F-Statistic for FE	3.744	3.128	3.174	5.389	2.95	3.331	7.139	2.591	2.757
DF_a for FE	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000
DF_r for FE	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000	1466.000
Probability for F-Statistic of Joint Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mean of Dependent Variable	2.686	7.612	3.066	0.373	0.126	0.076	4.574	0.008	0.042

Notes:

* p< .05, ** p< .01, *** p<.001

Models include school fixed effects.

Standard errors clustered at the school level.

Data are weighted to be nationally representative.

Data are from the National Education Longitudinal Study.

Table 7.A4 - Determinants of Grade 10 Educational Expectations, NELS Sophomore Cohort

	Dependent Variable = Expect at Least Some College			Dependent Variable = Expect BA or		
	(1)	(2)	(3)	(1)	(2)	
Student Characteristics						
Expectations, Grade 8	0.102***	0.102***	0.100***	0.189***	0.186***	0.
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(
Academic GPA, Grade 8 (0-4 scale)	0.034***	0.034***	0.032***	0.107***	0.110***	0.
	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(
Living with 2 Parents, Grade 8	-0.002	-0.001	-0.005	0.019	0.015	(
	(0.008)	(0.008)	(0.009)	(0.012)	(0.012)	(
Locus of Control, Grade 8 (standardized)	0.008	0.008	0.007	0.006	0.008	(
	(0.007)	(0.007)	(0.008)	(0.010)	(0.010)	(
Self-Concept, Grade 8 (standardized)	-0.002	-0.002	-0.002	0.011	0.011	(
	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)	(
Low SES Quintile Female, Grade 8	-0.108***	-0.110***	-0.105***	-0.241***	-0.213***	-0.
	(0.024)	(0.023)	(0.022)	(0.025)	(0.025)	(
Second SES Quintile Female, Grade 8	-0.030*	-0.030*	-0.029*	-0.200***	-0.177***	-0.
	(0.012)	(0.012)	(0.012)	(0.022)	(0.022)	(
Third SES Quintile Female, Grade 8	-0.011	-0.011	-0.010	-0.112***	-0.094***	-0.
	(0.012)	(0.012)	(0.012)	(0.021)	(0.021)	(
Fourth SES Quintile Female, Grade 8	-0.007	-0.006	-0.004	-0.086***	-0.071***	-0.
	(0.011)	(0.011)	(0.010)	(0.019)	(0.019)	(
Highest SES Quintile Female, Grade 8	0.000	0.001	0.002	-0.047*	-0.044*	-0
	(0.007)	(0.007)	(0.007)	(0.021)	(0.021)	(
Low SES Quintile Male, Grade 8	-0.111***	-0.112***	-0.110***	-0.249***	-0.225***	-0.
	(0.021)	(0.021)	(0.020)	(0.025)	(0.026)	(
Second SES Quintile Male, Grade 8	-0.059***	-0.058***	-0.058***	-0.228***	-0.207***	-0.
	(0.013)	(0.014)	(0.013)	(0.025)	(0.025)	(
Third SES Quintile Male, Grade 8	-0.020	-0.021	-0.020	-0.202***	-0.184***	-0.
	(0.013)	(0.013)	(0.013)	(0.024)	(0.024)	(
Fourth SES Quintile Male, Grade 8	0.009	0.009	0.008	-0.126***	-0.113***	-0.
	(0.010)	(0.010)	(0.009)	(0.022)	(0.022)	(
Hispanic, Grade 8	0.028*	0.027*	0.028*	0.035	0.045*	0
	(0.013)	(0.014)	(0.014)	(0.019)	(0.018)	(
Black, Grade 8	0.036**	0.033**	0.035**	0.122***	0.125***	0.
	(0.013)	(0.013)	(0.013)	(0.021)	(0.021)	(
Other, Grade 8	0.014	0.015	0.015	0.033	0.032	(
	(0.018)	(0.018)	(0.018)	(0.020)	(0.020)	(
One Sibling, Grade 8	-0.015	-0.016	-0.019	-0.044*	-0.040*	-0
	(0.012)	(0.012)	(0.012)	(0.017)	(0.017)	(
Two Siblings, Grade 8	-0.002	-0.002	-0.005	-0.048**	-0.045**	-0
	(0.012)	(0.012)	(0.012)	(0.018)	(0.017)	(
Three of More Siblings, Grade 8	-0.020	-0.020	-0.022	-0.083***	-0.079***	-0.
	(0.013)	(0.013)	(0.013)	(0.019)	(0.019)	(

See notes at end of table.

	Dependent Variable = Expect at Least Some College			Dependent Variable = Expect BA or M		
	(1)	(2)	(3)	(1)	(2)	(
Student Characteristics Cont'd						
Low Quartile Combined Math and Reading Test Score, Grade 8	-0.044***	-0.045***	-0.042***	-0.144***	-0.135***	-0.13
	(0.012)	(0.013)	(0.013)	(0.020)	(0.020)	(0.0
Second Quartile Combined Math and Reading Test Score, Grade 8	0.005	0.005	0.005	-0.094***	-0.089***	-0.09
	(0.009)	(0.009)	(0.009)	(0.017)	(0.017)	(0.0
Third Quartile Combined Math and Reading Test Score, Grade 8	0.015*	0.015*	0.015*	-0.031*	-0.030*	-0.0
	(0.006)	(0.006)	(0.006)	(0.014)	(0.014)	(0.0
HS Academic Program	0.033***	0.025*	0.025*	0.131***	0.133***	0.13
	(0.007)	(0.011)	(0.011)	(0.012)	(0.019)	(0.0
HS Vocational Program	0.007	0.016	0.017	-0.042**	-0.022	-0.0
	(0.013)	(0.016)	(0.016)	(0.016)	(0.027)	(0.0
School Characteristics						
Private School, Grade 12		-0.001	0.044**		0.058**	0.07
		(0.013)	(0.016)		(0.022)	(0.0
School Size, Grade 12		-0.001	-0.001		0.000	0.0
		(0.001)	(0.001)		(0.001)	(0.0
Percent of Previous Year's Graduates in 4-Yr College, Grade 10		0.019	0.021		0.060*	0.0
		(0.024)	(0.024)		(0.027)	(0.0
Percent of Free- and Reduced- Price Lunch Eligible Students, Grade 10		0.020	0.027		-0.028	-0.0
		(0.027)	(0.029)		(0.029)	(0.0
Students per Guidance Counselor, Grade 10, in Hundreds		0.001	0.002		-0.008*	-0.0
		(0.004)	(0.004)		(0.004)	(0.0
Students per Guidance Counselor*HS Academic Program		0.002	0.002		-0.001	-0.0
		(0.003)	(0.003)		(0.005)	(0.0
Students per Guidance Counselor*HS Vocational Program		-0.002	-0.002		-0.004	-0.0
		(0.004)	(0.004)		(0.006)	(0.0
County Characteristics						
Percent of County Population Unemployed, Grade 10			-0.275			0.4
			(0.189)			(0.2
County Per Capita Income, in thousands, Grade 10			-0.000			0.0
			(0.001)			(0.0
County Minimum PSE Tuition, In-State in thousands, Grade 12			-0.001			0.0
			(0.001)			(0.0
County Minimum PSE Room and Board Costs, in thousands, Grade 12			0.003			-0.0
			(0.002)			(0.0
N		15803			15803	
Mean of Dependent Variable	0.162	0.163	0.169	0.354	0.360	0.3
Variance of Dependent Variable	0.903	0.903	0.903	0.635	0.635	0.6

Notes:

* p< .05, ** p< .01, *** p<.001

Standard errors clustered at the school level.

Data are weighted to be nationally representative.

Data are from the National Education Longitudinal Study.

Table 7.A5 - Changes in Expectations over Time, NELS 1988-2000 Panel

Years	Changed at Least Once	Changed Exactly Once	Changed Twice	Changed Three or More Times	Ever Increased	Ever Decreased	Later Expectations Higher than Initial
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1988-2000	0.605	0.228	0.239	0.139	0.436	0.507	0.131
	(10,677)	(10,677)	(10,677)	(10,677)	(10,677)	(10,677)	(9864)
1988-1994	0.514	0.245	0.225	0.044	0.398	0.360	0.191
	(10,677)	(10,677)	(10,677)	(10,677)	(10,677)	(10,677)	(10,472)
1994-2000	0.344	-	-	-	-	-	0.064
	(9,696)						(9,696)
1988-1990	0.346	-	-	-	-	-	0.130
	(10,573)						(10,573)
1990-1992	0.251	-	-	-	-	-	0.149
	(8,924)						(8,924)
1992-1994	0.233	-	-	-	-	-	0.153
	(8,894)						(8,894)

Notes:

Data are weighted to be nationally representative. Data are from the National Education Longitudinal Study. Sample size included in parentheses. Changed variables i between the two years. Ever increases and ever decreased variables indicate whether a respondent ever changed her expectations within the period indicated. Later expe than initial indicates that the expectations in the earlier year were lower/higher than those in the latest year.

The sample used to calculate the statistics in columns 7 and 8 differs somewhat from the sample used to calculate the statistics in columns 1-6. This is because in orde columns 7-8, respondents must have had non-missing expectations data in both 1988 and 2000, whereas in order to have data in columns 1-6, respondents only had to expectations data in two (or more) of the five survey waves from 1988 to 2000.

Table 7.A6

Table A6 - Characteristics of Students that Update Expectations between 8th and 12th Grades, NELS 8th Grade Cohort

	Changed at Least Once, Grade 8 to Grade 12	Changed Twice, Grade 8 to Grade 12
Low SES Quintile Female, Grade 8	0.223***	0.058***
	(0.021)	(0.014)
Second SES Quintile Female, Grade 8	0.179***	0.058***
	(0.019)	(0.013)
Third SES Quintile Female, Grade 8	0.126***	0.028**
	(0.017)	(0.010)
Fourth SES Quintile Female, Grade 8	0.083***	0.024*
	(0.017)	(0.011)
Highest SES Quintile Female, Grade 8	-0.002	0.006
	(0.013)	(0.009)
Low SES Quintile Male, Grade 8	0.210***	0.042**
	(0.021)	(0.013)
Second SES Quintile Male, Grade 8	0.216***	0.061***
	(0.020)	(0.012)
Third SES Quintile Male, Grade 8	0.175***	0.050***
	(0.018)	(0.012)
Fourth SES Quintile Male, Grade 8	0.110***	0.044***
	(0.018)	(0.011)
Hispanic, Grade 8	-0.018	0.010
	(0.017)	(0.011)
Black, Grade 8	-0.025	0.026
	(0.019)	(0.013)
Other, Grade 8	-0.019	-0.003
	(0.020)	(0.012)
One Sibling, Grade 8	0.010	0.008
	(0.017)	(0.012)
Two Siblings, Grade 8	0.010	0.002
	(0.018)	(0.011)
Three of More Siblings, Grade 8	0.031	0.007
	(0.018)	(0.012)
Living with 2 Parents, Grade 8	-0.010	0.012
	(0.009)	(0.006)
Academic GPA, Grade 8 (0-4 scale)	-0.112***	-0.019***
	(0.007)	(0.005)
Low Quartile Combined Math and Reading Test Score, Grade 8	0.143***	0.026*
	(0.016)	(0.010)
Second Quartile Combined Math and Reading Test Score, Grade 8	0.146***	0.040***
	(0.013)	(0.008)
Third Quartile Combined Math and Reading Test Score, Grade 8	0.064***	0.030***
	(0.011)	(0.007)
LEP Status, Grade 8	0.003	-0.011
	(0.034)	(0.023)
Locus of Control, Grade 8 (standardized)	-0.033***	-0.006
	(0.008)	(0.006)
Self-Concept, Grade 8 (standardized)	-0.027**	-0.005
	(0.008)	(0.005)
Hours of TV Watched During the Week, Grade 8	-0.001	-0.001
	(0.003)	(0.002)
Hours of Homework per Week, Grade 8	-0.003**	-0.001
	(0.001)	(0.001)
N	18096	18096
R^2	0.215	0.073
F-Statistic for FE	1.129	0.975
DF_a for FE	1015	1015
DF_r for FE	17048	17048
Probability for F-Statistic of Joint Significance	0.003	0.705
Mean of Dependent Variable	0.391	0.097

Notes:
* p< .05, ** p< .01, *** p<.001
Models include school fixed effects.
Standard errors clustered at the school level.
Data are weighted to be nationally representative.
Data are from the National Education Longitudinal Study.

Table 7.A7. Changing Expectations by Eighth Grade Subgroups, NELS 1988-2000 Panel

	Male	Female	White/Asian Pacific Islander	Minority	Low SES Quintile	Second SES Quintile	Third SES Quintile	Fourth SES Quintile	Highest SES Quintile	Low Quartile Combined Math and Reading Test Score	Second Quartile Combined Math and Reading Test Score	Third Quartile Combined Math and Reading Test Score	High Quartile Combined Math and Reading Test Score
						Linear Expectations as Dependent Variable							
Standardized Academic GPA	0.074*	0.056***	0.046*	0.120***	0.017	0.017	0.069***	0.093***	0.096**	0.088***	0.073***	0.023	0.080***
	(0.032)	(0.013)	(0.023)	(0.029)	(0.061)	(0.061)	(0.020)	(0.020)	(0.034)	(0.021)	(0.019)	(0.064)	(0.020)
Standardized Combined Test Score	0.015	0.016	0.027	-0.021	0.004	0.004	0.022	0.013	0.011	-0.039	0.094*	0.048	0.008
	(0.023)	(0.017)	(0.015)	(0.033)	(0.036)	(0.036)	(0.021)	(0.023)	(0.018)	(0.042)	(0.037)	(0.062)	(0.021)
Standardized SES	0.001	0.019	0.018	-0.020	0.100	0.100	-0.004	-0.055	0.049	0.020	0.022	0.001	0.021
	(0.020)	(0.013)	(0.012)	(0.037)	(0.080)	(0.080)	(0.112)	(0.095)	(0.051)	(0.021)	(0.022)	(0.025)	(0.012)
Have Children	-0.146*	-0.162***	-0.119**	-0.223***	-0.114	-0.114	-0.183**	-0.146	-0.039	-0.183***	-0.262***	0.067	-0.292*
	(0.070)	(0.035)	(0.046)	(0.050)	(0.080)	(0.080)	(0.065)	(0.091)	(0.115)	(0.052)	(0.068)	(0.088)	(0.121)
1990	-0.090	-0.289**	-0.207*	-0.096	-0.346	-0.346	-0.287	0.071	-0.054	-0.147	-0.245	-0.091	-0.245
	(0.116)	(0.100)	(0.087)	(0.141)	(0.225)	(0.225)	(0.156)	(0.135)	(0.070)	(0.189)	(0.132)	(0.084)	(0.198)
1992	0.013	-0.176	-0.126	0.101	-0.192	-0.192	-0.187	0.151	0.005	0.096	-0.131	-0.040	-0.208
	(0.103)	(0.103)	(0.087)	(0.123)	(0.197)	(0.197)	(0.158)	(0.135)	(0.077)	(0.165)	(0.135)	(0.085)	(0.197)
1994	0.000	-0.080	0.000	0.000	-0.190	-0.190	-0.028	0.224	0.147	0.170	0.000	0.000	0.000
	(0.000)	(0.126)	(0.000)	(0.000)	(0.180)	(0.180)	(0.189)	(0.151)	(0.188)	(0.172)	(0.000)	(0.000)	(0.000)
N	19011	21718	31739	11870	8102	8102	8507	8227	7641	8194	10089	10667	10443
R^2	0.653	0.669	0.674	0.629	0.602	0.602	0.600	0.580	0.628	0.609	0.606	0.609	0.539
Mean of Dependent Variable	2.560	2.605	2.608	2.571	2.191	2.191	2.610	2.773	2.935	2.155	2.485	2.713	2.907

See notes at end of table.

Table 7.A7 Cont'd. Changing Expectations by Eighth Grade Subgroups, NELS 1988-2000 Panel

	Expect 4 Year College as Dependent Variable												
	Male	Female	White/Asian Pacific Islander	Minority	Low SES Quintile	Second SES Quintile	Third SES Quintile	Fourth SES Quintile	Highest SES Quintile	Low Quartile Combined Math and Reading Test Score	Second Quartile Combined Math and Reading Test Score	Third Quartile Combined Math and Reading Test Score	High Quartile Combined Math and Reading Test Score
Standardized Academic GPA	0.037**	0.030**	0.030**	0.048***	0.001	0.001	0.045***	0.061***	0.034**	0.042***	0.035*	0.028	0.040***
	(0.014)	(0.009)	(0.011)	(0.014)	(0.031)	(0.031)	(0.013)	(0.014)	(0.012)	(0.012)	(0.015)	(0.030)	(0.011)
Standardized Combined Test Score	0.029*	0.015	0.025*	0.006	0.009	0.009	0.024	0.017	0.022	-0.024	0.070**	0.032	0.031
	(0.014)	(0.012)	(0.011)	(0.018)	(0.033)	(0.033)	(0.015)	(0.021)	(0.015)	(0.033)	(0.026)	(0.030)	(0.019)
Standardized SES	-0.012	0.004	-0.005	-0.009	-0.003	-0.003	0.008	-0.088	0.021	-0.007	0.001	-0.022	0.011
	(0.013)	(0.010)	(0.009)	(0.016)	(0.050)	(0.050)	(0.086)	(0.083)	(0.021)	(0.018)	(0.019)	(0.020)	(0.013)
Have Children	-0.119**	-0.109***	-0.098***	-0.147***	-0.088	-0.088	-0.133***	-0.121	0.012	-0.119***	-0.146**	-0.054	-0.200*
	(0.037)	(0.028)	(0.027)	(0.033)	(0.046)	(0.046)	(0.040)	(0.064)	(0.105)	(0.032)	(0.048)	(0.057)	(0.092)
1990	-0.043	-0.205**	-0.141	-0.048	-0.181	-0.181	-0.244	0.080	-0.079	-0.012	-0.182	-0.065	-0.220
	(0.102)	(0.063)	(0.073)	(0.116)	(0.098)	(0.098)	(0.145)	(0.138)	(0.068)	(0.127)	(0.099)	(0.069)	(0.180)
1992	0.012	-0.150*	-0.099	0.052	-0.136	-0.136	-0.195	0.145	-0.037	0.095	-0.132	-0.021	-0.189
	(0.100)	(0.063)	(0.073)	(0.117)	(0.103)	(0.103)	(0.142)	(0.139)	(0.068)	(0.128)	(0.098)	(0.068)	(0.178)
1994	0.000	-0.105	0.000	0.000	0.000	0.000	-0.090	0.190	0.011	0.000	-0.058	0.060	-0.145
	(0.000)	(0.068)	(0.000)	(0.000)	(0.000)	(0.000)	(0.140)	(0.153)	(0.078)	(0.000)	(0.107)	(0.074)	(0.168)
N	19011	21718	31739	11870	8102	8102	8507	8227	7641	8194	10089	10667	10443
R^2	0.638	0.629	0.652	0.583	0.567	0.567	0.587	0.563	0.556	0.559	0.560	0.597	0.541
Mean of Dependent Variable	0.664	0.694	0.697	0.672	0.429	0.429	0.676	0.807	0.944	0.399	0.590	0.758	0.919

Notes:

* p< .05, ** p< .01, *** p<.001

Models include student fixed effects.

Standard errors clustered at the school level.

Data are weighted to be nationally representative.

Data are from the National Education Longitudinal Study.

Table 7.A8 - State Policy Effects on 10th Grade Educational Expectations, NELS and ELS Sophomore Cohorts

	Expect At Least Some College				Expect 4 Year College			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Merit Scholarships Available	0.002	0.001			0.003	-0.000		
	(0.001)	(0.002)			(0.002)	(0.002)		
Years Merit Scholarship Available			0.022	0.014			0.021	0.002
			(0.012)	(0.016)			(0.019)	(0.018)
1990	-0.000	0.017	0.001	0.020	-0.171***	-0.195***	-0.171***	-0.194***
	(0.005)	(0.020)	(0.005)	(0.019)	(0.010)	(0.025)	(0.011)	(0.024)
Low SES Quintile Female		-0.061***		-0.061***		-0.154***		-0.154***
		(0.009)		(0.009)		(0.012)		(0.012)
Second SES Quintile Female		-0.010		-0.010		-0.096***		-0.096***
		(0.007)		(0.007)		(0.012)		(0.012)
Third SES Quintile Female		-0.004		-0.004		-0.052***		-0.052***
		(0.008)		(0.008)		(0.014)		(0.014)
Fourth SES Quintile Female		0.005		0.005		-0.020		-0.020
		(0.007)		(0.007)		(0.011)		(0.011)
Highest SES Quintile Female		-0.004		-0.004		-0.011		-0.011
		(0.005)		(0.005)		(0.014)		(0.014)
Low SES Quintile Male		-0.105***		-0.105***		-0.204***		-0.204***
		(0.013)		(0.013)		(0.017)		(0.017)
Second SES Quintile Male		-0.058***		-0.058***		-0.160***		-0.160***
		(0.011)		(0.011)		(0.011)		(0.011)
Third SES Quintile Male		-0.022*		-0.022*		-0.100***		-0.100***
		(0.009)		(0.009)		(0.013)		(0.013)
Fourth SES Quintile Male		0.008		0.008		-0.035**		-0.035**
		(0.006)		(0.006)		(0.011)		(0.011)
Hispanic		0.033***		0.033***		0.076***		0.076***
		(0.009)		(0.009)		(0.013)		(0.013)
Black		0.061***		0.061***		0.130***		0.130***
		(0.008)		(0.008)		(0.011)		(0.011)
White		0.020**		0.020**		0.060***		0.060***
		(0.007)		(0.007)		(0.012)		(0.012)
One Sibling		-0.018		-0.018		-0.035*		-0.035*
		(0.010)		(0.010)		(0.014)		(0.014)
Two Siblings		-0.017		-0.017		-0.037**		-0.037**
		(0.011)		(0.011)		(0.013)		(0.013)
Three of More Siblings		-0.021		-0.021		-0.042**		-0.042**
		(0.011)		(0.011)		(0.013)		(0.013)
Low Quartile Combined Math and Reading Test Score, Grade 10		-0.082***		-0.082***		-0.189***		-0.189***
		(0.009)		(0.009)		(0.011)		(0.011)
Second Quartile Combined Math and Reading Test Score, Grade 10		0.007		0.007		-0.069***		-0.069***
		(0.006)		(0.006)		(0.007)		(0.007)
Third Quartile Combined Math and Reading Test Score, Grade 10		0.020***		0.020***		-0.007		-0.007
		(0.004)		(0.004)		(0.007)		(0.007)
Academic GPA, Grade 10 (0-4 scale)		0.050***		0.050***		0.112***		0.112***
		(0.004)		(0.004)		(0.005)		(0.005)
Living with 2 Parents, Grade 10		-0.005		-0.005		-0.020**		-0.020**
		(0.009)		(0.009)		(0.007)		(0.007)
Sibling Dropout, Grade 10		-0.030***		-0.030***		-0.051***		-0.051***
		(0.008)		(0.008)		(0.010)		(0.010)

See notes at end of table.

Table 7.A8 Cont'd. - State Policy Effects on 10th Grade Educational Expectations, NELS and ELS Sophomore Cohorts

	Expect At Least Some College				Expect 4 Year College			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
HS Academic Program		0.047***		0.047***		0.086***		0.086***
		(0.008)		(0.008)		(0.014)		(0.014)
HS Vocational Program		0.032*		0.032*		-0.049*		-0.049*
		(0.013)		(0.013)		(0.023)		(0.023)
Private School, Grade 10		0.011		0.011		0.061***		0.061***
		(0.008)		(0.008)		(0.017)		(0.017)
Parent Notified of Behavior Problem(s) at School, Grade 10		-0.039***		-0.039***		-0.050***		-0.050***
		(0.007)		(0.007)		(0.012)		(0.012)
Hours of TV per Week, Grade 10		-0.001		-0.001		0.001		0.001
		(0.001)		(0.001)		(0.002)		(0.002)
Hours of Homework per Week, Grade 10		0.002***		0.002***		0.004***		0.004***
		(0.000)		(0.000)		(0.000)		(0.000)
Percent of Previous Year's Graduates in 4-Yr College, Grade 10		0.019		0.020		0.046**		0.046**
		(0.011)		(0.011)		(0.013)		(0.013)
School Size, Grade 10		0.000		0.000		0.002*		0.002*
		(0.001)		(0.001)		(0.001)		(0.001)
Percent of Free- and Reduced- Price Lunch Eligible Students, Grade 10		-0.000		-0.000		-0.005		-0.005
		(0.016)		(0.016)		(0.020)		(0.020)
Students per Guidance Counselor, Grade 10, in Hundreds		-0.001		-0.001		-0.012***		-0.012***
		(0.002)		(0.002)		(0.003)		(0.003)
Students per Guidance Counselor*HS Academic Program		0.003		0.003		0.012***		0.012***
		(0.002)		(0.002)		(0.003)		(0.003)
Students per Guidance Counselor*HS Vocational Program		-0.001		-0.001		-0.002		-0.002
		(0.004)		(0.004)		(0.004)		(0.004)
County Minimum PSE Room and Board Costs, in thousands, Grade 12		-0.001*		-0.001*		-0.000		-0.000
		(0.001)		(0.001)		(0.001)		(0.001)
County Minimum PSE Tuition, In-State, Grade 12 (in thousands, 2007 $)		0.000		0.000		0.002		0.002
		(0.002)		(0.002)		(0.002)		(0.002)
Percent of State Adults with BA or Higher, Grade 10		0.705		0.752		-0.242		-0.225
		(0.468)		(0.453)		(0.614)		(0.611)
State Unemployment Rate, Grade 10		-1.300		-1.152		-0.092		-0.064
		(0.795)		(0.798)		(1.213)		(1.260)
State Median Household Income, Grade 10 (2007 Dollars)		-0.000		-0.000		-0.000		-0.000
		(0.000)		(0.000)		(0.000)		(0.000)
N	29057				29057			
R^2	0.006	0.151	0.006	0.152	0.047	0.309	0.047	0.309
F-Statistic for FE	3.54	2.80	3.57	2.79	5.25	3.34	5.34	3.34
DF_a for FE	50	50	50	50	50	50	50	50
DF_r for FE	29004	28950	29004	28952	29004	28950	29004	28952
Probability for F-Statistic of Joint Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mean of Dependent Variable	0.916				0.725			

Notes:
* p< .05, ** p< .01, *** p<.001
Models include state fixed effects.
Data are weighted to be nationally representative.
All covariates are measures in 10th grade.

Online Appendix

Chapter 8

Educational Mobility in the United States Since the 1930s

Michael Hout

Alexander Janus

Appendix Table 8.A1. Descriptive Statistics for the NCES Cohort Panel Data Sets

	NLS-72		HS&B		NELS:88	
	Mean/Prop.	Std. Dev.	Mean/Prop.	Std. Dev.	Mean/Prop.	Std. Dev.
Individual-Level Characteristics						
Father's Education	12.7	0.02	13.1	0.04	13.5	0.04
Mother's Education	12.4	0.02	12.8	0.03	13.3	0.03
Gender						
Male	0.50	0.005	0.49	0.007	0.50	0.008
Female	0.50	0.005	0.51	0.007	0.50	0.008
Racial Ancestry						
White	0.83	0.004	0.78	0.005	0.70	0.008
Black	0.09	0.003	0.11	0.003	0.12	0.007
Hispanic	0.03	0.002	0.09	0.003	0.11	0.004
Other	0.05	0.002	0.02	0.001	0.07	0.003
Intact Family	0.81	0.005	0.76	0.006	0.62	0.008
Father's Occupational Status	21.0	0.23	21.9	0.34	19.5	0.34
Mother's Occupational Status	15.6	0.18	21.4	0.34	18.4	0.33
Family Income	$59,747	$277	$65,635	$504	$77,608	$916
HS Track						
General	0.34	0.005	0.36	0.007	0.39	0.008
Academic	0.43	0.005	0.39	0.007	0.46	0.008
Vocational	0.23	0.004	0.24	0.006	0.15	0.006
Educational Plans	14.8	0.02	15.0	0.03	15.9	0.04
School-Level Characteristics						
Average Family Income	$56,591	$493	$61,240	$548	$85,692	$1,705
Prop. Fathers w/ College Deg.	0.18	0.006	0.21	0.006	0.33	0.009
Prop. Mothers w/ College Deg.	0.11	0.004	0.13	0.004	0.27	0.008
Urbanicity						
Urban	0.31	0.015	0.25	0.014	0.38	0.013

Suburban	0.50	0.016	0.48	0.016	0.37	0.013
Rural	0.19	0.013	0.27	0.014	0.25	0.012
Prop. Minority	0.22	0.008	0.13	0.005	0.68	0.008

Sources: National Longitudinal Study of the HS Class of 1972, High School and Beyond senior cohort, and National Education Longitudinal Study of 1988.

Appendix Table 8.A2. Logistic Regression Coefficients for All Variables in Various Models of High School Graduation by Model

	High School Class of 1980						High School Class of 1992					
	Model 0		Model 1		Model 2		Model 0		Model 1		Model 2	
Individual-Level Characteristics												
Intercept	4.966**	(.177)	3.985**	(.427)	4.024**	(.442)	2.683**	(.092)	2.643**	(.562)	4.731**	(.829)
Father's Education[1]	.047	(.084)	-.119	(.111)	-.038	(.069)	.465**	(.071)	.265	(.152)	.034	(.114)
Mother's Education[1]	.324*	(.139)	.237	(.142)	.035	(.078)	.174**	(.064)	-.120	(.165)	.091	(.118)
Gender (Omitted: Female)[2]			-.335	(.346)	-.398	(.232)			-.488	(.410)	-.816*	(.356)
Racial Ancestry (Omitted: White)												
Black			-.455	(.438)	-.802*	(.399)			-.828	(.530)	-.048	(.547)
Hispanic			-.136	(.412)	-.833*	(.361)			-.419	(.642)	.500	(.558)
Other			-.967	(.634)	-1.224*	(.513)			.393	(.798)	.359	(.720)
Intact Family			.705	(.415)	.722**	(.244)			1.905**	(.435)	.840*	(.363)
Father's Occupational Status[2]			.008	(.012)	-.001	(.007)			.013	(.021)	.001	(.012)
Mother's Occupational Status[2]			-.005	(.011)	.000	(.006)			.043	(.029)	.012	(.014)
Family Income[2,3]			-.006	(.006)	-.004	(.004)			-.008**	(.003)	-.002	(.005)
Math Test Score[2,4]			.665**	(.234)	.577**	(.171)			.433	(.326)	.351	(.257)
HS Track (Omitted: General)												
Academic			.848	(.542)	.710	(.412)			.135	(.803)	1.191*	(.595)
Vocational			.118	(.380)	.192	(.243)			.306	(.487)	-.170	(.388)
Educational Plans[1]			.406*	(.190)	.412**	(.076)			.605**	(.169)	.318**	(.106)
School-Level Characteristics												
Average Family Income[2,3]					-.017	(.014)					.024*	(.012)
Prop. Fathers w/ College Deg.[2]					1.714	(1.490)					-.412	(1.250)
Prop. Mothers w/ College Deg.[2]					1.450	(1.953)					.083	(1.375)
Average Math Test Score[2,4]					-.185	(.419)					.346	(.458)
Urbanicity (Omitted: Urban)												
Suburban					.205	(.301)					-.445	(.446)
Rural					.478	(.345)					1.751**	(.640)

Prop. Minority[2]	-.006	(.010)		.008	(.008)
Random Effect for Intercept	.596	(.360)		1.363**	(.480)

Sources: National Longitudinal Study of the HS Class of 1972, High School and Beyond senior cohort, and National Education Longitudinal Study of 1988.

*p < .05 **p < .01

[1] Centered: high school graduate.

[2] Centered: grand mean.

[3] In 10,000's.

[4] Standard deviation units.

Appendix Table 8.A3. Loogistic Regression Coefficients for All Variables in Various Models of College Graduation by Model

	High School Class of 1972						High School Class of 1992					
	Model 0		Model 1		Model 2		Model 0		Model 1		Model 2	
Individual-Level Characteristics												
Intercept	-1.211**	(.027)	-3.473**	(.143)	-3.249**	(.138)	-1.455**	(.043)	-3.406**	(.147)	-3.140**	(.141)
Father's Education[1]	.209**	(.012)	.067**	(.021)	.060**	(.019)	.265**	(.018)	.101**	(.024)	.080**	(.018)
Mother's Education[1]	.186**	(.014)	.085**	(.023)	.072**	(.021)	.173**	(.019)	.047	(.026)	.052**	(.019)
Gender (Omitted: Female)[2]			-.174*	(.069)	-.207**	(.063)			-.457**	(.083)	-.449**	(.062)
Racial Ancestry (Omitted: White)												
Black			.744**	(.164)	.323*	(.141)			-.120	(.191)	.031	(.127)
Hispanic			-.259	(.219)	-.734**	(.205)			-.472**	(.149)	-.564**	(.122)
Other			-.098	(.176)	-.065	(.169)			-.261	(.144)	-.070	(.104)
Intact Family			.267**	(.097)	.276**	(.086)			.584**	(.094)	.537**	(.069)
Father's Occupational Status[2]			.001	(.002)	.001	(.002)			.005*	(.002)	.003	(.002)
Mother's Occupational Status[2]			.000	(.002)	.000	(.002)			.003	(.002)	-.001	(.002)
Family Income[2,3]			.002	(.002)	.003	(.002)			.003**	(.001)	.002**	(.001)
Math Test Score[2,4]			.603**	(.047)	.577**	(.045)			.650**	(.061)	.716**	(.046)
HS Track (Omitted: General)												
Academic			.612**	(.082)	.627**	(.076)			.663**	(.092)	.694**	(.069)
Vocational			-.870**	(.142)	-.943**	(.132)			-.451**	(.162)	-.447**	(.125)
Educational Plans[1]			.593**	(.032)	.590**	(.026)			.423**	(.029)	.396**	(.023)
School-Level Characteristics												
Average Family Income[2,3]					-.017**	(.004)					.003**	(.001)
Prop. Fathers w/ College Deg.[2]					1.056**	(.305)					.428	(.221)
Prop. Mothers w/ College Deg.[2]					.528	(.394)					.168	(.233)
Average Math Test Score[2,4]					.162	(.110)					.032	(.085)
Urbanicity (Omitted: Urban)												
Suburban					-.046	(.078)					-.133	(.084)

Rural	.014	(.110)	-.050	(.095)
Prop. Minority[2]	.005**	(.002)	.000	(.002)
Random Effect for Intercept	.316**	(.077)	.344**	(.068)

Sources: National Longitudinal Study of the HS Class of 1972, High School and Beyond senior cohort, and
National Education Longitudinal Study of 1988.

*p < .05 **p < .01

[1] Centered: high school graduate.

[2] Centered: grand mean.

[3] In 10,000's.

[4] Standard deviation units.

Online Appendix

Chapter 9

How Is Family Income Related to Investments in Children's Learning?

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Consumer Expenditure Survey: Data Description

The Consumer Expenditure Survey (CEX) has two components: the Diary Survey and the Interview Survey (IS). We use the IS, which is a rotated panel in which approximately 7,500 units are interviewed every three months for five consecutive quarters, after which these households are replaced by new units.[1] The first quarter is a contact interview, while in the second to fifth quarters households are asked about their expenditures over the previous three months.

Appendix Table 9.A1 provides a detailed description of the enrichment expenditure items studied in this chapter. The CEX provides expenditure incurred in the previous three months, we annualize expenditures by multiplying each quarterly value by 4. To take account of differences in family size and composition, we adjust expenditures in the ten major categories for each family using an equivalence scale, which assigns a weight of 0.67 to the first adult, 0.33 to all other persons in the household over 17, and 0.2 to children 17 or under. (See http://www.oecd.org/dataoecd/61/52/35411111.pdf - Retrieved on February 23, 2010). This equivalence is similar to that being used by the OECD (Organization for Economic Cooperation and Development). The OECD scale assigns 0.33 to all other persons in the household 14 or over; and 0.2 to children under 14. Since all persons under age 18 are considered children in the United States, the OCED scale is modified to meet U.S. norms. The same equivalence scale is used to adjust expenditures on books and magazines, computer, sports, trips, and electronics. Other items that would be used only by adults or children are divided by the number of adults or children in the family who are likely to use these goods and services. Expenditures are expressed in 2003 dollars using the Personal Consumption Expenditure deflator of the Bureau of Economic Analysis. Since the expenditure is per quarter, we use a 3-month moving average of the personal consumer expenditure deflator.

Income data in the CEX are collected in the second and fifth interviews of a consumer unit, and cover the 12 months prior to the date of interview. Incomes in the third and fourth interviews are repeated from those reported in the second interview unless a consumer unit member over the age of 13 is new to the consumer unit or has not worked in previous interviews and has now started working. In these cases, incomes in the third and fourth quarters are revised to include the incomes of the new earners. In 2004, CEX started imputing missing income data. However, there is no imputation of missing income for the years prior to 2004. Therefore, in the empirical analysis that uses family income data (presented in the Appendix Tables 9.A4-9.A5) we exclude observations with imputed incomes. To reduce the likelihood of temporary fluctuations in income unduly influencing the analysis, we restrict the samples to families with non-negative incomes in the analyses reported in Appendix Tables 9.A4-9.A5. (One percent of the observations in our CEX sample have negative incomes.) Income data are expressed in 2003 dollars using the 12 month moving average of the Personal Consumption Expenditure deflator.

Appendix Table 9.A1: Measures of Family Investments in Children, Consumer Expenditure Survey

Item	Description
Recreational lessons and other instruction	Fee for recreational lessons and other instruction, including tutoring, membership fees for country clubs, health clubs, and other recreational organizations, civic, service, or fraternal organizations; fees for participant sports; management fees for recreational facilities.
Babysitting, nursery school and day care centers	Babysitting or other child care in your own home; babysitting or other child care in someone else's home; and other expenses for day care centers and nursery schools, including tuition; and school books, supplies, and equipment for day care centers and nursery schools.
College tuition & books	Tuition for college; schoolbooks, supplies, and equipment for college.
School books, supplies and equipment	School books, supplies, and equipment for elementary and high school; school books, supplies, and equipment for college; school books, supplies, and equipment for other schools; rentals of books and equipment, and other school-related expenses
Books and magazines (not related to school)	Books through book clubs, books not through book clubs, magazine or newspaper subscription, encyclopedia and other sets of reference books magazine or newspaper, single copy
Non-college tuition & school transportation	Tuition for elementary and high school, and private school bus
Computers	Computers, computer systems, and related hardware for non-business use; computer software and accessories for non-business use; repair of computers, computer systems, and related equipment for non-business use; and computer information services.

Items of enrichment: sports and other	Ping-Pong, pool tables, other similar recreation room items, general sports equipment, and health and exercise equipment; bicycles; camping equipment; hunting and fishing equipment; winter sports equipment; water sports equipment; other sports equipment; toys, games, hobbies, tricycles, and battery powered riders; playground equipment; rental and repair of sports, recreation, and exercise equipment; musical instruments, supplies, and accessories; and rental and repair of musical instruments, supplies and accessories.
Items of enrichment: electronics	Televisions; VCR, video disc player, video camera, and camcorder; Video cassettes, tapes, and discs; TV computers games and computer game software; streaming or downloaded video files; radio; tape recorder and player; sound components, component systems, and compact disc sound systems; accessories and other sound equipment including phonographs; satellite dishes; records, CDs, audio tapes; streaming or downloaded audio files; rental of televisions; rental of VCR, radio, and sound equipment; photographic film; film processing; rental and repair of photographic equipment; photographic equipment; rental of video cassettes, tapes, and discs; and online entertainment and games.
Out of town trips	Travel costs for out of town trips; lodging away from home on trips; entertainment expenses on out-of-town trips, including admissions to events, museums and tours; rental of all campers on out-of-town trips; rental of other vehicles on out-of-town trips; rental of motorized camper; rental of other RV's; fees for participant sports on out-of-town trips; admission fees to sporting events on out-of-town trips; miscellaneous recreational expenses and services on out-of-town trips.
Entertainment	Admission fees for entertainment activities, including movie, theater, concert, opera or other musical series (single admissions and season tickets); and admission fees to sporting events (single admissions and season tickets)

Appendix Table 9.A2: Measures of Family Income and Investments in Children, ECLS-K

	Kindergarten Fall	Kindergarten Spring	First Grade Spring	Third Grade Spring	Fifth Grade Spring
Total Family Income*		X	X	X	X
Early Education (including Head Start): (yes/no)	X				
Private School attendence (yes/no)	X	X	X	X	X
Extra-curricular activities**:					
music lessons		X	X	X	X
art classes or lessons		X	X	X	X
non-English language classes		X	X	X	X
dance lessons		X	X	X	X
drama lessons		X	X	X	X
organized performing arts programs		X	X	X	X
organized athletic activities		X	X	X	X
organized clubs		X	X	X	X
Number of children's books in home (0-200)	X		X	X	X
Number of children's audio tapes, CDs, records (0-100)	X		X	X	X
Home computer for child's use (yes/no)		X	X	X	X
Family receive newspapers or magazines (yes/no)				X	
Regular tutoring (yes/no)			X	X	X

*Family income is measured with a continous variable in kindergarten, and with categorical variable in first, third, and fifth grades.
** In kindergarten and first grade parents are asked if their children have ever participated in these activities; in third and fifth grade parents are asked if their children have participated in the past year

Appendix Table 9.A3: Mean Annualized Enrichment Expenditures, Families with Children, Consumer Expenditure Survey 1997-2006

	N	Total enrichment expenditure (% of total expenditure)	Books & magazines	Computer	Sport	Trips	Electronics	Recreation & activities	Entertainment	Non-college tuition & private bus	Child care	School supplies & books
					Equivalized					Per child		
Full sample	83094	2871 (8)	59	271	330	713	277	114	47	254	539	66
Quintile 1	16616	430 (3)	9	55	85	70	78	9	9	19	64	16
Quintile 2	16622	1134 (5)	26	139	179	214	163	35	21	68	201	32
Quintile 3	16618	2055 (7)	44	226	281	440	249	75	37	131	410	51
Quintile 4	16622	3527 (9)	78	361	407	845	348	148	60	246	753	78
Quintile 5	16616	7207 (9)	138	572	700	1998	546	303	110	806	1266	154
Mother's race/ethnicity:												
Whites	55378	3423 (8)	74	319	409	876	319	148	58	295	615	78
Black	9850	1525 (6)	25	146	157	253	162	32	24	137	401	40
Hispanic	12697	1460 (6)	21	144	150	338	185	37	26	143	304	35
Other	5169	2985 (8)	54	299	252	769	272	102	33	303	557	68
Mother's education:												
< HS	10772	856 (4)	12	94	128	205	144	15	15	40	149	23
HS	22880	1747 (6)	30	195	244	402	218	53	31	133	306	43
Some college	26388	2773 (8)	54	286	338	660	291	101	47	215	496	67
BA plus	23054	5039 (10)	116	410	501	1321	381	236	79	518	1001	108
Family type:												
Single-mother	15084	1805 (7)	40	173	197	350	201	65	34	134	406	54
Two-parent	68010	3107 (8)	63	292	360	794	294	125	50	280	568	69
Child's age:												
Preschool only	18035	3231 (9)	55	235	346	576	280	69	34	48	1438	25
School-age only	26061	3135 (8)	72	334	333	897	303	148	63	375	240	99
Preschool & school-age	38998	2528 (8)	52	245	321	655	258	112	43	268	323	63

Notes: The samples are restricted to families with children under 18 and respondents aged 18-54. Quintiles are based on an expenditure-to-needs ratio using total expenditure and poverty thresholds. Poverty thresholds are based on U.S. Census data. All expenditures are in 2003 dollars using the Personal Consumption Expenditures: Chain-Type Price Index, produced by the Bureau of Economic Analysis and hosted by the St. Louis Federal Reserve Bank (www.stlouisfed.org). Expenditures on books and magazines, computers, sport, out of town trips were equivalized as described in the text, and all other items are per child. In addition to the expenditures listed as column headings, total expenditure on enrichment also includes family expenditure on college tuition and books.

