



# Can Increased Educational Attainment Among Lower-Educated Mothers Reduce Inequalities in Children's Skill Development?

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**Abstract** A rich tradition of stratification research has established a robust link between mothers' education and the skills in children that forecast children's own mobility. Yet, this research has failed to consider that many U.S. women are now completing their education after having children. Such a trend raises questions about whether increases in mothers' educational attainment can improve their children's skill development and whether these gains are enough to reduce inequalities in skills compared with children whose mothers completed the same degree before they were born. To answer these questions, we draw on a nationally representative sample of mothers and children participating in the National Longitudinal Surveys (NLSY79 and CNLY), random- and fixed-effects techniques, and repeated measures of children's cognitive and noncognitive skills. Contrary to existing research and theory, our results reveal that educational attainment obtained after children's births is not associated with an improvement in children's skills. Such findings offer substantial refinement to a long-standing model of intergenerational mobility by suggesting that the intergenerational returns to mother's education are weaker when education is acquired after children are born. Results also highlight the limits of two-generation policy approaches to reducing inequality in future generations.

**Keywords** Maternal education · Child development · Stratification · Inequality · Family

## Introduction

In the modern economy, the intergenerational transmission of parents' socioeconomic status is no longer channeled principally through the father's characteristics. The mother's

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characteristics, too, are important predictors of children's socioeconomic mobility (Beller 2009). In fact, given economic and demographic changes in the U.S. over the last 50 years, there may be no factor more powerful in stratifying children's opportunities for mobility today than mother's educational attainment (McLanahan 2004). The explanations for the increased significance of women's education in the intergenerational transmission process are complex, but in short, education provides women with access to higher-paying, higher-status segments of the labor market (Card 1999); promotes union formation and stability (Isen and Stevenson 2010); and cultivates an array of nonpecuniary resources, including mental health, cognitive skills, and social capital (Mirowsky and Ross 2003). These resources, in turn, help mothers promote their children's development, academic success, and earning potential through various financial and parenting-related pathways (Harding et al. 2015; Haveman and Wolfe 1995).

Given the robustness of these links, which have been observed in correlational studies as well as studies using methods of causal inference (Black and Devereux 2011; Carneiro et al. 2013; Oreopoulos et al. 2006), many scholars have argued that investing in the education of lower-educated women is a promising strategy for reversing trends in rising inequality for the next generation of Americans (Attewell and Lavin 2007; Hout 2012; Kaushal 2014). In fact, based on this argument, large-scale programs sponsored by several U.S. agencies (Department of Labor, Department of Education) that aim to help parents return to school have already been formed (Askarinam 2016). Although this argument rests on solid empirical footing, there is one issue that is of critical importance for both policy and theories on socioeconomic mobility that remains unclear: whether these investments can be effective for women who already have children.

This issue of *sequencing* of educational attainment vis-à-vis the transition to motherhood is important for two reasons. First, it reflects the reality of U.S. women's educational trajectories today. For example, among mothers without bachelor's degrees participating in the National Longitudinal Surveys (NLSY79), 17 % returned to school to increase their education (from which, about one-half earned a high school diploma or GED, and the other half earned a degree in higher education; Augustine 2016). Yet, the vast literature linking maternal education to children's mobility-related outcomes has overlooked this trend by failing to consider whether mothers' education was completed *before* or *after* their child's birth.<sup>1</sup> Second, the issue of sequencing recognizes a central paradigm of population research: life course theory. This paradigm underscores how sequencing the transition into motherhood before the completion of formal education might result in "life course penalties" that interfere with (e.g., by creating competing work and family demands) or directly reduce (e.g., by creating increased financial

<sup>1</sup> In many cases, lack of attention to the timing of mother's degree completion vis-à-vis the child's birth is due to data limitations, in which education is assessed at the time of the interview and the date of degree completion is not known, although many other studies rely on data—such as the NSLY79, the Fragile Families and Child Wellbeing Study (FFCW), the Early Childhood Longitudinal Survey-Kindergarten Cohort (ECLS-K), the Early Childhood Longitudinal Survey-Birth Cohort (ECLS-B), and the Panel Study of Income Dynamics (PSID)—which (to varying degrees) allow researchers to assess whether the child's mother increased her education post-fertility. There is some indication that scholars have failed to account for the timing of education because of norms around life course sequencing and the stability of education (e.g., see Marini 1984; Sirin 2005), although there is scant empirical evidence to make such judgments. It is fair to say, however, that few studies deal with this issue of educational sequencing in either a methodological and conceptual sense, but there is increasing evidence (described in the text) that we should do so.

hardship) the potential for an increase in mothers' degree attainment to improve the mobility prospects of their children (Pearlin et al. 2005).

These insights thus highlight two questions that we aim to answer in this study. First, do the developmental skills of children born to lower-educated mothers (i.e., without a bachelor's degree) improve as a result of an increase in their mother's educational attainment? And second, are these gains strong enough to reduce inequalities in children's skills, compared with children whose mothers had completed the same level of education before they were born? To address these questions, we use methods that help address problems of unobserved heterogeneity (random effects and fixed effects); a nationally representative sample of mothers and children from the National Longitudinal Surveys (NLSY79 and CNLSY); and repeated measures of children's cognitive and noncognitive skills that are well-established indicators of socioeconomic mobility (Haegeland et al. 2010; Oreopoulos et al. 2006). Should the answers to either question be "no," we will have revealed a key limitation of a widely discussed policy regime and an unacknowledged stratifying element of mother's education: the significance of when in the life course, vis-à-vis children's births, mother's education was acquired.

## Previous Research and Contemporary Theory

### Increased Maternal Education and Children's Skill Development

Although parental education is widely considered to be the central mechanism in intergenerational mobility today (Erikson and Goldthorpe 2002), our understanding of this process does not reflect a key contemporary change in the life course. Specifically, many Americans now enter parenthood before completing schooling (Horn et al. 2005). This change in the life course has been particularly pronounced among women, who make up more than three-fourths of college students with dependent children today (Gault et al. 2014). This change has also been concentrated among more-disadvantaged women, who often had children when they were young, grew up in disadvantaged families, and are unmarried (Augustine 2016; MacGregor 2009; Taniguchi and Kaufman 2007). Given the characteristics of these women, scholars have suggested that promoting the continued educational attainment of less-educated mothers is a viable strategy for reducing inequality in future generations (Chase-Lansdale and Brooks-Gunn 2014; Kaushal 2014). Disadvantaged mothers themselves have echoed this idea, believing that increasing their education will improve their children's opportunities for mobility (Edin and Kefalas 2011; Katz 2013). The potential for an increase in the postnatal educational attainment of less-educated mothers to have such effects on their children, however, remains unclear.

At present, a handful of studies suggest that an increase in the education of less-educated mothers is associated with an increase in their children's cognitive skills, but these studies are limited in the generalizability of their findings to the broader U.S. population or in their ability to draw causal conclusions. For example, Harding (2015) and Magnuson et al. (2009) examined mothers with children under age 5, but many mothers do not return to school until their children are older (Augustine 2016). Two other known studies were based on samples of young mothers (Magnuson 2007) and women participating in a job training program in two U.S. cities (Gennetian et al. 2008). This latter study was also the only study to use methods addressing unmeasured

selection (Gennetian et al. 2008). Mothers who return to school, however, are likely to be “positively selected,” given that having children typically deters parents from returning to school (Taniguchi and Kaufman 2007). Mothers who return to school also report higher academic aspirations, better academic records, and better financial and social support compared with mothers who do not (Bradburn et al. 1995; Brooks-Gunn et al. 1993; Felmlee 1988; Way and Leadbeater 1999). Finally, prior studies have neither examined children’s noncognitive outcomes (except Harding 2015) nor compared the outcomes of children whose mothers increased their education with children whose mothers completed the same education before they were born.

### Maternal Education and Intergenerational Mobility

Despite the limitations of this research, the larger literature on intergenerational mobility—which has used various quasi-experimental strategies for making causal inferences (for a recent review, see Black and Devereux 2011)—provides ample support for the expectation that children’s skill development should benefit from an increase in their mother’s postnatal educational attainment (Haegeland et al. 2010; Oreopoulos et al. 2006; Plug 2004; Sacerdote 2002). Also supporting this expectation are studies that described the economic and parenting mechanisms linking maternal education to children’s skills.