Appendix Table 9.A4: Mean Equivalized (Annualized) Total Expenditures and Expenditures on Major Categories, Families with Children, Consumer Expenditure Survey, 1997–2006

	N	Total expenditure	Housing	Food	Healthcare	Transportation	Education/reading	Apparel	Entertainment	Personal care	Cash contributions	Insurance & retirement	Misc.	Alcohol/Tobacco
Full sample	83094	36065	12242	5108	1523	7179	822	1370	1963	248	669	4120	394	436
			(34)	(14)	(4)	(20)	(2)	(4)	(5)	(0.69)	(2)	(11)	(1)	(1)
Quintile 1	16616	13118	4989	3258	434	1634	97	552	474	100	134	1151	78	225
			(38)	(25)	(3)	(12)	(0.74)	(4)	(4)	(0.76)	(1)	(9)	(0.59)	(2)
Quintile 2	16622	21507	7959	4220	1002	2938	278	876	974	167	304	2281	182	337
			(37)	(20)	(5)	(14)	(1)	(4)	(5)	(0.78)	(1)	(11)	(0.85)	(2)
Quintile 3	16618	29372	10723	4896	1507	4134	507	1159	1534	224	500	3500	277	421
			(37)	(17)	(5)	(14)	(2)	(4)	(5)	(0.76)	(2)	(12)	(0.94)	(1)
Quintile 4	16622	40337	14564	5550	1947	6099	879	1601	2317	304	768	5167	437	509
			(36)	(14)	(5)	(15)	(2)	(4)	(6)	(0.75)	(2)	(13)	(1)	(1)
Quintile 5	16616	75994	22978	7421	2727	21089	2347	2376	4518	445	1640	8484	995	685
			(30)	(10)	(4)	(28)	(3)	(3)	(6)	(0.59)	(2)	(11)	(1)	(0.90)
Mother's race/ethnicity														
Whites	55378	40458	13363	5508	1825	8035	975	1477	2406	260	796	4824	465	539
			(33)	(14)	(5)	(20)	(2)	(4)	(6)	(0.64)	(2)	(12)	(1)	(1)
Black	9850	25623	9857	4089	843	4749	471	1282	976	323	455	2423	216	216
			(38)	(16)	(3)	(19)	(2)	(5)	(4)	(1)	(2)	(9)	(0.84)	(0.84)
Hispanic	12697	25296	9120	4238	817	5486	357	1060	970	162	321	2344	221	204
			(36)	(17)	(3)	(22)	(1)	(4)	(4)	(0.64)	(1)	(9)	(0.87)	(0.81)
Other	5169	35342	12962	4917	1328	6790	991	1159	1546	190	573	4198	398	317
			(37)	(14)	(4)	(19)	(3)	(3)	(4)	(0.54)	(2)	(12)	(1)	(0.9)
Mother's education:														
< HS	10772	20315	7193	3967	647	4247	152	872	765	131	202	1592	191	362
			(35)	(20)	(3)	(21)	(0.75)	(4)	(4)	(0.65)	(0.99)	(8)	(0.94)	(2)
HS	22880	29078	9646	4631	1240	6546	430	1087	1431	196	406	2877	317	480
			(33)	(16)	(4)	(23)	(1)	(4)	(5)	(0.67)	(1)	(10)	(1)	(2)
Some college	26388	36323	12011	5092	1618	7674	784	1377	2076	25	624	3976	389	452
			(33)	(14)	(4)	(21)	(2)	(4)	(6)	(0.7)	(2)	(11)	(1)	(1)
BA plus	23054	50064	17443	6136	2107	8807	1566	1876	2923	347	1200	6689	571	407
			(35)	(12)	(4)	(18)	(3)	(4)	(6)	(0.69)	(2)	(13)	(1)	(0.81)
Family type:														
Single-mother	15084	26862	10558	4531	1026	4495	517	1243	1292	239	268	1935	414	348
			(39)	(17)	(4)	(17)	(2)	(5)	(5)	(0.89)	(1)	(7)	(2)	(1)
Two-parent	68010	38106	12616	5237	1634	7774	889	1398	2112	250	758	4604	390	455
			(33)	(14)	(4)	(20)	(2)	(4)	(6)	(0.66)	(2)	(12)	(1)	(1)
Child's age:														
Preschool only	18035	36201	13770	4625	1401	7254	373	1332	1676	227	544	4240	356	415
			(38)	(13)	(4)	(20)	(1)	(4)	(5)	(1)	(2)	(12)	(1)	(1)

School-age only	26061	40026	12976 (32)	5654 (14)	1811 (5)	7932 (20)	1074 (3)	1484 (4)	2320 (6)	293 (1)	795 (2)	4705 (12)	462 (1)	533 (1)
Preschool & school-age	38998	33355	11045 (33)	4968 (15)	1388 (4)	6640 (20)	860 (3)	1312 (4)	1858 (6)	227 (1)	643 (2)	3673 (11)	367 (1)	380 (1)

Notes. Quintiles are based on an expenditure-to-needs ratio using total expenditure and poverty thresholds. Poverty thresholds are based on U.S. Census data. All expenditures are in 2003 dollars using the Personal Consumption Expenditures: Chain-Type Price Index, produced by the Bureau of Economic Analysis and hosted by the St. Louis Federal Reserve Bank (www.stlouisfed.org). Expenditures are equivalized as described in the text.

Appendix Table 9.A5: Family Income and Total Expenditures, 1997–2006

	Number of observations	Annual family income	Quarterly total expenditure	Annualized total expenditure	Annualized expenditure as % of income
Full Sample	65445	60985	9216	36864	60
Quintile 1	13075	15277	4640	18559	121
Quintile 2	13095	33776	6421	25683	76
Quintile 3	13057	51567	8528	34111	66
Quintile 4	13097	72476	10754	43016	59
Quintile 5	13121	131589	15715	62861	48
Mother's race/ethnicity:					
NH Whites	43388	69567	10378	41510	60
NH Black	7515	38738	6621	26485	68
Hispanic	10512	40192	6363	25453	63
Other	4030	64306	8990	35959	56
Mother's Education:					
< HS	8713	31032	5138	20554	66
HS	17785	47006	7468	29872	64
Some college	21136	59085	9298	37191	63
BA+	17811	91850	12859	51436	56
Family Type:					
Single-mother headed household	12370	25898	6845	27379	106
Two-parent headed household	53075	69162	9769	39075	56
Age of Children:					
Preschool only	14540	56974	9229	36915	65
School-age only	20444	62427	10248	40990	66
Both preschool & school-age	30461	61931	8517	34070	55

Notes: Income and expenditures are in 2003 dollars. Quintiles are based on family income to needs ratio. Sample is restricted to families with children under 18, respondents aged 18-54 and families with non-missing data on family income

Appendix Table 9.A6: Association between Annualized Family Income and Expenditures on Enrichment Items: Cross-Sectional Analysis

	Total enrichment expenditure	Books & magazines	Computer	Sport	Trips	Electronics	Recreation & activities	Entertainment	Non-college tuition & private bus	Child care	School supplies & books
Full sample	32.716***	0.525***	1.87***	2.966***	9.833***	1.955***	1.885***	.506***	5.363***	5.801***	.412***
	(1.057)	(.034)	(.139)	(.278)	(.435)	(.223)	(.119)	(.036)	(.621)	(.386)	(.059)
	[0.7]	[0.52]	[0.41]	[0.53]	[0.84]	[0.41]	[0.99]	[0.65]	[1.37]	[0.63]	[0.38]
Quintile 1	3.762	-0.138	-0.837	1.82***	-2.644*	2.464***	-0.157	-0.043	-0.824	3.602***	-0.04
	(3.166)	(.14)	(.73)	(.686)	(1.416)	(.48)	(.253)	(.096)	(.945)	(.913)	(.18)
	[0.07]	[-0.11]	[-0.13]	[0.2]	[-0.23]	[0.27]	[-0.1]	[-0.04]	[-0.23]	[0.34]	[-0.02]
Quintile 2	27.824***	.281	3.695***	4.942***	2.522	4.676***	1.395***	0.612***	-1.223	9.302***	0.316
	(4.314)	(.210)	(.985)	(1.048)	(1.819)	(.817)	(.249)	(.111)	(1.902)	(1.666)	(0.281)
	[0.63]	[0.29]	[0.76]	[0.75]	[0.27]	[0.75]	[1.11]	[0.8]	[-0.53]	[1.11]	[0.29]
Quintile 3	33.685***	0.414**	2.185*	2.289*	9.932***	2.737***	1.92***	0.704***	1.864	9.339***	0.649*
	(4.877)	(0.198)	(1.201)	(1.3)	(2.373)	(.739)	(.326)	(.146)	(1.587)	(2.002)	(0.348)
	[0.74]	[0.41]	[0.43]	[0.36]	[0.93]	[0.52]	[1.19]	[0.91]	[0.71]	[1.09]	[0.57]
Quintile 4	32.015***	0.568***	2.899**	3.402***	9.308***	2.965***	1.626***	0.45***	-0.534	11.196***	0.662*
	(5.302)	(0.202)	(1.157)	(1.225)	(2.585)	(.85)	(.366)	(.152)	(2.21)	(2.14)	(.418)
	[0.67]	[0.58]	[0.6]	[0.6]	[0.82]	[0.61]	[0.89]	[0.57]	[-0.11]	[1.15]	[0.59]
Quintile 5	30.21***	0.41***	1.238***	2.739***	9.51***	1.281***	1.952***	0.426***	7.143***	3.896***	0.259**
	(2.009)	(.061)	(.262)	(.482)	(.821)	(.328)	(.235)	(.072)	(1.334)	(.726)	(.105)
	[0.64]	[0.41]	[0.32]	[0.6]	[0.75]	[0.35	[0.88]	[0.56]	[1.43]	[0.42]	[0.27]
Mother's Education											
< HS	23.173***	0.313***	2.758***	2.177***	7.694***	2.453***	0.723***	0.505***	1.38**	4.052***	0.254***
	(2.312)	(.056)	(.432)	(.465)	(1.157)	(.351)	(.166)	(.096)	(.594)	(.88)	(.097)
	[0.82]	[0.8]	[0.9]	[0.51]	[1.13]	[0.5]	[1.48]	[1.04]	[1.16]	[0.81]	[0.34]
HS	29.381***	0.519***	2.294***	3.231***	9.117***	2.175***	1.249***	0.525***	3.426***	4.879***	.454***
	(1.59)	(.055)	(.286)	(.377)	(.891)	(.202)	(.138)	(.047)	(.736)	(.56)	(.075)
	[0.77]	[0.77]	[0.53]	[0.59]	[1.06]	[0.44]	[1.06]	[0.8]	[1.23]	[0.71]	[0.47]
Some college	32.048***	0.526***	2.035***	3.333***	9.333***	2.677***	1.624***	0.503***	4.684***	4.948***	0.446***
	(2.072)	(.059)	(.236)	(.446)	(.825)	(.746)	(.135)	(.046)	(.834)	(.568)	(.117)
	[0.67]	[0.55]	[0.4]	[0.56]	[0.84]	[0.52]	[0.94]	[0.63]	[1.42]	[0.56]	[0.38]
BA plus	34.459***	0.529***	1.64***	2.781***	10.269***	1.506***	2.184***	0.497***	6.227***	7.082***	0.362***
	(1.559)	(.052)	(.211)	(.44)	(.637)	(.166)	(.202)	(.059)	(1.025)	(.618)	(.092)
	[0.62]	[0.4]	[0.36]	[0.50]	[0.72]	[0.35]	[0.83]	[0.58]	[1.15]	[0.62]	[0.31]
Child's age:											
Preschool only	35.788***	0.456***	1.85***	2.832	7.907***	2.301***	1.062***	0.337***	0.806***	18.026***	0.21*
	(1.762)	(.048)	(.316)	(.386)	(.664)	(.312)	(.108)	(.038)	(.308)	(1.251)	(.117)
	[0.62]	[0.45]	[0.44]	[0.46]	[0.79]	[0.44]	[0.87]	[0.58]	[0.97]	[0.71]	[0.49]

School-age only	42.334***	0.88***	2.858***	3.354***	13.717***	2.061***	2.623***	0.804***	8.499***	2.383***	0.948***
	(1.956)	(.075)	(.291)	(.322)	(.842)	(.185)	(.228)	(.087)	(1.437)	(.399)	(.14)
	[0.83]	[0.72]	[0.52]	[0.60]	[0.96]	[0.4]	[1.09]	[0.8]	[1.44]	[0.59]	[0.58]
Preschool & school-age	33.957***	0.639***	1.905***	3.393***	10.244***	2.111***	2.239***	0.515***	5.925***	4.851***	0.397***
	(1.393)	(.044)	(.15)	(.477)	(.579)	(.361)	(.165)	(.036)	(.62)	(.381)	(.059)
	[0.82]	[0.74]	[0.47]	[0.63]	[0.97]	[0.49]	[1.21]	[0.71]	[1.51]	[0.88]	[0.38]

Notes: Each coefficient represents a separate regression of an enrichment item on income, controlling for maternal age, education, and race, number of family members less than 18, number of other adults in the family and number of persons over 64, urbanicity, month effects, and year effects. Standard errors, clustered on consumer units, are in parentheses, and expenditure elasticities are in brackets. In addition to the expenditures listed as column headings, total expenditure on enrichment also includes family expenditure on college tuition and books.

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Appendix Table 9.A7: Association between Annualized Total Family Budget and Expenditures on Enrichment: Longitudinal Analysis

	Fixed Effects Model
Full sample	59.38***
	(0.83)
	[0.75]
Quintile 1	75.88***
	(2.68)
	[2.31]
Quintile 2	134.0***
	(5.60)
	[2.54]
Quintile 3	177.54***
	(7.17)
	[2.54]
Quintile 4	210.41***
	(6.91)
	[2.41]
Quintile 5	64.25***
	(2.60)
	[0.68]
Mother's Education	
< HS	25.64***
	(1.50)
	[0.61]
HS	31.38***
	(1.23)
	[0.52]
Some college	43.60***
	(1.33)
	[0.57]
BA plus	87.79***
	(1.82)
	[0.87]
Child's Age	
Preschool only	36.536***
	(1.546)
	[0.41]
School-age only	61.941***
	(1.579)
	[0.79]
Preschool & school-age	63.249***
	(1.238)
	[0.83]

Notes: Each coefficient represents a separate regression of expenditure on items of enrichment on total expenditure controlling for maternal age, education, and race, number of family members less than 18, number of other adults in the family and number of persons over 64, urbanicity, month and year effects. Standard errors, clustered on consumer units, are in parentheses, and expenditure elasticities are in brackets.

Appendix Table 9.A8: Definitions, Additional Details, and Notes about Variables in ECLS-K Analyses

| Constructs and Variables	Definition, Details, and Notes
	Investments
Early education program	Child participated in early education program before kindergarten (dummy variable).
Foreign language instruction	Child receives instruction in non-English language (dummy variable).
Private school	Child attends private school (dummy variable).
Extra-curricular activities	Child has ever taken lessons in drama, crafts, music, dance, or art or participated in organized athletics, clubs, performing arts (8 dummy variables).
# of children's books in home	Number of children's books in the home. Ordinal variable, ranges from 0 to 200.
# of music tapes, CDs, or records in home	Number of audio materials in the child's home. Ordinal variable, ranges from 0 to 100.
Family has computer	Computer available in home for child to use (dummy variable).
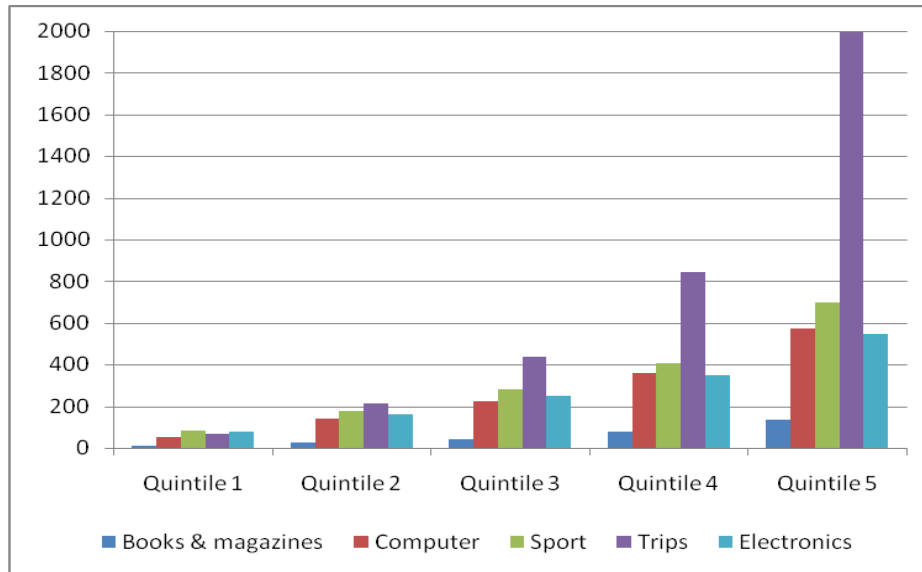
Figure 9.A1: Expenditures on enrichment items (in $), by expenditure quintles
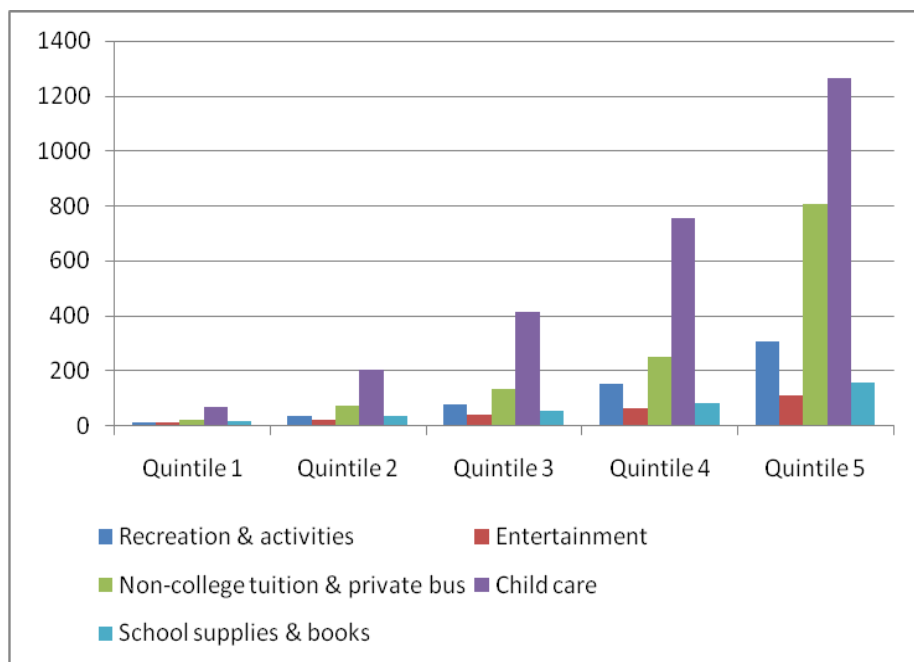(Mean annualized expenditure equivalized for family size)

Figure 9.A2: Expenditures on enrichment items (in $), by expenditure quintles
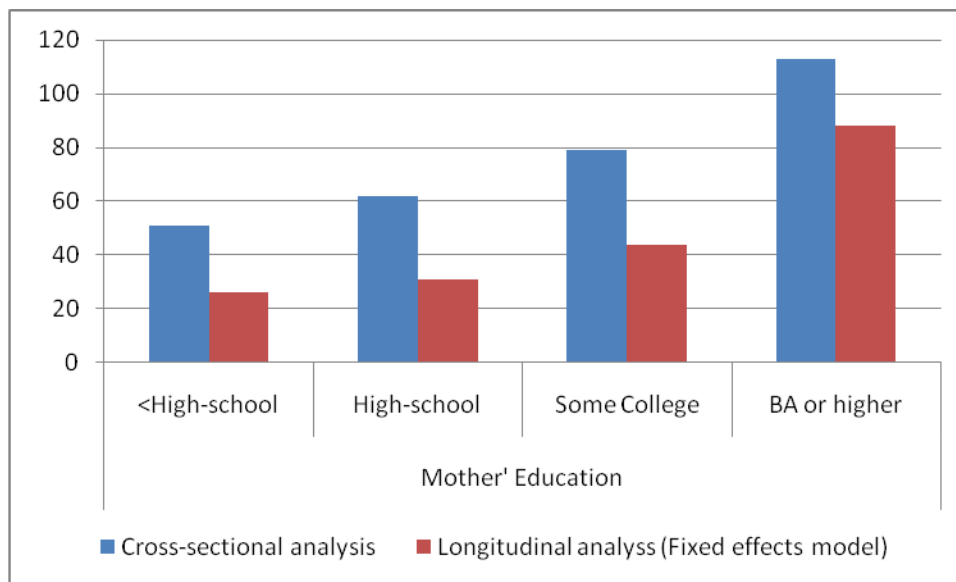(Mean annualized expenditure per child)

Figure 9.A3: Change in spending on enrichment items (in $) as family budgets increase by $1000, by mother's education groups (Estimates based on regression analysis cross-sectional models in table 9.1, and longitudinal models in appendix table 9.A7)
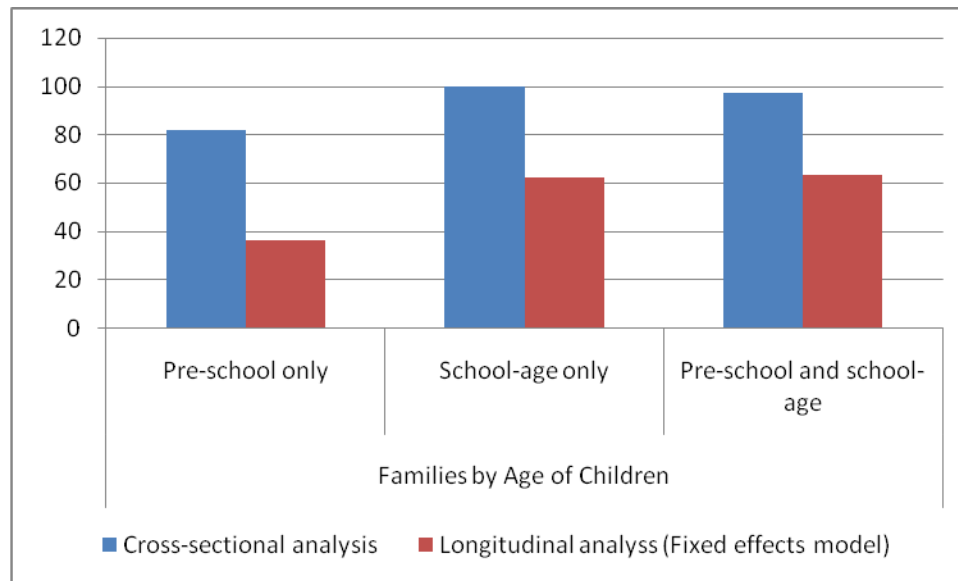
Figure 9.A4: Change in spending on enrichment items (in $) as family budgets increase by $1000, by age of children
(Estimates based on regression analysis cross-sectional models in table 9.1, and longitudinal models in appendix table 9.A7)

Figure 9.A5: Change in spending on enrichment items (in $) as as family budgets increase by $1,000, by expenditure quintile (Estimates based on regression analysis in table 9.1, adjusting for demographic characteristics)

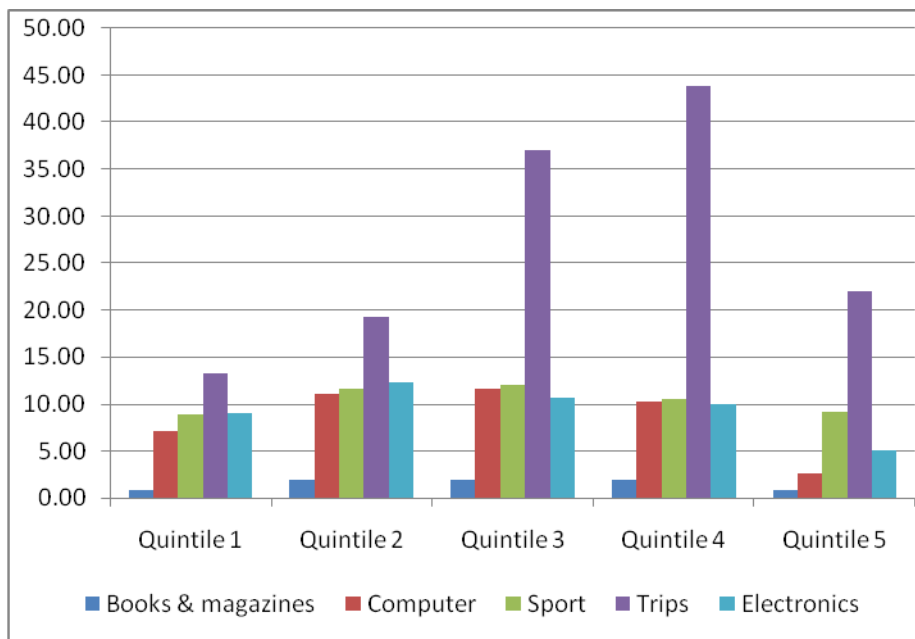Figure 9.A6: Changes in spending on additional enrichment items (in $) as family budgets increase by $1,000, by expenditure quintile
(estimates based on regression analysis in table 9.1, adjusting for demographic characteristics)

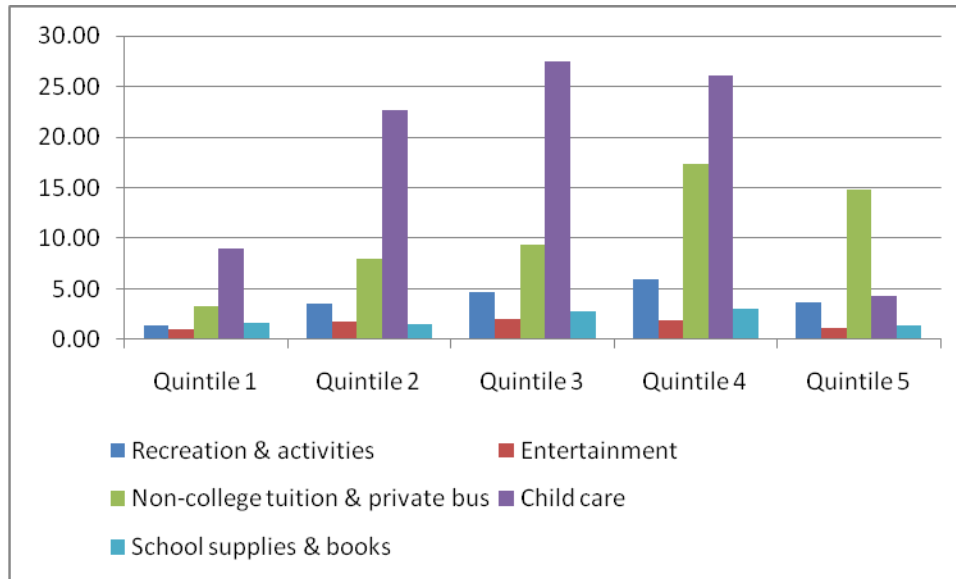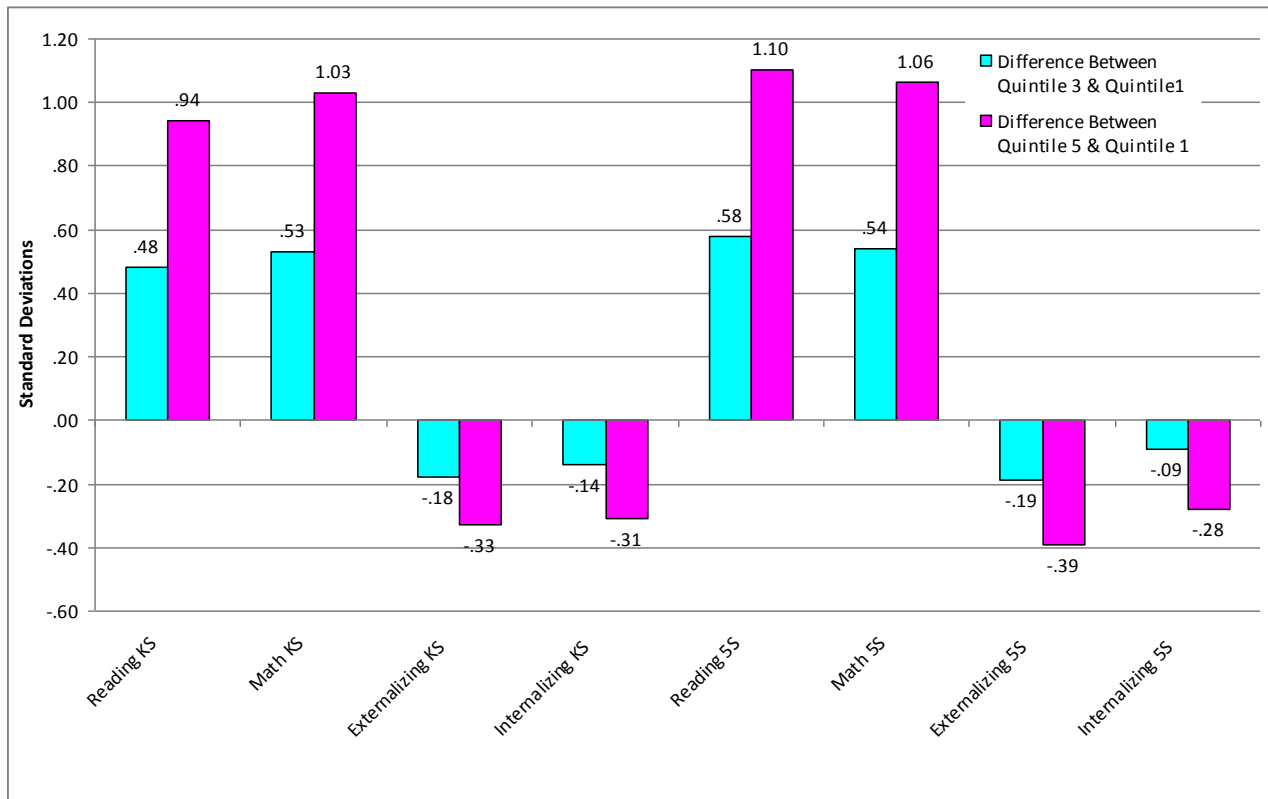Figure 9.A7: Income-related differences in children's achievement and behavior.
Notes: Quintile one includes families with the lowest incomes, and quintile five includes families with the highest incomes. KS = kindergarten spring; 5S = fifth-grade spring.

Figure 9.A8: Income-related differences in the percentage of children experiencing enrichment activities
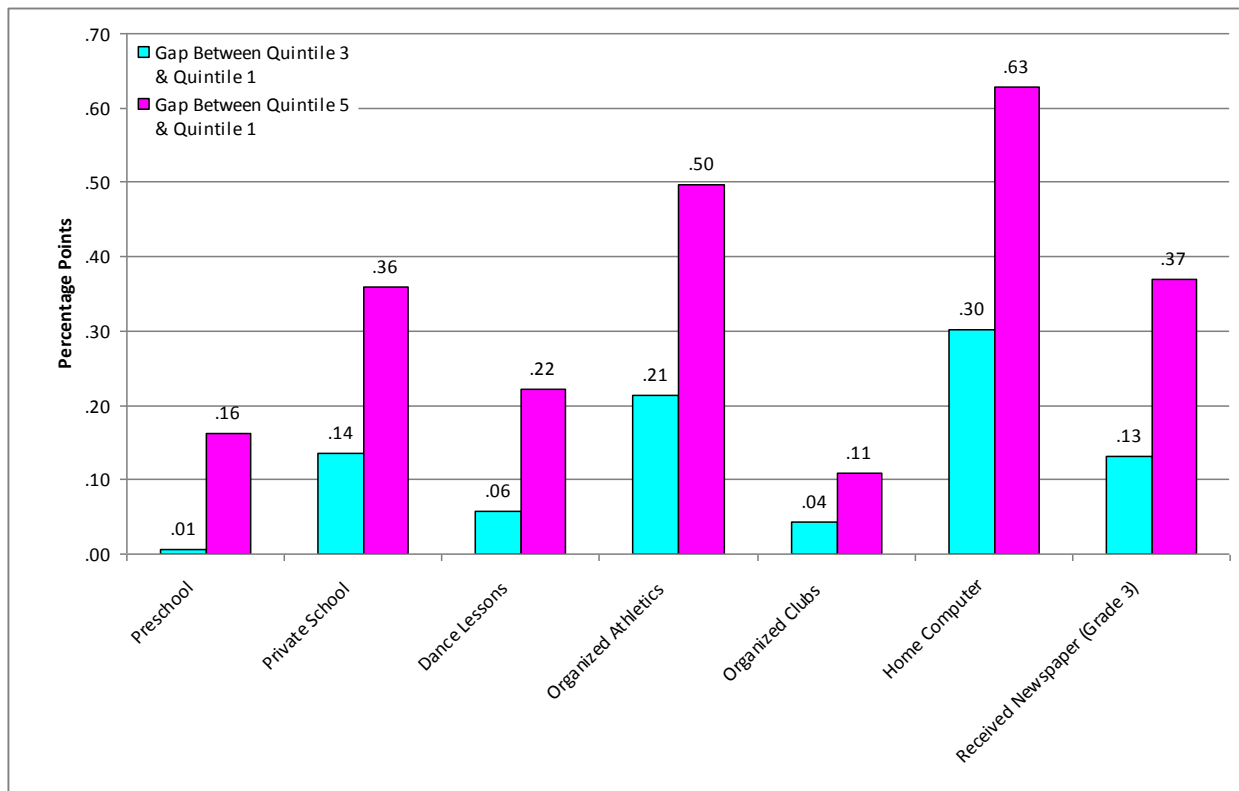Notes: Quintile one includes families with the lowest incomes, and quintile five includes families with the highest incomes. All items are measured during kindergarten unless otherwise noted.

Chapter 10
Parenting, Time Use, and Disparities in Academic Outcomes
Meredith Phillips

Section 10.A1. Challenges in Estimating the Effect of Time Use on Children's Development

Scholars face numerous challenges when trying to estimate how much time use matters for children's development. These challenges make it very hard to defend non-experimental estimates of the effects of time use on children's outcomes, which is why I do not present such estimates in my chapter.

Measurement problems can lead to both under and over-estimates of the importance of particular types of time use. Consider, for example, estimates of how much time parents spend reading to children. Surveys typically pose stylized questions to one parent, usually the mother, that ask, "How often do you read to your child?" or "How often do you read to your child in a typical week?" with four to six response options. These types of questions require that respondents estimate how much reading they typically do, and, as a result, such data contain reporting error. In addition, because surveys typically only ask one parent about his or her reading behavior, these types of questions understate the total amount of reading to which children are exposed, to the extent that other people (such as fathers, siblings, grandparents, or caregivers) also read to the child. Perhaps most important, these types of stylized questions do not collect any data on how long each reading interaction lasts, or how many such interactions happen in a typical day.

Child-focused time diaries eliminate some of these measurement problems. Time diaries gather data on all adult-child reading during a diary day (at least to the extent the respondent filling out the diary is aware of reading that other adults did with the child). In addition, diaries ask respondents to record the beginning and end of each reading session, which provides data on reading duration as well as reading frequency throughout a day. But, like stylized questions, diaries contain reporting errors as well. Diaries ask the respondents, typically mothers, to reflect

back on their child's day and describe what the child was doing. To the extent that adult-child reading sessions are short (which presumably is common with young children) and to the extent that reading happens spontaneously throughout the day rather than during a scheduled part of the day such as a bedtime ritual, the parent filling out the diary may forget to report the reading session. Moreover, because time diaries administered in the context of large-scale studies tend to ask respondents to report activities for only a few days (typically one weekday and one weekday), time diary estimates contain substantial sampling error—meaning that weekly estimates for any particular family are likely to be quite inaccurate to the extent that parents' reading time with children varies across days of the week. All of these measurement problems, in both stylized questions and time diaries, will lead researchers to *understate* the effects of reading on children's cognitive skills.

Measurement challenges can bias estimates in the other direction, as well, however. For example, parents who read a lot to their children may also talk more with their children and use more varied vocabulary in those conversations. If researchers use non-experimental data to estimate the effects of reading, without simultaneously taking into account the quantity and quality of parent-child conversation, such studies will misattribute the effects of conversation to the effects of reading, thereby *overstating* the apparent effects of reading.

Non-experimental estimates of time use will also be biased by scholars' failure to account for genetic influences. As both Becker and Coleman acknowledged in the introductory quotes at the beginning of this chapter, parents and children are similar not only because they share homes but because they share genes. For example, we know that mothers with better verbal skills use more varied vocabulary with their children, and we know that children who hear more varied vocabulary develop better verbal skills. While some of this association probably reflects the true effect of children's exposure to their mothers' vocabulary words on the children's verbal development, it is also likely that mothers who use more varied vocabulary with their children passed their genes for better verbal skills to their children and, as a result, their children are

better at acquiring verbal skills because of those genes. Failure to separate the effects of genes from the effects of vocabulary exposure will lead estimates of the effects of conversation on children's verbal skills to be too large.

To make matters more complicated, children themselves influence how much time their parents spend with them in various activities. For example, verbally adept children talk sooner, and more, and thus elicit more speech from their parents. As a result, it is difficult to separate the part of the association between parental speech and children's verbal skills that reflects the effects of speech on verbal skills from the part that reflects the effect of verbal skills on speech. If non-experimental studies do not address this problem of reverse causation, they may yield estimates of the effects of parents' time use that are too large.

Section 10.A2. Data Limitations and Future Research Needs

Even though the data in the chapter add to our understanding about socioeconomic and racial disparities in children's lives, the data are also imperfect. In particular, I worry that the accuracy of the social class and racial disparities may be influenced by two methodological features of the data collection process.

First, an ideal accounting of disparities in the time children spend conversing with adults or having books read to them would consider each child's entire day, regardless of where the adult-child interaction took place. But the PSID time diaries did not record the content of children's experiences while in school or at day care. Children from different ethnic and social class backgrounds spend similar amounts of time in elementary school, so the exclusion of in-school time use data for the older age group probably is not an important source of bias. But the associations of ethnicity and social class with the time younger children spend in non-parental care are more complicated, and thus the lack of specific information on children's time use in non-parental care settings makes the time use disparities shown for younger children potentially more biased.

Second, I worry that measurement error in time diaries may be systematically greater for some groups than others. I wonder, for example, whether low-income respondents systematically underreport short or mundane aspects of time use, such as reading to or talking with children. Such parents may be busier or under more stress and thus less inclined to provide detailed diary responses. Moreover, to the extent that interviewers are predominantly white and middle class, I wonder if they are equally likely to encourage respondents from all ethnic and social class backgrounds to fill out their time diaries as thoroughly as possible. Researchers could possibly investigate these measurement questions by incorporating both time diaries and experience sampling methods into their studies and then examining whether discrepancies between methods are larger for lower-income or African American respondents.

This chapter has several additional limitations. First, it focuses solely on white and African American children because few Latino children participated in the CDS. However, Latino students constitute more than 20 percent of the U.S. public school population and often struggle in school. Our understanding of time use and parenting differences would be improved considerably by collecting time use data for larger, representative samples of children from all ethnic groups.

Second, this chapter focuses solely on average time use differences among social class and racial groups, even though the distribution of time use is often quite skewed and varies tremendously within groups. Future research on this topic should focus less on comparing averages and more on comparing distributions.

Third, this chapter presents hardly any evidence on the extent of disparities in the *quality* of time use across social classes or racial groups. Small scale studies have highlighted considerable variation in the quality of parent-child conversations and parent-child reading (see, for example, Pan et al. 2005). Thus, in order to understand the extent of disparities in children's experiences of quality time, future research should attempt to measure the quality of parent-child interaction directly, perhaps by coding recorded samples of parent-child interaction.

Most important, this chapter is missing the link between its description of large social class and racial disparities in academic skills and behavior on the one hand and large time use disparities on the other. I strongly caution readers not to assume that these large time use disparities cause these large academic disparities. Certainly, a large literature suggests that some of the disparities shown in this chapter play a role in generating and maintaining disparities in academic skills. But non-experimental studies, especially from survey-based measures of parenting practices and children's time use, face large hurdles in giving us accurate estimates of the effects of parenting and time use on children's outcomes. Recent research has tried to provide more reasonable estimates of these effects and should serve as a model for future research in this area (see, for example, Robinson 2008).

Section 10.A3. Sample, Measures, and Analysis

Only a subset of CDS children provided time-diary data, and only a subset of those provided data for both a weekday and weekend. I restrict all analyses to African American and white children who provided time-diary data for both days. In addition, I exclude two children who do not have data on their age in months at the time of the parent interview. These restrictions produce a sample of 2,470 children, 1,088 of whom are African American. Table 10.A1 shows that this analytical sample differs very little from the full CDS sample.

Appendix Table 10.A1. Comparison of Weighted Full and Analytic Samples

	Full Sample			Just Blacks and Whites			Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Male	3563	0.50	0.50	3097	0.51	0.50	2470	0.51	0.50
White	3555	0.63	0.48	3097	0.80	0.40	2470	0.81	0.39
Child's age (yrs)	3557	6.30	3.77	3092	6.31	3.77	2470	6.24	3.77
Number of children in family	3563	2.39	1.10	3097	2.30	1.03	2470	2.29	1.03
Two parent, biological family	3563	0.68	0.47	3097	0.68	0.47	2470	0.70	0.46
Years of education of primary caregiver	3450	12.73	2.95	2995	13.34	2.16	2392	13.42	2.12
Total family income (5-year average)	3563	50760	47186	3097	54917	49691	2470	54292	42998
Woodcock Johnson letter word score (age standardized)	1964	0.00	1.00	1870	0.02	0.99	1672	0.03	1.00
Woodcock Johnson applied problems score (age standardized)	1955	0.00	1.00	1860	0.03	0.98	1664	0.05	0.98
Attention difficulties index	2781	0.00	1.00	2423	-0.02	1.00	1896	-0.02	0.99
Antisocial behavior index	2781	0.00	1.00	2423	0.03	1.01	1896	0.03	1.00

Note: All estimates are weighted. Analytic sample is limited to black and white children with both a weekend and weekday time diary and with complete data on age in months at time of primary caregiver interview.

Measures

Academic Skills and Behaviors:

Verbal and Math Test Scores
 I use two subtests from the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R): the Letter-Word Identification subtest and the Applied Problems subtest. The WJ-R was administered one-on-one to children who were at least three years old. I used the age-standardized scores provided by the PSID, and then standardized those scores to a mean of zero, standard deviation of one for the weighted sample of all tested children.

Attention Difficulties
I constructed an index of four parent-reported attention items drawn from the Behavior Problems Index (BPI) and the Positive Behaviors Scale. Parents only reported for children who were at least three years old. For the three BPI items, primary caregivers reported on the extent to which their child "has difficulty concentrating, cannot pay attention for long," "is easily confused, seems to be in a fog," and "is restless or overly active, cannot sit still." The one Positive

Behavior Scale item asked primary caregivers to report on the extent to which their child "does neat, careful work." Because the BPI and Positive Behaviors Scale provide different ordinal response options, I standardized the items before creating the index. The index has a Cronbach's alpha of .68 for the 1997 wave.

Antisocial Behavior
I constructed an index of twelve parent-reported antisocial behavior items drawn from the Behavior Problems Index (BPI) and the Positive Behaviors Scale. Parents only reported for children who were at least three years old. For the nine BPI items, primary caregivers reported on the extent to which their child "cheats or tells lies," "argues too much," "bullies or is cruel or mean to others," "is disobedient," "does not seem to feel sorry after misbehaves," "has trouble getting along with other people his/her age," "is impulsive, or acts without thinking," "has a very strong temper and loses it easily," and "breaks things on purpose or deliberately destroys his/her own or another's things." The three Positive Behavior Scale items asked primary caregivers to report on the extent to which their child "waits his/her turn in games and other activities," "thinks before he/she acts, is not impulsive," and "usually does what you tell him/her to do." Because the BPI and Positive Behaviors Scale provide different ordinal response options, I standardized the items before creating the index. The index has a Cronbach's alpha of .84 for the 1997 wave.

The two indices correlate .58 with one another. The antisocial behaviors index correlates very highly with the BPI externalizing scale (.89) and the BPI total index (.82).

Time Use:

All the time use measures count time spent in *both* primary and secondary activities. To compute weekly time, I multiplied the weekday diary estimate by five and the weekend diary estimate by two, and summed those quantities. Note that numbers below refer to the codes in the 1997 CDS PSID SSL Coding Manual (1997).

Weekly Time in Novel places
Sum of time spent in indoor recreation places (60), outdoor recreation places (70), church (81), and commercial establishments. Commercial establishments include restaurants (50); stores, shopping centers, malls, beauty parlors (82); banks, offices, library, fire stations (83); other, hospital (89). 16% of children spent no time during in the week in novel places. The top 1% of children spent 43 hours per week or more in novel places.

Weekly Time Eating Meals with Adults
Sum of time spent in meals at home (439), meals away from home eaten at others' home (439), and meals away from home (449). But only counts time when adults were participants, where adults are mother (B), father (C), step-mother (E), step-father (F), grandparent(I), other relative (J), other non-relative (K). Note that the relatives (J) and non-relatives (K) categories do not unambiguously refer to adults; they may include relatives who are children (such as cousins), but they exclude brothers, sisters, and friends. 3% of children spent no time during the week eating meals with adults. The top 1% of children spent 23.3 hours or more eating meals with adults.

Weekly Time in Interactive Play with Adults
Sum of time spent playing pretend (866), playing puzzles or educational games (874), and playing with toys (875). But only counts time when adults were participants (see "eating meals" measure for definition of adults). 67% of children spent no time during the week in interactive

play with adults. The top 1% of children spent 25 or more hours per week in interactive play with adults.

Weekly Time in Conversation with Adults
Sum of time spent visiting with others (752), in phone conversations (961), other talking/conversations (962), and conversations with household members (963). But only counts time when adults were participants (see "eating meals" measure for definition of adults). 9.7% of children spent no time during the week talking with adults. The top 1% of children spent 53.2 or more hours per week talking with adults.

Primary Caregiver's Verbal Responsiveness
When the interviewer was visiting the home, collecting data, s/he reported on whether the primary caregiver spontaneously spoke or conversed with the child and whether the primary caregiver responded verbally to the child's speech, questions, or requests. These two ordinal items are part of the HOME scale. I made an index of the two items, and then standardized the index to a mean of zero, standard deviation of 1. The two-item index has a Cronbach's alpha of .85.

Weekly Time Read to by Adults
Sum of time spent being read to or listening to a story (943). Only counts time when adults were participants (see "eating meals" measure for definition of adults). 81% of children spent no time during the week being read to or listening to a story. The top 1% of children spent 5.75 or more hours per week being read to or listening to a story.