For example, higher levels of education have been shown to grant mothers access to higher-paying jobs that provide the means to access quality childcare, safe neighborhoods, good schools, nutritious foods, and enriching materials and experiences (e.g., books, lessons), all of which have a significant effect on children’s development at various stages (Augustine et al. 2009; Berger et al. 2009; Bornstein and Bradley 2003/2014; Parcel and Menaghan 1990). Education also gives mothers access to higher-prestige jobs, which are characterized by greater scheduling flexibility, employment stability, autonomy, creativity, and job satisfaction—aspects of work that are associated with more-positive parenting, higher-quality parent-child relationships, more parental involvement, and better child cognitive and behavioral outcomes (Han 2005; Lareau 2004/2011; Menaghan and Parcel 1991).

Mothers with more education are also connected to a broader network of social ties (Blossfeld and Andreas 2003), which relay information about the quality of schools and teachers, parenting practices, and opportunities for their children’s development outside of the school (Carbonaro 1998; Choi et al. 2008). More-educated mothers have advanced language skills that they use in their daily interactions with their children to build their cognitive and noncognitive abilities and negotiate advantages for them (e.g., advanced class placement) (Hart and Risley 1995; Lareau 2011; Suizzo and Stapleton 2007). They are more apt to adopt a style of parenting that emphasizes greater time investments and socialization of their children toward higher expectations of status attainment (Bianchi et al. 2006; Halle et al. 1997). And they have personal resources (e.g., self-efficacy, critical thinking skills) that help them manage stressors that can threaten their mental health and their children’s social and cognitive functioning (Augustine and Crosnoe 2010).

### Life Course Timing and the Returns to Education Among Women With Children

Nevertheless, despite such evidence, whether these findings can be generalized to educational credentials acquired by less-educated women *after* their children are born

remains unclear. Prior research has underscored this point by calling attention to population heterogeneity in the returns to education (see Brand and Xie 2010), although such heterogeneity has been largely considered in terms of the characteristics of the adults who earned the education, such as their gender, race, age at completion/enrollment, or propensity to enroll based on a composite of background characteristics (Brand and Xie 2010; Elman and O'Rand 2004; Hout 2012). Scholars have yet to examine population variability along the increasingly salient dimension of whether individuals have dependent children or to explore what this source of variability means for their children's outcomes.

The importance of doing so is underscored by a tenet of the life course paradigm: the sequencing of life course transitions. This tenet highlights how the benefits that individuals derive from their social roles depend on their sequencing vis-à-vis other life course transitions (Elder 1994). Specifically, the ordering of some roles can carry long-term "life course penalties" because "the demands and conditions encountered in out-of-sequence or off-time transitions interfere with the achievement and enactment of other roles and statuses" (Pearlin et al. 2005:212). Importantly, the early transition out of education precipitated by the transition to parenthood or the need to work is argued to carry the greatest long-term life course penalties. Such insights thus suggest that mothers who acquire additional education at a time considered to be out of sequence (after they have children) (Marini 1984) will have more difficulty realizing the benefits of their new degree and passing on its previously documented advantages to their children.

There are also substantive explanations for this possibility. Mothers may gain less from schooling because they are less prepared to succeed after having been out of school; they are disconnected from their peers because of their age and lifestyle differences; they have less time to invest in schooling given the competing demands of motherhood (and for most, the competing demands of employment); and their parents provide less social support (Armstrong and Hamilton 2013; Bozick and DeLuca 2005; Carney-Crompton and Tan 2002). They may also face financial hardships because they need to reduce their work hours to accommodate time for school; they take on new costs (e.g., tuition, childcare); and they receive low levels of financial support from their parents or partners (Goldrick-Rab and Sorensen 2010; MacGregor 2009). They may also experience increased stress as a result of the concurrent demands of managing school, employment, and childrearing—activities that can also decrease the amount of time mothers invest in their children (Carney-Crompton and Tan 2002; Johnson et al. 2000). Finally, these mothers may experience fewer financial returns to their degree because they lack the requisite work experience of someone at the same life stage and educational level and the social networks of a traditional student. As such, they remain in lower-status, lower-paying jobs upon degree completion (Elman and O'Rand 2004; Felmlee 1988; Light 1995).