Weekly Time Doing Literacy Activities
Sum of time spent reading to another child (238), on computer/internet but not playing games (503, 510, 511), reading or looking at books (939), reading magazines (941), reading newspapers (959), reading something else (942), being read to or listening to a story (943), writing (852), and reading or writing letters/mail (979). 48% of children spent no time during the week doing literacy activities. The top 1% of children spent 13.41 or more hours per week doing literacy activities.

Other Variables:

Primary Caregiver's Educational Attainment
Based primarily the PSID's variable for the primary caregiver's educational attainment. However, 36 children were missing data on that variable but had valid values on a pcg educational attainment variable from the head/wife data. I used the head/wife data to impute pcg's educational attainment for those children. (The two variables correlate .97 for children who have data for both; some of the discrepancy arises because GEDs were coded as different numbers of years completed in the two variables.) To construct the categorical variable, I coded pcgs with 11 or fewer years of completed schooling as drop outs, pcgs with 12 years of schooling as high school graduates, pcgs with 13-15 years of schooling as having some college, and pcgs with 16 or more years of schooling as college graduates.

Family Structure
Based on a combination of information about whether children live with their biological parents and the presence of another caregiver in a household. I coded children as living with two biological parents, living with 1 biological parent and at least one other adult caregiver, living with one biological parent and no other adult caregiver, and living with no biological parents (e.g., children raised by grandparents).

Family Size
Number of children in the family unit.

Primary Caregiver's Work Status
Based on data about hours worked from head/wife reports. Sum of hours per week on main job and two extra jobs. Sum then recoded to not employed, part-time work (1 to 39 hours), and full-time work (40 plus hours).

Primary Caregiver's Parents' Educational Attainment
Based on data from head/wife files. Recoded to grandfathers' and grandmothers' estimated years of schooling and then averaged. Note that zeros could mean either no education or educated outside the U.S. I recoded zeros to missing because one of the options for years of schooling was 0-5 years.

Family Income
Mean of last five years of available family income data (1992 through 1996). The PSID moved to a biennial interview schedule after 1997, so there are no 1998 reports of income in 1997. Nonetheless, before taking the average, I inflated all reports to 1997 values using the CPI-U-RS. I also constructed a measure of average income over the first five years of the child's life. That measure had more missing data but was correlated .9 with the "last five years" measure. I created income quintiles based on the weighted sample of children in the full sample.

Neighborhood Safety Index
Index composed of 4 items: "How would you rate your neighborhood as a place to raise children?", "How safe is it to walk around alone in your neighborhood after dark?," "Do you leave your doors unlocked when you are at home?," "Do you leave your car doors unlocked when you are at home?." Because the items had different scales, I standardized them and then combined them. The index has a Cronbach's alpha of .70.

Birth Weight
I constructed two dummy variables from the data on pounds and ounces at birth. Children are coded as low birth weight if they weighed 5 pounds, 8 ounces or less. They are coded as very low birth weight if they weighed 3 pounds, 5 ounces or less.

Health at Birth
Dummy variable recording whether primary caregiver described child's health at birth as worse than others.

Child's Health
Rating by pcg of child's health on ordinal scale ranging from poor to excellent.

Primary Caregiver's Health
Ordinal rating by pcg (based on head/wife data) of health on ordinal scale ranging from poor to excellent.

Primary Caregiver's Depression/Anxiety
Based on the K-10 Non-Specific Psychological Distress Scale. Primary caregivers report on Likert scale how often in last four weeks they felt tired, nervous, hopeless, restless, depressed, etc.

Primary Caregiver's Self Esteem
Based on 10-item Rosenberg Self-Esteem Scale. Primary caregivers report how strongly they agree/disagree that they have good qualities, do things well, are satisfied with self, and so on.

Primary Caregiver's Self Efficacy
Based on 7-item Perlin Self-Efficacy Scale. Primary caregivers report how strongly they agree/disagree that they have little control, feel helpless, cannot change important things in their lives, etc

Analysis

All analyses control for gender and the child's age in months at the time of the parent interview. For the analyses of racial disparities, I estimate models that also adjust for the following variables: two dummy variables for birth weight, a dummy variable for poor health at birth, ordinal variables for child health, pcg health, pcg depression/anxiety, pcg self esteem, pcg self efficacy, pcg educational attainment (as dummies), family structure (as dummies), number of children in the family, pcg work status (as dummies), grandparent years of education, the neighborhood safety index, and the natural log of family income averaged over the last five years. All models include dummy indicators for missing data, all are weighted, and all adjust the standard errors for clustering within families.

Because many of the time use variables were skewed, I tested the sensitivity of the estimates to trimming the distribution at different points. For the estimates presented in this chapter, I trimmed off the top 1% of the observations for each of the time diary measures. Estimated

income and racial disparities based on the trimmed models tend to be smaller than disparities from the untrimmed models, though are not always, and tend to be slightly more precise.

Figure 10.A1. Disparities in academic skills and behaviors, by age and parent's education
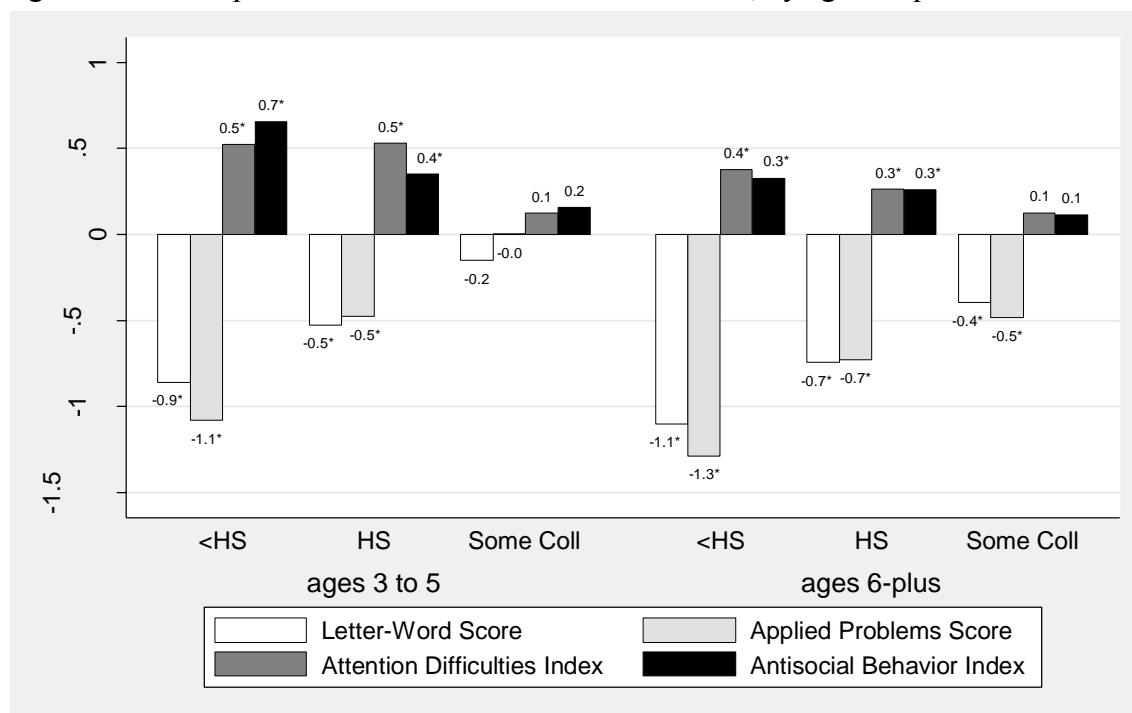
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates.

Figure 10.A2. Disparities in weekly time in novel places, by age and parent's education

Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates.

Figure 10.A3. Income disparities in weekly time eating meals with adults, by age
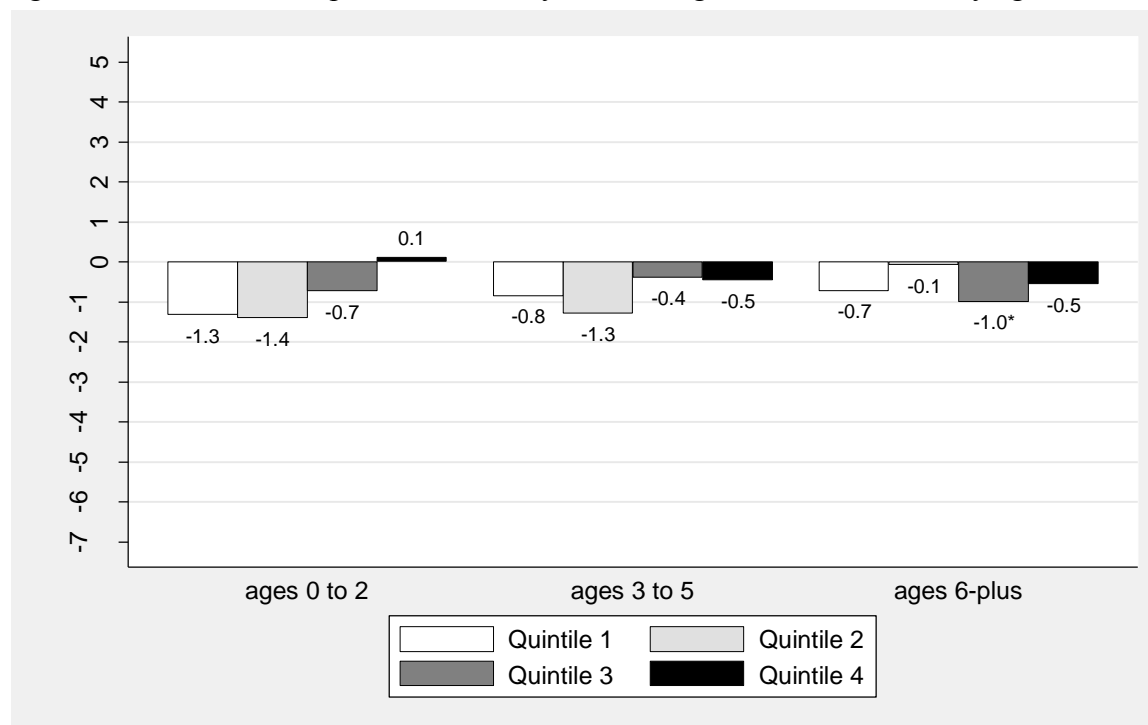
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose family income is in the top quintile.

Figure 10.A4. Black-white disparities in weekly time eating meals with adults, by age

Source: Author's calculations using PSID-CDS.
Note: Controls include measures of child health, parent health, and socioeconomic status. See text and appendix for more details.
*Denotes statistically significant difference at .05 level or below.

Figure 10.A5. Disparities in weekly time eating meals with adults, by age and parent's education

Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates

Figure 10.A6. Income disparities in weekly time in interactive play with adults, by age
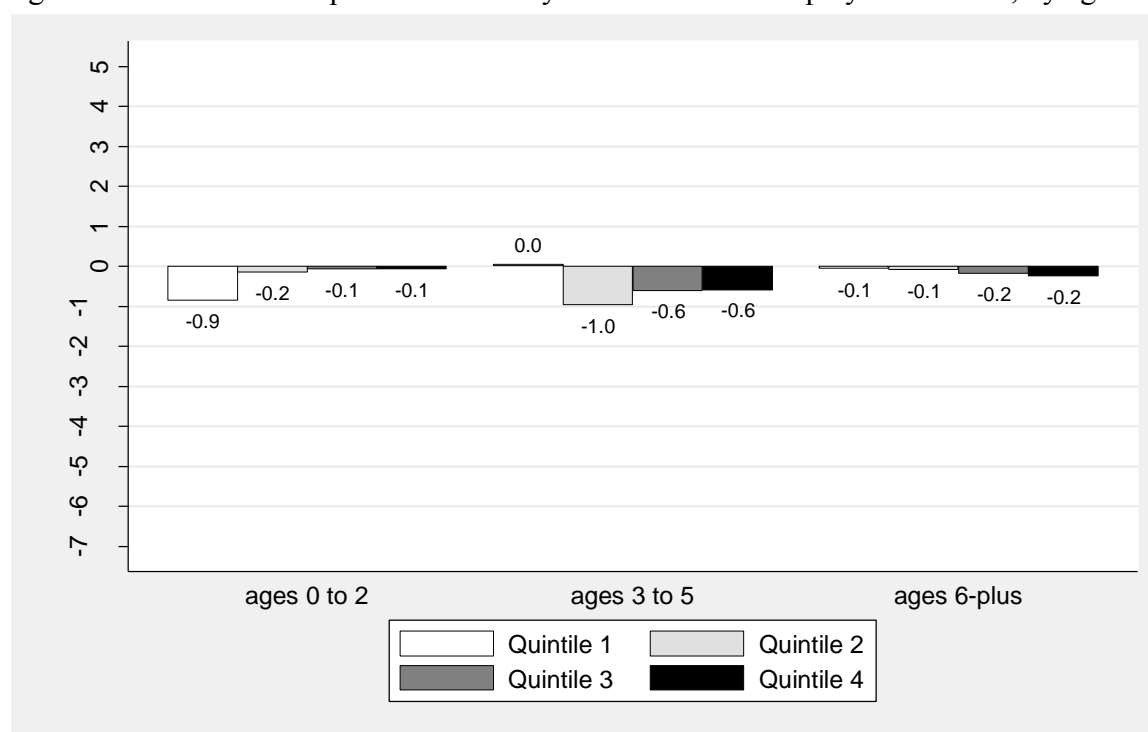
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose family income is in the top quintile.

Figure 10.A7. Black-white disparities in weekly time in interactive play with adults, by age
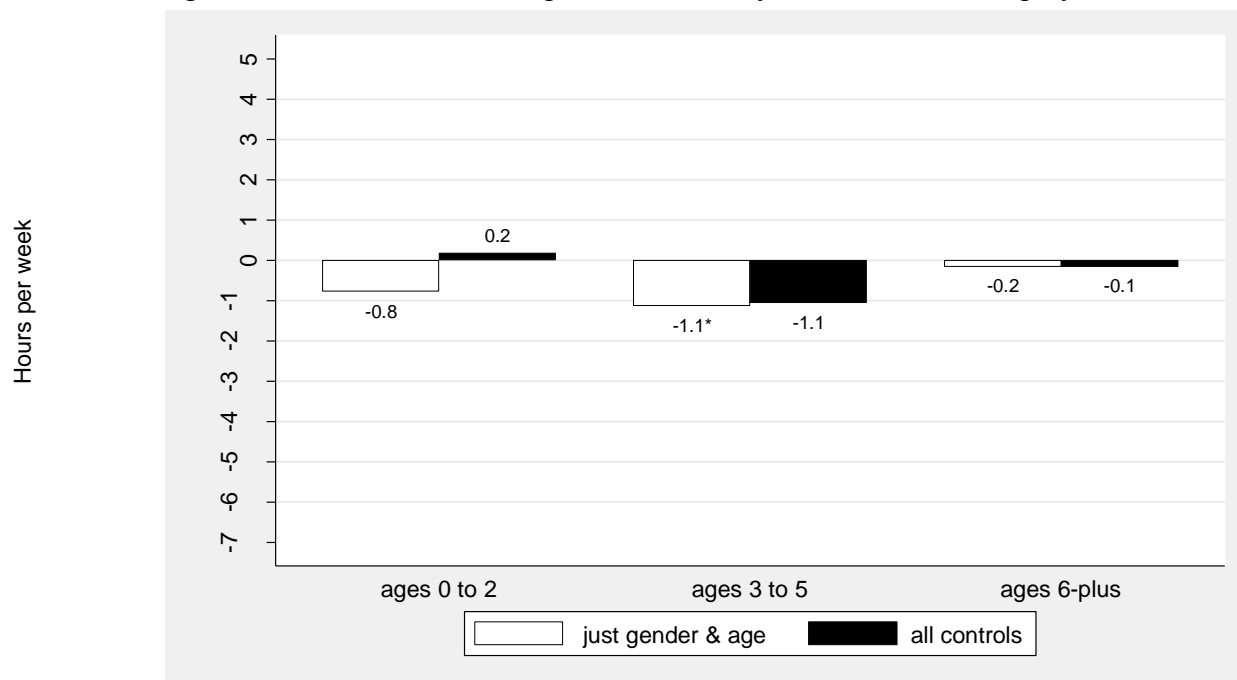
Source: Author's calculations using PSID-CDS.
Note: Controls include measures of child health, parent health, and socioeconomic status. See text and appendix for more details.
*Denotes statistically significant difference at .05 level or below.

Figure 10.A8. Disparities in weekly time in interactive play with adults, by age and parent's education
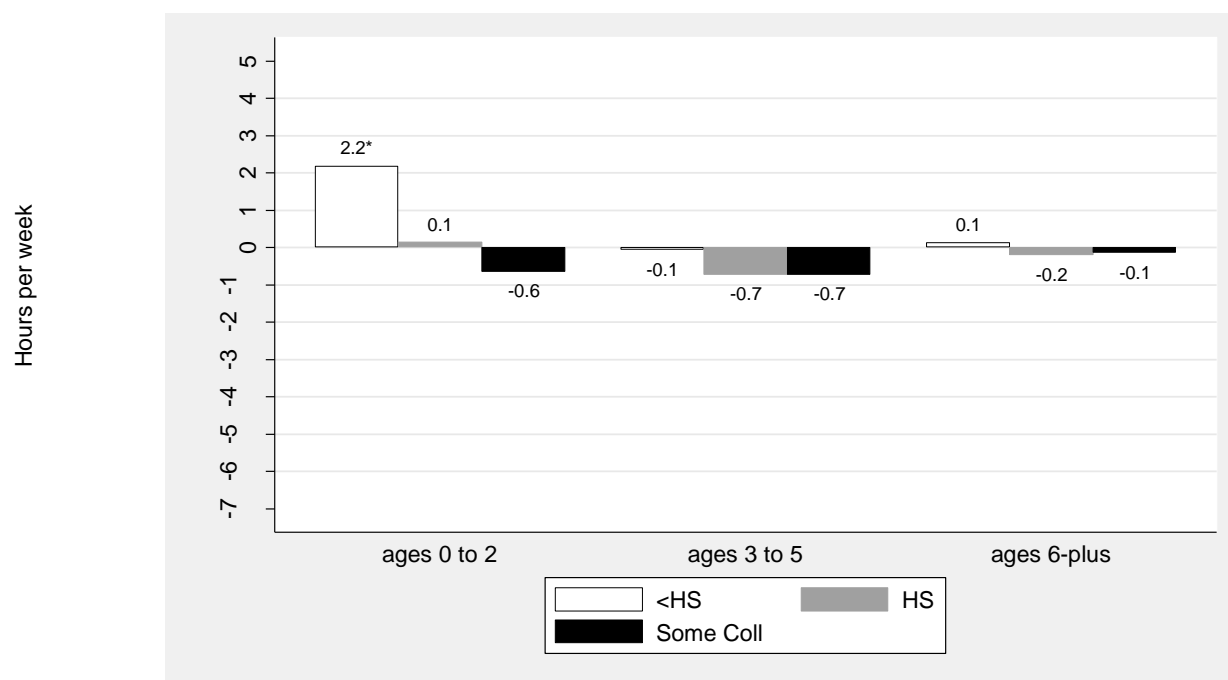
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates.

Figure 10.A9. Disparities in weekly time in conversation with adults, by age and parent's education
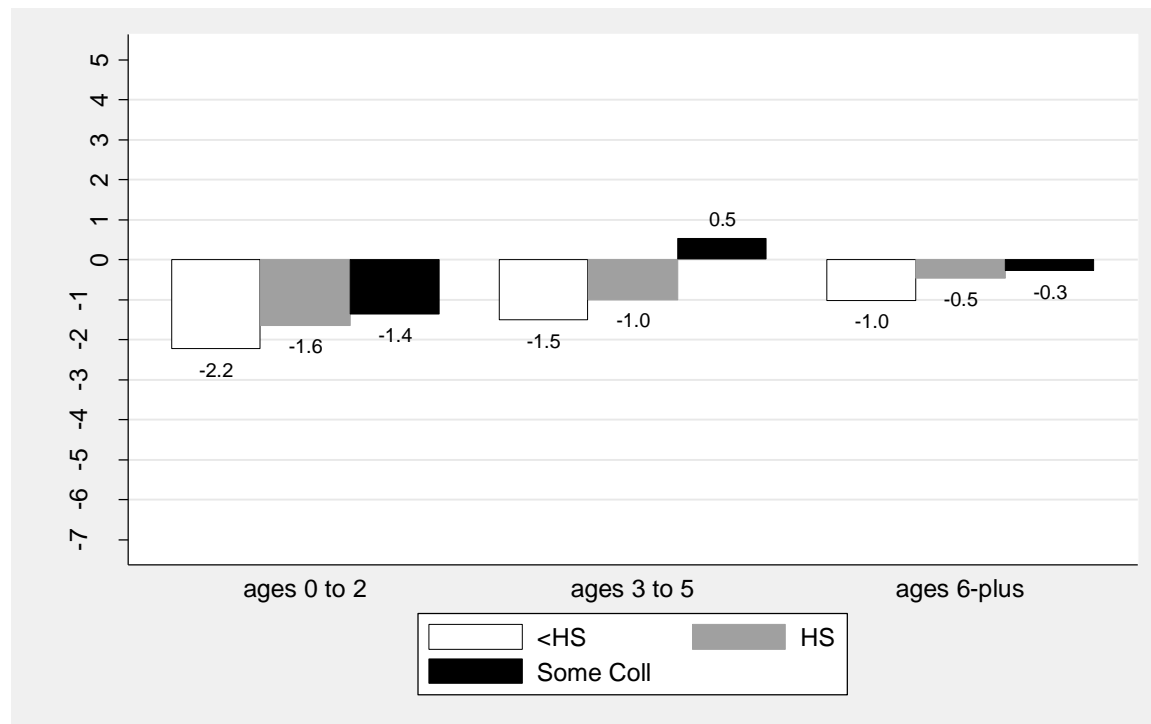
Figure 10.A10. Disparities in primary caregivers' verbal responsiveness, by age and parent's education
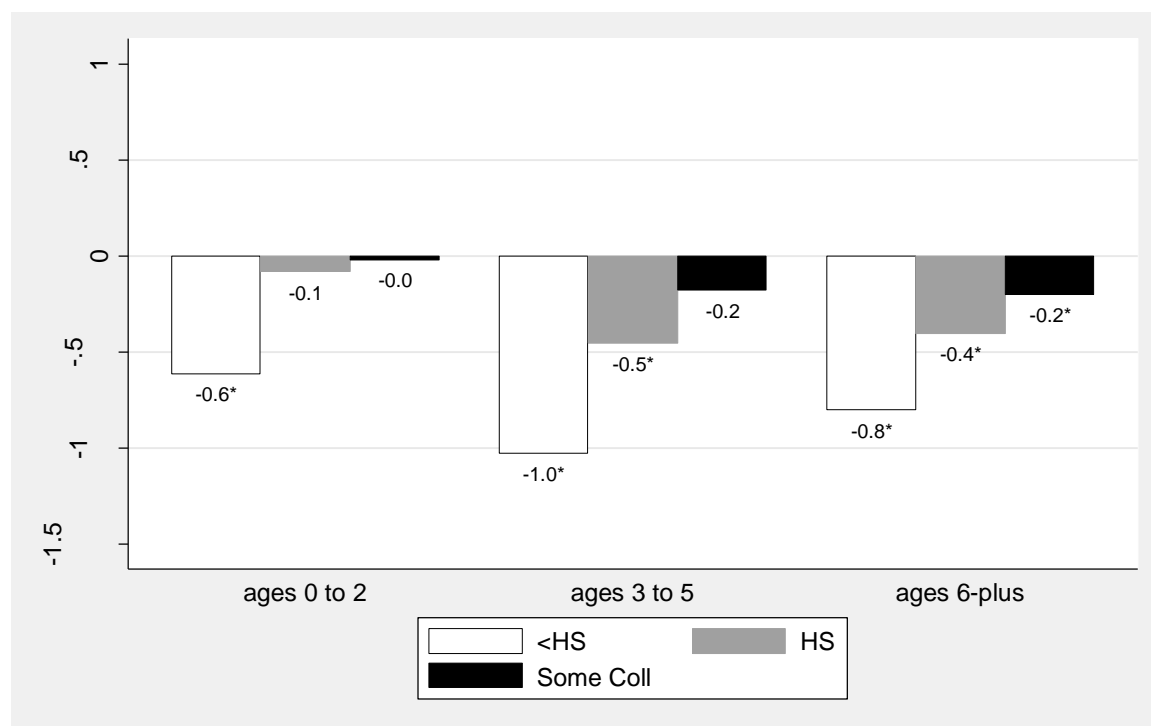
Figure 10.A11. Disparities in weekly time spent in literacy activities, by age and parent's education
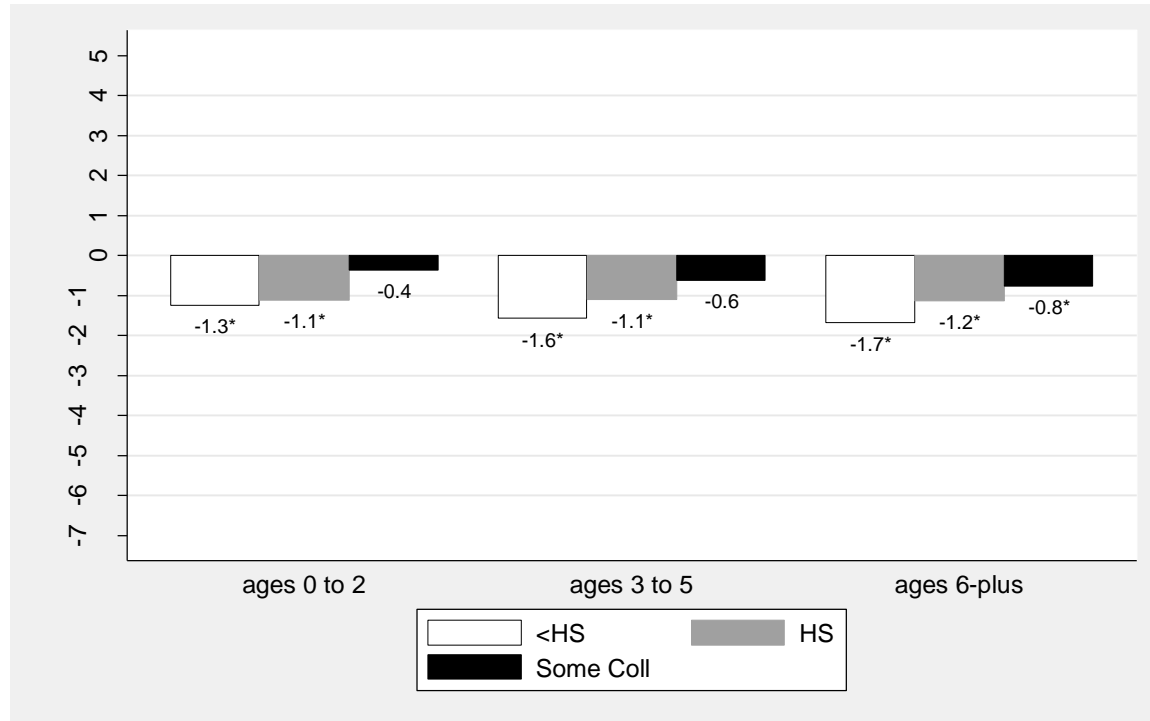
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates.

Figure 10.A12. Income disparities in weekly time read to by adults, by age
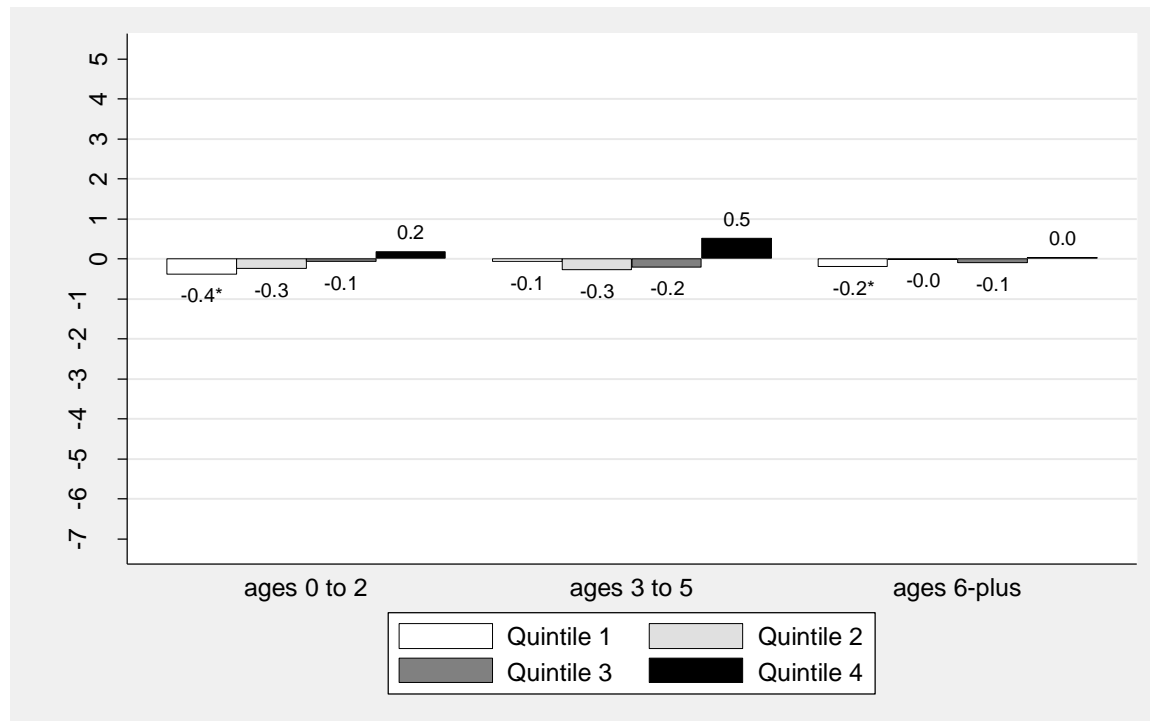
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose family income is in the top quintile.

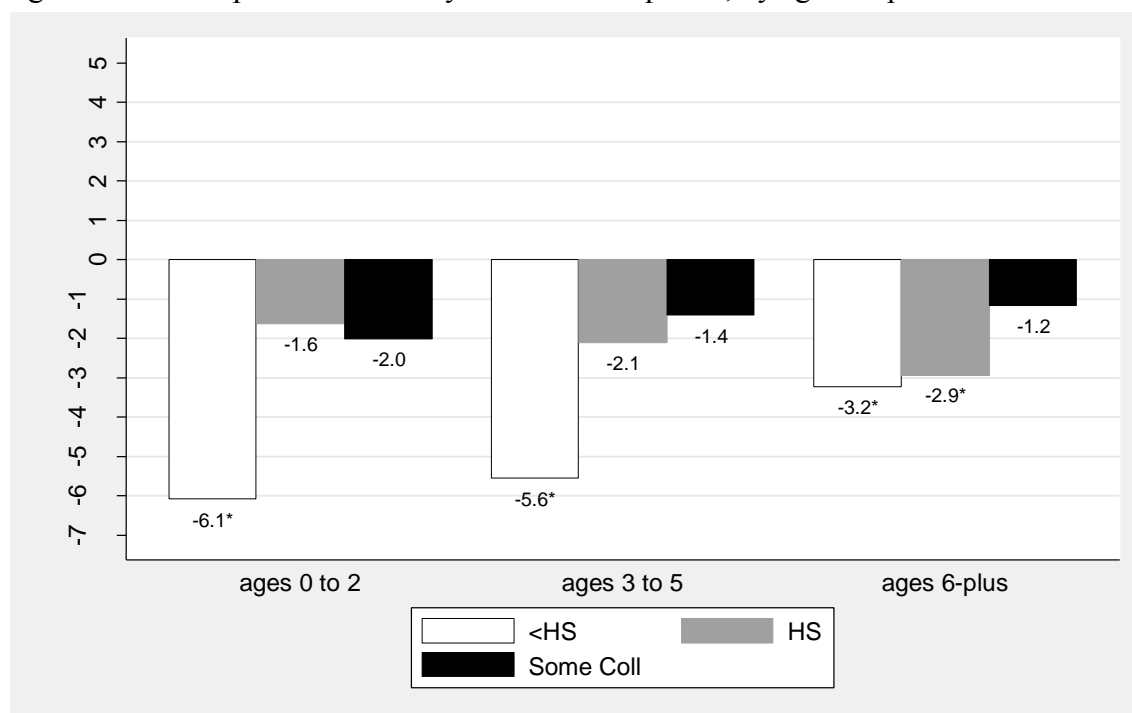Figure 10.A13. Disparities in weekly time read to by adults, by age and parent's education
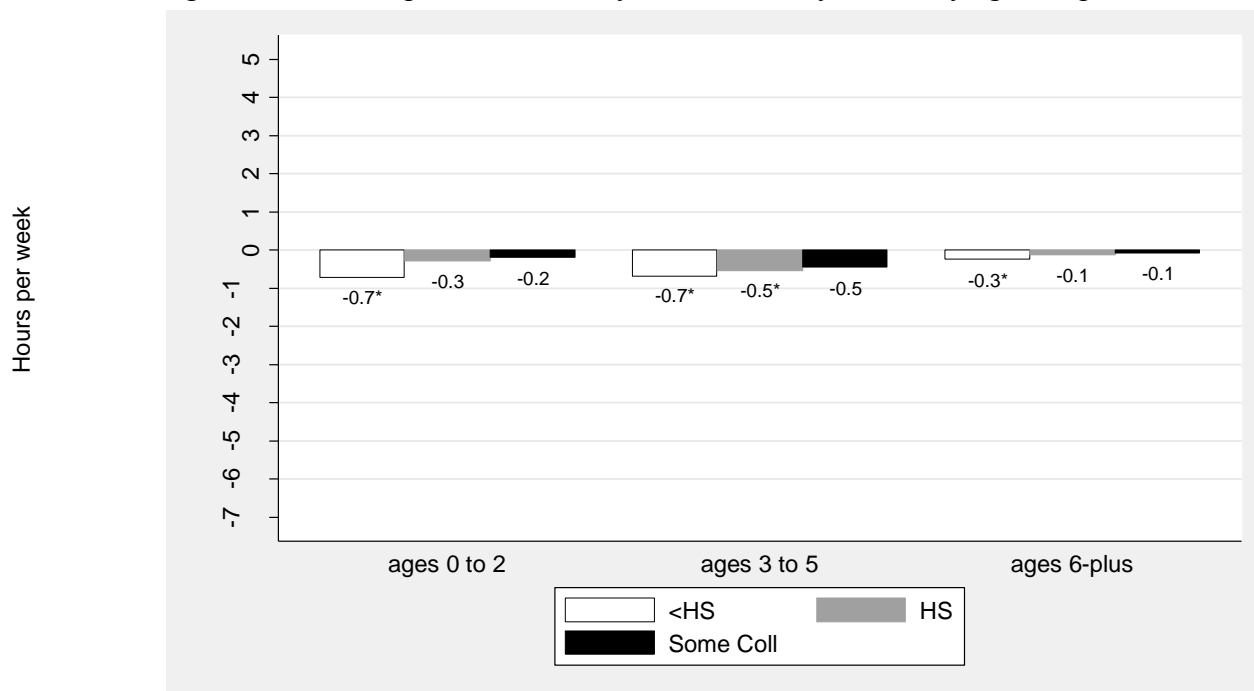
Source: Author's calculations using PSID-CDS.
Note: Estimates are adjusted for child's age in month and gender.
*Denotes statistically significant difference at .05 level or below.
Bars show difference relative to children whose primary caregivers are college graduates.

Figure 10.A14. Black-white disparities in weekly time read to by adults, by age

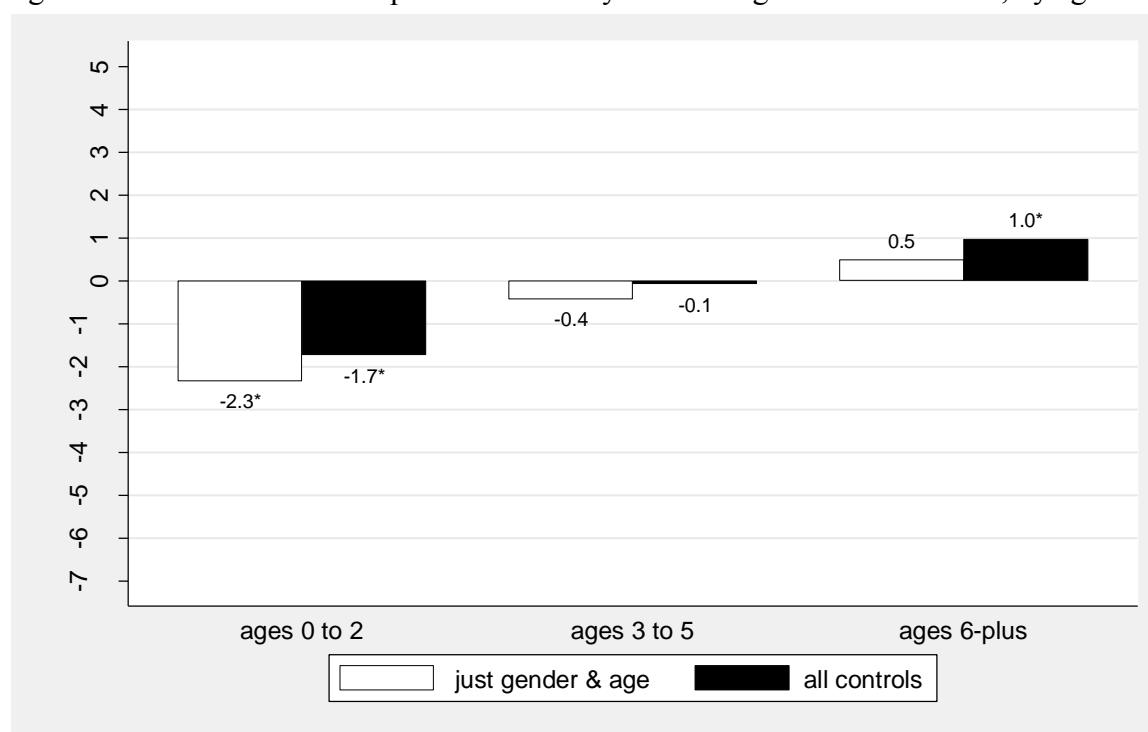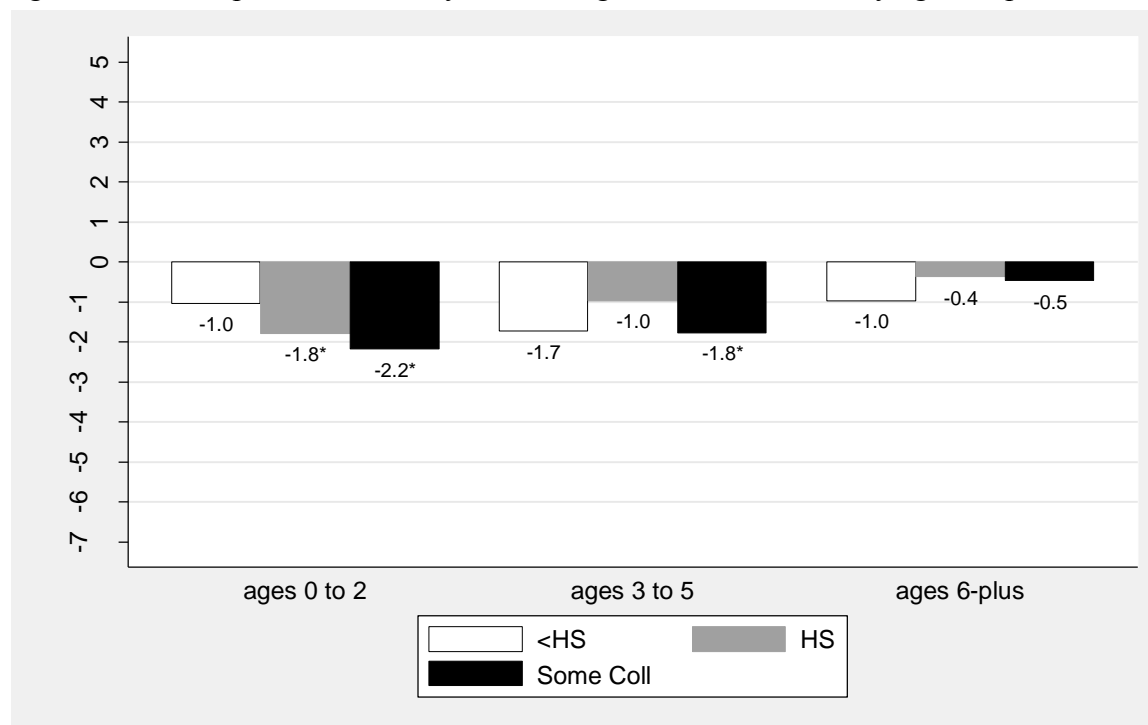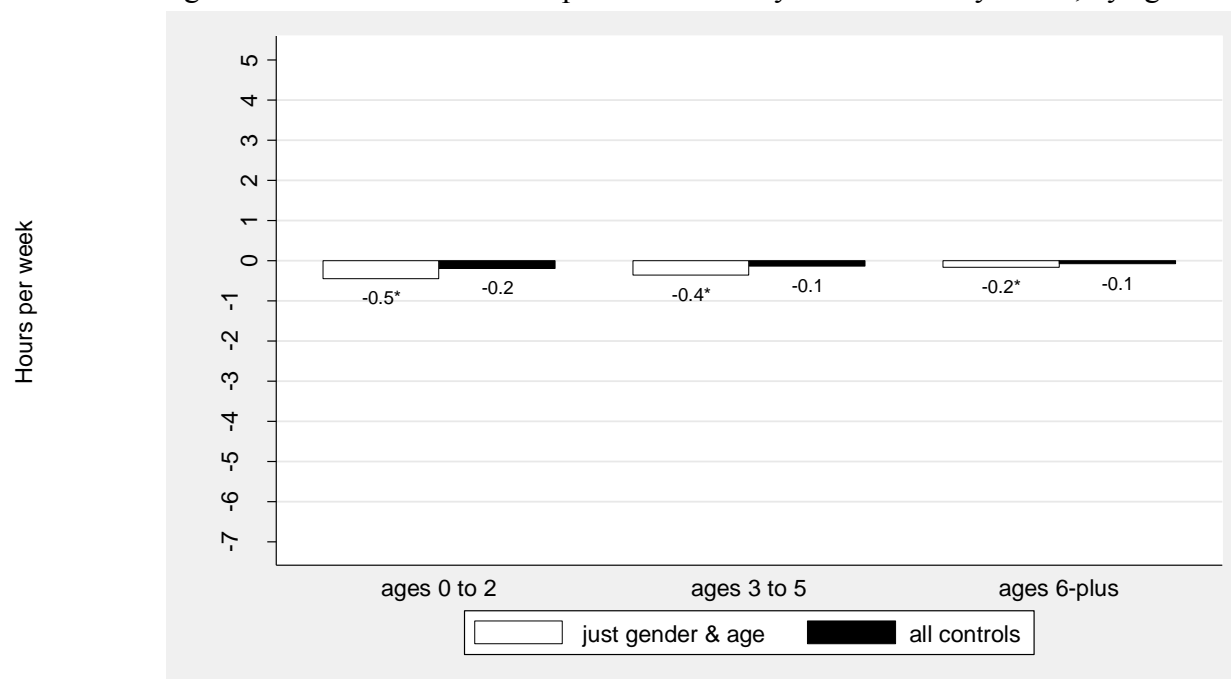Source: Author's calculations using PSID-CDS.
Note: Controls include measures of child health, parent health, and socioeconomic status. See text and appendix for more details.
*Denotes statistically significant difference at .05 level or below.

Table 11.A1. Mean Values for Outcomes and Control Variables Used in
Regression Analysis: National Longitudinal Study of
Adolescent Health, Youth Ages 12-15 at Wave 1 (n = 4,251)

Educational Well-Being		
School engagement (1996)	3.140	(0.020)
GPA (transcript, 1996 - 1997)*	2.667	(0.039)
Advanced math course*	0.648	
High school graduation	0.837	
GPA (self-reported, wave 1)	2.919	(0.025)
School engagement (wave 1)	3.169	(0.017)
Race / ethnicity		
Hispanic	0.110	
Black	0.131	
Asian	0.029	
Native American	0.020	
White	0.702	
Other race	0.008	
Age (wave 1)		
<14	0.362	
14	0.323	
15	0.315	
Female	0.516	
Foreign born	0.043	
Urban (wave 1)	0.481	
Family income-to-needs ratio (wave 1)		
<1	0.131	
1 to 1.9	0.186	
2 to 3.9	0.348	
4+	0.215	
Missing	0.119	
Mother's years of schooling (wave 1)		
< 12 years		
12 years	0.321	
13-15 years	0.300	
? 16 years	0.243	
Mother's age at birth	26.116	(0.157)
Parenting (wave 1)		
Parental presence	3.080	(0.021)
Mother's involvement	3.803	(0.047)
Biological father's involvement	2.603	(0.059)

Note: Standard errors of the means for continuous variables are shown in parentheses. *Estimates based on 3,390 adolescents included in the high school transcript analytic subsample.

Table 11.A2. Pairwise Correlations (Unweighted) among Educational Outcomes

	(1)	(2)	(3)	(4)
(1) School engagement (1996)	1.000			
(2) Grade point average (1996 - 1997)	0.234	1.000		
(3) Advanced math course completion	0.138	0.540	1.000	
(4) High school graduation	0.125	0.364	0.297	1.000

Source : Author's tabulations, National Longitudinal Study of Adolescent Health.

Note : Correlations based on analysis sample described in text and cases with nonmissing data on all four educational outcomes.

Table 11.A3. Regression of **School Engagement** (Self-Reported at Wave 2) on Family Structure and Select Independent Variables: National Longitudinal Study of Adolescent Health (n = 4,251)

	Model 1		Model 2		Model 3	
School engagement (wave 1)	------		0.521 *	0.025	0.512 *	0.024
Family structure (waves 1 and 2)						
Stable two biological parents	------		------		------	
Stable single mother	-0.150 *	0.046	-0.065	0.035	-0.029	0.039
Stable married stepfamily	0.007 †	0.050	0.066 †	0.043	0.084 †	0.045
Stable cohabiting stepfamily	-0.264 *	0.083	-0.077	0.064	-0.048	0.067
Family structure transiton	-0.211 *	0.055	-0.147 *	0.049	-0.129 *	0.045
Race / ethnicity						
Hispanic	------		------		------	
Black	0.359 *	0.063	0.212 *	0.053	0.221 *	0.052
Asian	0.189 *	0.088	0.092	0.087	0.096	0.085
Native American	0.019	0.124	0.125	0.102	0.119	0.101
White	0.131 *	0.059	0.071	0.048	0.070	0.050
Other race	0.021	0.202	0.028	0.148	0.001	0.154
Age (wave 1)						
<14	------		------		------	
14	-0.108 *	0.037	-0.042	0.028	-0.037	0.028
15	-0.194 *	0.037	-0.081 *	0.028	-0.075 *	0.028
Female (1 = yes)	0.097 *	0.028	0.025	0.023	0.033	0.023
Foreign born (1=yes)	0.069	0.053	0.031	0.047	0.031	0.047
Urban (wave 1)	-0.042	0.038	-0.019	0.034	-0.020	0.034
Family income-to-needs ratio (wave 1)						
<1	------		------		------	
1 to 1.9	------		------		-0.017	0.046
2 to 3.9	------		------		-0.028	0.050
4+	------		------		0.028	0.053
Missing	------		------		0.023	0.060
Mother's years of schooling (wave 1)						
< 12 years	------		------			
12 years	------		------		0.006	0.045
13-15 years	------		------		-0.021	0.044
>= 16 years	------		------		-0.012	0.051
Mother's age at child's birth	------		------		-0.001	0.002
Parenting (wave 1)						
Parental presence	------		------		0.047 *	0.014
Mother's involvement	------		------		-0.009	0.007
Biological father's involvement	------		------		0.008	0.007
Constant	3.103 *	0.060	1.456 *	0.090	1.371 *	0.122

Note : * p < .05 (two-tailed test). † Differs significantly from family structure transition (p < .05, two-tailed test).

Table 11.A4. Coefficients (and Standard Errors) from OLS Regression of **GPA** (from 1996-97 Transcripts) on Selected Independent Variables: National Longitudinal Study of Adolescent Health (n = 3,390)

	Model 1		Model 2		Model 3	
GPA (self-reported, wave 1)	------		0.719 *	(0.023)	0.668 *	(0.023)
Family structure (waves 1 and 2)						
Stable two biological parents	------		------		------	
Stable single mother	-0.158 *	(0.053)	-0.064	(0.050)	0.013	(0.053)
Stable married stepfamily	-0.147	(0.089)	-0.078	(0.066)	-0.011	(0.063)
Stable cohabiting stepfamily	-0.338 *	(0.123)	-0.129	(0.119)	-0.019	(0.126)
Family structure transiton	-0.265 *	(0.083)	-0.170 *	(0.072)	-0.057	(0.070)
Race / ethnicity						
Hispanic	------		------		------	
Black	-0.180	(0.114)	-0.158	(0.097)	-0.181	(0.089)
Asian	0.488 *	(0.146)	0.229	(0.123)	0.138	(0.116)
Native American	-0.084	(0.207)	-0.108	(0.145)	-0.126	(0.137)
White	0.398 *	(0.070)	0.185 *	(0.054)	0.112 *	(0.055)
Other race	0.508 *	(0.202)	0.162	(0.120)	0.133	(0.125)
Age (wave 1)						
<14	------		------		------	
14	-0.051	(0.044)	0.017	(0.037)	0.030	(0.037)
15	-0.107 *	(0.053)	0.004	(0.041)	0.019	(0.042)
Female	0.301 *	(0.042)	0.179 *	(0.033)	0.208 *	(0.032)
Foreign born	0.006	(0.102)	-0.047	(0.089)	-0.028	(0.083)
Urban (wave 1)	-0.129 *	(0.062)	-0.099	(0.054)	-0.113 *	(0.050)
Family income-to-needs ratio (wave 1)						
<1	------		------		------	
1 to 1.9	------		------		0.127	(0.074)
2 to 3.9	------		------		0.203 *	(0.078)
4+	------		------		0.180 *	(0.077)
Missing	------		------		0.178	(0.094)
Mother's years of schooling (wave 1)						
< 12 years	------		------		------	
12 years	------		------		0.079	(0.056)
13-15 years	------		------		0.216 *	(0.068)
>= 16 years	------		------		0.343 *	(0.068)
Mother's age at birth	------		------		0.010 *	(0.003)
Parenting (wave 1)						
Parental presence	------		------		-0.003	(0.018)
Mother's involvement	------		------		-0.016	(0.009)
Biological father's involvement	------		------		0.014 *	(0.006)
Constant	2.407 *	(0.087)	0.394 *	(0.095)	-0.003	(0.146)

Note: * p < .05 (two-tailed test). [†] Differs significantly from family structure transition (p < .05, two-tailed test).

Table 11.A5. Coefficients (and Standard Errors) from Logistic Regression of **Advanced Math Course Completion** on Selected Independent Variables: National Longitudinal Study of Adolescent Health (n = 3,390)

	Model 1		Model 2		Model 3	
GPA (self-reported, wave 1)	------		1.717 *	(0.131)	1.588 *	(0.135)
School engagement (wave 1)	------		-0.143	(0.084)	-0.079	(0.083)
Family structure (waves 1 and 2)						
Stable two biological parents	------		------		------	
Stable single mother	-0.182 [†]	(0.139)	-0.020 [†]	(0.166)	0.184	(0.184)
Stable married stepfamily	-0.363	(0.191)	-0.296	(0.225)	-0.091	(0.246)
Stable cohabiting stepfamily	-1.198 *	(0.334)	-1.035 *	(0.366)	-0.734	(0.398)
Family structure transiton	-0.623 *	(0.209)	-0.576 *	(0.218)	-0.283	(0.220)
Race / ethnicity						
Hispanic	------		------		------	
Black	-0.032	(0.225)	0.066	(0.258)	-0.086	(0.261)
Asian	0.988 *	(0.395)	0.646	(0.453)	0.388	(0.498)
Native American	-0.420	(0.391)	-0.627 *	(0.366)	-0.673	(0.371)
White	0.486 *	(0.187)	0.112	(0.220)	-0.152	(0.233)
Other race	2.183 *	(0.720)	1.915 *	(0.878)	1.913	(1.000)
Age (wave 1)						
<14	------		------		------	
14	-0.192	(0.118)	-0.082	(0.134)	-0.036	(0.142)
15	-0.274	(0.150)	-0.081	(0.156)	-0.027	(0.165)
Female	0.233	(0.105)	-0.005	(0.114)	0.071	(0.116)
Foreign born	0.273	(0.311)	0.169	(0.303)	0.229	(0.313)
Urban (wave 1)	0.094	(0.158)	0.195	(0.181)	0.187	(0.181)
Family income-to-needs ratio (wave 1)						
<1	------		------		------	
1 to 1.9	------		------		-0.164	(0.232)
2 to 3.9	------		------		0.161	(0.192)
4+	------		------		0.256	(0.214)
Missing	------		------		0.073	(0.211)
Mother's years of schooling (wave 1)						
< 12 years	------		------		------	
12 years	------		------		0.496 *	(0.216)
13-15 years	------		------		0.655 *	(0.215)
>= 16 years	------		------		1.403 *	(0.200)
Mother's age at birth	------		------		0.027 *	(0.011)
Parenting (wave 1)						
Parental presence	------		------		0.025	(0.058)
Mother's involvement	------		------		-0.020	(0.035)
Biological father's involvement	------		------		0.042	(0.028)
Constant	0.352	(0.219)	-3.916 *	(0.448)	-5.235 *	(0.634)

Note: * p < .05 (two-tailed test). [†] Differs significantly from family structure transition (p < .05, two-tailed test).

Table 11.A6. Coefficients (and Standard Errors) from Logistic Regression of **High School Graduation** (by Wave 3) on Selected Independent Variables: National Longitudinal Study of Adolescent Health (n = 4,251)

	Model 1		Model 2		Model 3	
GPA (wave 1)	------		1.075 *	(0.087)	0.944 *	(0.091)
School engagement (wave 1)			0.262 *	(0.094)	0.299 *	(0.096)
Family structure (waves 1 and 2)						
Stable two biological parents	------		------		------	
Stable single mother	-0.566 *	(0.164)	-0.362 *	(0.166)	-0.173	(0.196)
Stable married stepfamily	-0.314 †	(0.205)	-0.207	(0.223)	-0.145	(0.245)
Stable cohabiting stepfamily	-1.166 *	(0.276)	-0.825 *	(0.356)	-0.697	(0.376)
Family structure transiton	-0.844 *	(0.210)	-0.654 *	(0.209)	-0.401	(0.223)
Race / ethnicity						
Hispanic	------		------		------	
Black	0.357	(0.250)	0.267	(0.247)	0.100	(0.247)
Asian	1.395 *	(0.447)	1.089 *	(0.498)	0.773	(0.509)
Native American	0.476	(0.438)	0.692	(0.483)	0.522	(0.485)
White	0.547 *	(0.160)	0.309	(0.159)	-0.052	(0.179)
Other race	0.545	(0.702)	0.520	(0.733)	0.365	(0.819)
Age (wave 1)						
<14	------		------		------	
14	-0.156	(0.134)	0.004	(0.136)	0.057	(0.139)
15	-0.133	(0.182)	0.116	(0.182)	0.152	(0.177)
Female	0.368 *	(0.105)	0.163	(0.110)	0.207	(0.113)
Foreign born	-0.316	(0.260)	-0.416	(0.295)	-0.287	(0.281)
Urban (wave 1)	-0.227	(0.150)	-0.157	(0.156)	-0.194	(0.146)
Family income-to-needs ratio (wave 1)						
<1	------		------		------	
1 to 1.9	------		------		0.348	(0.192)
2 to 3.9	------		------		0.695 *	(0.210)
4+	------		------		0.865 *	(0.260)
Missing	------		------		0.216	(0.219)
Mother's years of schooling (wave 1)						
< 12 years	------		------			
12 years	------		------		0.319	(0.199)
13-15 years	------		------		0.750 *	(0.215)
>= 16 years	------		------		0.976 *	(0.268)
Mother's age at birth	------		------		0.012	(0.017)
Parenting (wave 1)						
Parental presence	------		------		-0.026	(0.067)
Mother's involvement	------		------		0.059	(0.037)
Biological father's involvement	------		------		0.022	(0.037)
Constant	1.458 *	(0.187)	-2.198 *	(0.387)	-3.217 *	(0.683)

Note: * p < .05 (two-tailed test). † Differs significantly from family structure transition (p < .05, two-tailed test).

Table 11.A7. **Coefficients (and Standard Errors) from Regression of Academic Outcomes on Family Structure and Select Independent Variables: National Longitudinal Study of Adolescent Health**

	Model 1: Baseline		Model 2: Model 1 + Wave 1 Well-Being		Model 3: Model 2 + Parent Selectivity Controls	
School Engagement						
Family structure (waves 1 and 2)						
Stable						
Two biological parents	------		------		------	
Single mother	-0.150 *	(0.046)	-0.065	(0.035)	-0.029	(0.039)
Married stepfamily	0.007	(0.050)	0.066	(0.043)	0.083	(0.045)
Cohabiting stepfamily	-0.264 *	(0.083)	-0.077	(0.064)	-0.050	(0.067)
Transition						
Two bio parents to single mother	-0.048	(0.115)	-0.055	(0.079)	-0.045	(0.076)
Single mother to stepfamily (either type)	-0.271 *	(0.079)	-0.205 *	(0.079)	-0.184 *	(0.077)
Married stepfamily to single mother	-0.482 *†	(0.167)	-0.377 *†	(0.179)	-0.352 *†	(0.176)
Cohabiting stepfamily to single mother	-0.118	(0.134)	-0.004	(0.101)	0.007	(0.093)
Grade Point Average						
Family structure (waves 1 and 2)						
Stable						
Two biological parents	------		------		------	
Single mother	-0.158 *	(0.053)	-0.065	(0.049)	0.012	(0.053)
Married stepfamily	-0.147	(0.089)	-0.078	(0.066)	-0.011	(0.064)
Cohabiting stepfamily	-0.338 *	(0.123)	-0.130	(0.119)	-0.020	(0.126)
Transition						
Two bio parents to single mother	0.018	(0.154)	-0.041	(0.124)	0.021	(0.116)
Single mother to stepfamily (either type)	-0.402 *	(0.131)	-0.221 *	(0.110)	-0.092	(0.112)
Married stepfamily to single mother	-0.101	(0.238)	0.079	(0.207)	0.158	(0.221)
Cohabiting stepfamily to single mother	-0.353 *	(0.127)	-0.308 *	(0.125)	-0.168	(0.123)

(Continued.)

Table 11.A7. (Continued)

	Model 1: Baseline		Model 2: Model 1 + Wave 1 Well-Being		Model 3: Model 2 + Parent Selectivity Controls	
Advanced Math Course Taking						
Family structure (waves 1 and 2)						
Stable						
Two biological parents	------		------		------	
Single mother	-0.184	(0.139)	-0.026	(0.167)	0.179	(0.185)
Married stepfamily	-0.364	(0.190)	-0.297	(0.225)	-0.099	(0.245)
Cohabiting stepfamily	-1.201 *	(0.333)	-1.043 *	(0.364)	-0.745	(0.394)
Transition						
Two bio parents to single mother	0.340	(0.422)	0.285	(0.484)	0.465	(0.491)
Single mother to stepfamily (either type)	-0.598 *	(0.295)	-0.328	(0.307)	0.003	(0.335)
Married stepfamily to single mother	-1.354 *	(0.467)	-1.415 *†	(0.465)	-1.233 *†	(0.492)
Cohabiting stepfamily to single mother	-1.022 *	(0.398)	-1.190 *	(0.423)	-0.819 *	(0.420)
High School Graduation						
Family structure (waves 1 and 2)						
Stable						
Two biological parents	------		------		------	
Single mother	-0.566 *	(0.165)	-0.362 *	(0.166)	-0.165	(0.195)
Married stepfamily	-0.315	(0.205)	-0.207	(0.223)	-0.143	(0.245)
Cohabiting stepfamily	-1.166 *	(0.276)	-0.825 *	(0.355)	-0.690	(0.376)
Transition						
Two bio parents to single mother	-0.681	(0.413)	-0.600	(0.419)	-0.564	(0.447)
Single mother to stepfamily (either type)	-0.851 *	(0.275)	-0.582 *	(0.283)	-0.225	(0.304)
Married stepfamily to single mother	-1.465 *†	(0.457)	-1.172 *†	(0.434)	-1.179 *†	(0.415)
Cohabiting stepfamily to single mother	-0.578	(0.520)	-0.533	(0.584)	-0.128	(0.616)

Note: Results for school engagement and GPA are based on logistic regression models and those for completion of advanced math and high school graduation are based on logistic regression models. All models also include controls for academic well-being at wave 1, as described in text. Controls for Wave 1 well-being and selectivity are displayed in appendix Tables 11.A3 – 11.A6.

* $p < .05$ (two-tailed test). †Transition from married stepfamily to single mother differs significantly from stable married stepfamily. ‡Transition from cohabiting stepfamily to single mother differs significantly from stable cohabiting stepfamily. ⁺Transition from single mother to stepfamily differs significantly from stable single-mother family.

Online Appendix 12

Converging Evidence for Neighborhood Effects on Children's Test Scores:

An Experimental, Quasi-experimental, and Observational Comparison*

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This online appendix presents additional material for our chapter on the relationship between neighborhood environments and children's academic achievement.

Appendix Table 12.A1 compares the average baseline child, household and neighborhood characteristics for people in the different neighborhood-effect studies that we review in our chapter.

Appendix Table 12.A2 reports the average neighborhood conditions during the study period for the control group in each of our studies, as well as the effects of voucher-assisted mobility on these average neighborhood characteristics (the effects of treatment on the treated).

Appendix Table 12.A3 reports average crime rates for each of the five cities in the Moving to Opportunity study sample for a selected year (1998). MTO enrolled and randomly assigned families over the period from 1994–98; relative rankings of MTO cities with respect to their levels of homicide or other crimes are similar if we look at crime data from other years.

Appendix figure 12.A1 reports the results of testing for neighborhood effects on verbal scores in the Project on Human Development in Chicago Neighborhoods (PHDCN) sample separately for African American versus Hispanic children. In the originally published PHDCN paper Sampson, Sharkey and Raudenbush (2008) treated extreme concentrated disadvantage as a binary variable and therefore discarded children who had no probability of ever living in such extreme conditions. In this analysis, however, we treat concentrated disadvantage as a continuous variable and are able to use data from all of the Hispanics (N = 733) and African Americans (N = 1,066) in the original sample. More specifically, we use a propensity score matching model to use covariates from the first wave of the longitudinal PHDCN samples to predict the level of concentrated neighborhood disadvantage that families will experience during the second wave of the study. We then stratify the sample on these predicted "dosages," with 23 strata for blacks and 25 strata for Hispanics. Within strata there is balance in baseline covariates, although at the same

time there is also some variation within these strata in the neighborhood environments that families actually experience. Under the assumption that within strata, variation in actual neighborhood environments is uncorrelated with other determinants of children's learning, then we can fit a model to the data that weights the different strata-specific relationships in concentrated disadvantage and verbal scores to get an overall estimated relationship. The best model for both Hispanics and African Americans is a negatively sloped line. While the negative relationship is not quite statistically different from zero for Hispanics, at the same time we also cannot reject the null hypothesis that this negative relationship is the same as the one we find for African Americans.

Appendix Figures 12.A2 and 12.A3 report the results of testing for non-linearity of concentrated neighborhood disadvantage on children's verbal scores using data from MTO, and provide one way to explore the possibility of non-linearities visually. We plot the level of the average concentrated disadvantage index and average reading and math scores (converted to Z-scores with mean of 0, standard deviation of 1) for the compliers and would-be compliers in each MTO treatment and control group in each site, and then connect these points, so that the horizontal distance covered by each line shows the treatment-on-the-treated effect in that site on concentrated disadvantage while the vertical distance covered by each line shows the treatment-on-the-treated effect on test scores. Appendix Figure 12.A2 provides some suggestive evidence for non-linearity in reading scores, although this is less clear for math in Appendix Figure 12.A3. Of course with just 15 data points our ability to draw strong conclusions is quite limited.

We have also carried out a series of empirical analyses to formally test for non-linearity in the relationship between neighborhood concentrated disadvantage and children's test scores. Our first test of non-linearity comes from the PHDCN data. As noted above, our analysis calculates a predicted neighborhood "dosage" for all African Americans and Hispanics in the dataset and then

stratifies the sample with respect to this predicted dosage to ensure balance in baseline covariates for people who actually experience different neighborhood environments and so for whom we would wish to compare outcomes. Within each of the 23 strata for African Americans and 25 strata for Hispanics, we first examine whether the best-fitting function between concentrated disadvantage and children's verbal scores is linear or quadratic. In no case can we reject linearity, although of course within strata the range of concentrated disadvantage that families experience is limited so it is perhaps not surprising that a straight line serves as a reasonable local approximation. Our other test is to fit a two-level model to the data and see whether there is variation across strata in the slopes of these lines. While we cannot reject the null that all the slopes are the same, this is not a very high-powered test.

An alternative approach is suggested by Kling, Liebman and Katz (2007), who take advantage of the fact that there is variation across MTO cities and treatment groups in the degree to which MTO treatment group assignment affects different neighborhood attributes. They propose an instrumental variables (IV) design in which interactions between indicators for MTO city and MTO treatment group assignment are used as instruments for specific neighborhood attributes in a regression against whatever outcome measures are of interest. This design essentially asks whether those treatment groups in sites that experience the largest changes in particular neighborhood attributes are also the ones that experience the largest changes in outcomes. The power of this test is limited by the fact that we have just three randomized groups and five cities in MTO, so that the IV design essentially collapses the data into just 15 points. The test also assumes that the only reason that there are differences across cities in responses to the MTO treatment is because the amount of neighborhood change experienced by families in response to randomized MTO treatment group assignment varies across cities. With that caveat in mind, we find some suggestive

evidence of non-linearity in the MTO data for reading scores, where the IV coefficient on the concentrated disadvantage index is .75 (standard error .47) and the coefficient on concentrated disadvantage index squared is −.26 (standard error .14). The coefficients and standard errors for math scores equal −.61 (.45) and .18 (.13). It is not clear exactly how much should be made of these results given that they are estimated fairly imprecisely.

While our analyses do not yield clear, convincing evidence for such non-linearities, it is important to note that our tests have relatively weak statistical power.

Appendix Figure 12.A1: Propensity Adjusted Relationship Between Concentrated Disadvantage and Verbal Test Scores for African American and Hispanic Children in the PHDCN Study, Age Cohorts Six to Twelve
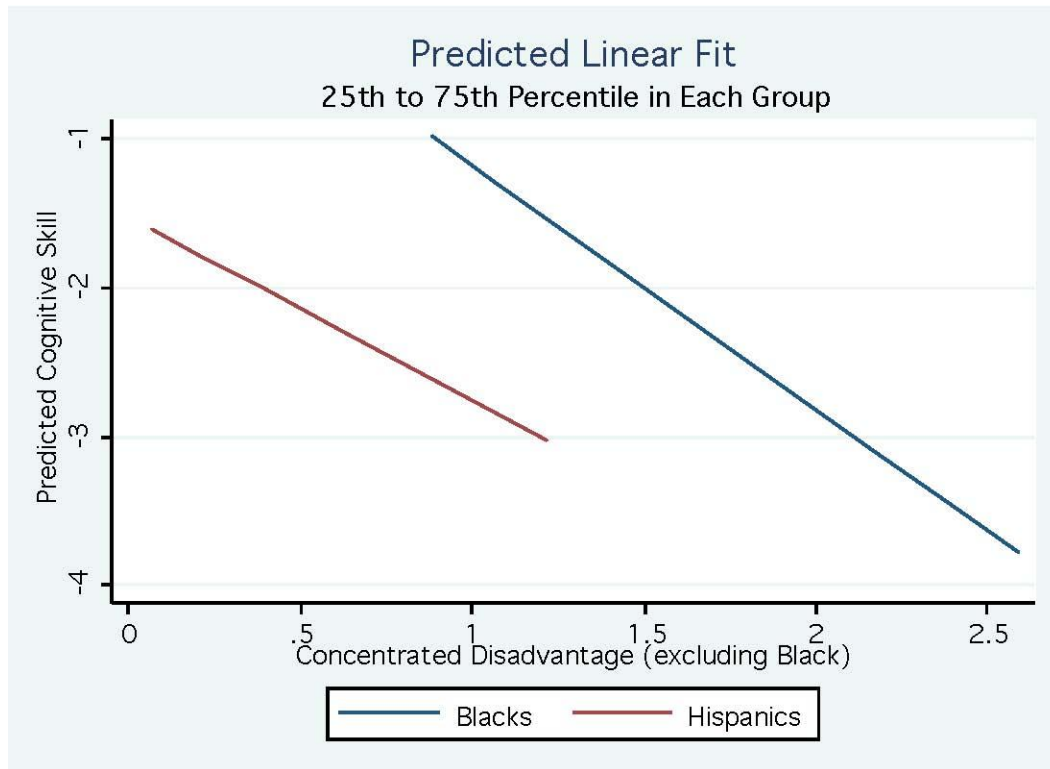
Appendix Figure 12.A2: Relationship Between Concentrated Neighborhood Disadvantage and Children's Reading Scores Across MTO Sites

MTO Impacts on Reading and Neighborhood Disadvantage

Reading Z-Scores

Concentrated Disadvantage Index

Vertical height of arrow represents effect of a voucher move on reading.
Horizontal length of arrow represents effect of a voucher move on concentrated disadvantage.
The effect on reading is statistically significant only for the NYS8 group.
Balt = Baltimore, Bos = Boston, Chi = Chicago, LA = Los Angeles, NY = New York.
Ex = Experimental Group, S8 = Section 8 Group.

Appendix Figure 12.A3: Relationship Between Concentrated Neighborhood Disadvantage and Children's Math Scores Across MTO Sites

MTO Impacts on Math and Neighborhood Disadvantage

Math Z-Scores

Concentrated Disadvantage Index

BosEx
BosS8
NYS8
NYEx
BaltEx
ChiEx
BaltS8
LAEx
LAS8
ChiS8

Vertical height of arrow represents effect of a voucher move on reading.
Horizontal length of arrow represents effect of a voucher move on concentrated disadvantage.
The effect on math is statistically significant only for the BaltEx and NYS8 groups.
Balt = Baltimore, Bos = Boston, Chi = Chicago, LA = Los Angeles, NY = New York.
Ex = Experimental Group, S8 = Section 8 Group.

Appendix Figure 12.A4: MTO Site-by-Site Results in Effects of Treatment Assignment on Beat-Level Local Violent Crime Rates
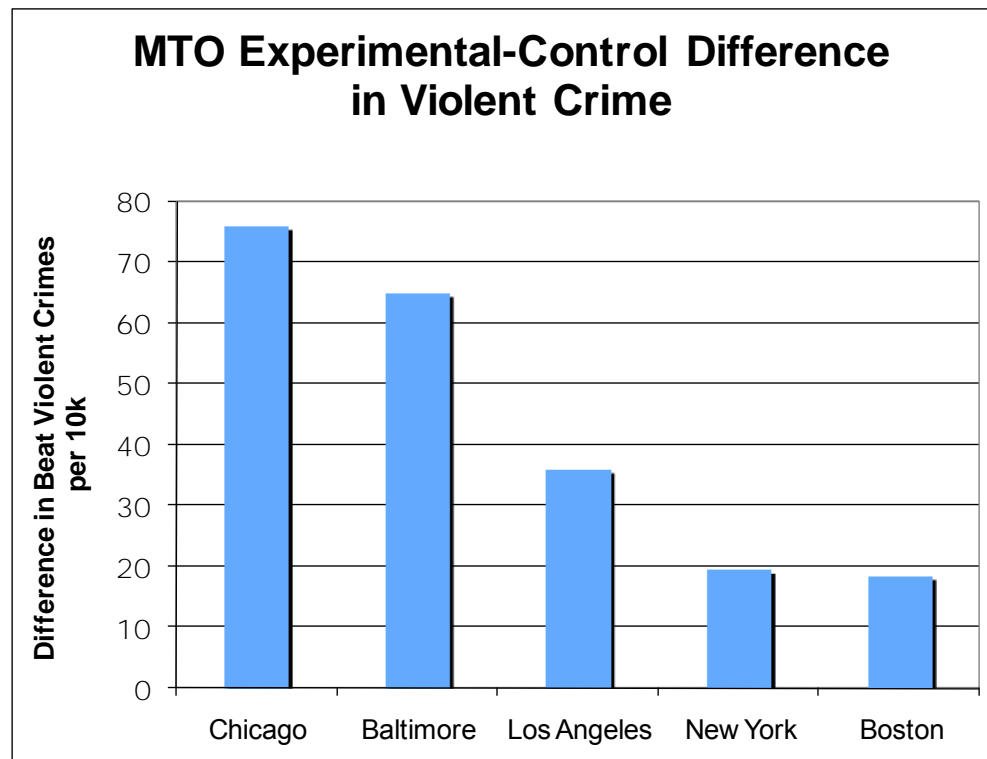
Notes: The y-axis in the figure shows the difference in the average violent crime rate per 10,000 police beat or district residents for families assigned to the MTO experimental treatment group rather than the MTO control group (an intent to treat effect), for each of the MTO sites listed along the x-axis.

Appendix Table 12.A1: Comparing Baseline Characteristics Across Study Samples

	Gautreaux	Public Housing Demolitions	PHDCN: African American	PHDCN: Hispanic	CHAC: Public Housing	CHAC: In MTO Tract at Baseline	MTO: Full Sample	MTO: Chicago Only	MTO: Chicago, Baltimore Only	MTO: NY, LA, Boston
Child Age	8.47	10.34	9.01	8.93	7.76	7.67				
		(4.01)	(2.52)	(2.49)	(2.21)	(2.25)				
Household Head Characteristics:										
Age	36.06		36.83	35.34	30.51	30.05	34.09	32.49	32.91	34.81
			(9.30)	(6.93)	(6.64)	(6.33)	(9.08)	(8.78)	(8.78)	(9.18)
African American	1.00	1.00	0.98	0.01	0.98	0.99	.67	.99	.99	.47
			(0.13)	(0.09)	(0.13)	(0.08)	(.4)	(.09)	(.12)	(.50)
Hispanic			0.00	0.95	0.01	0.00	.29	.01	.01	.46
			(0.04)	(0.22)	(0.09)	(0.03)	(.45)	(.08)	(.11)	(.50)
Employed			0.53	0.52	0.35	0.33	.27	.27	.26	.27
			(0.50)	(0.50)	(0.48)	(0.47)	(.43)	(.43)	(.43)	(.44)
Receiving Welfare	50.03		0.48	0.23	0.83	0.85	.74	.81	.81	.71
			(0.50)	(0.42)	(0.38)	(0.36)	(.43)	(.39)	(.39)	(.45)
Neighborhood Characteristics:										
Tract Poverty Rate		0.84	0.27	0.22	0.61	0.71	.50	.66	.58	.45
		(0.11)	(0.13)	(0.10)	(0.19)	(0.11)	(.14)	(.10)	(.15)	(.12)
Tract share black			0.76	0.13	0.89	0.99	.59	.99	.90	.39
			(0.29)	(0.18)	(0.24)	(0.06)	(.33)	(.04)	(.23)	(.21)
Tract share adults unemployed			0.17	0.11	0.33	0.39	.25	.40	.33	.20
			(0.07)	(0.04)	(0.13)	(0.11)	(.12)	(.08)	(.12)	(.08)
Tract share female-headed			0.52	0.29	0.77	0.85	.65	.88	.80	.56

households								
	(0.14)	(0.11)	(0.18)	(0.06)	(.20)	(.06)	(.18)	(.14)
Tract share persons on welfare	0.24	0.15	0.47	0.55	.23	.36	.26	.22
	(0.10)	(0.08)	(0.17)	(0.14)	(.13)	(.12)	(.16)	(.11)
Tract share persons under age 18	0.30	0.31	0.45	0.50	.38	.49	.40	.36
	(0.06)	(0.06)	(0.11)	(0.07)	(.11)	(.06)	(.13)	(.09)
Concentrated disadvantage index	2.20	0.70	3.00	3.39	2.18	3.16	2.74	1.84
	(1.11)	(0.85)	(0.77)	(0.33)	(.72)	(.29)	(.71)	(.46)
Concentrated disadvantage index (without % black)	1.93	0.84	2.25	2.56	1.69	2.34	1.99	1.51
	(1.18)	(0.87)	(0.61)	(0.31)	(.51)	(.27)	(.55)	(.38)

Notes: This table reports baseline household and neighborhood characteristics for the different studies that we review: Project on Human Development in Chicago Neighborhoods (Sampson, Sharkey and Raudenbush, 2008); Chicago public housing demolition study (Jacob 2004); Chicago CHAC voucher study for families living in public housing at baseline (Ludwig et al., 2010); and results from the Moving to Opportunity (MTO) study for different cities (Sanbonmatsu et al., 2006). The concentrated disadvantage index is a weighted average of several different census tract-level characteristics including tract-share poor, tract-share black, tract-share unemployed, tract-share households headed by a female, tract-share on welfare, and share of the tract's population that is under age 18.

Appendix Table 12.A2: Control Means and Effects of Voucher-Induced Mobility at Follow-Up—Neighborhood Characteristics

	CHAC: Public Housing at Baseline	CHAC: In MTO Census Tract at Baseline	MTO: Full Sample	MTO: Chicago Only	MTO: Chicago and Baltimore Only	MTO: NY, LA, and Boston
Tract Poverty Rate						
Control Mean	0.481	0.467	0.392	0.419	0.387	0.394
Impact of voucher moves	−0.274*	−0.336	−0.190*	−0.183*	−0.140*	−0.213*
	(0.094)	(0.259)	(.019)	(.069)	(.041)	(.018)
Tract share black						
Control Mean	0.837	0.912	0.548	0.857	0.848	0.371
Impact of voucher moves	0.028	−0.112	−0.022	0.038	−0.059	−0.009
	(0.091)	(0.287)	(.028)	(.086)	(.057)	(.029)
Tract share adults unemployed						
Control Mean	0.142	0.147	0.191	0.243	0.221	0.173
Impact of voucher moves	−0.0421	−0.060	−0.074*	−0.068	−0.065*	−0.077*
	(0.025)	(0.053)	(.010)	(.039)	(.023)	(.009)
Tract share female-headed households						
Control Mean	0.327	0.353	0.558	0.649	0.640	0.510
Impact of voucher moves	−0.145*	−0.277	−0.133*	−0.076	−0.105*	−0.144*
	(0.060)	(0.183)	(.020)	(.070)	(.043)	(.020)
Tract share persons on welfare						
Control Mean	0.257	0.289	0.177	0.192	0.164	0.184
Impact of voucher moves	−0.113*	−0.239	−0.085*	−0.064	−0.038	−0.108*
	(0.052)	(0.169)	(.011)	(.038)	(.022)	(.012)
Tract share persons under age 18						
Control Mean	0.402	0.412	0.357	0.387	0.359	0.355
Impact of voucher moves	−0.091*	−0.155	−0.054*	−0.095*	−0.055*	−0.051*
	(0.036)	(0.109)	(.009)	(.029)	(.017)	(.009)

Concentrated disadvantage index						
Control Mean	2.057	2.170	1.869	2.307	2.192	1.678
Impact of voucher moves	−0.548*	−1.012	−0.488*	−0.404	−0.397*	−0.528*
	(0.258)	(0.809)	(.067)	(.240)	(.143)	(.064)
Concentrated disadvantage index (without % black)						
Control Mean	1.357	1.408	1.409	1.59	1.482	1.366
Impact of voucher moves	−0.572*	−0.918	−0.465*	−0.436	−0.348*	−0.516*
	(0.215)	(0.648)	(.052)	(.189)	(.110)	(.051)

Notes: This table reports the effects of relocating using a housing voucher on different neighborhood characteristics reported at left; that is, each cell in the table represents the difference in average neighborhood characteristics for children who moved with a voucher versus the average for those children in the control group who would have moved had their families been assigned a voucher (the effect of treatment on the treated, or TOT). The voucher effect cells report the difference in average characteristics with the standard error underneath reported in parentheses. Each column reports results for a different study and/or sample within a study: Project on Human Development in Chicago Neighborhoods (Sampson, Sharkey and Raudenbush, 2008); Chicago public-housing demolition study (Jacob 2004); Chicago CHAC voucher study for families living in public housing at baseline (Ludwig et al., 2010); and results from the Moving to Opportunity (MTO) study for different cities (Sanbonmatsu et al., 2006). The concentrated disadvantage index is a weighted average of several different census tract-level characteristics including tract-share poor, tract-share black, tract-share unemployed, tract-share households headed by a female, tract-share on welfare, and share of the tract's population that is under age 18.
* denotes statistically significant at the 5 percent level.

Appendix Table 12.A3: Citywide Crime Rates for the Five MTO Cities

	1998 Homicide Rate	1998 UCR Part 1 Violent Crime Rate	1998 UCR Part 1 Property Crime Rate
Baltimore	47.1	2,420	8,527
Boston	6.1	1,327	4,924
Chicago	25.6	2,191	6,884
Los Angeles	11.8	1,359	3,714
New York	8.6	1,167	3,225

Table shows crime rates per 100,000 city residents.

Source: U.S. Statistical Abstracts, 2000, table 332. Violent crime rate for Chicago is taken from the Chicago PD annual report for 1998, rather than from the Statistical Abstracts, because the city's forcible rape figures are not reported in accordance with the national Uniform Crime Reporting guidelines and so not reported by the FBI (Chicago uses a broader definition than rape, to include all criminal sexual assaults, although only 2,387 out of the city's total 62,947 part 1 UCR violent crimes were criminal sexual assaults, so this should not have much impact on the comparability of the figures reported in the table). The population denominator we use for Chicago for 1998 is linearly interpolated from 1990 and 2000 decennial census figures.

Online Appendix

Chapter 13
Unpacking Neighborhood Influences on Education Outcomes:
Setting the Stage for Future Research
Harding et al.

Table of Contents

In this online appendix we include a more detailed description of effect heterogeneity and an expanded discussion of our illustrative example.

A. Effect Heterogeneity

The theoretical perspectives discussed in of our chapter provide broad outlines of how neighborhood effects on educational outcomes might work, but none of these frameworks adequately considers how the daily experiences of youth differ within neighborhoods, i.e. how they spend their time, where they spend their time, with whom they spend their time, and how such exposure influences attitudes, frames, expectations, etc. These differences are a potentially important but largely uninvestigated source of effect heterogeneity. Here we provide further discussion to motivate the importance of effect heterogeneity in a conceptual framework as well as in the design of studies and subsequent empirical analysis.

We begin with differences across individuals in social networks as one possible source of neighborhood effect heterogeneity. Though most neighborhood effects theories implicitly assume that neighborhoods play some role in structuring the social networks of

their residents, we actually know little about whether—or more importantly for whom—this is the case, particularly among youth. Social networks are one of the key conduits through which information and cultural frames or scripts are transmitted, but by no means the only one. Social networks of youth of a similar age ("peer networks") have received considerable attention in the literature (e.g. Anderson 1999). Such peer networks may play important roles as cultural conduits, as most theories of peer effects assume, but our theories need to be more specific about who those peers are, which peer attachments are more common among young people in poor neighborhoods, and what is transmitted through peer networks. Harding (2009, 2010) argues that older adolescents and young adults on the street in poor violent neighborhoods have considerable cultural power and play an important role in socializing younger adolescents by exposing them to local cultural frames and scripts regarding schooling and sexual behavior.

A second source of effect heterogeneity is different behavioral adaptations to the challenges of daily life in poor neighborhoods. A focus on behavioral adaptations explicitly considers the individual as an actor who can adapt in different ways to mitigate or overcome challenges faced in different neighborhoods. The distinction developed by Sharkey (2006) between "imposed" environments (everything present in the neighborhood where an individual lives) and "selected" environments (the people and institutions with whom he or she interacts) highlights the idea that youth living in the same neighborhood may choose very different social environments for themselves. Different choices or adaptations can have different consequences. For example, violent neighborhoods provide particular challenges to adolescents. In order to feel safe, some adolescents may engage in behaviors such as demonstrating toughness, altering daily

travel routines, forming strong bonds of mutual protection with friends, or relying on

older individuals for protection in order to avoid victimization (Anderson 1999, Harding

2009, 2010). These same behaviors may have unintended educational consequences

because they can be interpreted as resistant or disruptive by teachers (Dance 2002).

Another example is provided by Carter (2005) who argues that "cultural authenticity" (in

the form of speech styles, clothing, music and other tastes) among ethno-racial minority

groups can have positive payoffs in terms of group membership and solidarity (what

Carter calls "non-dominant cultural capital") but also can be misinterpreted by white

middle-class teachers as oppositional or resistant. Parents may also adapt their parenting

practices in response to the neighborhood environment, for example by limiting their

children's interactions with neighbors (Furstenberg et al. 1999, Jarrett 1997ab).

A third potential source of neighborhood effect heterogeneity is variation in

family characteristics and the interaction between family characteristics and the

properties of social settings. Here effect heterogeneity is driven less by differences in

social interactions and more by differences between individuals and families. We

illustrate some of the complexities inherent in this type of effect heterogeneity through

the example in Appendix Table 13.A1. This relatively simple example focuses on one

type of neighborhood mechanism, a neighborhood resource, and two sources of effect

heterogeneity: family capacity and access to non-neighborhood opportunities.

Appendix Table 13.A1: Effect Heterogeneity by Family Capacity for Neighborhood Resource

	High Family Capacity		Low Family Capacity	
	High Access to	Low Access to	High Access to	Low Access to

	Outside Opportunities	Outside Opportunities	Outside Opportunities	Outside Opportunities
High Neighborhood Resources	+	+	?	−
Low Neighborhood Resources	+	-	?	−

The two rows in the above table represent different types of neighborhoods –

neighborhoods with either high or low resources. Without loss of generality,

neighborhood resources might include different types of social services and non-school

educational programs. Examples would be a neighborhood health center, an after-school

program, or summer day camp. Such resources can remove youth from the physical and

social dangers of the street by providing safe venues as well as positive socialization, for

example through well-designed and supervised community centers with an array of age-

appropriate social activities. We assume, however, that these resources are not abundant

enough to serve all children in the neighborhood. We also assume that such resources

might be acquired elsewhere, should an individual or family be able to access non-local

resources. Alternatively, this model could be developed to consider how families of

different types were affected by neighborhood deficits, e.g. a lack of safe streets.

Presumably, high capacity families would be more capable of minimizing the effects of

deficiencies.

The four columns represent different types of families. Particular differences are

discussed below. The cell in each column represents a prediction of whether the outcome

on some generic variable of interest would be positive or negative. Examples might be

educational attainment, presence of behavioral problems, adolescent pregnancy or gang problems. In this scheme, a neighborhood effect only occurs in a particular column (that is for a particular family type) when the outcome differs depending on whether the neighborhood has a high versus low level of resources.

Our table distinguishes families along two dimensions. First is the capacity of the family. By this we simply mean the ability of a family to take advantage of resources if they are available to them. High capacity families are those that will capitalize on the opportunities available to their children. Low capacity families will not. The level of capacity might be the result of family structure, parental education, family income, the number of children, or parental health.

The second dimension distinguishes families in terms of their access to opportunities outside their neighborhood. These opportunities might have to do with family members or friends. A single mother might send her child each weekend to play with her sister's children in a safer neighborhood. Alternatively, because a neighborhood has good access to public transportation or a family has a car, a parent might well be able to access resources for their children outside the neighborhood that are not available in their own neighborhood, such as a higher quality school.

The above typology results in four types of families: high capacity-high outside opportunities, high capacity-low outside opportunities, low capacity-high outside opportunities, low capacity-low outside opportunities families. Now consider why the level of resources in a neighborhood does or does not affect a particular type of family:

High/High   Families are able to provide necessary resources for their children
                     whether or not those resources are available in their neighborhood.
                     Example: Wealthy family living in the downtown of a large city
                     whose children attend private schools.

High/Low   Because these families have low access to outside opportunities, they only can provide those opportunities to their children if they are available in their neighborhood. Example: A high capacity, but relatively poor family living in a neighborhood with many social services. This is the one family type where neighborhood resources make a difference. Example: A low-income family taking the initiative to enroll their child in a specially tailored school program, like that offered in the Harlem Children's Zone.

Low/High   What the prediction should be here is unclear, though the low capacity of the family means that they will not take advantage of neighborhood resources even when they are present. What is unclear is whether the presence of outside opportunities results in a positive outcome. For example, as Carol Stack argued in *All Our Kin* (1974)*, the presence of high capacity extended kin members results in positive outcomes for the children of a low capacity parent.

Low/Low   These are families that are low capacity and do not have good outside opportunities. Even if their neighborhood has considerable resources, they are unable to take advantage of them. Example: a single parent addicted to drugs who has alienated her extended family.

It is important to remember that this model is meant to represent a set of ideal types. Obviously, it is quite simplistic. Despite its simplicity, it provides at least two important insights. First, of the four types of families, the resources of the neighborhood only make a difference for one type of family—the high capacity family that does not have good access to opportunities outside the neighborhood. All other families are not affected by neighborhood resources because either they do not need them (they have high access to opportunities outside the neighborhood) or they are unable to use them (they are low capacity).

Second, our schema, if correct, would suggest that policy interventions that seek to enhance place-based resources should focus on three aims. First is providing good

neighborhood resources to high capacity families. This might mean either investing in their neighborhoods or moving them from a low to a high resource neighborhood. Second, policy interventions should be developed to help low capacity families access the resources in their neighborhoods. This means getting local social service organizations to reach out to the most troubled families as opposed to simply helping those who actively seek assistance. Third, our model demonstrates the appreciable difficulties in improving the lives of low capacity families in low resource neighborhoods. To help these families, one needs to get them access to resources generally and, just as importantly, to help them to take full advantage of those resources.

B. Further Random Assignment Design Research Considerations

In our chapter we very briefly sketched a study design to examine one potential neighborhood effects mechanisms, neighborhood violence. The goal of the hypothetical study was to estimate the effects of neighborhood violence on youth educational outcomes. Here we discuss features of the research design in greater detail. Our aim is not to present a complete research design (or even one that is clearly feasible without vast resources), but rather to discuss aspects of the research design that illustrate ways to apply the ideas discussed in the main text.

Consider first the various approaches to identifying the effect of neighborhood violence. Handled through a standard multivariate regression analysis, any estimate of neighborhood violence on youth educational achievement might be biased by confounding characteristics of the youth, his or her family, and other aspects of the neighborhood environment that influence school performance and that are also correlated

with neighborhood violence. This situation leaves researchers in a dilemma: Where can a researcher find exogenous sources of variation to identify the effects of a neighborhood characteristic like exposure to violence? We need one or more variables that produce variation in exposure to violence but do not otherwise affect the outcome of interest. We can think about this by considering two sources of plausible exogenous variation: variation that is planned and variation emerging from a natural experiment. Planned variation can arise from random assignment or experimental designs. Randomization ensures that individuals (or whatever unit is randomized) assigned to the treatment and control groups are the same across both observed and unobserved characteristics, except for chance variation. One strategy is for the researcher to indirectly manipulate neighborhood conditions by encouraging residential mobility, for example, by offering a housing voucher (such as in the Moving to Opportunity mobility experiment). A second strategy is to directly alter neighborhood characteristics through a place-based intervention. In a placed-based intervention, a random subset of neighborhoods would experience a direct intervention such as newly built after school clubs or the addition of street workers to reduce gang violence, and a random subset of otherwise comparable neighborhoods would not receive the intervention. A third strategy, the one we use in this example, is to randomly manipulate exposure to the neighborhood characteristic.

Well-conceived and properly implemented random assignment studies have high potential for unraveling causal effects, but researchers are faced with trade-offs. Practical and ethical considerations may make the manipulation of certain processes difficult or undesirable no matter how important these processes may be from an explanatory perspective. However, mechanisms that involve, for example, gangs, drugs, or violence

can still be examined through experimental manipulations as long as the manipulation focuses on increasing the safety of the treated group and leaves the control group no worse off. Further, a number of circumstances can dilute the intended treatment effects (often described as issues of noncompliance). For example, participants may not take up the offer of a new opportunity, service or program and ethical considerations often preclude requiring or mandating participation. Researchers also cannot prevent study participants from accessing a similar service on their own, or unintentionally receiving the experimental treatment even if initially assigned to the control group. Second, depending on the mechanisms and outcomes of interest, experiments can be expensive and may require a very long follow-up before meaningful outcomes are measurable. The costs of experiments may limit sample sizes and statistical power to detect effects that are small or moderate in magnitude. Third, a series of practical constraints must be carefully weighed: implementation and noncompliance may mean that not everyone in the treatment group receives the intended intervention, the study population may be narrowly defined and thus results may not be generalizable to full-scale or mandatory programs, and well-done experiments can only focus on a limited number of interventions. As a result, while experiments are useful for identifying causal effects once leading hypotheses have been identified, they may not be as useful for generating hypotheses. In fact, the power of randomized designs to make contributions to the literature may not be fully leveraged until after researchers have analyzed observational and/or qualitative data to generate a narrow set of hypotheses. For more on random assignment study designs, we refer readers to Orr (1999).

The second type of study design that harnesses exogenous variation in the treatment is a "natural experiment" in which policy manipulations or other social or economic processes not directly related to the outcome create exogenous variation in either residential mobility or neighborhood characteristics. Examples include the residential mobility created by demolition of public housing projects (Jacob 2004), and the use of natural boundaries that determine public school districts (Hoxby 2001). Here researchers must be opportunistic and leverage naturally occurring exogenous variation in the neighborhoods that youth experience. The challenge is that such variation must be known a priori and must be measured. Moreover, any claim that such variation is truly exogenous is based on assumptions about social and economic processes and subject to skepticism from other researchers. The neighborhood effects literature has produced few if any natural experiments whose identification strategies have not been met by significant skepticism.

In the illustrative example, we focus on planned variation through a random assignment design. We propose manipulating the amount of time youth spend in their neighborhood under the assumption that out-of-school time use affects exposure to violence which affects educational performance. Note that there are multiple ways in which exposure to violence may affect educational outcomes (see the main text) and that many, such as stress or trauma, require long-term cumulative exposure to violence. Since in this example the change in exposure to violence is short term, we focus on outcomes that are more likely to respond immediately to a reduction in exposure to violence, such as school attendance, tardiness, and engagement in school. These responses to exposure to violence can ultimately contribute to achievement.

Our proposed study design is individual random assignment embedded within a matched-neighborhood design. The matched neighborhoods allow us to place youth into neighborhoods that are similar to their own on demographic and economic characteristics but have lower levels of violence. In the first stage, selected high violence neighborhoods are matched to neighborhoods comparable on poverty, race, and education that have lower rates of violence (see Seith et al, 2003 on the feasibility of matched-neighborhood designs). An intervention could be designed that is non-academic and that involves engagement with the neighborhood – such as working on a local clothing drive. For the second stage of the study, we could recruit youth from the neighborhoods with higher levels of neighborhood violence, so that the neighborhoods where subjects are assigned by the intervention are all less risky than their home neighborhoods. We would randomly assign these youth to teams in different locations outside of their own neighborhoods, some of which would have lower neighborhood violence than others. Some type of financial incentive might be designed to encourage participation in the intervention activity.

The first important piece of data collection is baseline information through a survey measuring the characteristics of the individuals and their families prior to the intervention (including a variety of indicators to gauge family capacity as described in the first section of this appendix) and baseline characteristics of the neighborhoods through census or comparable community-level data including crime rates. During the intervention, monitoring of program implementation verifies treatment fidelity and identifies any unintended consequences. To assess the impact of the intervention, data collection would include a follow-up survey to document youth time use (hours spent

engaged in certain activities, where and with whom); longitudinal school records to track youth attendance, disciplinary actions taken by the school, and school grades over the course of the intervention; follow-up information on the characteristics of the experimental and control neighborhoods; and open ended qualitative interviews to capture more nuanced aspects of time use and participation in the program as well as subjects' experiences with schooling and with neighborhood violence both prior to and during the intervention.

Our proposed randomized design to manipulate time use can test the hypothesis that spending time in a lower violence neighborhood results in lower exposure to violence and increases youth school attendance, reduces tardiness and school disciplinary action. Under this hypothesis, we would expect, for example, the difference between post-intervention attendance rates and pre-intervention attendance rates to be larger in groups assigned to lower violence neighborhoods. The intervention manipulates exposure to neighborhoods that differ in their levels of violence but does not directly manipulate exposure to violence itself. We can use survey data and qualitative data to measure the intervention's impact on exposure by asking youth about their experiences with violence in their day-to-day activities and traveling to and from school, and we can consider measures of anxiety or stress that can be captured through survey reports.

Stratification of the sample based on pre-intervention youth characteristics – such as measures of their vulnerability – or family characteristics -- such as family capacity -- could be used to explicitly test hypotheses about effect heterogeneity. For example, we might expect that only highly vulnerable youth in a high violence neighborhood would be affected by exposure to violence. The sample would be stratified by youth vulnerability

and then the youth in each stratum would be randomized to the control or intervention group.

Although this research design is appealing in its simplicity, it is important to note its limitations. The randomized experiment will not allow for testing of other neighborhood effects mechanisms unless one is willing to make very strong assumptions about selection on observables and independent mechanisms. As we discuss in the main text, examining multiple mechanisms requires multiple sources of exogenous variation. Moreover, even well-thought out simple designs can generate perplexing findings that might be due to the unanticipated effects of treatment assignment, and this sometimes necessitates a reconsideration of the initial study design. Nevertheless, when designed well, randomized experiments and natural experiments, such as the one described here focused on neighborhood violence, offer promise for uncovering mechanisms.

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Online Appendix

Chapter 14

The Effects of Local Employment Losses on Children's Educational Achievement

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Technical Appendix

As an example of our analysis strategy, when looking at the effect of losses on test scores, we estimate the equation:

$$Score_{dcy} = \varphi_1 JL_{cq} + \varphi_2 JL_{cq-1} + \varphi_3 JL_{cq-2} + \varphi_4 JL_{cq-3} + \theta_y + \theta_c + \theta_c * y + \theta_c * y^2 + \varepsilon \quad (1)$$

where $Score_{dcy}$ is the average normalized test score for students in demographic group d (such as female 8th graders) in county c in year y, and JL_{cq} through JL_{cq-3} is a set of quarterly measures representing the number of jobs lost to closings and layoffs for that county c in the four quarters of year y, as discussed in more detail below. All models also include year indicators, county indicators, and linear and quadratic county time trends (county indicators interacted with year and year squared). In some regressions, we estimate a variation on equation (1) that replaces $Score_{dcy}$ with another county-year outcome, such as an indicator for whether a student in demographic d scored above a specific threshold.

To create the county level measures JL_{cq} through JL_{cq-3}, we sum job losses over the quarter and normalize that sum by the number of prime-aged adults 25 to 64 residing in the county. When using this measure, if a county with 100,000 adults aged 25 to 64

experienced exactly one job loss in a quarter, and that job loss affected 1000 individuals, then the value of the variable *JL* for that county in that quarter would be 1000/100,000, or 1.00%.

In some cases, we use an alternate measure of job losses that represents the share of losses attributable to a given demographic group g:

$$JL_{gcq} = \sum_i \text{share\_}g_i L_{icq},$$

where *g* is a population subgroup such as high school graduates, women, African Americans, or 16- to 20-year-olds, *c* is county, *q* is quarter, and L_{icq} is the number of jobs lost in the industry, *i*, that experienced the closing. *Share_g_i* is group *g*'s national share of employment in industry *i*. When using this measure, if the county in the above example experienced the loss in an industry that employs 50 percent women and 30 percent African Americans nationally, then *JL* would equal 0.50% for women and 0.30% for African Americans.

Estimating φ_1 through φ_4, the effects of job losses in each quarter on that year's test scores (or another outcome), using county and year fixed effects and county-specific time trends produces coefficients free of bias due to unobserved time-invariant effects and nonlinear trends. This means the estimated effects are not mistakenly capturing the fact that counties with above average closings may have below average scores, or that both closings and scores are increasing over the sample period and trending faster in some counties. For example, an estimate of φ_1 of -0.1 when looking at the effect of normalized job losses on normalized reading scores would imply that a county that experienced a job loss to 1% of its working-age population in the quarter of the test had reading scores 1/10 of a standard deviation lower than would otherwise be expected given that county's typical test scores and recent trend in scores.

But while controlling for these unobserved effects removes the county- and year-specific components from the error term, it is reasonable to expect some arbitrary contemporaneous and/or serial correlation in the remaining idiosyncratic errors that could bias the standard errors around the estimates of φ. For instance, it is likely that residuals in a given county are correlated over time, or that business closings in one year may induce further business closings in the next year—making prediction errors in one period correlated with those in another. Following Stock and Watson (2006), we correct for these correlated errors using a county-level cluster-robust variance estimator, which produces appropriate confidence intervals around estimates of we correct for these correlated errors using a county-level cluster-robust variance estimator, which produces appropriate confidence intervals around estimates of φ.

Appendix Table 14.A1. County Variables

	Mean	Std. Dev	Min	Max
Demographics[a]				
Job losses$_q$	0.16	0.45	0	5.55
Job losses$_{q-1}$	0.18	0.49	0	5.54
Job losses$_{q-2}$	0.22	0.62	0	6.13
Job losses$_{q-3}$	0.22	0.65	0	9.02
Working Age Population (age 25-64)	50,908	71,552	2,158	587,183
Unemployment rate	5.73	2.62	0.80	34.10
Percent Poverty	15.20	4.37	6.80	32.00
Dissimilarity Index	24.2	17.3	0	82.0
Percent Minority	26.52	17.44	0.46	70.19
Percent Black	21.74	16.59	0	62.72
Percent Hispanic	2.96	2.88	0.12	21.14
Percent Asian	0.64	0.78	0	5.70
Percent Other	1.82	5.00	0	39.00
Test scores				
8th grade[b]				
Reading score				
Overall	212.3	51.5	132	290
Low parent education subgroup	209.5	51.3	132	290
High parent education subgroup	215.9	51.6	132	290
Math score				
Overall	256.2	67.8	137	386
Low parent education subgroup	252.2	67.4	137	386
High parent education subgroup	261.5	67.9	137	386
4th grade[c]				
Reading score				
Overall	197.4	52.1	118	275
Low parent education subgroup	192.5	52.1	118	275
High parent education subgroup	203.6	51.5	118	275
Math score				
Overall	236.8	71.7	111	374
Low parent education subgroup	231.8	71.9	111	374
High parent education subgroup	243.2	71.0	114	374

Other outcomes[a]
  # of legally reportable offenses per 1000
students

# of legally reportable offenses per 1000 students	4.7	3.4	0	25.7
8th grade attrition (%)	5.77	3.10	0	33.24
4th grade attrition (%)	5.45	2.32	0	15.55
Resources[a]				
Total Per Pupil Exp	7000	1364	4378	15300
1 Year Teacher Turnover (%)	19.81	5.31	5.73	45.16
Tax Revenue (population weighted)	1479	574	0	6300

[a]N=1100 (100 counties X 11 years)

[b]N=1,054,642 students (across all years)

[c]N=1,075,670 students (across all years)

Job losses defined as: number of workers who lost jobs/population aged 25-64
q refers to the quarter when test was taken

Dissimiliarity index can be interpreted as the percentage of whites (or of nonwhites) that would have to move to a different school in order to produce a completely even distribution. Dissimilarity index presented here ranges from 0-100.

Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs; 1990 U. S. Decenial Census; U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics; and North Carolina Education Research Data Center.

Appendix Table 14.A2. Regressions on Math and Reading Scores

	8th graders		4th graders	
Student characteristics	Reading	Math	Reading	Math
	b	b	b	b
	SE	SE	SE	SE
All				
losses$_q$	-0.0054	-0.0065	-.0100†	-0.0051
	(0.0052)	(0.0060)	(0.0053)	(0.0068)
losses$_{q-1}$	-.0114†	-0.0140	-0.0049	-0.0043
	(0.0061)	(0.0091)	(0.0065)	(0.0064)

5

<u>By education</u>[a]

<u>HS or less</u>

losses$_q$	-.0135*	-.0133*	-.0110†	-0.0066
	(0.0059)	(0.0061)	(0.0065)	(0.0068)
losses$_{q-1}$	-.0108†	-0.0131	-0.0026	0.0007
	(0.0058)	(0.0090)	(0.0066)	(0.0078)

<u>More than HS</u>

losses$_q$	0.0056	0.0012	-0.0075	-0.0005
	(0.0073)	(0.0088)	(0.0068)	(0.0097)
losses$_{q-1}$	-.0151†	-0.0218	-0.0054	-0.0082
	(0.0087)	(0.0133)	(0.0084)	(0.0090)

<u>Girls, HS or less</u>

losses$_q$	-.0137**	-.0140†	-0.0091	-0.0061
	(0.0049)	(0.0083)	(0.0064)	(0.0083)
losses$_{q-1}$	-0.0047	-0.0062	-0.0088	-0.0096
	(0.0062)	(0.0099)	(0.0103)	(0.0107)

<u>Girls, More than HS</u>

losses$_q$	0.0053	0.0044	-0.0104	-0.0056
	(0.0074)	(0.0093)	(0.0087)	(0.0111)
losses$_{q-1}$	-0.0170	-0.0117	-0.0033	-0.0073
	(0.0105)	(0.0125)	(0.0101)	(0.0164)

<u>Boys, HS or less</u>

losses$_q$	-0.0147	-0.0133	-.0132†	-0.0064
	(0.0106)	(0.0084)	(0.0079)	(0.0075)
losses$_{q-1}$	-.0160†	-.0199*	0.0057	.0118†
	(0.0087)	(0.0098)	(0.0074)	(0.0070)

<u>Boys, More than HS</u>

losses$_q$	0.0045	-0.0033	-0.0027	0.0064
	(0.0099)	(0.0124)	(0.0103)	(0.0107)
losses$_{q-1}$	-0.0133	-.0343†	-0.0029	-0.0035

	(0.0122)	(0.0198)	(0.0126)	(0.0117)

By race/ethnicity and education

<u>Whites, HS or less</u>

$losses_q$	-.0133*	-0.0140	-0.0053	-0.0084
	(0.0053)	(0.0104)	(0.0077)	(0.0083)
$losses_{q-1}$	-0.0017	-0.0049	0.0020	0.0051
	(0.0078)	(0.0111)	(0.0085)	(0.0095)

<u>Whites, More than HS</u>

$losses_q$	0.0079	0.0031	0.0032	0.0099
	(0.0067)	(0.0086)	(0.0075)	(0.0104)
$losses_{q-1}$	-.0148†	-0.0192	-0.0029	-0.0086
	(0.0079)	(0.0139)	(0.0078)	(0.0086)

<u>Blacks, HS or less</u>

$losses_q$	0.0009	-0.0187	-0.0408	-0.0190
	(0.0107)	(0.0157)	(0.0252)	(0.0178)
$losses_{q-1}$	-0.0203	-0.0198	0.0121	0.0202
	(0.0158)	(0.0136)	(0.0241)	(0.0159)

<u>Blacks, More than HS</u>

$losses_q$	-0.0173	-0.0263	-0.0317	-0.0232
	(0.0215)	(0.0242)	(0.0238)	(0.0234)
$losses_{q-1}$	-0.0314	-0.0507	-0.0352	-0.0414
	(0.0303)	(0.0377)	(0.0363)	(0.0304)

<u>Hispanics, HS or less</u>

$losses_q$	-0.0102	-0.0064	0.0027	-0.0082
	(0.0599)	(0.0585)	(0.0343)	(0.0402)
$losses_{q-1}$	-0.0688	-0.0538	-0.0038	-0.0033
	(0.0471)	(0.0384)	(0.0394)	(0.0280)

<u>Hispanics, More than HS</u>

$losses_q$	-0.0137	-0.0355	.1824*	.2035*
	(0.0578)	(0.0527)	(0.0725)	-(0.0793)
$losses_{q-1}$	-0.0385	-0.0013	-0.0550	0.0810

(0.0861)	(0.0887)	(0.0784)	(0.1072)

†p<.10, *p<.05, **p<.01

[a]Refers to the educational attainment of the student's parents. Gender and race/ethnicity refer to the student.

losses defined as: number of workers who lost jobs/population aged 25-64

q refers to the quarter when test was taken

All regressions include controls for losses in q-2 and q-3; coefficients are suppressed. Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs, and North Carolina Education Research Data Center.

Appendix Table 14.A3. Regressions on Math and Reading Scores

Student characteristics	Affected worker characteristics	8th graders		4th graders	
		Reading	Math	Reading	Math
		b	b	b	b
		SE	SE	SE	SE
By education[a]					
HS or less	HS or less				
	losses$_q$	-0.0122*	-0.0112†	-0.0101	-0.0040
		(0.0056)	(0.0064)	(0.0062)	(0.0065)
	losses$_{q-1}$	-0.0089	-0.0115	0.0012	0.0015
		(0.0054)	(0.0084)	(0.0064)	(0.0069)
	More than HS				
	losses$_q$	-0.0129*	-0.0127*	-0.0097	-0.0077
		(0.0060)	(0.0055)	(0.0062)	(0.0062)
	losses$_{q-1}$	-0.0126*	-0.0133	-0.0038	0.0003
		(0.0052)	(0.0088)	(0.0060)	(0.0085)
More than HS	HS or less				
	losses$_q$	0.0070	0.0026	-0.0078	-0.0009
		(0.0069)	(0.0081)	(0.0067)	(0.0083)
	losses$_{q-1}$	-0.0135†	-0.0185	-0.0053	-0.0089
		(0.0072)	(0.0120)	(0.0076)	(0.0079)
	More than HS				
	losses$_q$	0.0028	-0.0006	-0.0052	0.0011
		(0.0071)	(0.0083)	(0.0061)	(0.0107)
	losses$_{q-1}$	-0.0145	-0.0228†	-0.0040	-0.0035
		(0.0101)	(0.0129)	(0.0087)	(0.0103)
By Gender and Education					
Girls, HS or less	Female				
	losses$_q$	-0.0136*	-0.0171	-0.0142†	-0.0108
		(0.0062)	(0.0112)	(0.0072)	(0.0097)
	losses$_{q-1}$	-0.0039	-0.0036	-0.0091	-0.0095
		(0.0062)	(0.0110)	(0.0102)	(0.0090)
	Male				
	losses$_q$	-0.0117**	-0.0102†	-0.0051	-0.0028
		(0.0036)	(0.0060)	(0.0055)	(0.0067)
	losses$_{q-1}$	-0.0046	-0.0076	-0.0075	-0.0085
		(0.0054)	(0.0081)	(0.0097)	(0.0108)

Girls, More than HS	Female				
	losses$_q$	0.0045	0.0013	-0.0138	-0.0071
		(0.0075)	(0.0094)	(0.0089)	(0.0120)
	losses$_{q-1}$	-0.0123	-0.0049	0.0021	-0.0059
		(0.0115)	(0.0137)	(0.0088)	(0.0137)
	Male				
	losses$_q$	0.0051	0.0057	-0.0071	-0.0041
		(0.0067)	(0.0084)	(0.0077)	(0.0095)
	losses$_{q-1}$	-0.0178*	-0.0154	-0.0071	-0.0076
		(0.0090)	(0.0098)	(0.0097)	(0.0167)
Boys, HS or less	Female				
	losses$_q$	-0.0151	-0.0150	-0.0164*	-0.0063
		(0.0118)	(0.0099)	(0.0079)	(0.0097)
	losses$_{q-1}$	-0.0136	-0.0153	0.0074	0.0126†
		(0.0093)	(0.0106)	(0.0065)	(0.0066)
	Male				
	losses$_q$	-0.0121	-0.0101	-0.0096	-0.0056
		(0.0088)	(0.0070)	(0.0073)	(0.0055)
	losses$_{q-1}$	-0.0151*	-0.0204*	0.0031	0.0090
		(0.0073)	(0.0083)	(0.0071)	(0.0063)
Boys, More than HS	Female				
	losses$_q$	0.0060	-0.0008	-0.0019	0.0074
		(0.0112)	(0.0138)	(0.0122)	(0.0139)
	losses$_{q-1}$	-0.0171	-0.0314	0.0034	0.0016
		(0.0112)	(0.0195)	(0.0121)	(0.0113)
	Male				
	losses$_q$	0.0033	-0.0038	-0.0025	0.0051
		(0.0085)	(0.0107)	(0.0081)	(0.0077)
	losses$_{q-1}$	-0.0083	-0.0307†	-0.0075	-0.0073
		(0.0118)	(0.0177)	(0.0108)	(0.0102)
By Race and Education					
White, HS or less	White				
	losses$_q$	-0.0122*	-0.0121	-0.0050	-0.0079
		(0.0051)	(0.0107)	(0.0073)	(0.0074)
	losses$_{q-1}$	0.0000	-0.0054	0.0019	0.0078
		(0.0107)	(0.0132)	(0.0110)	(0.0133)
White, More than HS	White				
	losses$_q$	0.0064	0.0027	0.0077	0.0132

Student group[a]	Student characteristics				
		(0.0064)	(0.0088)	(0.0071)	(0.0114)
	$losses_{q-1}$	-0.0154†	-0.0205	-0.0066	-0.0099
		(0.0090)	(0.0133)	(0.0091)	(0.0120)
Black, HS or less	Black				
	$losses_q$	0.0067	-0.0265†	-0.0086	-0.0060
		(0.0114)	(0.0155)	(0.0164)	(0.0135)
	$losses_{q-1}$	-0.0003	-0.0049	0.0142	0.0108
		(0.0049)	(0.0045)	(0.0108)	(0.0077)
Black, More than HS	Black				
	$losses_q$	-0.0162	-0.0279	-0.0227	0.0139
		(0.0132)	(0.0170)	(0.0258)	(0.0237)
	$losses_{q-1}$	-0.0175†	-0.0145	-0.0155	-0.0074
		(0.0101)	(0.0159)	(0.0155)	(0.0118)
Hispanic, HS or less	Hispanic				
	$losses_q$	-0.0001	-0.0002	0.0010	0.0009
		(0.0023)	(0.0021)	(0.0014)	(0.0013)
	$losses_{q-1}$	-0.0030	-0.0013	0.0001	-0.0001
		(0.0019)	(0.0020)	(0.0013)	(0.0009)
Hispanic, More than HS	Hispanic				
	$losses_q$	-0.0012	-0.0014	0.0054	0.0066
		(0.0046)	(0.0030)	(0.0057)	(0.0049)
	$losses_{q-1}$	-0.0004	0.0014	-0.0012	-0.0011
		(0.0031)	(0.0034)	(0.0028)	(0.0042)

†p<.10, *p<.05, **p<.01

[a]Refers to the educational attainment of the student's parents. Gender and race/ethnicity in the student characteristics column refer to the student.

losses defined as: number of workers who lost jobs/population aged 25-64
q refers to the quarter when test was taken
All regressions include controls for losses in q-2 and q-3; coefficients are suppressed.
Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs; 1990 U. S. Decenial Census; and North Carolina Education Research Data Center.

Appendix Table 14.A4. Regressions on Attrition and Legally Reportable Offenses							
	8th graders				4th graders		
	All Counties	Disadvantaged counties	Non-disadvantaged counties		All Counties	Disadvantaged counties	Non-disadvantaged counties
	b	b	b		b	b	b
Attrition from prior year[a]	SE	SE	SE		SE	SE	SE
$losses_q$	-0.0006	0.0002	-0.0013		-0.0005	0.0003	-0.0011
	(0.0014)	(0.0018)	(0.0020)		(0.0011)	(0.0020)	(0.0014)
$losses_{q-1}$	-0.0021	-0.0011	-0.0025		0.0001	0.0000	0.0005
	(0.0013)	(0.0018)	(0.0017)		(0.0010)	(0.0017)	(0.0013)
	All districts						
	All Counties	Disadvantaged counties	Non-disadvantaged counties				
	b	b	b				
Legally Reportable Offenses[b]	SE	SE	SE				
Total losses in prior year	0.0046	0.1686†	-0.0371				
	(0.0807)	(0.0935)	(0.0971)				
†p<.10, *p<.05, **p<.01							
[a]Defined as percentage of students who took the end-of-grade tests in the prior year but not the current year.							
[b]Defined as number of legally reportable offenses per 1000 students.							
losses defined as: number of workers who lost jobs/population aged 25-64							
q refers to the quarter when test was taken							

Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs, and North Carolina Education Research Data Center.

Appendix Table 14.A5. Quantile Regressions on Math and Reading Scores

	8th grade		4th grade	
	Reading	Math	Reading	Math
P (under percentile X)	<u>b</u> <u>SE</u>	<u>b</u> <u>SE</u>	<u>b</u> <u>SE</u>	<u>b</u> <u>SE</u>
HS or less[a]				
10th				
$losses_q$	0.0028	0.0033*	0.0030†	0.0031
	(0.0026)	(0.0016)	(0.0018)	(0.0022)
$losses_{q-1}$	0.0023	0.0025	0.0028	-0.0009
	(0.0022)	(0.0018)	(0.0024)	(0.0018)
20th				
$losses_q$	0.0043	0.0051†	0.0052†	-0.0005
	(0.0031)	(0.0029)	(0.0030)	(0.0026)
$losses_{q-1}$	0.0044†	0.0025	0.0018	-0.0009
	(0.0025)	(0.0032)	(0.0023)	(0.0029)
30th				
$losses_q$	0.0030	0.0057	0.0036	0.0035
	(0.0028)	(0.0036)	(0.0033)	(0.0040)
$losses_{q-1}$	0.0036	0.0053	-0.0003	-0.0007
	(0.0031)	(0.0038)	(0.0027)	(0.0039)
40th				
$losses_q$	0.0029	0.0032	0.0043	0.0037
	(0.0028)	(0.0045)	(0.0036)	(0.0043)
$losses_{q-1}$	0.0044†	0.0059	0.0016	-0.0022
	(0.0026)	(0.0052)	(0.0032)	(0.0036)
50th				
$losses_q$	0.0007	0.0035	0.0052	0.0039
	(0.0027)	(0.0046)	(0.0036)	(0.0039)
$losses_{q-1}$	0.0040	0.0073	-0.0005	-0.0019
	(0.0024)	(0.0055)	(0.0032)	(0.0041)
60th				

losses$_q$	0.0028	0.0048	0.0037	0.0039
	(0.0027)	(0.0041)	(0.0037)	(0.0037)
losses$_{q-1}$	0.0016	0.0069	-0.0020	-0.0025
	(0.0027)	(0.0054)	(0.0033)	(0.0039)

70th

losses$_q$	0.0038	0.0041	0.0024	0.0022
	(0.0023)	(0.0029)	(0.0033)	(0.0034)
losses$_{q-1}$	0.0020	0.0042	-0.0049	-0.0019
	(0.0023)	(0.0044)	(0.0033)	(0.0034)

80th

losses$_q$	0.0007	0.0021	0.0003	0.0011
	(0.0021)	(0.0027)	(0.0023)	(0.0026)
losses$_{q-1}$	0.0006	0.0038	-0.0017	-0.0029
	(0.0025)	(0.0036)	(0.0029)	(0.0033)

90th

losses$_q$	0.0002	0.0004	-0.0000	0.0011
	(0.0016)	(0.0024)	(0.0018)	(0.0022)
losses$_{q-1}$	0.0021	-0.000	0.0019	0.0004
	(0.0020)	(0.0033)	(0.0016)	(0.0028)

More than HS[a]

10th

losses$_q$	-0.0011	-0.0030	0.0038	0.0027
	(0.0029)	(0.0029)	(0.0024)	(0.0023)
losses$_{q-1}$	0.0032	0.0026	-0.0038	0.0025
	(0.0027)	(0.0030)	(0.0047)	(0.0032)

20th

losses$_q$	-0.0041	-0.0002	0.0052†	-0.0011
	(0.0033)	(0.0029)	(0.0031)	(0.0038)
losses$_{q-1}$	0.0076†	0.0085†	-0.0006	0.0026
	(0.0044)	(0.0046)	(0.0052)	(0.0039)

30th

losses$_q$	-0.0058	0.0002	0.0035	0.0014
	(0.0038)	(0.0030)	(0.0036)	(0.0049)

14

losses$_{q-1}$	0.0061	0.0096†	-0.0001	-0.0015
	(0.0046)	(0.0049)	(0.0044)	(0.0066)
40th				
losses$_q$	-0.0056	-0.0037	0.0017	-0.0005
	(0.0043)	(0.0320)	(0.0036)	(0.0049)
losses$_{q-1}$	0.0045	0.0112*	0.0024	0.0013
	(0.0046)	(0.0051)	(0.0046)	(0.0052)
50th				
losses$_q$	-0.0046	-0.0041	0.0033	0.0013
	(0.0034)	(0.0037)	(0.0041)	(0.0046)
losses$_{q-1}$	0.0094*	0.0108†	0.0006	0.0012
	(0.0043)	(0.0056)	(0.0044)	(0.0040)
60th				
losses$_q$	-0.0018	-0.0028	-0.0005	-0.0018
	(0.0031)	(0.0042)	(0.0038)	(0.0044)
losses$_{q-1}$	0.0060	0.0118*	0.0023	0.0062
	(0.0039)	(0.0050)	(0.0042)	(0.0043)
70th				
losses$_q$	-0.0051*	-0.0012	0.0016	-0.0031
	(0.0025)	(0.0037)	(0.0034)	(0.0040)
losses$_{q-1}$	0.0027	0.0035	0.0039	0.0050
	(0.0035)	(0.0041)	(0.0038)	(0.0035)
80th				
losses$_q$	-0.0027	0.0007	0.0005	-0.0028
	(0.0023)	(0.0039)	(0.0030)	(0.0036)
losses$_{q-1}$	0.0038	0.0042	0.0073	0.0035
	(0.0033)	(0.0040)	(0.0053)	(0.0028)
90th				
losses$_q$	-0.0014	-0.0023	0.0028	-0.0000
	(0.0024)	(0.0025)	(0.0021)	(0.0025)
losses$_{q-1}$	0.0017	0.0055†	0.0043	0.0010
	(0.0024)	(0.0030)	(0.0033)	(0.0021)

†p<.10, *p<.05, **p<.01

aRefers to the educational attainment of the student's parents.

losses defined as: number of workers who lost jobs/population aged 25-64
q refers to the quarter when test was taken
All regressions include controls for losses in q-2 and q-3; coefficients are suppressed.

Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs, and North Carolina Education Research Data Center.

Appendix Table 14.A6. Robustness checks

	8th graders		4th graders	
	Reading	Math	Reading	Math
	<u>b</u>	<u>b</u>	<u>b</u>	<u>b</u>
	<u>SE</u>	<u>SE</u>	<u>SE</u>	<u>SE</u>
Merged small counties				
HS or less[a]				
$losses_q$	-0.0132*	-0.0144*	-0.0094	-0.0061
	(0.0060)	(0.0061)	(0.0063)	(0.0070)
$losses_{q-1}$	-0.0111†	-0.0132	-0.0030	0.0008
	(0.0058)	(0.0090)	(0.0067)	0.0078
More than HS[a]				
$losses_q$	0.0053	0.0005	-0.0084	-0.0027
	(0.0074)	(0.0089)	(0.0069)	(0.0092)
$losses_{q-1}$	-0.0145†	-0.0214	-0.0068	-0.0092
	(0.0087)	(0.0133)	(0.0083)	(0.0091)
Losses in student's original county of residence				
HS or less[a]				
$losses_q$	-0.0114*	-0.0119*	-0.0113†	-0.0061
	(0.0057)	(0.0060)	(0.0064)	(0.0069)
$losses_{q-1}$	-0.0092†	-0.0115	-0.0049	-0.0013
	(0.0055)	(0.0082)	(0.0065)	(0.0076)
More than HS[a]				
$losses_q$	0.0097	0.0054	-0.0108	-0.0042
	(0.0073)	(0.0086)	(0.0068)	(0.0102)
$losses_{q-1}$	-0.0155†	-0.0194	0.0040	-0.0080
	(0.0093)	(0.0143)	(0.0081)	(0.0089)
Next year's job losses				
HS or less[a]				
$losses_{q+1}$	0.0067†	0.0070	0.0047	0.0046

	(0.0039)	(0.0062)	(0.0045)	(0.0051)
losses$_{q+2}$	-0.0028	-0.0055	-0.0084†	-0.0012
	(0.0044)	(0.0071)	(0.0049)	0.0057
More than HS[a]				
losses$_{q+1}$	0.0009	-0.0016	0.0009	0.0002
	(0.0042)	(0.0094)	(0.0056)	(0.0063)
losses$_{q+2}$	-0.0077	-0.0092	-0.0004	-0.0109†
	(0.0072)	(0.0076)	(0.0053)	(0.0060)

†$p<.10$, *$p<.05$, **$p<.01$

[a]Refers to the educational attainment of the student's parents.

losses defined as: number of workers who lost jobs/population aged 25-64
q refers to the quarter when test was taken

Appendix Figure 14.A1. Recency-weighted job losses by county by year.

1997

1998

1999

2000

2001

2002

2003

2004

2005

2006

2007
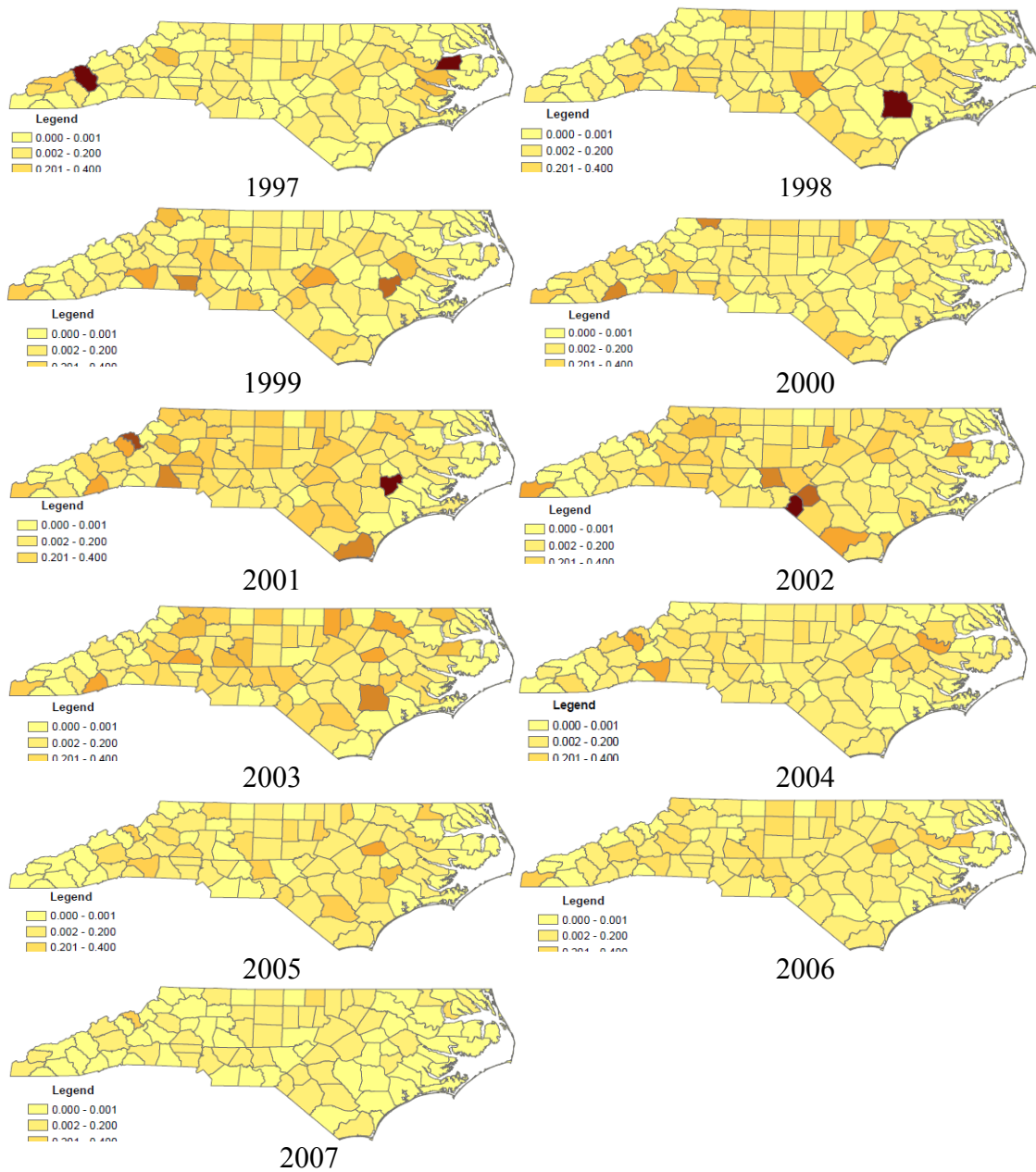
Shading from 0 to .001 recency-weight percent affected (lightest) to 1.8 to 2+ recency-weight percent affected (darkest) in 0.2 percent increments.
Source: Authors' calculations, based on North Carolina Employment Security Commission, Announced Business Closings and Permanent Layoffs.

Online Appendix for Chapter 17

Year-by-Year and Cumulative Impacts of Attending a High-Mobility Elementary School on Children's Mathematics Achievement in Chicago 1995–2005

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This appendix provides detail about the research design, analytic methods, and results of our study of school-level mobility in Chicago.

Research Design and Mobility Rates

We analyzed our data in two phases. The first phase followed 23,344 students from ages 8 to 10 attending 445 elementary schools during 1997-2000 and focused on school-wide effects. The second phase considered 309,064 children who attended 515 Chicago public schools while 8 to10 years of age during the years 1995-2005 and focused on within-school differences in grade-level in-migration rates. Figure 1 below graphically displays the design. The columns in the figure are cohorts born in 1996, 1997, etc. The entries in the columns are the mean school-level mobility rates as these students progress from grade 3 to 5. The rows are years of data collection. The first phase of the study was based on the third column of data, representing students who entered grade 3 in 1998. The second phase used all of the data.

The entries in the figure are school-level mobility rates. We see that mean school-level mobility rates hovered below 10 percent in 1996 and gradually diminished to just below 8 percent by the end of the period of our study. Individual students experienced reduced school-level mobility rates on average as they progressed from grades 3 to 5, but these changes were tiny over such a three-year interval. A school-level mobility rate of 10 percent implies that about 3 new students would enter a typical classroom during the course of the year. Some schools had mobility rates as high as 20% .

Figure 17.A1: Mean school-level mobility Rates, by year of data collection (rows) and year of entry to grade 3 (columns). Data collection in 1995 generated baseline measures for the 1996 cohort.

Year of entry into grade 3

Year of data collection	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1995										
1996	0.097									
1997	0.095	0.097								
1998	0.089	0.091	0.098							
1999		0.088	0.090	0.095						
2000			0.088	0.093	0.095					
2001				0.082	0.084	0.089				
2002					0.081	0.086	0.087			
2003						0.084	0.088	0.086		
2004							0.077	0.079	0.079	
2005								0.078	0.083	0.079

Analytic Methods

We are interested in the estimating the average effect of a given "dosage" of an approximately continuous variable z_h measuring school mobility relative to an alternative dosage $z_h^/$ of school mobility during academic year h on student mathematics achievement. If a student is exposed to dosage z_h, that student will display math achievement $Y(z_h)$ whereas if exposed to dosage $z_h^/$, the outcome or "response" will be $Y(z_h^/)$. The causal effects of interest have the form $Y(z_h) - Y(z_h^/)$. In principle, the range of dosages is constrained to $0 \leq z_h \leq 1$ by our definition of school mobility rate (Equation 1 of the paper). However, the range of plausible dosages to which children of varied background might actually be exposed is an empirical question that we address in Section 5.

We are also interested in the cumulative effects, on average, of exposure to school mobility, that is, the effects of $z_t = \sum_{h=1}^{t} z_h$, the exposure experienced up to (and including) year t in achievement Y_t in year t. The potential outcomes at year t are $Y(z_t)$ and the causal effects of interest are $Y(z_t) - Y(z_t^/)$ where $z_t^/ = \sum_{h=1}^{t} z_h^/$.

After exploring the plausible dosages and dose-response associations, we settled on a linear dose-response relationship as a reasonable approximation. Thus, we summarize the time-specific causal effects as $\Delta = [Y(z_h) - Y(z_h^/)]/(z_h - z_h^/)$ for $z_h \neq z_h^/$. Similarly, the cumulative effects are linear, $\Omega = [Y(z_t) - Y(z_t^/)]/(z_t - z_t^/)$ for $z_t \neq z_i^/$. Note that Δ and Ω are person-specific random variables having population means $E_p(\Delta) = \delta_p$ and $E_p(\Omega) = \omega_p$ where the expectation is taken over units within some population or sub-population p.

Identification of Causal Effects

In non-experimental studies like ours, causal inference is challenging. We know that schools in Chicago that experience high levels of student mobility serve somewhat disadvantaged populations. Nevertheless, it may be that schools experiencing high influxes of students during the year are more effective or at least more attractive than schools that mobile students might otherwise choose. So selection bias poses one challenge to valid causal inference. We use propensity score stratification to adjust for observed confounders when we estimate year-by-year effects.

Given our aim of understanding the cumulative effects of exposure to a high-mobility school, another challenge is reciprocal causation over time. The parents of a child suffering the negative effects of attending a high mobility school may decide to transfer schools, possibly increasing or decreasing the risk of attending another school with high mobility. Thus, the outcomes of earlier dosages of school mobility may change

the expected dosage of school mobility experienced in the future. A fixed effects specification, effective in removing time-invariant confounding, is not ideally suited to the presence of such time-varying confounding. Robins, Hernan, and Brumback (2000) proposed a marginal structural means model with inverse probability of treatment weighting to cope with this problem, and Hong and Raudenbush (2008) extended this to the case where students move across classrooms or schools over time. We employ this strategy as well.

To understand grade-level effects, we control for school-specific grade and year effects. This enables us to compare cohorts attending the same school and same grade but in different years while also removing school-specific year effects. Controlling for school-wide year effects wipes out any chance that this analysis could identify impacts of school-level mobility but provides a sharp focus on within school differences in outcomes by grade level. The assumptions required for valid causal inference are thereby relaxed as we shall describe below.

In the next three sections we consider our analytic strategies in more detail.

Year-by-Year Effects: Propensity Score Stratification

For years $h = 0$ (1997), $h = 1$ (1998), $h=2$ (1999) and $h = 3$ (2000), define Z_{hij} as the school mobility level or dosage experienced by that student at time h and define the math achievement outcomes as Y_{hij}. Define X_{hij} as a vector of covariates available prior to receipt of the treatment at time h. The pre-treatment covariates at time h can then be gathered into the vector L_{hij} that captures a student's history of covariates, treatments, and outcomes, where

$$
\begin{aligned}
L_{1ij} &= \{X_{1ij}, Z_{0ij}, Y_{0ij}\} \; (for \; 1998) \\
L_{2ij} &= \{X_{1ij}, X_{2ij}, Z_{0i}, Z_{1i}, Y_{0ij}, Y_{1ij}\} \; \left(for \; 1999\right) \\
L_{3ij} &= \{X_{1ij}, X_{2ij}, X_{3ij}, Z_{0i}, Z_{1i}, Z_{2i}, Y_{0ij}, Y_{1ij}, Y_{2ij}\} \; \left(for \; 2000\right).
\end{aligned}
\tag{1}
$$

For binary treatments, finely stratifying on the propensity score – the conditional probability of treatment group assignment given pre-treatment covariates – will, in large samples, balance the treatment groups on all the pre-treatment covariates. Hence, the difference between the two treatment means within each stratum will be an unbiased estimate of the treatment effect for students in that stratum under the assumption of ignorable treatment assignment, that is under the assumption $Y(z_h), Y(z_h^{/}) \perp Z_h \mid L_h$ (Rosenbaum and Rubin, 1983). Most applications of this logic involve binary treatments, whereas our study uses an approximately continuous dosage measure. Imai and van Dyk (2003) extended the logic of propensity score stratification to the case of continuous treatment regimes, and we adopt their methods here. Define $P_h(L_h) = E(Z_h \mid L_h)$ as the propensity function or propensity score, in effect, the expected

dosage given the past history as captured by L_h. The key result is that, in large samples, conditioning on the one-dimensional function $P_h(L_h)$ is equivalent to conditioning on the high-dimensional covariate L_h. Thus, if treatment assignment is ignorable given L_h, then it is also strongly ignorable given $P_h(L_h)$. An additional assumption is that the propensity function is correctly specified. However, that assumption can be checked and virtually assured to hold by checking balance, that is checking to see whether the association between Z_h and each element of L_h is null within strata sharing the same or very similar $P_h(L_h)$. We can rectify a failure of balance by either re-stratifying or dropping strata that fail to produce balance. Dropping cases may seem problematic, but the cases so dropped are those that fail the test of common support and therefore contain no causal information. Doing so, of course, modifies the target population for causal inference.

Our estimation model for the propensity score analysis is

$$Y_{hij} = \gamma_{0h} + \delta_h Z_{hij} + \sum_{s=1}^{S-1} \gamma_s D_{shij} + u_{hj} + \varepsilon_{hij} \qquad (2)$$

where D_{shij} is a dummy variable indicating membership of student i attending school j at time h and in propensity stratum s, for $s=1,…,S-1$; and γ_s is a stratum-specific fixed effect. Under the assumption of ignorable treatment assignment given propensity stratum membership, $E(u_h | Z_h = z_h, L_h) = E(u_h | L_h)$ and $E(\varepsilon_h | Z_h = z_h, L_h) = E(\varepsilon_h | L_h)$ and so Equation (5) identifies the causal effect, δ_h. Here $u_{hj}, \varepsilon_{hij}$ are school and student random effects, respectively. Covariates can be included on the right-hand-side of Equation 5 to increase precision, and we did that in our analyses.

Inverse Probability of Treatment Weighting with Continuous Treatment for Cumulative Effects

One of our primary aims was to assess the cumulative effect of exposure to high school mobility. Small effects estimated in a single year may accumulate into large effects, but empirically testing this proposition requires longitudinal data on exposure to school mobility. As mentioned, a key challenge is that responses to earlier outcomes can change the risk of exposure to school mobility in the future while also predicting future outcomes. Robins, Hernan, and Brumbeck (2000) discuss the application of inverse probability of treatment weighting (IPTW) to the case of a repeated cumulative dosage. The key idea is that observed time-varying confounders are controlled through weighting rather than by incorporating these confounders as explanatory variables. The key assumptions are three:

(i)   Sequentially strongly ignorable treatment assignment requires that the dosage of school mobility received at each time h is independent of all future potential outcomes at a given time given past observables. That is $Z_h \perp Y(z_h), Y(z_{h+1}),…, Y(z_T) | L_h$ for $h=1,…,T-1$ where T is the number of time-series observations.

(ii)   As in the case of propensity score stratification, we correctly specify the propensity function $P_h(L_h) = E(Z_h \mid L_h)$.

(iii)   We shall also assume for simplicity that yearly dose-response relationships are equal and additive.

Hong (in press) shows that a failure of common support will generally cause bias in applications of IPTW. We therefore use only those cases in the IPTW analysis that we found to meet the common support test in the propensity score analysis described just above.

The logic of IPTW works as follows. First, write down the model one would estimate if the treatment had been assigned at random with equal probability for all at each time point. Next, define the IPT weights. Third, analyze the "as if randomized" model but with weighting.

Analytic Model for the Outcome. If school mobility had been assigned to students at random each year, we would estimate a cross-classified random effects model wherein time-series observations are cross classified by the child and the school attended. We formulate first a within-cell model that describes the association between time-varying predictors and outcomes for each "cell" defined by the cross-classification of students and schools. The parameters of this model can, in principle, vary over children and schools as a function of explanatory variables and random effects.

Level 1 (between time-points within student-by-school "cells"):

$$Y_{ti} = \pi_{0ti} + \pi_{1i}(Age_{ti}) + \pi_{2i}\sum_{h=1}^{t} Z_{hi} + e_{ti}, \qquad e_{ti} \sim N(0,\sigma^2) \tag{3}$$

where Y_{ti} is the math outcome for child i at time t; π_{0ti} is an intercept that will change over time and as a function of which schools the child has attended by time t; π_{1i} is the annual growth rate of child i if that child attends schools of average effectiveness; π_{2i} is a treatment effect that might in principle vary by student; Z_{hi} is the mobility rate for the school child i attends in year h; and e_{ti} is a random error identically and independently distributed $N(0,\sigma^2)$.

Level-2 (between cells):

$$\pi_{0ti} = \theta_0 + b_{00i} + \sum_{h=0}^{t} c_{j_{hi}}$$

$$\pi_{1i} = \theta_1 + b_{10i} \tag{4}$$

$$\pi_{2i} = \omega.$$

Here θ_0 is the overall average intercept and b_{00i} is a child-specific random effect; θ_1 is the overall average growth rate per year and b_{10i} is a child-specific random effect on the growth rate; ω is the average cumulative effect of school mobility; and $c_{j_{hi}}$ is the random effect associated with school j_{hi}, the school child i attends at time h. Note that these school random effects cumulate. For the random effects we assume

$$\begin{bmatrix} b_{00i} \\ b_{10i} \end{bmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{b00} & \tau_{b01} \\ \tau_{b10} & \tau_{b11} \end{pmatrix}\right], \qquad c_{j_{hi}} \overset{iid}{\sim} N(0, \tau_c^2). \qquad (5)$$

The logic may be clearer if we look at the combined model and how it changes over three years:

Year 0 (1997): $Y_{0i} = (\theta_0 + b_{00i}) + c_{00j_{0i}} + e_{0i}$

Year 1 (1998): $Y_{1i} = (\theta_0 + b_{00i}) + (\theta_1 + b_{10i})(age)_{1i} + \omega Z_{1i} + (c_{00j_{0i}} + c_{00j_{1i}}) + e_{1i}$

Year 2 (1999): $Y_{2i} = (\theta_0 + b_{00i}) + 2(\theta_1 + b_{10i})(age)_{2i} + \omega(Z_{1i} + Z_{2i}) + (c_{00j_{0i}} + c_{00j_{1i}} + c_{00j_{2i}}) + e_{2i}$

Year 3 (2000): $Y_{3i} = (\theta_0 + b_{00i}) + 3(\theta_1 + b_{10i})(age)_{3i} + \omega(Z_{1i} + Z_{2i} + Z_{3i}) + (c_{00j_{0i}} + c_{00j_{1i}} + c_{00j_{2i}} + c_{00j_{3i}}) + e_{3i}$

$$(6)$$

Under this specification, the gain a student experiences during each year h (apart from within-child noise e_{ti}) is $\theta_1 + b_{10i} + \omega Z_{hi} + c_{00j_{hi}}$, the sum of three pieces: the child-specific annual growth rate, $\theta_1 + b_{10i}$, the school's "value added" $c_{00j_{hi}}$, and the cumulating treatment effect ωZ_{hi}.

Defining the weights. Equations 6 and 7 would identify the cumulative effect of school mobility under sequential random assignment of students to doses of school mobility (and, of course, assuming our simple causal structure). However, in fact, students will be assigned doses of school mobility with varied probabilities depending on their past experiences and background characteristics. To solve this problem, the IPTW approach borrows the idea of weighting from sample survey research: those who are "over-represented" at each dosage level will be weighted down.

Specifically, for each student i at time h define the hth "pieces" of the weight sp_{hi}

$$sp_{0i} = 1, \quad sp_{1i} = \frac{f(z_{1i})}{f(z_{1i} \mid L_{1i})}, \quad sp_{2i} = \frac{f(z_{2i} \mid Z_{1i})}{f(z_{2i} \mid L_{2i})}, \quad sp_{3j} = \frac{f(z_{3i} \mid Z_{1i}, Z_{2i})}{f(z_{3i} \mid L_{3i})}. \qquad (7)$$

Then the stabilized weights for at time t is $sw_{ti} = \prod_{h=1}^{t} sp_{hi}$. Thus, for times 1,2, and 3 we have

$$sp_{0i} = 1, \; sw_{1j} = sp_{1j}, \quad sw_{2j} = sp_{1j} * sp_{2j} \quad sw_{3j} = sp_{1j} * sp_{2j} * sp_{3j}. \tag{8}$$

Robins (2000) proved that maximization of the score function weighted by weights of the type in Equation 10 would yield consistent estimates of treatment effects under our assumptions. Hong and Raudenbush (2008) extended this approach to multilevel data, specifically to the case of cross-classified random effects, the design of the current study. They showed how to apply the weights and derive consistent, maximum pseudo-likelihood, model-based standard errors in this case. The model-based standard errors are important because Huber-White robust standard errors are not readily available in the case of students moving across schools because the vector of residuals for each student is potentially correlated with the vector of residuals for every other student.

Evaluating the density functions $f(z_h \mid L_h)$. If a treatment z_h is binary, P_h =Prob($Z_h = z_h \mid L_h$) for $z_h = 0,1$. Thus, cases are weighted inversely proportional to the probability of being selected into the treatment they actually received. Cases over-represented by selection bias are thus down-weighted. The numerators of s_{ph} are the probabilities under randomization, that is, with no dependence on L_h. In contrast, when Z_h is a continuous variable taking on values z_h, $f(z_h \mid L_h)$ is the conditional probability density function evaluated at z_h. To implement this approach, one must therefore adopt a continuous density function to represent the distribution of dosages given L_h. After examining the residuals from our model of $P(z_h \mid L_h) = E(z_h \mid L_h)$, we selected the normal density function for f. The resulting weighted analysis using Equation 6 and will provide us with our estimate of the cumulative effects of school mobility.

Grade-Level Analysis Using Fixed Effects

In this analysis we analyzed data from 309,064 children who attended 515 Chicago public schools while 8-10 years of age during the years 1995-2005. We focused on within-school differences in grade-level in-migration rates. Our aim was to compare cohorts of students within the same school and the same grade but different years, controlling for school-wide year effects. This can be described as an analysis using school-by-year and school-by-grade fixed effects. With 515 schools, three grades, and 11 years of data, such an analysis appears to require many thousands of fixed effects and would thereby seem computationally formidable. However, we can achieve the same result using a cross-classified random effects model that adaptively centers the year and grade indicator variables around their school means (Raudenbush, 2009). The model is

$$Y_{tij} = \alpha_0 + \delta(Z_{tij} - \overline{Z}..._j) + \alpha_4(G_{4tij} - \overline{G}_4..._j) + \alpha_5(G_{5tij} - \overline{G}_5..._j) + \gamma_{99}(D_{99tij} - D_{99}..._j)$$
$$+ \gamma_{00}(D_{00tij} - D_{00}..._j) + \gamma_{01}(D_{01tij} - D_{01}..._j) + c_j + r_i + e_{tij}. \tag{9}$$

A nice feature of this model is that it relaxes the ignorable treatment assignment assumption defined for the earlier analyses above. Consider, for example, the conditionally expected error term of Equation 9 for 1999, grade 4:

$$E(c_j + r_i + e_{tij} \mid year = 2000, grade = 4, Z_{tij} = Z_{2000,4j})$$
$$= E(c_j \mid year = 2000, grade = 4, Z_{tij} = Z_{2000,4j}) \qquad (7)$$
$$+ E(r_i + e_{tij} \mid year = 2000, grade = 4, Z_{tij} = Z_{2000,4j}).$$

We know with certainty that the covariance

$$E[c_j(Z_{2000,4,j} - \overline{Z}..._j) \mid Z_{tij} = Z_{2000,4,j}] = 0 \qquad (8)$$

by virtue of school-mean centering: any within-school deviation score $(Z_{tij} - \overline{Z}..._j)$ cannot be linearly related to the school-level variable c_j. (To see this note that

$\sum_{j=1}^{J}\sum_{i=1}^{n_j}\sum_{t=1}^{T_{ij}} c_j(Z_{tij} - \overline{Z}..._j) = \sum_{j=1}^{J} c_j \sum_{i=1}^{n_j}\sum_{t=1}^{T_{ij}}(Z_{tij} - \overline{Z}..._j) = 0$ because the sum of within-school

deviation scores on any variable must be zero. That is $\sum_{i=1}^{n_j}\sum_{t=1}^{T_{ij}}(Z_{tij} - \overline{Z}..._j) = 0$) .)

What about the assumption that

$$E(r_i \mid year = 2000, grade = 4, Z_{tij} = Z_{2000,4j}) = 0 ? \qquad (9)$$

This says that unobserved child characteristics are unrelated to school level mobility in a given year and grade and also within a given school. Here we must assume that, within the same school and same grade, different cohorts of kids are exchangeable, *controlling for a school-specific year effect*. This is not too unrealistic. For example, if a school is in a gentrifying (or declining) neighborhood, the average effect of such school-specific historical change will be removed from our model by this school-specific fixed effect. If assumption (9) is plausible, we, see, for example, that the comparison between grade 4 in 2000 and grade 4 in 1999 is:

$$E(Y_{tij} \mid year = 2000, grade = 4, Z_{tij} = Z_{2000,4j}) - E(Y_{tij} \mid year = 1999, grade = 4, Z_{tij} = Z_{1999,4j})$$
$$= [\alpha_0 + \delta(Z_{2000,4j} - \overline{Z}..._j) + \alpha_4(1 - \overline{G}_{4}..._j) - \alpha_5\overline{G}_{5}..._j - \gamma_{99}D_{99}..._j + \gamma_{00}(1 - D_{00}..._j) - \gamma_{01}D_{01}..._j]$$
$$- [\alpha_0 + \delta(Z_{1999,4j} - \overline{Z}..._j) + \alpha_4(1 - \overline{G}_{4}..._j) - \alpha_5\overline{G}_{5}..._j + \gamma_{99}(1 - D_{99}..._j) - \gamma_{00}D_{00}..._j - \gamma_{01}D_{01}..._j]$$
$$= \delta(Z_{2000,4j} - Z_{1999,4j}) + \gamma_{00} - \gamma_{99}$$

$$(10)$$

which is what we want.

Results

Year-by-year School-level Effects Based on Propensity Score Stratification

The variables predicting exposure to treatment in the propensity score models are as follows.

Student-Level Variables:
Prior reading achievement, Iowa Test of Basic Skills;
Prior math achievement, Iowa Test of Basic Skills;
Concentrated disadvantage: A composite measure of neighborhood disadvantage as measured by percent of population in poverty, percent of unemployed adults, percent of families receiving welfare, and percent of single-parent families;
Gender;
Race / Ethnicity (white or Asian, black, Hispanic);
Grade level;
Age upon school entry;
Grade Repetition;
An indicator of whether or not an individual has moved between schools;
Prior grade level mobility: Prior rates of exposure to in-migration during the academic year at an individual's grade level.

School-Level Variables:
Prior school-level mobility: Prior rate of exposure to in-migration during the academic year at the school level;
School ethnic composition (percent black, percent white);
Percentage of low-income students in the student body;
Percentage of students with limited English proficiency;
School size;
School mean neighborhood concentrated disadvantage;
Average math pretest, Iowa Test of Basic Skills.

Table 17.A2

Propensity Score Model Estimating the Effect of School-Level Mobility on Math Achievement, 1998			
Fixed Effect	*Coefficient*	*S.E.*	*T-Ratio*
Level-2			
Intercept, γ_{00}	-2.089	.012	-169.874
School-Level Mobility 1998, γ_{01}	-.573	.283	-2.021
Level-1			
Math 1997, γ_{10}	.654	.008	85.247
Continuous Propensity Score, γ_{20}	-4.284	3.031	-1.413
Stratum2, γ_{30}	-.124	.073	-1.694
Stratum3, γ_{40}	-.050	.102	-.484
Stratum4, γ_{50}	.032	.149	.218
Stratum5, γ_{60}	-.009	.163	-.054

Stratum6, γ_{70}	.033	.185	.177
Stratum7, γ_{80}	.027	.197	.135
Stratum8, γ_{90}	.078	.212	.370
Stratum9, γ_{100}	.074	.223	.331
Stratum10, γ_{110}	.141	.232	.608
Stratum11, γ_{120}	.105	.239	.439
Stratum12, γ_{130}	.024	.246	.098
Stratum13, γ_{140}	.155	.252	.614
Stratum14, γ_{150}	.081	.259	.314
Stratum15, γ_{160}	.118	.266	.445
Stratum16, γ_{170}	.168	.271	.621
Stratum17, γ_{180}	.092	.290	.318
Stratum18, γ_{190}	.159	.297	.534
Stratum19, γ_{200}	.127	.301	.420
Stratum20, γ_{210}	.076	.308	.247
Stratum21, γ_{220}	.063	.313	.200
Stratum22, γ_{230}	.134	.319	.419
Stratum23, γ_{240}	.185	.325	.570
Stratum24, γ_{250}	.223	.345	.647
Stratum25, γ_{260}	.217	.353	.613
Stratum26, γ_{270}	.183	.359	.509
Stratum27, γ_{280}	.219	.372	.590
Stratum28, γ_{290}	.237	.378	.629
Stratum29, γ_{300}	.270	.434	.623
Stratum30, γ_{310}	.046	.130	.356
Stratum31, γ_{320}	.068	.159	.424
Stratum32, γ_{330}	.082	.159	.514
Stratum33, γ_{340}	.027	.157	.169
Stratum34, γ_{350}	-0.061	.149	-.411
Stratum35, γ_{360}	-0.056	.174	-.324
Stratum36, γ_{370}	.021	.146	.143
Stratum37, γ_{380}	.234	.277	.845
Stratum38, γ_{390}	.158	.279	.566
Stratum39, γ_{400}	.109	.285	.381
Stratum40, γ_{410}	.087	.288	.303
Stratum41, γ_{420}	.215	.291	.738
Stratum42, γ_{430}	.166	.284	.585
Stratum43, γ_{440}	.204	.330	.620
Stratum44, γ_{450}	.173	.333	.521
Stratum45, γ_{460}	.235	.339	.694
Stratum46, γ_{470}	.215	.342	.631
Stratum47, γ_{480}	.201	.389	.517
Stratum48, γ_{490}	.271	.397	.683
Stratum49, γ_{500}	.210	.404	.520

Stratum50, γ_{510}	.291	.409	.712
Stratum51, γ_{520}	.285	.417	.684
Stratum52, γ_{530}	.329	.467	.704
Stratum53, γ_{540}	.338	.499	.677

Random Effect	Standard Deviation	Variance Component	
Intercept, u_0	.235	.055	
Level-1 Effect, r	.691	.478	

Table 17.A3

Propensity Score Model Estimating the Effect of School-Level Mobility on Math Achievement, 1999			
Fixed Effect	Coefficient	S.E.	T-Ratio
Level-2			
Intercept, γ_{00}	-1.395	.011	-130.677
School-Level Mobility 1999, γ_{01}	-.529	.238	-2.223
Level-1			
Math 1998, γ_{10}	.798	.008	104.902
Continuous Propensity Score, γ_{20}	-5.902	2.73	-2.162
Stratum2, γ_{30}	.122	.097	1.265
Stratum3, γ_{40}	.136	.114	1.200
Stratum4, γ_{50}	.189	.132	1.433
Stratum5, γ_{60}	.209	.146	1.434
Stratum6, γ_{70}	.228	.154	1.482
Stratum7, γ_{80}	.194	.161	1.204
Stratum8, γ_{90}	.260	.176	1.480
Stratum9, γ_{100}	.212	.182	1.164
Stratum10, γ_{110}	.214	.190	1.127
Stratum11, γ_{120}	.157	.196	.803
Stratum12, γ_{130}	.216	.202	1.069
Stratum13, γ_{140}	.270	.208	1.299
Stratum14, γ_{150}	.299	.212	1.406
Stratum15, γ_{160}	.235	.219	1.076
Stratum16, γ_{170}	.251	.222	1.129
Stratum17, γ_{180}	.219	.230	.952
Stratum18, γ_{190}	.242	.232	1.044
Stratum19, γ_{200}	.329	.238	1.382
Stratum20, γ_{210}	.339	.245	1.387
Stratum21, γ_{220}	.281	.248	1.131

Stratum22, γ_{230}	.270	.255	1.061
Stratum23, γ_{240}	.316	.261	1.210
Stratum24, γ_{250}	.299	.266	1.125
Stratum25, γ_{260}	.334	.274	1.220
Stratum26, γ_{270}	.331	.279	1.186
Stratum27, γ_{280}	.377	.291	1.295
Stratum28, γ_{290}	.393	.298	1.319
Stratum29, γ_{300}	.390	.308	1.266
Stratum30, γ_{310}	.460	.324	1.422
Stratum31, γ_{320}	.440	.338	1.302
Stratum32, γ_{330}	.620	.413	1.502
Stratum33, γ_{340}	-.130	.134	-.968
Stratum34, γ_{350}	.062	.051	1.223
Stratum35, γ_{360}	.104	.079	1.314
Stratum36, γ_{370}	.135	.083	1.634
Stratum37, γ_{380}	.213	.176	1.212
Stratum38, γ_{390}	.208	.175	1.188
Stratum39, γ_{400}	.301	.169	1.782
Stratum40, γ_{410}	.300	.173	1.733
Stratum41, γ_{420}	.559	.353	1.582
Stratum42, γ_{430}	.551	.367	1.501
Stratum43, γ_{440}	.629	.355	1.770
Stratum44, γ_{450}	.490	.356	1.378

Random Effect	Standard Deviation	Variance Component
Intercept, u_0	.213	.045
Level-1 Effect, r	.698	.487

Table 17.A4

Propensity Score Model Estimating the Effect of School-Level Mobility on Math Achievement, 2000			
Fixed Effect	Coefficient	S.E.	T-Ratio
Level-2			
Intercept, γ_{00}	-.732	.009	-82.306
School-Level Mobility 2000, γ_{01}	-.721	.235	-3.064
Level-1			
Math 1999, γ_{10}	.822	.005	151.240
Continuous Propensity Score, γ_{20}	.310	1.47	.211
Stratum2, γ_{30}	-.006	.054	-.108

Stratum3, γ_{40}	.017	.069	.249
Stratum4, γ_{50}	-.138	.075	-1.834
Stratum5, γ_{60}	-.118	.081	-1.463
Stratum6, γ_{70}	-.074	.089	-.827
Stratum7, γ_{80}	-.106	.093	-1.141
Stratum8, γ_{90}	-.096	.099	-.968
Stratum9, γ_{100}	-.094	.107	-.886
Stratum10, γ_{110}	-.112	.110	-1.022
Stratum11, γ_{120}	-.150	.111	-1.351
Stratum12, γ_{130}	-.104	.115	-.908
Stratum13, γ_{140}	-.160	.117	-1.363
Stratum14, γ_{150}	-.156	.120	-1.295
Stratum15, γ_{160}	-.170	.122	-1.394
Stratum16, γ_{170}	-.151	.125	-1.213
Stratum17, γ_{180}	-.155	.128	-1.204
Stratum18, γ_{190}	-.157	.130	-1.210
Stratum19, γ_{200}	-.087	.134	-.651
Stratum20, γ_{210}	-.137	.137	-1.003
Stratum21, γ_{220}	-.192	.139	-1.377
Stratum22, γ_{230}	-.164	.142	-1.153
Stratum23, γ_{240}	-.144	.145	-.994
Stratum24, γ_{250}	-.102	.148	-.690
Stratum25, γ_{260}	-.118	.149	-.793
Stratum26, γ_{270}	-.185	.153	-1.206
Stratum27, γ_{280}	-.154	.155	-.989
Stratum28, γ_{290}	-.185	.161	-1.147
Stratum29, γ_{300}	-.131	.166	-.794
Stratum30, γ_{310}	-.188	.168	-1.119
Stratum31, γ_{320}	-.186	.173	-1.075
Stratum32, γ_{330}	-.183	.178	-1.025
Stratum33, γ_{340}	-.186	.184	-1.009
Stratum34, γ_{350}	-.201	.190	-1.061
Stratum35, γ_{360}	-.152	.205	-.745
Stratum36, γ_{370}	-.191	.232	-.828
Stratum37, γ_{380}	.017	.060	.286
Stratum38, γ_{390}	.021	.040	.524
Stratum39, γ_{400}	-.045	.040	-1.122
Stratum40, γ_{410}	-.006	.046	-.141
Stratum41, γ_{420}	.029	.067	.438
Stratum42, γ_{430}	-.074	.056	-1.306
Stratum43, γ_{440}	-.035	.065	-.538
Stratum44, γ_{450}	-.100	.096	-1.037
Stratum45, γ_{460}	-.083	.096	-.864
Stratum46, γ_{470}	-.052	.102	-.512

Stratum47, γ_{480}	-.119	.108	-1.101
Stratum48, γ_{490}	-.167	.116	-1.437
Stratum49, γ_{500}	-.174	.117	-1.490
Stratum50, γ_{510}	-.113	.130	-.871
Stratum51, γ_{520}	-.048	.129	-.373
Stratum52, γ_{530}	-.087	.127	-.682

Random Effect	Standard Deviation	Variance Component	
Intercept, u_0	.172	.029	
Level-1 Effect, r	.649	.422	

Table 17.A5

Propensity Score Model Estimating the Effect of Grade-Level Mobility on Math Achievement, 1998			
Fixed Effect	**Coefficient**	**S.E.**	**T-Ratio**
Level-2			
Intercept, γ_{00}	-2.095	.013	
Level-1			
Math 1997, γ_{10}	.652	.008	
Log Grade-Level Mobility 1998, γ_{01}	-.040	.027	
Continuous Propensity Score, γ_{20}	-.350	.168	
Stratum2, γ_{30}	-.030	.151	
Stratum3, γ_{40}	.104	.219	
Stratum4, γ_{50}	.179	.255	
Stratum5, γ_{60}	.272	.292	
Stratum6, γ_{70}	.336	.321	
Stratum7, γ_{80}	.334	.328	
Stratum8, γ_{90}	.366	.341	
Stratum9, γ_{100}	.327	.351	
Stratum10, γ_{110}	.383	.358	
Stratum11, γ_{120}	.464	.365	
Stratum12, γ_{130}	.417	.370	
Stratum13, γ_{140}	.449	.375	
Stratum14, γ_{150}	.481	.381	
Stratum15, γ_{160}	.461	.386	
Stratum16, γ_{170}	.476	.391	
Stratum17, γ_{180}	.473	.396	
Stratum18, γ_{190}	.491	.399	
Stratum19, γ_{200}	.455	.402	

Stratum20, γ_{210}	.518	.407
Stratum21, γ_{220}	.463	.411
Stratum22, γ_{230}	.510	.414
Stratum23, γ_{240}	.480	.418
Stratum24, γ_{250}	.474	.420
Stratum25, γ_{260}	.527	.424
Stratum26, γ_{270}	.524	.426
Stratum27, γ_{280}	.529	.433
Stratum28, γ_{290}	.485	.437
Stratum29, γ_{300}	.528	.444
Stratum30, γ_{310}	.502	.448
Stratum31, γ_{320}	.531	.453
Stratum32, γ_{330}	.509	.457
Stratum33, γ_{340}	.493	.462
Stratum34, γ_{350}	.549	.467
Stratum35, γ_{360}	.527	.472
Stratum36, γ_{370}	.519	.481
Stratum37, γ_{380}	.405	.494
Stratum38, γ_{390}	.349	.307
Stratum39, γ_{400}	.347	.311
Stratum40, γ_{410}	.445	.431
Stratum41, γ_{420}	.522	.433
Stratum42, γ_{430}	.447	.442
Stratum43, γ_{440}	.493	.443
Stratum44, γ_{450}	.531	.443
Stratum45, γ_{460}	.497	.512
Stratum46, γ_{470}	.500	.519
Stratum47, γ_{480}	.412	.531
Stratum48, γ_{490}	.470	.559

Random Effect	Standard Deviation	Variance Component
Intercept, U_0	.246	.061
Level-1 Effect, r	.686	.471

Table 17.A6

Propensity Score Model Estimating the Effect of Grade-Level Mobility on Math Achievement, 1999			
Fixed Effect	Coefficient	S.E.	T-Ratio
Level-2			

Intercept, γ_{00}	-1.406	.011	-126.386
Level-1			
Math 1998, γ_{10}	.790	.008	101.171
Log Grade-Level Mobility 1999, γ_{01}	-.047	.021	-2.184
Continuous Propensity Score, γ_{20}	-.024	.116	-.203
Stratum2, γ_{30}	.078	.150	.524
Stratum3, γ_{40}	.051	.166	.309
Stratum4, γ_{50}	.006	.180	.035
Stratum5, γ_{60}	-.053	.197	-.268
Stratum6, γ_{70}	-.024	.206	-.119
Stratum7, γ_{80}	-.030	.215	-.141
Stratum8, γ_{90}	-.083	.222	-.374
Stratum9, γ_{100}	-.068	.228	-.296
Stratum10, γ_{110}	-.044	.232	-.190
Stratum11, γ_{120}	-.102	.237	-.430
Stratum12, γ_{130}	-.086	.240	-.359
Stratum13, γ_{140}	-.063	.244	-.257
Stratum14, γ_{150}	-.111	.250	-.443
Stratum15, γ_{160}	-.127	.253	-.501
Stratum16, γ_{170}	-.128	.253	-.504
Stratum17, γ_{180}	-.132	.256	-.514
Stratum18, γ_{190}	-.122	.259	-.470
Stratum19, γ_{200}	-.120	/262	-.457
Stratum20, γ_{210}	-.126	.265	-.477
Stratum21, γ_{220}	-.139	.267	-.520
Stratum22, γ_{230}	-.190	.270	-.703
Stratum23, γ_{240}	-.167	.273	-.610
Stratum24, γ_{250}	-.137	.276	-.495
Stratum25, γ_{260}	-.161	.278	-.580
Stratum26, γ_{270}	-.129	.281	-.460
Stratum27, γ_{280}	-.165	.283	-.584
Stratum28, γ_{290}	-.163	.287	-.569
Stratum29, γ_{300}	-.200	.290	-.690
Stratum30, γ_{310}	-.262	.295	-.890
Stratum31, γ_{320}	-.237	.297	-.798
Stratum32, γ_{330}	-.228	.302	-.756
Stratum33, γ_{340}	-.264	.307	-.860
Stratum34, γ_{350}	-.267	.315	-.850
Stratum35, γ_{360}	-.276	.331	-.832
Stratum36, γ_{370}	-.050	.142	-.349
Stratum37, γ_{380}	-.121	.139	-.865
Stratum38, γ_{390}	-.085	.111	-.774
Stratum39, γ_{400}	-.010	.142	-.073

	Coefficient	S.E.	T-Ratio
Stratum40, γ_{410}	.245	.147	1.666
Stratum41, γ_{420}	-.126	.087	-1.443
Stratum42, γ_{430}	-.004	.079	-.047
Stratum43, γ_{440}	-.102	.247	-.412
Stratum44, γ_{450}	-.082	.249	-.330

Random Effect	Standard Deviation	Variance Component	
Intercept, u_0	.219	.048	
Level-1 Effect, r	.696	.485	

Table 17.A7

Propensity Score Model Estimating the Effect of Grade-Level Mobility on Math Achievement, 2000			
Fixed Effect	Coefficient	S.E.	T-Ratio
Level-2			
Intercept, γ_{00}	-.735	.009	-80.67
Level-1			
Math 1999, γ_{10}	.821	.005	152.699
Log Grade-Level Mobility 2000, γ_{01}	-.003	.013	-.241
Continuous Propensity Score, γ_{20}	.022	.103	.214
Stratum2, γ_{30}	.003	.051	.063
Stratum3, γ_{40}	-.063	.056	-1.133
Stratum4, γ_{50}	-.089	.070	-1.270
Stratum5, γ_{60}	-.069	.069	-.987
Stratum6, γ_{70}	-.078	.080	-.979
Stratum7, γ_{80}	-.083	.086	-.972
Stratum8, γ_{90}	-.128	.090	-1.421
Stratum9, γ_{100}	-.125	.095	-1.318
Stratum10, γ_{110}	-.122	.097	-1.262
Stratum11, γ_{120}	-.108	.101	-1.072
Stratum12, γ_{130}	-.074	.104	-.722
Stratum13, γ_{140}	-.115	.108	-1.066
Stratum14, γ_{150}	-.105	.109	-.964
Stratum15, γ_{160}	-.149	.113	-1.320
Stratum16, γ_{170}	-.131	.114	-1.154
Stratum17, γ_{180}	-.116	.116	-1.000
Stratum18, γ_{190}	-.177	.117	-1.511
Stratum19, γ_{200}	-.123	.120	-1.027
Stratum20, γ_{210}	-.161	.121	-1.328
Stratum21, γ_{220}	-.187	.125	-1.490

Stratum22, γ_{230}	-.179	.126	-1.425
Stratum23, γ_{240}	-.179	.129	-1.388
Stratum24, γ_{250}	-.157	.131	-1.196
Stratum25, γ_{260}	-.161	.135	-1.192
Stratum26, γ_{270}	-.196	.136	-1.443
Stratum27, γ_{280}	-.192	.137	-1.402
Stratum28, γ_{290}	-.221	.139	-1.588
Stratum29, γ_{300}	-.174	.141	-1.236
Stratum30, γ_{310}	-.147	.143	-1.025
Stratum31, γ_{320}	-.170	.145	-1.172
Stratum32, γ_{330}	-.203	.149	-1.364
Stratum33, γ_{340}	-.192	.152	-1.265
Stratum34, γ_{350}	-.190	.152	-1.249
Stratum35, γ_{360}	-.207	.155	-1.337
Stratum36, γ_{370}	-.165	.158	-1.053
Stratum37, γ_{380}	-.173	.164	-1.054
Stratum38, γ_{390}	-.243	.167	-1.452
Stratum39, γ_{400}	-.331	.189	-1.755
Stratum40, γ_{410}	.034	.187	.182
Stratum41, γ_{420}	.157	.133	1.185
Stratum42, γ_{430}	.094	.091	1.023
Stratum43, γ_{440}	.072	.075	.960
Stratum44, γ_{450}	-.014	.064	-.216
Stratum45, γ_{460}	.074	.054	1.371
Stratum46, γ_{470}	-.142	.156	-.913
Stratum47, γ_{480}	-.381	.222	-1.713
Stratum48, γ_{490}	-.193	.262	-.736
Stratum49, γ_{500}	-.139	.167	-.835
Stratum50, γ_{510}	-.135	.161	-.840
Stratum51, γ_{520}	-.226	.163	-1.390
Stratum52, γ_{530}	-.278	.173	-1.609
Stratum53, γ_{540}	-.287	.177	-1.618
Stratum54, γ_{550}	-.168	.141	-1.187
Stratum55, γ_{560}	-.162	.141	-1.143
Stratum56, γ_{570}	-.184	.141	-1.303
Stratum57, γ_{580}	-.153	.141	-1.082
Stratum58, γ_{590}	-.306	.151	-2.029

Random Effect	Standard Deviation	Variance Component
Intercept, U_0	.177	.031
Level-1 Effect, r	.649	.421

Table 17.A8 Cumulative School-level Effects Based on IPTW

Cumulative Effects of School-Level Mobility			
Fixed Effects (Level 1)	*Coefficient*	*S.E.*	*T-Ratio*
Intercept, π_0	-1.273	.056	-22.683
Year, π_1	.807	.028	28.876
School-level Mobility, π_2	-0.721	.266	-2.707
Random Effects	*Standard Deviation*	*Variance Component*	*Chi-Square*
Intercept (Row-Level), b_{00}	.844	.712	200826.7
Year (Row-Level)), b_{10}	.183	.034	27188.1
Intercept (Column-Level), c_{00}	.136	.018	4241.7
Within-school variance σ^2	.479	.228	

Table 17.A9 Yearly Grade Level Effects Based on Fixed Effects

Pooled effects of Grade-Level Mobility

The output below reports the effect of log grade-level mobility controlling for achievement decile. Results are broken down by ethnicity. Note that the first ten π coefficients report the mean achievement for eight-year-old students within each decile. Growth curves in mathematics achievement is estimated through the use of age-by-decile interaction effects. Decile 1 is the lowest achievement group, and decile 10 is the highest.

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. d.f.	*p*-value
For Decile 1, π_1					
White, γ_{10}	-2.192672	0.012272	-178.674	colspan=2>Unable to compute	
Black, γ_{11}	-2.201539	0.007081	-310.893	465228	<0.001
Hispanic, γ_{12}	-2.081012	0.008336	-249.635	465228	<0.001
For Decile 2, π_2					
White, γ_{20}	-1.556582	0.011747	-132.509	465228	<0.001
Black, γ_{21}	-1.617241	0.007114	-227.348	465228	<0.001
Hispanic, γ_{22}	-1.535469	0.007969	-192.681	465228	<0.001
For Decile 3, π_3					
White, γ_{30}	-1.228234	0.010953	-112.134	465228	<0.001
Black, γ_{31}	-1.285129	0.007155	-179.620	465228	<0.001
Hispanic, γ_{32}	-1.214024	0.007827	-155.098	465228	<0.001
For Decile 4, π_4					
White, γ_{40}	-0.923453	0.010622	-86.936	465228	<0.001

	Coefficient	SE	t-ratio	df	p-value
Black, γ_{41}	-1.010491	0.007180	-140.728	465228	<0.001
Hispanic, γ_{42}	-0.927174	0.007726	-120.006	465228	<0.001
For Decile 5, π_5					
White, γ_{50}	-0.654857	0.009953	-65.793	465228	<0.001
Black, γ_{51}	-0.754281	0.007200	-104.762	465228	<0.001
Hispanic, γ_{52}	-0.659928	0.007698	-85.728	465228	<0.001
For Decile 6, π_6					
White, γ_{60}	-0.382228	0.009537	-40.079	465228	<0.001
Black, γ_{61}	-0.500723	0.007220	-69.347	465228	<0.001
Hispanic, γ_{62}	-0.404799	0.007662	-52.834	465228	<0.001
For Decile 7, π_7					
White, γ_{70}	-0.123131	0.009158	-13.445	465228	<0.001
Black, γ_{71}	-0.240103	0.007274	-33.007	465228	<0.001
Hispanic, γ_{72}	-0.139889	0.007676	-18.225	465228	<0.001
For Decile 8, π_8					
White, γ_{80}	0.191260	0.008668	22.065	465228	<0.001
Black, γ_{81}	0.055297	0.007303	7.572	465228	<0.001
Hispanic, γ_{82}	0.161915	0.007638	21.198	465228	<0.001
For Decile 9, π_9					
White, γ_{90}	0.586928	0.008226	71.353	465228	<0.001
Black, γ_{91}	0.431544	0.007373	58.531	465228	<0.001
Hispanic, γ_{92}	0.536767	0.007703	69.682	465228	<0.001
For Decile 10, π_{10}					
White, γ_{100}	1.356503	0.007735	175.371	465228	<0.001
Black, γ_{101}	1.032199	0.007573	136.297	465228	<0.001
Hispanic, γ_{102}	1.148862	0.007869	145.996	465228	<0.001
For 1996 Fixed Effect, π_{11}					
Intercept, θ_{11}	0.014487	0.003487	4.154	465228	<0.001
For 1997 Fixed Effect, π_{12}					
Intercept, θ_{12}	0.055806	0.003419	16.322	465228	<0.001
For 1998 Fixed Effect, π_{13}					
Intercept, θ_{13}	0.083262	0.003604	23.100	465228	<0.001
For 1999 Fixed Effect, π_{14}					
Intercept, θ_{14}	0.050940	0.003618	14.080	465228	<0.001
For 2000 Fixed Effect, π_{15}					
Intercept, θ_{15}	0.065976	0.003610	18.276	465228	<0.001
For 2001 Fixed Effect, π_{16}					
Intercept, θ_{16}	0.011242	0.003619	3.107	465228	0.002
For 2002 Fixed Effect, π_{17}					
Intercept, θ_{17}	0.036728	0.003672	10.003	465228	<0.001
For 2003 Fixed Effect, π_{18}					
Intercept, θ_{18}	0.031096	0.003702	8.400	465228	<0.001
For 2004 Fixed Effect, π_{19}					
Intercept, θ_{19}	-0.002345	0.003764	-0.623	465228	0.533
For 2005 Fixed Effect, π_{20}					
Intercept, θ_{20}	-0.028761	0.003804	-7.561	465228	<0.001
For Log Grade-level Mobility, π_{21}					
White, γ_{210}	-0.001224	0.003843	-0.319	465228	0.750
Black, γ_{211}	-0.010125	0.002932	-3.453	465228	<0.001
Hispanic, γ_{212}	-0.002761	0.003432	-0.804	465228	0.421
For Age 9-by-Decile 1, π_{22}					
White, γ_{220}	1.025294	0.016841	60.879	465228	<0.001
Black, γ_{221}	0.962022	0.004090	235.197	465228	<0.001
Hispanic, γ_{222}	1.089500	0.008124	134.116	465228	<0.001
For Age 9-by-Decile 2, π_{23}					
White, γ_{230}	0.994106	0.015784	62.981	465228	<0.001

	Coefficient	SE	t-ratio	df	p-value
Black, γ_{231}	0.841139	0.004254	197.740	465228	<0.001
Hispanic, γ_{232}	0.976041	0.007006	139.313	465228	<0.001
For Age 9-by-Decile 3, π_{24}					
White, γ_{240}	0.916396	0.014020	65.366	465228	<0.001
Black, γ_{241}	0.774915	0.004441	174.481	465228	<0.001
Hispanic, γ_{242}	0.882665	0.006529	135.187	465228	<0.001
For Age 9-by-Decile 4, π_{25}					
White, γ_{250}	0.875806	0.013354	65.585	465228	<0.001
Black, γ_{251}	0.692432	0.004569	151.556	465228	<0.001
Hispanic, γ_{252}	0.821233	0.006203	132.395	465228	<0.001
For Age 9-by-Decile 5, π_{26}					
White, γ_{260}	0.830609	0.011906	69.762	465228	<0.001
Black, γ_{261}	0.619878	0.004659	133.040	465228	<0.001
Hispanic, γ_{262}	0.758186	0.006088	124.546	465228	<0.001
For Age 9-by-Decile 6, π_{27}					
White, γ_{270}	0.784296	0.010948	71.640	465228	<0.001
Black, γ_{271}	0.538684	0.004750	113.416	465228	<0.001
Hispanic, γ_{272}	0.687210	0.005971	115.086	465228	<0.001
For Age 9-by-Decile 7, π_{28}					
White, γ_{280}	0.703259	0.010038	70.056	465228	<0.001
Black, γ_{281}	0.458957	0.004970	92.354	465228	<0.001
Hispanic, γ_{282}	0.613479	0.006003	102.187	465228	<0.001
For Age 9-by-Decile 8, π_{29}					
White, γ_{290}	0.643706	0.008750	73.566	465228	<0.001
Black, γ_{291}	0.379982	0.005082	74.767	465228	<0.001
Hispanic, γ_{292}	0.542089	0.005860	92.508	465228	<0.001
For Age 9-by-Decile 9, π_{30}					
White, γ_{300}	0.561145	0.007554	74.281	465228	<0.001
Black, γ_{301}	0.288540	0.005372	53.712	465228	<0.001
Hispanic, γ_{302}	0.439217	0.006114	71.839	465228	<0.001
For Age 9-by-Decile 10, π_{31}					
White, γ_{310}	0.322257	0.005883	54.777	465228	<0.001
Black, γ_{311}	0.068225	0.006009	11.354	465228	<0.001
Hispanic, γ_{312}	0.194422	0.006591	29.496	465228	<0.001
For Age 10-by-Decile 1, π_{32}					
White, γ_{320}	1.679739	0.017391	96.588	465228	<0.001
Black, γ_{321}	1.569374	0.004266	367.889	465228	<0.001
Hispanic, γ_{322}	1.751512	0.008425	207.904	465228	<0.001
For Age 10-by-Decile 2, π_{33}					
White, γ_{330}	1.655592	0.016410	100.892	465228	<0.001
Black, γ_{331}	1.437213	0.004472	321.407	465228	<0.001
Hispanic, γ_{332}	1.651136	0.007368	224.084	465228	<0.001
For Age 10-by-Decile 3, π_{34}					
White, γ_{340}	1.572161	0.014688	107.039	465228	<0.001
Black, γ_{341}	1.345942	0.004701	286.306	465228	<0.001
Hispanic, γ_{342}	1.555951	0.006939	224.238	465228	<0.001
For Age 10-by-Decile 4, π_{35}					
White, γ_{350}	1.534223	0.014140	108.503	465228	<0.001
Black, γ_{351}	1.270822	0.004836	262.784	465228	<0.001
Hispanic, γ_{352}	1.500848	0.006623	226.606	465228	<0.001
For Age 10-by-Decile 5, π_{36}					
White, γ_{360}	1.462693	0.012543	116.611	465228	<0.001
Black, γ_{361}	1.203221	0.004936	243.781	465228	<0.001
Hispanic, γ_{362}	1.437433	0.006494	221.351	465228	<0.001
For Age 10-by-Decile 6, π_{37}					
White, γ_{370}	1.416904	0.011711	120.994	465228	<0.001

	Coefficient	Std	t-ratio		d.f.	p-value
Black, γ_{371}	1.117955	0.005055	221.140		465228	<0.001
Hispanic, γ_{372}	1.349886	0.006414	210.461		465228	<0.001
For Age 10-by-Decile 7, π_{38}						
White, γ_{380}	1.323638	0.010718	123.499		465228	<0.001
Black, γ_{381}	1.033997	0.005280	195.822		465228	<0.001
Hispanic, γ_{382}	1.269718	0.006464	196.432		465228	<0.001
For Age 10-by-Decile 8, π_{39}						
White, γ_{390}	1.265134	0.009411	134.431		465228	<0.001
Black, γ_{391}	0.948001	0.005444	174.140		465228	<0.001
Hispanic, γ_{392}	1.181372	0.006365	185.601		465228	<0.001
For Age 10-by-Decile 9, π_{40}						
White, γ_{400}	1.178947	0.008059	146.296		465228	<0.001
Black, γ_{401}	0.852926	0.005695	149.758		465228	<0.001
Hispanic, γ_{402}	1.066485	0.006580	162.078		465228	<0.001
For Age 10-by-Decile 10, π_{41}						
White, γ_{410}	0.932684	0.006323	147.515		465228	<0.001
Black, γ_{411}	0.611341	0.006396	95.582		465228	<0.001
Hispanic, γ_{412}	0.814603	0.007149	113.944		465228	<0.001

Final estimation of row and level-1 variance components:

Random Effect	Standard Deviation	Variance Component	d.f.	χ^2	p-value
Intercept , b_{00j}	0.27514	0.07570	309063	656226.11300	<0.001
level-1, e	0.40745	0.16602			

Final estimation of column level variance components:

Random Effect	Standard Deviation	Variance Component	d.f.	χ^2	p-value
Intercept , c_{00k}	0.14629	0.02140	510	31851.32651	<0.001
Log Mobility ,	0.05180	0.00268	510	2766.13965	<0.001

Table 17.A10 Effects of Grade-Level Mobility within Achievement Strata

The output below represents a similar model as the previous, but examines the effect of log grade-level mobility *within achievement decile*. Results are broken down by ethnicity. Note that the first ten π coefficients report the mean achievement for eight-year-old students within each decile. Growth curves in mathematics achievement is estimated through the use of age-by-decile interaction effects. Decile 1 is the lowest achievement group, and decile 10 is the highest.

Fixed Effect	Coefficient	Standard error	t-ratio		Approx. d.f.	p-value
For Decile 1, π_1						
White, γ_{10}	-2.192673	0.012341	-177.673	colspan=2>Unable to compute		

Black, γ_{11}	-2.200947	0.007078	-310.946		465715	<0.001
Hispanic, γ_{12}	-2.080569	0.008339	-249.493		465715	<0.001
For Decile 2, π_2						
White, γ_{20}	-1.557420	0.011779	-132.223		465715	<0.001
Black, γ_{21}	-1.617046	0.007110	-227.444		465715	<0.001
Hispanic, γ_{22}	-1.536258	0.007966	-192.858		465715	<0.001
For Decile 3, π_3						
White, γ_{30}	-1.229215	0.010972	-112.037		465715	<0.001
Black, γ_{31}	-1.285083	0.007151	-179.711		465715	<0.001
Hispanic, γ_{32}	-1.214578	0.007824	-155.240		465715	<0.001
For Decile 4, π_4						
White, γ_{40}	-0.924110	0.010633	-86.906		465715	<0.001
Black, γ_{41}	-1.010574	0.007176	-140.818		465715	<0.001
Hispanic, γ_{42}	-0.927460	0.007723	-120.095		465715	<0.001
For Decile 5, π_5						
White, γ_{50}	-0.654317	0.009953	-65.738		465715	<0.001
Black, γ_{51}	-0.754312	0.007196	-104.823		465715	<0.001
Hispanic, γ_{52}	-0.659906	0.007695	-85.753		465715	<0.001
For Decile 6, π_6						
White, γ_{60}	-0.381646	0.009537	-40.019		465715	<0.001
Black, γ_{61}	-0.500816	0.007217	-69.397		465715	<0.001
Hispanic, γ_{62}	-0.404967	0.007659	-52.874		465715	<0.001
For Decile 7, π_7						
White, γ_{70}	-0.123127	0.009156	-13.447		465715	<0.001
Black, γ_{71}	-0.240048	0.007271	-33.016		465715	<0.001
Hispanic, γ_{72}	-0.139606	0.007675	-18.191		465715	<0.001
For Decile 8, π_8						
White, γ_{80}	0.191394	0.008665	22.089		465715	<0.001
Black, γ_{81}	0.055293	0.007299	7.575		465715	<0.001
Hispanic, γ_{82}	0.162131	0.007638	21.228		465715	<0.001
For Decile 9, π_9						
White, γ_{90}	0.586812	0.008222	71.368		465715	<0.001
Black, γ_{91}	0.431668	0.007369	58.575		465715	<0.001
Hispanic, γ_{92}	0.536527	0.007702	69.659		465715	<0.001
For Decile 10, π_{10}						
White, γ_{100}	1.356611	0.007731	175.478		465715	<0.001
Black, γ_{101}	1.032498	0.007570	136.392		465715	<0.001
Hispanic, γ_{102}	1.148872	0.007870	145.984		465715	<0.001
For 1996 Fixed Effect, π_{11}						
Intercept, θ_{11}	0.013176	0.003449	3.820		465715	<0.001
For 1997 Fixed Effect, π_{12}						
Intercept, θ_{12}	0.055144	0.003380	16.314		465715	<0.001
For 1998 Fixed Effect, π_{13}						
Intercept, θ_{13}	0.081171	0.003563	22.784		465715	<0.001
For 1999 Fixed Effect, π_{14}						
Intercept, θ_{14}	0.050147	0.003569	14.052		465715	<0.001
For 2000 Fixed Effect, π_{15}						
Intercept, θ_{15}	0.065965	0.003568	18.490		465715	<0.001
For 2001 Fixed Effect, π_{16}						
Intercept, θ_{16}	0.009085	0.003569	2.545		465715	0.011
For 2002 Fixed Effect, π_{17}						
Intercept, θ_{17}	0.034717	0.003618	9.594		465715	<0.001
For 2003 Fixed Effect, π_{18}						
Intercept, θ_{18}	0.029204	0.003646	8.009		465715	<0.001
For 2004 Fixed Effect, π_{19}						
Intercept, θ_{19}	-0.003128	0.003700	-0.845		465715	0.398

For 2005 Fixed Effect, π_{20}
Intercept, θ_{20}	-0.029466	0.003745	-7.867	465715	<0.001

For Mobility-by-Decile 1, π_{21}
White, γ_{210}	0.000182	0.014243	0.013	465715	0.990
Black, γ_{211}	-0.021994	0.003962	-5.551	465715	<0.001
Hispanic, γ_{212}	-0.036251	0.007482	-4.845	465715	<0.001

For Mobility-by-Decile 2, π_{22}
White, γ_{220}	0.003068	0.012538	0.245	465715	0.807
Black, γ_{221}	-0.018090	0.004011	-4.510	465715	<0.001
Hispanic, γ_{222}	0.000301	0.006301	0.048	465715	0.962

For Mobility-by-Decile 3, π_{23}
White, γ_{230}	0.002166	0.011508	0.188	465715	0.851
Black, γ_{231}	-0.013215	0.004075	-3.243	465715	0.001
Hispanic, γ_{232}	0.002564	0.005717	0.449	465715	0.654

For Mobility-by-Decile 4, π_{24}
White, γ_{240}	-0.003110	0.010687	-0.291	465715	0.771
Black, γ_{241}	-0.009880	0.004052	-2.439	465715	0.015
Hispanic, γ_{242}	-0.004801	0.005289	-0.908	465715	0.364

For Mobility-by-Decile 5, π_{25}
White, γ_{250}	-0.016362	0.008918	-1.835	465715	0.067
Black, γ_{251}	-0.006332	0.004004	-1.582	465715	0.114
Hispanic, γ_{252}	-0.000536	0.005100	-0.105	465715	0.916

For Mobility-by-Decile 6, π_{26}
White, γ_{260}	-0.000932	0.008382	-0.111	465715	0.911
Black, γ_{261}	-0.004980	0.004005	-1.243	465715	0.214
Hispanic, γ_{262}	-0.006426	0.005008	-1.283	465715	0.199

For Mobility-by-Decile 7, π_{27}
White, γ_{270}	-0.006620	0.007595	-0.872	465715	0.383
Black, γ_{271}	-0.010839	0.004123	-2.629	465715	0.009
Hispanic, γ_{272}	0.006837	0.004880	1.401	465715	0.161

For Mobility-by-Decile 8, π_{28}
White, γ_{280}	-0.006986	0.006428	-1.087	465715	0.277
Black, γ_{281}	-0.007701	0.004127	-1.866	465715	0.062
Hispanic, γ_{282}	-0.001326	0.004709	-0.282	465715	0.778

For Mobility-by-Decile 9, π_{29}
White, γ_{290}	0.002709	0.005462	0.496	465715	0.620
Black, γ_{291}	-0.007909	0.004210	-1.879	465715	0.060
Hispanic, γ_{292}	-0.007650	0.004798	-1.594	465715	0.111

For Mobility-by-Decile 10, π_{30}
White, γ_{300}	-0.008008	0.004032	-1.986	465715	0.047
Black, γ_{301}	-0.012118	0.004435	-2.732	465715	0.006
Hispanic, γ_{302}	-0.009632	0.005109	-1.885	465715	0.059

For Age 9-by-Decile 1, π_{31}
White, γ_{310}	1.025817	0.016929	60.594	465715	<0.001
Black, γ_{311}	0.961910	0.004100	234.597	465715	<0.001
Hispanic, γ_{312}	1.086904	0.008154	133.295	465715	<0.001

For Age 9-by-Decile 2, π_{32}
White, γ_{320}	0.994563	0.015814	62.891	465715	<0.001
Black, γ_{321}	0.841341	0.004264	197.320	465715	<0.001
Hispanic, γ_{322}	0.976073	0.007020	139.046	465715	<0.001

For Age 9-by-Decile 3, π_{33}
White, γ_{330}	0.917322	0.014045	65.312	465715	<0.001
Black, γ_{331}	0.774885	0.004453	174.020	465715	<0.001
Hispanic, γ_{332}	0.883161	0.006539	135.052	465715	<0.001

For Age 9-by-Decile 4, π_{34}
White, γ_{340}	0.876937	0.013388	65.501	465715	<0.001

Black, γ_{341}	0.693049	0.004578	151.389	465715	<0.001
Hispanic, γ_{342}	0.821129	0.006210	132.236	465715	<0.001
For Age 9-by-Decile 5, π_{35}					
White, γ_{350}	0.831885	0.011946	69.638	465715	<0.001
Black, γ_{351}	0.620499	0.004669	132.886	465715	<0.001
Hispanic, γ_{352}	0.758197	0.006096	124.376	465715	<0.001
For Age 9-by-Decile 6, π_{36}					
White, γ_{360}	0.786076	0.010977	71.609	465715	<0.001
Black, γ_{361}	0.539378	0.004759	113.344	465715	<0.001
Hispanic, γ_{362}	0.687255	0.005978	114.964	465715	<0.001
For Age 9-by-Decile 7, π_{37}					
White, γ_{370}	0.704630	0.010054	70.082	465715	<0.001
Black, γ_{371}	0.459294	0.004979	92.243	465715	<0.001
Hispanic, γ_{372}	0.613993	0.006013	102.114	465715	<0.001
For Age 9-by-Decile 8, π_{38}					
White, γ_{380}	0.645574	0.008761	73.683	465715	<0.001
Black, γ_{381}	0.380649	0.005091	74.765	465715	<0.001
Hispanic, γ_{382}	0.542000	0.005866	92.397	465715	<0.001
For Age 9-by-Decile 9, π_{39}					
White, γ_{390}	0.563888	0.007565	74.542	465715	<0.001
Black, γ_{391}	0.289131	0.005382	53.719	465715	<0.001
Hispanic, γ_{392}	0.438834	0.006122	71.677	465715	<0.001
For Age 9-by-Decile 10, π_{40}					
White, γ_{400}	0.324037	0.005888	55.029	465715	<0.001
Black, γ_{401}	0.068788	0.006022	11.422	465715	<0.001
Hispanic, γ_{402}	0.193697	0.006600	29.350	465715	<0.001
For Age 10-by-Decile 1, π_{41}					
White, γ_{410}	1.679920	0.017535	95.806	465715	<0.001
Black, γ_{411}	1.568417	0.004287	365.842	465715	<0.001
Hispanic, γ_{412}	1.747370	0.008484	205.972	465715	<0.001
For Age 10-by-Decile 2, π_{42}					
White, γ_{420}	1.656079	0.016524	100.220	465715	<0.001
Black, γ_{421}	1.437131	0.004498	319.492	465715	<0.001
Hispanic, γ_{422}	1.652234	0.007409	223.000	465715	<0.001
For Age 10-by-Decile 3, π_{43}					
White, γ_{430}	1.572796	0.014766	106.514	465715	<0.001
Black, γ_{431}	1.346349	0.004724	285.018	465715	<0.001
Hispanic, γ_{432}	1.557262	0.006987	222.877	465715	<0.001
For Age 10-by-Decile 4, π_{44}					
White, γ_{440}	1.533584	0.014193	108.053	465715	<0.001
Black, γ_{441}	1.271180	0.004860	261.566	465715	<0.001
Hispanic, γ_{442}	1.501942	0.006665	225.355	465715	<0.001
For Age 10-by-Decile 5, π_{45}					
White, γ_{450}	1.461701	0.012629	115.740	465715	<0.001
Black, γ_{451}	1.204242	0.004959	242.828	465715	<0.001
Hispanic, γ_{452}	1.439165	0.006542	219.987	465715	<0.001
For Age 10-by-Decile 6, π_{46}					
White, γ_{460}	1.417061	0.011813	119.957	465715	<0.001
Black, γ_{461}	1.119249	0.005078	220.408	465715	<0.001
Hispanic, γ_{462}	1.350556	0.006454	209.266	465715	<0.001
For Age 10-by-Decile 7, π_{47}					
White, γ_{470}	1.322620	0.010767	122.842	465715	<0.001
Black, γ_{471}	1.034566	0.005304	195.053	465715	<0.001
Hispanic, γ_{472}	1.272995	0.006514	195.430	465715	<0.001
For Age 10-by-Decile 8, π_{48}					
White, γ_{480}	1.263943	0.009452	133.724	465715	<0.001

Black, γ_{481}	0.948870	0.005467	173.549	465715	<0.001
Hispanic, γ_{482}	1.182889	0.006400	184.818	465715	<0.001
For Age 10-by-Decile 9, π_{49}					
White, γ_{490}	1.178946	0.008085	145.818	465715	<0.001
Black, γ_{491}	0.854126	0.005717	149.401	465715	<0.001
Hispanic, γ_{492}	1.066386	0.006626	160.947	465715	<0.001
For Age 10-by-Decile 10, π_{50}					
White, γ_{500}	0.931527	0.006339	146.962	465715	<0.001
Black, γ_{501}	0.611223	0.006423	95.159	465715	<0.001
Hispanic, γ_{502}	0.813682	0.007194	113.108	465715	<0.001

Final estimation of row and level-1 variance components:

Random Effect	Standard Deviation	Variance Component	d.f.	χ^2	p-value
Intercept , b_{00j}	0.27486	0.07555	309063	654216.21549	<0.001
level-1, e	0.40826	0.16668			

Final estimation of column level variance components:

Random Effect	Standard Deviation	Variance Component	d.f.	χ^2	p-value
Intercept , c_{00k}	0.14619	0.02137	514	31811.75710	<0.001

Table 17.A11 Cumulative Grade-level Effects Based on IPTW

Cumulative Effects of School-Level Mobility			
Fixed Effects (Level 1)	*Coefficient*	*S.E.*	*T-Ratio*
Intercept, π_0	-1.265	.021	-59.36
Year, π_1	.789	.010	79.88
School-level Mobility, π_2	-.666	.094	-7.07
Random Effects	*Standard Deviation*	*Variance Component*	*Chi-Square*
Intercept (Row-Level), b_{00}	.874	.764	210826.4
Year (Row-Level)), b_{10}	.207	.043	28620.7
Intercept (Column-Level), c_{00}	.120	.015	3685.4
Within-school variance σ^2	.473	.224	

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Online Appendix

Chapter 18

The Effect of School Neighborhoods

on Teacher Career Decisions

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TABLE 18.A1a: School-Level Correlations Among Neighborhood Characteristics

	Income	Density	Nonwhite	% > BA	Married	Vacant	Same House	Subway	Crime
Pop Density	-0.0043								
% Non-White	-0.6797	0.1086							
% > BA	0.8872	0.2184	-0.6332						
% HH Married	-0.013	-0.4351	-0.2401	-0.2411					
% Vacant	-0.0491	0.0385	0.3237	-0.0335	-0.4265				
% Same House	-0.3002	-0.2993	0.2039	-0.4538	0.2465	-0.157			
Subway Dist	0.195	-0.4117	-0.101	0.0363	0.3149	-0.2085	0.2626		
Violent Crime	-0.4204	0.0422	0.4607	-0.3541	-0.3106	0.5005	0.0436	-0.1842	
Amenities	0.1325	0.6579	-0.0938	0.4018	-0.4899	0.1154	-0.4693	-0.4307	0.0187

TABLE 18.A1b: School-Level Correlations Between School and Neighborhood Characteristics

	Income	Density	Non-White	> BA	Married HH
Enrollment	0.0728	-0.1261	-0.1105	-0.0088	0.2673
Lunch	-0.6059	0.2697	0.5582	-0.4719	-0.2211
Attendance	0.1029	-0.0435	-0.1921	0.0552	0.2255
%Black	-0.1727	-0.0843	0.6139	-0.174	-0.3541
%Hispanic	-0.3344	0.3847	0.0986	-0.1897	-0.1047
%Asian	0.2059	-0.1382	-0.3069	0.158	0.4098
%ELL	-0.2265	0.2814	0.0273	-0.14	0.1201
%Tchrs > 5yrs exp	0.1326	-0.2274	-0.2038	0.0562	0.2693
Suspensions	-0.0526	0.1015	0.0895	0.0047	-0.1393
Violent Crime	-0.0288	0.1064	0.1414	0.0139	-0.1986
Low Performance	-0.3021	0.1135	0.3249	-0.2378	-0.1507
	Vacant	**Same HH**	**Subway**	**Violence**	**Amenities**
Enrollment	-0.1677	-0.0209	0.0502	-0.1433	-0.106
Lunch	0.1914	-0.0087	-0.3937	0.3402	0.1498
Attendance	-0.1991	0.0802	0.1567	-0.1721	-0.0893
Black	0.3769	0.1775	0.0352	0.2857	-0.1372
Hispanic	-0.0345	-0.2197	-0.3191	0.1261	0.2934
Asian	-0.3289	-0.0174	0.2324	-0.3133	-0.0165
ELL	-0.1826	-0.1486	-0.1862	-0.0466	0.1866
Teachers > 5yrs Exp	-0.1392	0.096	0.1845	-0.1831	-0.1653
Suspensions	0.0513	-0.0346	-0.0613	0.0377	0.0861
Violent Crime	0.1533	-0.068	-0.1017	0.1089	0.126
Low Performance	0.1436	0.0186	-0.1289	0.2665	0.0303

TABLE 18.A2a: Modeling Whether a Teacher Applies to Transfer – Full Sample (odds ratios)

	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	0.9336*	0.9306*	0.9169**	0.9627**
	(0.0299)	(0.0268)	(0.0285)	(0.0137)
Pop Density / 10000	1.0707	1.0376	1.0496	1.0511
	(0.0472)	(0.0413)	(0.0441)	(0.0381)
Pop Density Squared	0.9968	0.9987	0.9978	0.9966
	(0.0030)	(0.0027)	(0.0028)	(0.0027)
% Non-White	1.0058***	0.9963	0.9986	1.0026
	(0.0017)	(0.0025)	(0.0026)	(0.0017)
% HH Married With Kids	0.9863*	0.9954	0.9937	0.9954
	(0.0059)	(0.0058)	(0.0060)	(0.0042)
% Lots Vacant	1.0200~	1.0109	1.0097	1.0030
	(0.0117)	(0.0109)	(0.0112)	(0.0092)
% Same House 5 years	1.0023	1.0011	1.0036	1.0060
	(0.0057)	(0.0052)	(0.0054)	(0.0044)
% Education BA or >	1.0152	1.0102	1.0160~	0.9941
	(0.0098)	(0.0089)	(0.0095)	(0.0037)
Subway Distance	1.0585	1.1031	1.1431	1.0650
	(0.1435)	(0.1385)	(0.1470)	(0.1251)
Subway Distance Squared	0.9755	0.9737	0.9716	0.9761
	(0.0341)	(0.0310)	(0.0307)	(0.0302)
High Violent Crime	1.0627	0.9695	0.9751	1.0548
	(0.0807)	(0.0686)	(0.0713)	(0.0650)
Amenity Factor	0.9335	0.9237	0.9181	0.9754
	(0.0493)	(0.0475)	(0.0481)	(0.0303)
Amenity Factor Squared	0.9706~	0.9948	0.9847	0.9820
	(0.0150)	(0.0149)	(0.0161)	(0.0184)
Observations	128045	118659	76300	
chi^2	187.8954	618.0945	1117.6845	
Univariate				x
teacher controls		x	x	x
school controls			x	x

TABLE 18.A2b: Modeling Whether a Teacher Applies to Transfer – Low Density Sample

	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	0.9419	0.9689	0.9475	0.9451*
	(0.0446)	(0.0418)	(0.0437)	(0.0231)
Pop Density / 10000	1.4030*	1.0618	1.0928	1.0760
	(0.2396)	(0.1843)	(0.1983)	(0.1815)
Pop Density Squared	0.9607	1.0028	0.9962	0.9985
	(0.0268)	(0.0292)	(0.0297)	(0.0271)
% Non-White	1.0048*	0.9948	0.9970	1.0008
	(0.0021)	(0.0033)	(0.0035)	(0.0026)
% HH Married With Kids	0.9840*	0.9929	0.9894	0.9873~
	(0.0074)	(0.0081)	(0.0081)	(0.0065)
% Lots Vacant	1.0244	1.0070	1.0108	1.0053
	(0.0183)	(0.0162)	(0.0167)	(0.0136)
% Same House 5 years	1.0006	0.9968	1.0009	1.0042
	(0.0078)	(0.0066)	(0.0070)	(0.0059)
% Education BA or >	0.9936	0.9937	0.9979	0.9932
	(0.0123)	(0.0122)	(0.0129)	(0.0058)
Subway Distance	1.1273	1.1864	1.2703	1.1139
	(0.1788)	(0.1801)	(0.2036)	(0.1693)
Subway Distance Squared	0.9759	0.9627	0.9529	0.9677
	(0.0380)	(0.0354)	(0.0363)	(0.0363)
High Violent Crime	0.9750	0.9681	0.9920	1.0651
	(0.1166)	(0.1068)	(0.1169)	(0.1088)
Amenity Factor	1.0034	0.9639	0.9948	1.0185
	(0.0665)	(0.0602)	(0.0655)	(0.0500)
Amenity Factor Squared	0.9918	0.9998	0.9992	0.9942
	(0.0170)	(0.0168)	(0.0183)	(0.0203)
Observations	69411	64171	39535	
chi^2	129.7075	384.0339	641.2161	
Univariate				x
teacher controls		x	x	x
school controls			x	x

TABLE 18.A2c: Modeling Whether a Teacher Applies to Transfer – High Density Sample

	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	0.8960*	0.8994*	0.8910*	0.9767
	(0.0484)	(0.0425)	(0.0442)	(0.0175)
Pop Density / 10000	1.0810	1.2008	1.2324~	1.1220
	(0.1340)	(0.1451)	(0.1461)	(0.1228)
Pop Density Squared	0.9968	0.9912	0.9892	0.9937
	(0.0068)	(0.0067)	(0.0066)	(0.0062)
% Non-White	1.0059	0.9962	0.9989	1.0023
	(0.0036)	(0.0043)	(0.0047)	(0.0024)
% HH Married With Kids	0.9936	0.9981	0.9981	0.9985
	(0.0106)	(0.0104)	(0.0108)	(0.0065)
% Lots Vacant	1.0207	1.0182	1.0139	0.9997
	(0.0168)	(0.0171)	(0.0170)	(0.0129)
% Same House 5 years	1.0018	1.0067	1.0092	1.0106
	(0.0097)	(0.0094)	(0.0098)	(0.0068)
% Education BA or >	1.0364*	1.0272~	1.0344*	0.9966
	(0.0178)	(0.0159)	(0.0171)	(0.0048)
Subway Distance	3.2373	1.2484	0.9417	1.0541
	(2.5464)	(0.8092)	(0.6723)	(0.7846)
Subway Distance Squared	0.1534~	0.5851	0.8776	0.7794
	(0.1644)	(0.4905)	(0.8250)	(0.7917)
High Violent Crime	1.1738	1.0178	1.0035	1.0102
	(0.1254)	(0.1009)	(0.0982)	(0.0778)
Amenity Factor	0.8603	0.7877*	0.7525**	0.8583~
	(0.1114)	(0.0883)	(0.0788)	(0.0689)
Amenity Factor Squared	0.9866	1.0779	1.0813	1.0726
	(0.0712)	(0.0758)	(0.0744)	(0.0588)
Observations	58634	54488	36765	
chi^2	66.1902	305.3255	615.4564	
Univariate				x
teacher controls		x	x	x
school controls			x	x

TABLE 18.A3a: Modeling Where A Teacher Applies to Transfer To – Full Sample

VARIABLES	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	1.0530~	1.0643*	1.0686*	1.0809***
	(0.0295)	(0.0290)	(0.0304)	(0.0155)
Pop Density / 10000	0.9749	0.9817	0.9843	0.9425
	(0.0455)	(0.0479)	(0.0512)	(0.0383)
Pop Density Squared	1.0022	1.0022	1.0020	1.0054*
	(0.0028)	(0.0030)	(0.0031)	(0.0026)
% Non-White	0.9949**	0.9990	0.9981	0.9933**
	(0.0018)	(0.0029)	(0.0032)	(0.0023)
% HH Married With Kids	1.0126*	1.0028	0.9996	0.9972
	(0.0061)	(0.0066)	(0.0072)	(0.0051)
% Lots Vacant	0.9896	0.9958	1.0003	1.0065
	(0.0134)	(0.0144)	(0.0153)	(0.0118)
% Same House 5 years	0.9875*	0.9877*	0.9881~	0.9830***
	(0.0055)	(0.0062)	(0.0067)	(0.0050)
% Education BA or >	1.0032	0.9951	0.9950	1.0152***
	(0.0097)	(0.0096)	(0.0101)	(0.0035)
Subway Distance	1.3591*	1.1850	1.2339	1.0424
	(0.1909)	(0.1675)	(0.1846)	(0.1507)
Subway Distance Squared	0.9652	0.9880	0.9811	1.0104
	(0.0357)	(0.0358)	(0.0373)	(0.0402)
High Violent Crime	0.9934	0.9682	0.9711	0.8212*
	(0.0921)	(0.0889)	(0.0937)	(0.0663)
Amenity Factor	1.0560	0.9867	1.0290	1.0664*
	(0.0698)	(0.0582)	(0.0630)	(0.0331)
Amenity Factor Squared	1.0222	1.0112	1.0214	1.0465*
	(0.0232)	(0.0214)	(0.0228)	(0.0235)
Observations	2435595	2390167	1540257	
chi^2	456.3906	679.5239	22307.0505	
Univariate				x
current school controls		x	x	x
teacher controls			x	x

TABLE 18.A3b: Modeling Where a Teacher Applies to Transfer To – Low Density Sample

VARIABLES	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	1.0199	1.1020~	1.1155*	1.1105***
	(0.0476)	(0.0575)	(0.0611)	(0.0284)
Pop Density / 10000	0.9321	0.9253	0.9778	0.9685
	(0.1815)	(0.1826)	(0.2071)	(0.1663)
Pop Density Squared	0.9922	1.0030	0.9934	0.9798
	(0.0310)	(0.0315)	(0.0334)	(0.0286)
% Non-White	0.9973	1.0026	1.0021	0.9950
	(0.0020)	(0.0039)	(0.0041)	(0.0032)
% HH Married With Kids	1.0219**	1.0027	1.0006	1.0148*
	(0.0076)	(0.0096)	(0.0102)	(0.0075)
% Lots Vacant	1.0092	1.0145	1.0195	1.0103
	(0.0215)	(0.0217)	(0.0230)	(0.0191)
% Same House 5 years	0.9883~	0.9899	0.9889	0.9883~
	(0.0069)	(0.0082)	(0.0088)	(0.0070)
% Education BA or >	1.0242*	1.0016	1.0005	1.0089
	(0.0123)	(0.0148)	(0.0156)	(0.0057)
Subway Distance	1.0302	1.0062	0.9951	1.1230
	(0.1605)	(0.1615)	(0.1684)	(0.1910)
Subway Distance Squared	1.0126	1.0198	1.0231	1.0028
	(0.0404)	(0.0417)	(0.0440)	(0.0429)
High Violent Crime	0.7332*	0.7149*	0.6911*	0.6138***
	(0.1107)	(0.1011)	(0.1049)	(0.0720)
Amenity Factor	0.8423	0.8028*	0.8157~	0.8864
	(0.0915)	(0.0819)	(0.0867)	(0.0686)
Amenity Factor Squared	0.9084*	0.9150*	0.9155*	0.9755
	(0.0422)	(0.0374)	(0.0408)	(0.0334)
Observations	1273456	1266513	852171	
chi^2	266.2695	393.0693	889.3649	
Univariate				x
current school controls		x	x	x
teacher controls			x	x

TABLE 18.A3c: Modeling Where a Teacher Applies to Transfer To – High Density Sample

VARIABLES	Model 1	Model 2	Model 3	Model 4
Median Family Inc / 10,000	1.0308	0.9804	0.9779	1.0589*
	(0.0308)	(0.0347)	(0.0361)	(0.0240)
Pop Density / 10000	1.3532***	1.3205***	1.3434***	1.3536***
	(0.1073)	(0.1078)	(0.1104)	(0.1123)
Pop Density Squared	0.9850***	0.9864**	0.9855***	0.9857***
	(0.0041)	(0.0041)	(0.0041)	(0.0042)
% Non-White	0.9915**	0.9947	0.9931	0.9907**
	(0.0028)	(0.0042)	(0.0044)	(0.0033)
% HH Married With Kids	1.0070	1.0026	0.9997	0.9775**
	(0.0084)	(0.0110)	(0.0113)	(0.0082)
% Lots Vacant	0.9754	0.9873	0.9947	0.9997
	(0.0161)	(0.0179)	(0.0188)	(0.0151)
% Same House 5 years	0.9866	0.9912	0.9932	0.9754**
	(0.0084)	(0.0080)	(0.0084)	(0.0083)
% Education BA or >	0.9952	1.0093	1.0099	1.0240***
	(0.0092)	(0.0118)	(0.0125)	(0.0061)
Subway Distance	5.6793*	4.7040*	5.7789*	3.1031
	(4.5912)	(3.5578)	(4.4808)	(2.5370)
Subway Distance Squared	0.2575	0.3467	0.3124	0.4793
	(0.2851)	(0.3593)	(0.3293)	(0.5043)
High Violent Crime	1.2038~	1.1948~	1.1923	0.9685
	(0.1207)	(0.1283)	(0.1317)	(0.0968)
Amenity Factor	0.9570	0.9561	0.9960	1.1677*
	(0.0904)	(0.0958)	(0.1040)	(0.0849)
Amenity Factor Squared	1.2608***	1.1838*	1.1884*	1.1421*
	(0.0884)	(0.0777)	(0.0823)	(0.0664)
Observations	1162139	1123654	756066	
chi^2	485.6503	3334.7207	1984.5860	
Univariate				x
current school controls		x	x	x
teacher controls			x	x

TABLE 18.A4a: Modeling Whether a Teacher Applies to Transfer By Background – Low Density Sample

	White	Black	Hispanic	Female	Male	31 or >	<31
Median Fam Inc / 10,000	0.9166~	1.0462	0.9531	0.9284	1.0050	0.9603	0.9211
	(0.0472)	(0.1001)	(0.0946)	(0.0463)	(0.0670)	(0.0473)	(0.0558)
Pop Density / 10000	1.3003	0.6951	0.8790	1.1653	0.8846	1.0776	1.1301
	(0.2553)	(0.2603)	(0.3731)	(0.2264)	(0.2291)	(0.2264)	(0.2454)
Pop Density Squared	0.9659	1.0902	1.0156	0.9830	1.0364	0.9958	0.9942
	(0.0311)	(0.0618)	(0.0661)	(0.0310)	(0.0441)	(0.0344)	(0.0353)
% Non-White	0.9977	0.9951	0.9944	0.9983	0.9924*	0.9990	0.9937~
	(0.0036)	(0.0062)	(0.0070)	(0.0040)	(0.0038)	(0.0040)	(0.0037)
% HH Married With Kids	0.9946	0.9618*	0.9812	0.9949	0.9736*	0.9872	0.9930
	(0.0084)	(0.0162)	(0.0169)	(0.0086)	(0.0115)	(0.0097)	(0.0090)
% Lots Vacant	1.0161	0.9788	1.0583~	1.0089	1.0198	1.0001	1.0247
	(0.0198)	(0.0222)	(0.0346)	(0.0186)	(0.0191)	(0.0184)	(0.0195)
% Same House 5 years	1.0047	0.9636**	1.0309*	0.9997	0.9998	0.9998	1.0021
	(0.0075)	(0.0138)	(0.0160)	(0.0073)	(0.0099)	(0.0080)	(0.0085)
% Education BA or >	1.0084	0.9533	1.0019	1.0056	0.9696	0.9995	0.9959
	(0.0138)	(0.0285)	(0.0269)	(0.0142)	(0.0196)	(0.0153)	(0.0153)
Subway Distance	1.1379	1.9823*	1.7298~	1.1880	1.5432~	1.3760~	1.1263
	(0.1759)	(0.6649)	(0.5702)	(0.1951)	(0.3448)	(0.2624)	(0.2131)
Subway Dist Squared	0.9829	0.8727~	0.8770	0.9705	0.9000~	0.9308	0.9892
	(0.0378)	(0.0717)	(0.0718)	(0.0375)	(0.0515)	(0.0446)	(0.0453)
High Violent Crime	1.0305	0.9406	1.0847	1.0465	0.8871	0.9628	1.0401
	(0.1345)	(0.1632)	(0.2097)	(0.1252)	(0.1406)	(0.1283)	(0.1433)
Amenity Factor	0.9932	0.9319	1.1762	1.0200	0.9604	1.0213	0.9660
	(0.0644)	(0.1156)	(0.1484)	(0.0738)	(0.0865)	(0.0799)	(0.0735)
Amenity Factor Squared	0.9999	0.9841	1.0478	0.9989	1.0089	0.9972	1.0021
	(0.0172)	(0.0476)	(0.0472)	(0.0200)	(0.0281)	(0.0237)	(0.0198)
Observations	25118	7730	4144	30130	9405	25174	14343
chi^2	482.3451	279.9801	138.0363	565.8564	239.7787	557.3397	463.8060

TABLE 18.A4b: Modeling Whether A teacher Applies to Transfer by Background – High Density Sample

	white	Black	hispanic	female	male	31 or >	<31
Median Fam Inc/10,000	0.9025*	0.8844	0.9822	0.8978*	0.8758*	0.8729*	0.9192
	(0.0460)	(0.0886)	(0.0862)	(0.0465)	(0.0576)	(0.0507)	(0.0544)
Pop Density / 10000	1.3390*	1.1285	1.0524	1.3215*	1.0625	1.2854~	1.1740
	(0.1680)	(0.2362)	(0.2142)	(0.1577)	(0.1965)	(0.1752)	(0.1921)
Pop Density Squared	0.9853*	0.9909	0.9981	0.9853*	0.9974	0.9879	0.9907
	(0.0069)	(0.0121)	(0.0113)	(0.0066)	(0.0103)	(0.0074)	(0.0095)
% Non-White	0.9991	1.0177~	0.9969	0.9977	1.0023	0.9985	0.9997
	(0.0049)	(0.0099)	(0.0095)	(0.0049)	(0.0064)	(0.0046)	(0.0066)
% HH Married W/Kids	0.9967	0.9932	0.9909	1.0017	0.9875	1.0019	0.9923
	(0.0112)	(0.0209)	(0.0186)	(0.0110)	(0.0153)	(0.0112)	(0.0138)
% Lots Vacant	1.0196	0.9942	1.0193	1.0183	1.0010	1.0038	1.0291
	(0.0188)	(0.0244)	(0.0359)	(0.0175)	(0.0246)	(0.0209)	(0.0211)
% Same House 5 years	1.0118	0.9973	1.0289~	1.0199*	0.9839	1.0092	1.0114
	(0.0103)	(0.0186)	(0.0175)	(0.0100)	(0.0140)	(0.0108)	(0.0128)
% Education BA or >	1.0257	1.0811*	1.0207	1.0365*	1.0310	1.0430*	1.0216
	(0.0182)	(0.0364)	(0.0324)	(0.0182)	(0.0222)	(0.0184)	(0.0226)
Subway Distance	0.4951	2.2625	5.3499	1.4781	0.2842	0.4464	4.2485
	(0.4560)	(2.9184)	(6.8882)	(1.1709)	(0.2935)	(0.3668)	(4.4779)
Subway Dist Squared	1.3743	0.4403	0.1540	0.4097	6.5763	2.1663	0.1272
	(1.7300)	(0.8079)	(0.2606)	(0.4373)	(8.6352)	(2.4122)	(0.1799)
High Violent Crime	1.0517	0.9004	1.0407	1.0168	0.9345	1.1418	0.8042~
	(0.1239)	(0.1216)	(0.1523)	(0.0991)	(0.1288)	(0.1314)	(0.0962)
Amenity Factor	0.7446*	0.7244*	0.7719	0.7273**	0.8412	0.7831~	0.7140**
	(0.0903)	(0.1094)	(0.1320)	(0.0731)	(0.1397)	(0.1004)	(0.0828)
Amenity Factor Squared	1.1124	0.9813	1.0568	1.0949	1.0164	1.0139	1.1855~
	(0.0959)	(0.1043)	(0.1343)	(0.0834)	(0.0974)	(0.0800)	(0.1108)
Observations	19497	7559	6979	28149	8616	23133	13632
chi^2	402.2507	213.8291	209.7827	529.3538	299.5989	566.1374	261.4353

TABLE 18.A5a: Modeling Where a Teacher Applies to Transfer To – Low Density Sample

|	white	black	hispanic	female	male	31 or >	<31
Median Fam Inc / 10,000	1.1093~	1.0519	1.1858**	1.1149*	1.1262~	1.1243*	1.1030~
	(0.0640)	(0.0646)	(0.0745)	(0.0610)	(0.0709)	(0.0616)	(0.0635)
Pop Density / 10000	1.0079	1.3432	0.7127	0.9667	1.2423	0.8729	1.0896
	(0.2312)	(0.3043)	(0.1666)	(0.2068)	(0.2907)	(0.1821)	(0.2446)
Pop Density Squared	0.9840	0.9599	1.0484	0.9924	0.9740	1.0096	0.9785
	(0.0363)	(0.0344)	(0.0424)	(0.0339)	(0.0359)	(0.0338)	(0.0346)
% Non-White	1.0004	1.0052	0.9994	1.0013	1.0064	1.0024	1.0016
	(0.0044)	(0.0047)	(0.0043)	(0.0041)	(0.0046)	(0.0041)	(0.0044)
% HH Married With Kids	1.0028	1.0089	0.9811~	1.0029	0.9840	1.0011	1.0000
	(0.0104)	(0.0129)	(0.0103)	(0.0103)	(0.0111)	(0.0101)	(0.0106)
% Lots Vacant	1.0166	1.0335	1.0171	1.0177	1.0312	1.0033	1.0347
	(0.0256)	(0.0234)	(0.0248)	(0.0234)	(0.0239)	(0.0233)	(0.0238)
% Same House 5 years	0.9880	0.9964	0.9795*	0.9873	0.9999	0.9852~	0.9930
	(0.0097)	(0.0091)	(0.0091)	(0.0089)	(0.0093)	(0.0086)	(0.0093)
% Education BA or >	1.0019	1.0102	0.9799	0.9991	1.0079	0.9937	1.0078
	(0.0168)	(0.0176)	(0.0154)	(0.0155)	(0.0194)	(0.0159)	(0.0163)
Subway Distance	1.0200	0.8061	1.1725	0.9735	1.1599	0.9056	1.1012
	(0.1841)	(0.1538)	(0.1829)	(0.1662)	(0.2079)	(0.1478)	(0.2007)
Subway Dist Squared	1.0211	1.0538	0.9704	1.0265	1.0038	1.0432	1.0019
	(0.0460)	(0.0531)	(0.0381)	(0.0443)	(0.0457)	(0.0431)	(0.0463)
High Violent Crime	0.6236**	0.8731	0.5361***	0.6963*	0.6680*	0.7900	0.5821***
	(0.1095)	(0.1510)	(0.0880)	(0.1063)	(0.1315)	(0.1209)	(0.0956)
Amenity Factor	0.8463	0.7107*	0.6739***	0.8079*	0.8690	0.7757*	0.8495
	(0.0935)	(0.0967)	(0.0768)	(0.0873)	(0.0976)	(0.0840)	(0.0916)
Amenity Factor Squared	0.9281~	0.8899*	0.8547**	0.9158*	0.9026~	0.8978*	0.9288~
	(0.0416)	(0.0524)	(0.0460)	(0.0402)	(0.0525)	(0.0420)	(0.0411)
Observations	526924	146546	121126	739037	113134	465019	387152
chi^2	807.6608	461.7738	498.2228	692.9616	683.6534	635.9415	955.9567

TABLE 18.A5b: Modeling Where a Teacher Applies to Transfer To – High Density Sample

	white	black	hispanic	female	male	31 or >	<31
Median Fam Inc/10,000	0.9849	0.9706	0.8781**	0.9763	0.9858	0.9703	0.9817
	(0.0396)	(0.0505)	(0.0379)	(0.0365)	(0.0415)	(0.0352)	(0.0411)
Pop Density / 10000	1.3073**	1.2808*	1.3284**	1.3565***	1.2798**	1.3699***	1.3081**
	(0.1176)	(0.1279)	(0.1348)	(0.1121)	(0.1222)	(0.1130)	(0.1195)
Pop Density Squared	0.9864**	0.9887*	0.9882*	0.9849***	0.9886*	0.9850***	0.9864**
	(0.0044)	(0.0054)	(0.0052)	(0.0041)	(0.0049)	(0.0041)	(0.0045)
% Non-White	0.9894*	1.0045	0.9967	0.9919~	0.9992	0.9962	0.9905~
	(0.0050)	(0.0065)	(0.0049)	(0.0045)	(0.0049)	(0.0041)	(0.0052)
% HH Married W/Kids	1.0025	0.9941	1.0018	1.0029	0.9850	0.9998	1.0007
	(0.0126)	(0.0138)	(0.0104)	(0.0117)	(0.0111)	(0.0102)	(0.0133)
% Lots Vacant	1.0006	0.9668	1.0153	0.9949	0.9917	0.9868	1.0027
	(0.0217)	(0.0202)	(0.0222)	(0.0190)	(0.0208)	(0.0177)	(0.0219)
% Same House 5 years	0.9971	0.9819~	0.9925	0.9923	0.9958	0.9906	0.9962
	(0.0094)	(0.0101)	(0.0095)	(0.0087)	(0.0090)	(0.0079)	(0.0100)
% Education BA or >	1.0073	1.0257	1.0352*	1.0090	1.0154	1.0157	1.0061
	(0.0132)	(0.0180)	(0.0140)	(0.0126)	(0.0138)	(0.0120)	(0.0141)
Subway Distance	5.2355~	4.8397~	6.1887*	6.8771*	2.7184	5.0699*	6.4502*
	(4.6400)	(4.4433)	(5.3921)	(5.4717)	(2.1598)	(3.7986)	(5.8731)
Subway Dist Squared	0.4226	0.2378	0.1848	0.2640	0.6538	0.3176	0.3189
	(0.5269)	(0.2870)	(0.1989)	(0.2881)	(0.6650)	(0.3241)	(0.3997)
High Violent Crime	1.0898	1.2769~	1.4497**	1.1672	1.2924*	1.2932*	1.0921
	(0.1319)	(0.1832)	(0.1758)	(0.1306)	(0.1551)	(0.1430)	(0.1368)
Amenity Factor	1.0393	0.9187	0.9737	0.9852	1.0397	0.8902	1.1377
	(0.1238)	(0.1150)	(0.1413)	(0.1041)	(0.1185)	(0.0901)	(0.1399)
Amenity Squared	1.2060*	1.0473	1.0505	1.2170**	1.0594	1.1494*	1.2013*
	(0.0917)	(0.0809)	(0.1072)	(0.0841)	(0.0879)	(0.0753)	(0.0988)
Observations	467448	129462	106994	655726	99932	410768	343552
chi^2	2284.5926	276.2299	550.1863	1603.2888	861.6894	1373.0730	1847.7578

Appendix Figure 18.A1a: Applications per Vacancy
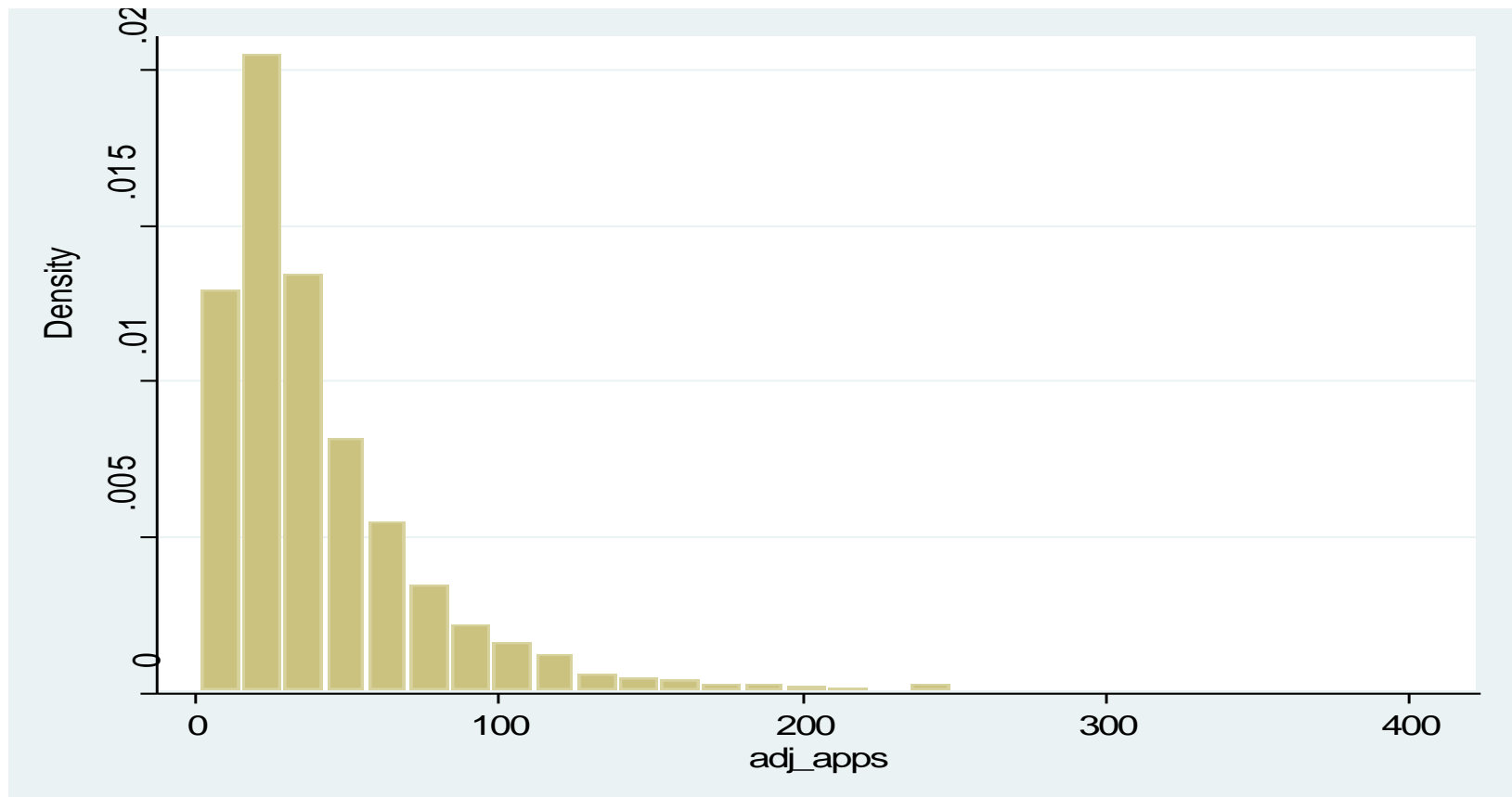
Appendix Figure 18.A1b: Log of Applications per Vacancy
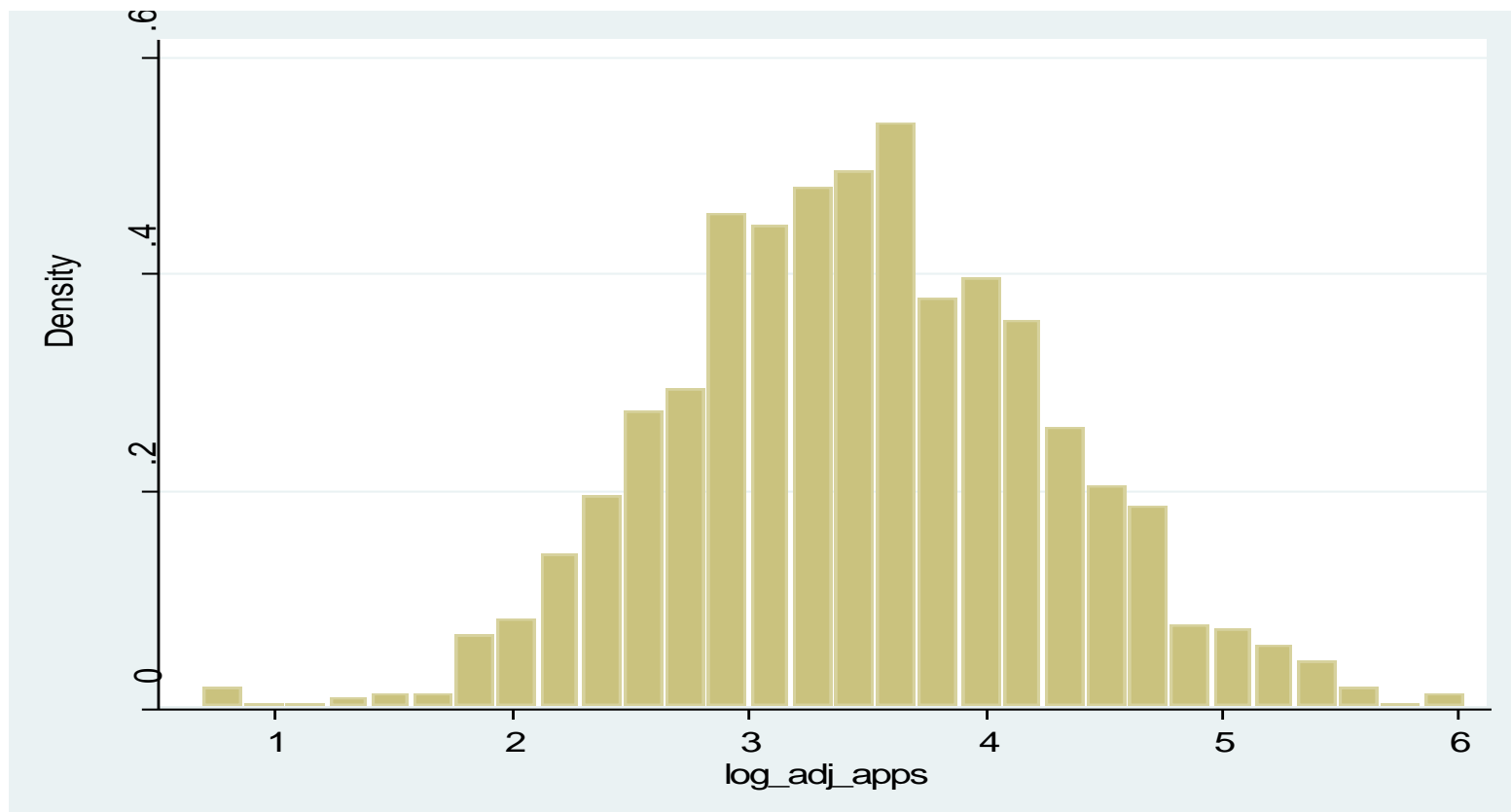
Online Appendix

Chapter 20

Immigrants and Inequality in Public Schools

Schwartz and Stiefel

Appendix Table 20.A1: The foreign-born population in major metropolitan areas, 2007 ACS estimates

	Total Population			5-17 year olds		
	Total	# foreign-born	% foreign-born	Total	# foreign-born	% foreign-born
Miami	5,413	2,005	37.04%	881	121	13.76%
Los Angeles	12,876	4,489	34.86%	2,427	233	9.61%
New York	18,816	5,329	28.32%	3,189	289	9.06%
Houston	5,629	1,205	21.40%	1,123	101	9.03%
Washington DC	5,306	1,089	20.52%	920	78	8.48%
Dallas	6,144	1,092	17.78%	1,198	94	7.88%
Chicago	9,523	1,679	17.63%	1,772	110	6.21%
Phoenix	4,179	736	17.61%	793	71	9.00%
Boston	4,483	714	15.92%	731	43	5.95%
Philadelphia	5,828	509	8.73%	1,027	36	3.54%
Detroit	4,468	389	8.71%	837	31	3.69%
United States	301,621	38,060	12.62%	53,237	2,673	5.02%

Source: 2007 American Community Survey 1-Year Estimates, MSA level

Note: Numbers in 1,000s.

Appendix Table 20.A2: Enrollment in public and private schools, major US cities

	K-8 enrollment		9-12 enrollment	
	public school	private school	public school	private school
Philadelphia	75.35%	24.65%	79.82%	20.18%
New York City	77.92%	22.08%	81.29%	18.71%
Boston	78.97%	21.03%	86.23%	13.77%
Washington DC	80.15%	19.85%	81.56%	18.44%
Chicago	85.21%	14.79%	85.02%	14.98%
Los Angeles	87.77%	12.23%	89.57%	10.43%
Dallas	88.13%	11.87%	88.55%	11.45%
Miami	91.97%	8.03%	91.58%	8.42%
Detroit	92.11%	7.89%	94.31%	5.69%
Houston	92.41%	7.59%	90.97%	9.03%
Phoenix	92.69%	7.31%	92.62%	7.38%
United States	88.66%	11.34%	90.50%	9.50%

Source: 2005-2007 American Community Survey 3-Year Estimates, Principle City

Appendix Table 20.A3: Characteristics of U.S. Children 0-17 years by nativity, 2005-2006

	Total	FB	NB
Asian	4.9%	21.0%	4.2%
Black	15.9%	8.2%	16.2%
Hispanic	20.0%	52.8%	18.6%
Native Amer	0.8%	0.1%	0.8%
White	58.5%	17.9%	60.3%
English Proficient	94.7%	65.2%	96.4%
LEP	5.3%	34.8%	3.7%
Bilingual	14.9%	49.6%	13.0%
English only	79.9%	15.7%	83.4%
Parents < HS education	12.0%	30.8%	11.2%
Parents HS grad	54.9%	37.0%	55.7%
Parents 4yr college degree	33.1%	32.2%	33.1%
FB parents	21.4%	84.9%	18.6%
NB parents	75.7%	8.0%	78.7%
Parents' nativity unknown	2.9%	7.1%	2.7%
Family below poverty line	17.5%	27.2%	17.1%
Family above poverty line	82.5%	72.8%	83.0%
Family below 2x poverty line	39.1%	57.5%	38.3%
Family above 2x poverty line	60.9%	42.5%	61.7%

Source: Urban Institute Children of Immigrants Data Tool. http://datatool.urban.org/
Data from IPUMS datasets drawn from the 2005 and 2006 ACS.

Appendix Table 20.A4: Heterogenity among the Foreign- and Native-Born

	California			Florida			Illinois			NJ			NY			TX		
	Total	FB	NB	Total	FB	NB	Total	FB	NB	Total	FB	NB	Total	FB	NB	Total	FB	NB
Asian	11.8%	24.3%	10.8%	2.6%	8.9%	2.2%	4.2%	21.1%	3.5%	7.8%	27.4%	6.7%	6.6%	25.4%	5.5%	3.3%	11.6%	2.8%
Black	7.6%	1.4%	8.1%	21.9%	17.8%	22.2%	18.8%	3.6%	19.5%	16.3%	10.9%	16.6%	18.5%	17.8%	18.6%	13.0%	3.0%	13.6%
Hispanic	47.7%	62.9%	46.5%	23.4%	58.4%	21.0%	20.1%	52.1%	18.7%	18.8%	38.9%	17.5%	20.0%	32.4%	19.3%	44.6%	77.0%	42.6%
Native Amer	0.4%	0.0%	0.4%	0.2%	0.1%	0.2%	0.1%	0.1%	0.1%	0.2%	0.0%	0.2%	0.3%	0.3%	0.3%	0.2%	0.0%	0.2%
White	32.6%	11.3%	34.2%	51.9%	14.8%	54.3%	56.8%	23.1%	58.3%	57.0%	22.7%	59.0%	54.6%	24.1%	56.4%	39.0%	8.3%	40.8%
Proficient	88.5%	58.0%	91.5%	94.5%	71.0%	96.5%	94.3%	64.6%	96.0%	95.2%	76.3%	96.7%	93.7%	72.5%	95.3%	90.1%	57.8%	92.7%
LEP	11.5%	42.0%	8.6%	5.5%	29.0%	3.5%	5.7%	35.4%	4.0%	4.8%	23.7%	3.4%	6.3%	27.5%	4.7%	9.9%	42.2%	7.3%
Bilingual	32.8%	50.7%	31.0%	19.9%	53.5%	17.0%	16.1%	52.8%	14.1%	19.6%	52.7%	17.1%	20.6%	47.5%	18.5%	24.3%	49.6%	22.3%
Eng only	55.7%	7.3%	60.4%	74.6%	17.5%	79.6%	78.2%	11.8%	81.9%	75.7%	23.7%	79.5%	73.2%	25.0%	76.8%	65.9%	8.2%	70.5%
Parents < HS	20.4%	40.4%	18.9%	10.5%	19.4%	10.0%	11.0%	28.5%	10.2%	7.9%	16.8%	7.4%	11.6%	21.0%	11.0%	19.3%	44.8%	17.8%
Parents HS grad	50.1%	33.9%	51.3%	58.0%	45.2%	58.9%	52.7%	39.4%	53.3%	46.9%	38.4%	47.4%	51.4%	45.6%	51.8%	53.3%	31.7%	54.6%
Parents 4yr college degree	29.5%	25.8%	29.8%	31.4%	35.5%	31.2%	36.3%	32.1%	36.5%	45.2%	44.8%	45.2%	37.0%	33.4%	37.2%	27.4%	23.4%	27.6%
FB parents	47.8%	89.2%	44.6%	29.3%	89.1%	25.3%	22.9%	86.2%	20.1%	29.5%	84.3%	26.2%	31.7%	86.9%	28.3%	30.3%	89.3%	26.7%
NB parents	48.9%	2.5%	52.4%	67.5%	5.0%	71.7%	74.4%	7.8%	77.4%	68.0%	9.7%	71.5%	65.4%	6.1%	69.0%	66.7%	4.0%	70.6%
Parents' nativity unknown	3.3%	8.2%	3.0%	3.2%	5.9%	3.0%	2.6%	6.0%	2.5%	2.5%	6.0%	2.3%	3.0%	7.1%	2.7%	3.0%	6.7%	2.8%
family below poverty	17.4%	30.5%	16.5%	16.4%	21.2%	16.1%	16.3%	23.4%	16.0%	11.3%	16.6%	11.0%	19.0%	25.9%	18.5%	23.8%	39.6%	22.8%
family above poverty	82.6%	69.5%	83.6%	83.6%	78.8%	84.0%	83.7%	76.7%	84.0%	88.7%	83.4%	89.0%	81.1%	74.1%	81.5%	76.3%	60.4%	77.2%
family below 2x poverty	41.0%	63.1%	39.3%	40.4%	55.0%	39.4%	35.4%	52.3%	34.6%	26.0%	39.6%	25.1%	38.2%	53.6%	37.2%	49.0%	72.0%	47.6%
family above 2x poverty	59.0%	36.9%	60.7%	59.6%	45.0%	60.6%	64.6%	47.8%	65.4%	74.1%	60.4%	74.9%	61.8%	46.4%	62.8%	51.1%	28.0%	52.4%

Children of Immigrants Data Tool. http://datatool.urban.org/charts/datatool/pages.cfm. The Urban Institute.

Data from the Integrated Public Use Microdata Series datasets drawn from the 2005 and 2006 American Community Survey.

Appendix Table 20.A5: Language and nativity, NYC 3rd-8th graders, 2000				
	English at home	Non-English and LEP	Non-English and English proficient	Total
Native	214,076 62.3% 92.3%	17,464 5.1% 56.0%	112,281 32.7% 77.7%	343,821 100% 84.3%
Immigrant	17,836 27.9% 7.7%	13,740 21.5% 44.0%	32,276 50.6% 22.3%	63,852 100% 15.7%
Total	231,912 56.9% 100%	31,204 7.6% 100%	144,557 35.5% 100%	407,673 100% 100%
Source: authors' calculations, NYC Department of Education administrative data, 2000				

Appendix Table 20.A6: Demographic composition of NYC school zones, 2000

	mean	min	max
immigrant	33.49%	4.56%	73.66%
white	30.70%	0%	95.67%
black	30.21%	0%	94.50%
Hispanic	28.86%	1.32%	89.85%
Asian	9.32%	0%	86.53%
poor	23.97%	2.24%	63.06%
over 65	11.40%	3.55%	30.33%
under 18	26.06%	6.50%	49.78%
HS plus	68.09%	34.03%	97.72%
avg income, in $1,000s	187.32	6.19	2,749.99
total population	12,584	1,430	85,908
Observations	588		

Source: authors' calculations, Neighborhood Change Database, 2000

Appendix Table 20.A7a: Weighted averages, school resources, NYC public schools, by race and nativity, 2000

	Overall		White		Black		Hispanic		Asian	
	NB	FB	NB	FB	NB	FB	NB	FB	NB	FB
enrollment	1,012	1,151	1,020	1,085	953	1,075	1,052	1,189	1,091	1,209
licensed teachers	79.2%	79.8%	89.6%	87.1%	75.6%	75.9%	76.5%	74.8%	87.8%	86.0%
teachers at school under 2 years	35.2%	33.8%	29.0%	30.1%	37.9%	36.7%	36.4%	36.2%	29.1%	29.9%
teachers with 5+ years experience	58.3%	59.5%	65.4%	63.9%	55.7%	56.5%	56.5%	56.4%	64.5%	63.8%
teachers with Masters	76.9%	78.2%	84.7%	82.9%	73.5%	74.2%	75.4%	75.2%	84.0%	83.1%
pupil-teacher ratio	15.8	16.0	16.8	16.0	15.3	15.7	15.6	15.7	16.9	16.8
Observations	343,821	63,852	54,873	10,766	132,087	13,988	127,838	23,829	29,023	15,269

Source: authors' calculations, NYC Department of Education administrative data, 2000

Note: these are weighted averages of the average school characteristics for a student of a particular nativity and race.

For example: in 2000, the average native-born student in grades 3-8 attends a school with an enrollment of 1,012 where 79% of the teachers are liscensed,

35% have been at the school for under 2 years, 58% have more than 5 years of experience and 77% have Masters degrees.

Appendix Table 20.A7b: Exposure Index: student body composition, NYC public schools, by race and nativity, 2000

	Overall		White		Black		Hispanic		Asian	
	NB	FB	NB	FB	NB	FB	NB	FB	NB	FB
% foreign-born	14.5%	21.8%	13.5%	25.3%	12.3%	17.1%	15.9%	20.9%	20.6%	25.1%
% LEP	7.5%	9.8%	2.5%	4.0%	5.6%	5.3%	12.0%	15.9%	5.7%	8.4%
% poor	80.4%	82.5%	52.9%	69.2%	86.7%	86.4%	87.8%	89.6%	71.2%	77.2%
% white	16.2%	15.8%	51.1%	43.3%	6.0%	5.1%	9.5%	7.4%	25.4%	19.5%
% black	37.1%	29.2%	13.1%	13.8%	62.3%	68.6%	26.2%	21.4%	15.4%	16.1%
% Hispanic	36.8%	39.6%	20.7%	23.6%	26.9%	21.2%	55.8%	62.0%	27.9%	33.0%
% Asian	10.0%	15.4%	15.1%	19.3%	4.7%	5.1%	8.5%	9.3%	31.3%	31.5%
Observations	343,821	63,852	54,873	10,766	132,087	13,988	127,838	23,829	29,023	15,269

Source: authors' calculations, NYC Department of Education administrative data, 2000

The exposure indices report the the share of a school's population belonging to a certain group for an average student of particular nativity and race.

For example: in 2000, an average 3-8 grade native-born student is exposed to a student body that is 14.5% FB, 7.5% LEP, 80% poor,

16% white, 37% black, 37% Hispanic and 10% Asian.

Appendix Table 20.A7c: Exposure Index: composition of foreign-born schoolmates, NYC public schools, by race and nativity, 2000

	Overall		White		Black		Hispanic		Asian	
	NB	FB	NB	FB	NB	FB	NB	FB	NB	FB
% FB who are LEP	19.4%	21.6%	7.0%	8.7%	15.9%	12.4%	29.9%	35.6%	12.7%	17.4%
% FB who are poor	82.1%	83.9%	59.9%	71.0%	86.6%	86.5%	88.4%	90.0%	71.2%	81.2%
% FB who are white	14.5%	16.9%	40.7%	53.9%	6.4%	5.1%	9.7%	6.9%	22.6%	17.1%
% FB who are black	28.4%	21.9%	9.2%	6.6%	52.4%	64.8%	16.1%	11.8%	9.4%	9.1%
% FB who are Hispanic	38.0%	37.3%	19.8%	15.3%	30.5%	20.2%	57.3%	64.9%	21.8%	25.5%
% FB who are Asian	19.1%	23.9%	30.2%	24.3%	10.7%	9.9%	16.9%	16.3%	46.2%	48.3%
Observations	343,821	63,852	54,873	10,766	132,087	13,988	127,838	23,829	29,023	15,269

Source: authors' calculations, NYC Department of Education administrative data, 2000

The exposure indices report the the share of a school's population belonging to a certain group for an average student of particular nativity and race.

For example: in 2000, an average 3-8 grade native-born student is exposed to a population of foreign-born schoolmates that is 19% LEP, 82% poor, 14% white, 28% black, 38% Hispanic and 19% Asian.

Appendix Table 20.A8: Number of NYC 3rd-8th grade test takers, by region, 2000

	reading test takers	math test takers	test takers
USA	336,800	339,537	343,821
former USSR	6,536	6,501	6,602
E Europe	2,176	2,176	2,209
W Europe	1,636	1,649	1,666
China	3,299	4,121	4,150
E Asia	2,612	2,613	2,660
S Asia	4,851	4,849	4,918
W Asia/N Africa	1,374	1,396	1,405
Sub-Sah Africa	1,471	1,489	1,519
DR	9,320	12,798	12,929
Caribbean	10,553	10,796	10,929
non-Span S Amer	4,031	4,024	4,068
Mexico/Cent/S Amer	7,922	10,414	10,526

Source: authors' calculations, NYC Department of Education administrative data, 2000

Appendix Table 20.A9: Quantitative studies examining disparities in performance due to nativity

Authors/Date	Data	Grades	Measures	Controlled Findings
Kao (1999)	NELS-88, 1988 (24,599 original sample)	8	Math and reading test scores	Generally, by race, first- and second-generation immigrants do better than same race native-born and as well as or better than white native-born.
Kao and Tienda (1995)	NELS-88, 1988 (24,599 original sample)	8	Math test scores	Both first- and second-generation immigrants outperform native-born. Within race/ethnic groups, only first-generation immigrants uniformly outperform native-born.
Glick and White (2003)	HSB 1980, 1990 (13,152 students) NELS-88, 1990, 1992 (16,376 students)	10 and 12	Math and reading test scores	In levels, 1980s immigrants perform worse than native-born; in 1990s, they perform better. In changes, immigrants about on par with native-born.
Glick and White (2009)	HBS 1980 sophomore cohort (12,807 weighted obs) NELS-88 1990 sophomore cohort (16,376 weighted obs)	8 and 9	Math and reading test scores	There is no statistically significant effect of being an immigrant - generation status is not significant. No evidence any one group of first-generation youth perform lower than their co-ethnic native peers.
Berg and Kain (2003)	Texas School Micro Panel, 1999 (207,609 students)	6	Math test scores	All immigrants perform better than native-born. Hispanic immigrants perform better than Hispanic native-born, but Asians do about the same.
Fuligni (1997)	microdata from two high schools and two middle schools in CA	6, 8 and 10	Math and English course grades	First and second generation students outperform their native-born peers. A small part of the disparity is explained by socioeconomic characteristics; family or community emphasis on education explains more of the variation though.
Schwartz and Stiefel (2006)	NYC Department of Education adminstrative data, 1998 and 2001 (57,152-72,509 students)	5 and 8	Math and reading test scores	Immigrants outperform the native-born. While there are some regional disparities, most are driven by sociodemographic and educational characteristcs.
Note: NELS = National Education Longitudinal Study; HSB = High School and Beyond survey				
These studies all use individual level data and focus on differences between immigrant and native-born K-12 students in the U.S.				
Immigrant is defined as being foreign-born.				

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Appendix Table 20.A10: The determinants of school composition, 2000

	% FB (1)	% LEP (2)	% poor (3)	% white (4)	% black (5)	% Hispanic (6)	% Asian (7)
Zone Characteristics							
% foreign-born	0.275***	0.252***	0.362***	-0.125***	-0.092*	0.080	0.137***
	(0.017)	(0.030)	(0.067)	(0.048)	(0.052)	(0.053)	(0.050)
% Black	-0.044***	-0.093***	0.270***	-0.632***	0.948***	-0.203***	-0.113***
	(0.008)	(0.015)	(0.037)	(0.038)	(0.025)	(0.037)	(0.019)
% Hispanic	-0.043***	0.070**	0.163***	-0.775***	-0.036	0.887***	-0.0767
	(0.015)	(0.033)	(0.062)	(0.074)	(0.042)	(0.071)	(0.053)
% Asian	-0.010	-0.116***	-0.191**	-0.819***	0.014	-0.277***	1.082***
	(0.022)	(0.039)	(0.077)	(0.065)	(0.047)	(0.066)	(0.064)
% over 65	0.026	-0.051	-0.550**	0.189	0.032	-0.544***	0.322***
	(0.043)	(0.091)	(0.227)	(0.190)	(0.127)	(0.155)	(0.098)
% under age 18	-0.034	0.086	-0.594***	0.132	0.043	-0.431**	0.256***
	(0.046)	(0.099)	(0.226)	(0.221)	(0.142)	(0.195)	(0.096)
% speaking no English	0.031	0.546***	0.123	0.324***	-0.042	0.088	-0.370**
	(0.044)	(0.084)	(0.181)	(0.119)	(0.127)	(0.148)	(0.146)
average household income	0.002	-0.002	-0.010***	0.005*	0.001	-0.006***	0.0004
	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)
% below poverty level	0.146***	0.197***	0.630***	-0.291***	0.104	0.065	0.121
	(0.026)	(0.049)	(0.108)	(0.087)	(0.079)	(0.084)	(0.078)
% with at least a HS degree	0.102***	0.203***	-0.309**	-0.262***	0.242***	0.048	-0.029
	(0.029)	(0.054)	(0.121)	(0.085)	(0.083)	(0.088)	(0.085)
Constant	-11.13***	-17.83***	78.08***	81.33***	-9.147	32.45***	-4.575
	(3.426)	(6.417)	(14.68)	(11.05)	(9.119)	(10.56)	(10.16)
Borough fixed effects	Y	Y	Y	Y	Y	Y	Y
Observations	633	633	633	633	633	633	633
R-squared	0.701	0.706	0.730	0.842	0.924	0.882	0.864

Note: Average income measured in $1,000s. Robust standard errors, adjusted for within-zone clusters, in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Appendix Table 20.A11: % immigrant in school, reading and math performance, by nativity and race, 2000 only

	All	FB	NB	NB			
				Black	Hispanic	Asian	White
	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Math

% immigrant in school	0.005***	0.006***	0.005***	0.001***	0.002***	-0.003***	-0.006***
std. error	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Observations	402,631	63,094	339,537	130,158	126,071	28,872	54,436
R-squared	0.003	0.004	0.002	0.000	0.001	0.001	0.005

Reading

% immigrant in school	0.002***	0.003***	0.001***	0.001***	0.001***	-0.005***	-0.007***
std. error	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Observations	392,843	56,043	336,800	130,476	122,922	28,879	54,523
R-squared	0.000	0.001	0.000	0.000	0.000	0.003	0.005

Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)
All models include year dummies.

Appendix Table 20.A12: % Immigrant in school and grade, reading performance, 1997-2002

| | All | FB | NB | NB | | | |
| | | | | Black | Hispanic | Asian | White |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
School fixed effects							
% immigrant in school	-0.001	-0.003**	-0.001	-0.003*	-0.000	0.001	-0.001
std. error	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
# fixed effects	1,090	1,085	1,089	1,087	1,089	1,045	1,029
R-squared	0.171	0.168	0.174	0.104	0.090	0.142	0.147
Grade-school fixed effects							
% immigrant in grade	0.000	-0.002**	0.000	-0.000	0.000	0.001	0.000
std. error	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
# fixed effects	3,704	3,638	3,702	3,677	3,680	3,328	3,208
R-squared	0.178	0.178	0.181	0.114	0.100	0.161	0.157
Observations	2,113,801	303,144	1,810,657	704,351	655,774	152,536	297,995

Robust standard errors, adjusted for within-school clusters, in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$)

All models include year dummies. Test scores measured as z-scores.

A grade-school fixed effect allows each grade in every school to have a unique intercept. This means that the intercept for 3rd graders in school A will be different than the intercept for 4rd graders in school A and for 3rd graders in school B.

Figure 20.A1

Appendix Figure 1: Distribution of % foreign-born by NYC school zone, 2000
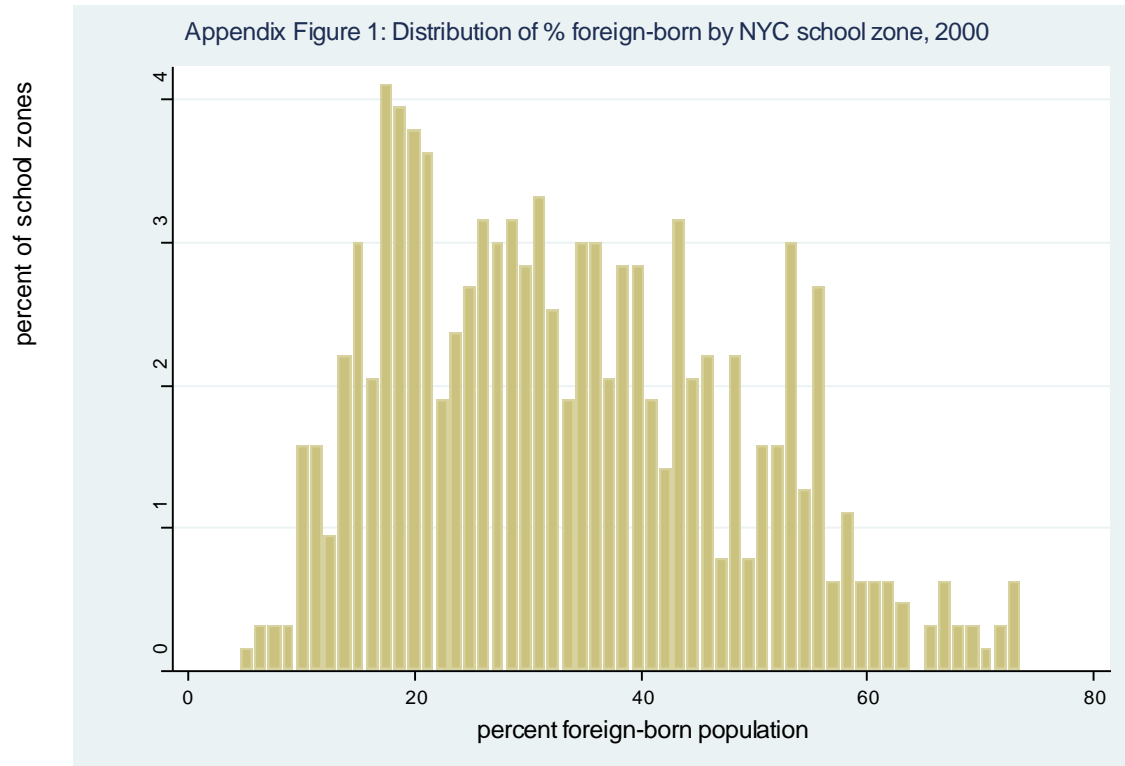
Source: authors' calculations, Neighborhood Change Database, 2000

Figure 20.A2

Appendix Figure 2: Math scores and immigrant share for the native-born, by race
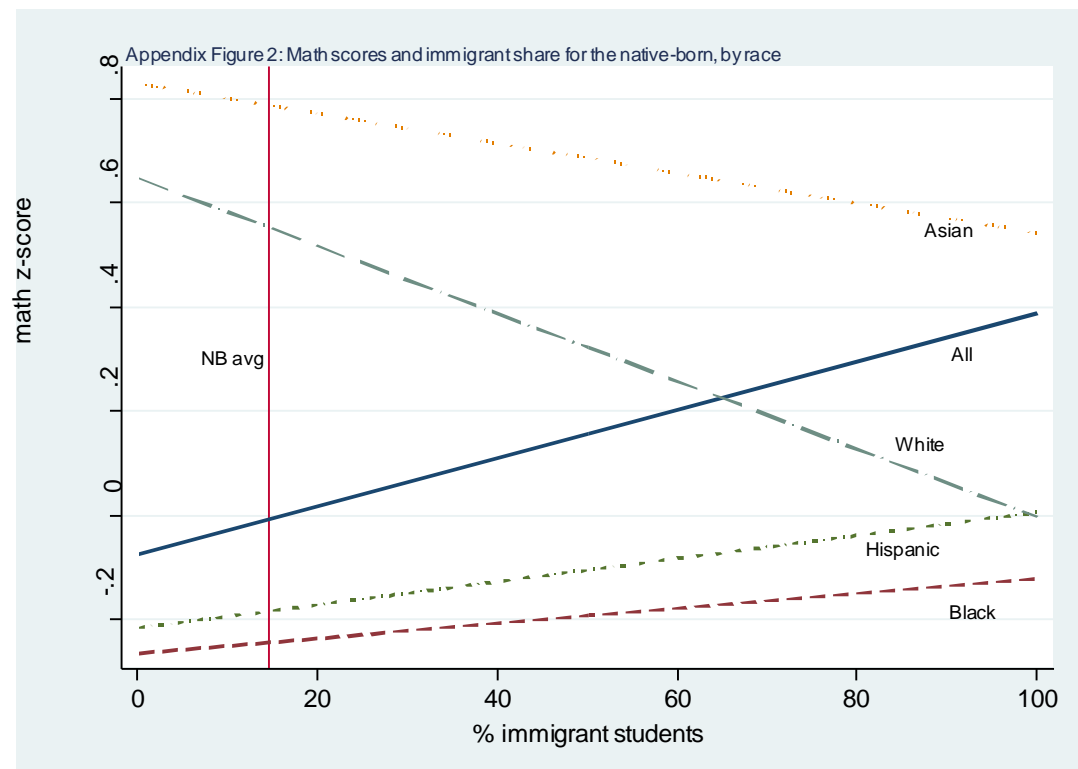
Online Appendix

Chapter 22

The Challenges of Finding Causal Links between Family

Educational Practices and Schooling Outcomes

Frank F. Furstenberg

Early Research on the Influence of Families on Children's Success in School

It is fruitless to search for a single starting point in the tradition of studying family's influence on educational success because it was such a central theme of social science research in the middle decades of the past century. Almost all of the pre-war and early postwar community studies exhibited some interest in the topic, particularly when their focus was on social class differences in family life. Explicit attention to the family and parents' role in children's school achievement figured prominently in the classic works of *Middletown*, *Elmtown's Youth*, *Crestwood Heights*, and the *Urban Villagers*, to mention but a few examples (Gans 1962; Hollingshead 1949; Lynd and Lynd 1929; Seeley 1963). Similarly, reaching back to the work of prominent studies of race, class, and family life by Dubois, Frazier, Davis and Havighurst, Clayton and Drake, Liebow, and Rainwater, researchers have been keen to understand the differences in family life and educational outcomes among blacks and whites within and across social strata (Furstenberg 2007).

This early research laid a broad foundation for a more concentrated effort in the second half of the century to explore the processes or mechanisms within families that influence educational achievement and create mobility or stasis from one generation to the next. Various lines of research in developmental psychology and sociology typically concentrated on one mechanism or another that had emerged from comparative studies in the 1960s through the 1980s. These mechanisms include:

1. Cognitive training (language use and acquisition; family educational practices)

2. Cultural values (conveying beliefs and attitudes that contribute to education, schooling, and social position acquired early in life)

3. Parental practices (in discipline, control, monitoring, advocacy, and bonding)

4. Structural features (parental resources flowing from family organization and social position)

5. Social connections (the ability of parents to place the child in advantageous educational settings).

There are numerous reviews of this literature, and I single out only a few of the most prominent and influential studies that identified various mechanisms through which the family and parents exert their influence. Hart and Risley (1995), for example, in a remarkable study of language acquisition, find that by age 2, children from the households of educated and affluent parents have far better command of language, speech practices, and vocabulary than their counterparts in families without money or education. Parents from affluent families continuously instructed, questioned, praised, explained, and responded to their children. In contrast, these practices were uncommon

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in disadvantaged families. Their research brings to mind the important distinction introduced by Basil Bernstein (1971) in his pioneering research on class differences in language codes. Children from privileged families in his studies were learning "elaborated" speech codes, which provided tools for learning, while disadvantaged children operated with "restricted" speech codes, which appeared to thwart curiosity and exploration. Bernstein and others argued that parents with limited education and income, often residing in dangerous environments, were often more oriented to preventing harm from happening.

These different competencies that elite parents impart can be independent of their own educational values and expectations, another mechanism of fostering educational success. A number of researchers, among them Miller and Swanson (1958) and Kohn (1959), have shown how parents' position in and understanding of the stratification system shape their goals for their children. These researchers emphasized how parents extrapolate from their educational and occupational experience to value certain and promote particular values that they deem important to their children's success, including the promise of education as an avenue to later success. Parents also command a very different view of what is required to enter higher-level occupations when they themselves hold those jobs. It is difficult to train parents who lack the experience of the educational and work worlds to prepare their children to enter worlds about which they have limited knowledge. This line of research has continued to the present, with important studies by Mortimer (2005) and Menaghan and Parcel (1995). (For a recent review of this literature, see Parcel, Dufur, and Cornell forthcoming)

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Annette Lareau, an urban ethnographer, has also amplified and extended this cultural

model of the family's influence. In her book *Unequal Childhoods,* Lareau (2008) describes

just how different the world of schooling appears from the vantage point of working-

class and upper-middle-class families. The "culture" of families—their belief systems

and related stock of daily practices—is created in part by family members' own

knowledge of the world (cultural capital). On the basis of family background (how they

were brought up), their education, and occupations, these families display a different

understanding of their job as parents. Lareau uses the term "concerted cultivation" to

describe the approach favored by advantaged parents that involves teaching children

how to negotiate by inquiry in unfamiliar environments. She contrasts this orientation to

parenting with a style she calls "natural growth," the approach favored by working-

class parents that is aimed at keeping children in line and out of trouble. These different

orientations, Lareau reasons, have powerful consequences for school performance and

educational attainment.

In a related vein, developmental psychologists have explored the connection

between class differences in parenting styles and later school behavior. Different

practices of support, punishment, and control shape broad habits of interaction between

parents and children. A long tradition of studies, beginning with the seminal work of

Baumrind (1967), Maccoby and Martin (1983), and Hess and Holloway (1984), shows

that the formation of relationships in the family, habits of managing emotion, anger, and

disobedience may shape children's ability to function outside the home, particularly in

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school. Consequently, altering parenting practices has been for some decades an important target for intervention.

In yet another line of research, students of stratification have explored family influences that contribute to intergenerational continuities and discontinuities in socioeconomic status. The work of Blau and Duncan (1967), Sewell (1971), Hout (1984), and more broadly the Wisconsin tradition of examining intergenerational mobility, is particularly informative. Research has shown that education, occupation, and income--the basis of economic stratification--separately and in combination are strongly related to academic success via a host of direct and indirect ties that ultimately determine mobility. As some of the earliest studies of stratification revealed, families realize their material, social, and cultural knowledge gained from their social position in society to shape their children's values, expectations, and schooling practices (See Musick and Mare, 2006, for a review of this literature.)

This process of "family socialization" is not just conducted inside the household. Money buys neighborhood access to quality schools, which reinforce school advantage, and lack of money constrains how effective parents can be in implementing educational ambitions for their children (Lareau 2000). Parents who have the resources (education, income, and occupation standing) will generally be more effective in promoting their educational ambitions for their children, and their children will in turn be more receptive and responsive to these goals when peers and peers' parents also share these goals (Coleman 1988). In sum, families operate in a socioeconomic context (or, more

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loosely, a social class system) that pervasively influences how effective parents are in promoting their educational ambitions (Furstenberg et al. 1999).

Numerous nonexperimental studies have also examined family structure and educational values. As far back as the 1960s, Elizabeth Herzog (1963), conducted an extensive review of the literature, noticed that family structure was often confounded with unequal resources, obscuring the interpretation of its effect on child outcomes. Over the years, researchers have been able to devise new methods of adjusting for social selection. Though controversy remains, it appears at least from the nonexperimental literature, that family structure (two biological parents versus single-parent households) is strongly related to academic success and educational attainment (McLanahan and Sandefur 1994). There have been numerous efforts to model how social class influences family structure (and is also influenced by family structure), but only a tiny fraction of these studies has traced how these processes operate inside the family to create academic disadvantage. However, we know that marital transitions lead to residential and school instability; they increase children's mental health problems and are linked to a decline in parental supervision. Perhaps it would be more accurate to say that we have not learned how to compensate for the pervasive influence of behaviors associated with the disadvantages linked to socioeconomic status and family structure.

Yet another important line of research investigates parents' ability to reach beyond the home, connect to the school, and seek resources that may promote both school skills and educational attainment (See, for example, Epstein 1988; Litwak and Meyer 1974; Sussman and Burchinal 1962). James Coleman's notable article on social

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capital identified the fit between the family system and the school system as an important condition for integrating the home-school agenda. When families are embedded in a community of like-minded parents, they are more likely to succeed in promoting their own values. Both the ability to make connections and deploy them to advance their children's educational objectives, Coleman observed, is linked to how families are situated in the community, their access to alternatives to public schools, and parents' skills at ferreting out educational resources.

Reginald Clark (1983) wove these different strands of research together in a remarkable, in-depth qualitative study, finding that low-income families that produce successful students are organized differently and exhibit different cultural styles. Clark also sought to explain why some families were successful in promoting school success despite seemingly limited assets. The study examined a small group of disadvantaged African-American parents, carefully comparing families that were rearing children who were succeeding in school with those that were not. Drawing together theoretical insights from the emerging studies on the significance of early education, strong and cohesive values, and good management skills for advocacy and location of resources, Clark found that a constellation of values, habits, and practices gave children "school survival skills" to beat the odds.

Specifically, Clark's findings supported the notion that families that instill high educational values take a set of discrete actions to reinforce their expectations. These actions include engendering a culture of literacy in the home; closely monitoring their children's schoolwork; providing feedback and responding to their children's

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educational activities; creating rituals and routines to establish good habits; advocating for their children; and finding resources in the community. Clark was not at all oblivious to the active role that children play in responding to parental influences. He acknowledged that children's own personalities and aptitudes affect the outcomes, although parents in high-achieving families tend to persist in their efforts to promote academic success, even if they did not always succeed, regardless of their child's personality. Clark's work provided an important guide for community-based programs and influenced many of the leading educational figures in the 1980s and 1990s (Comer 1988).

This cursory review of the nonexperimental literature is intended to illustrate how many different processes within the family operate concurrently to produce variation in children's school success. The different studies point to a number of different mechanisms within families that could account for why sharp differences in school readiness and success appear across social strata. In all likelihood, these mechanisms are overlapping, mutually reinforcing, and play out over time because they are all linked to the family's social position. This is not to say that social position "determines" what families do, but the recurrent and consistent patterns of family beliefs and practices mean that these behavioral patterns will create sharply divergent patterns of school success by socio-economic status. They affect parents' goals and practices regarding education. They influence what the child brings to the classroom on the first day of school (or preschool) and they continue to affect children's performance in the school system over time. No less important, they are amplified and exacerbated

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by teachers' perceptions of children's abilities and the quality of schooling available to them. In short, the family system is embedded in a neighborhood and school system that typically reinforces social inequities.

As I have argued in greater detail elsewhere (Furstenberg 2009), these practices established in the home set the course of school success very early in life, but they usually cumulate over the course of childhood (see, for example, Entwisle, Alexander, and Olson 1997). Parents of different strata are differently situated to take remedial actions when children are struggling in school. Privileged parents can seek help, advocate more effectively for change, and can often exit the public school system when things are not going well. Such actions are much less likely to be available to the underprivileged.

In examining the causal impacts in the next section, it is important not to lose sight of the possibility that families are creating very different learning environments for their children, differences that flow from their own social position. The repertoire of skills they bring as parents to educate their children, the assets they can command to introduce their children to attractive school settings and like-minded playmates and peers, and their capacity to take action when they discern learning problems all contribute to the distinctions that play out over children's school lives.

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