### Summary of Current Study

Drawing on the life course paradigm, methods that help promote causal inference, and a nationally representative sample of children and mothers, we investigate (1)

whether an increase in maternal educational attainment, for children born to less-educated mothers (i.e., without a bachelor's degree), improves children's cognitive and noncognitive skill development; and (2) whether such gains are enough to reduce inequalities in their skills compared with children whose mothers completed the same level of education before they were born. We consider educational increases at three levels: the high school level, two-year level (e.g., associate's degree), and four-year level (i.e., bachelor's degree), although we acknowledge that such strata smooth over substantial diversity linked to credential type (e.g., high school diploma vs. GED), institution (e.g., online vs. brick and mortar), and degree (e.g., major; associate's vs. vocational degree). Parsing out these differences, however, is beyond the scope of this study.

In brief, we expect the answer to our second question to be “no.” The answer to the first question is less clear given that the weight of the literature suggests some level of positive effect. Effects may also vary depending on the level of education earned or other factors (e.g., age of the child at completion, time since completion, child gender), which we examine as well.

## Methods

### Data

Data come from the National Longitudinal Survey of Youth (NLSY79), a cohort study of the life course experiences of 6,283 women aged 14–22 when data collection first began in 1979. Participants were surveyed annually through 1994, and biennially thereafter. In 1986, the study added the CNLY, an ongoing biennial survey of NLSY79 mothers and their children that has collected data on more than 11,000 children—about 95 % of all children born to NLSY79 women. These surveys are the best source of data for this study because they are nationally representative and intergenerational; they sampled women when they were young, before most had children and were “at risk” of returning to school; they include precise data on the timing of mother's degree attainment; they include repeated measures of children's cognitive and noncognitive outcomes based on two widely used, well-validated instruments; and they include rich “pretreatment” measures of mothers, such as their ability or aspirations, which are rarely included in observational studies. These surveys do, however, have limitations—namely, the NLSY79 does not reflect the ethnic diversity or experiences of more recent cohorts of U.S. women, and about 11 % of the CNLSY children were born before the start of the NLSY79.

### Sample

Children are the unit of analysis. Thus, we formed our analytical sample by drawing on the sample of 11,503 children ever interviewed through the 2010 data collection and assigned a valid sampling weight. We then excluded children born to mothers from one of the NLSY oversamples ( $n = 1,744$  children), which were dropped partway through the study and have large amounts of missing data. Children who did not continuously

coreside with their mother through the final child assessment at age 14 ( $n = 1,130$  children) were also dropped. These restrictions resulted in a final analytical sample of 8,627 children. Their characteristics are described in Table 1.

## Measures

### *Maternal Education Measures*

To capture mothers' complete educational histories, we drew on multiple pieces of information, including mothers' reports of the highest grade and years of schooling they completed (reported annually from 1979 to 1993, and biennially from 1994 to 2010); whether the mother received a high school diploma/GED and, if so, the date it was received (reported every survey wave); the highest degree ever received (reported annually from 1988 to 1993, and biennially from 1994 to 2010); the month and year the highest degree was received (reported annually from 1988 to 1993, and biennially from 1994 to 2010); if a college degree was received and, if so, what type (two- vs. four-year; reported annually from 1979 to 1984); whether a degree was received since the last interview (reported annually from 1980 to 1984); and whether the woman was currently enrolled in school (all waves). Combining this information allowed us to determine if mothers exited and reentered the educational system, as well as the exact month and year that she earned each degree.<sup>2</sup> Drawing on information on the child's birth date, we reconfigured these chronological measures to create a series of time-varying measures of highest level of education at each child age, which in our longitudinal analyses, is the metric of time, not year. The categories of education are based on assignment to one of four groups: (1) less than a high school education, (2) high school diploma/GED, (3) associate's/two-year degree, and (4) bachelor's degree or higher. Using information on the child's birth year, we also created a time invariant measure for *maternal education at the child's birth*.

Using the time-varying measure of highest level of education at each child age, we also created a time-varying binary marker for *additional maternal education*. This measure indicated whether or not a child's mother, for each child age, had earned additional educational attainment (1 = increased level of education; 0 = no increase). Once an increase occurred, children received a value of "1" for each subsequent year. Additional education included the transition to any of the following categories: a high school diploma/GED, an associate's/two-year degree, or a bachelor's degree. Additional education was counted only for children whose mothers had less than a bachelor's degree when they were born and had reported exiting and reentering the school system to indicate a return to school.

<sup>2</sup> For women who earned degrees/diplomas prior to 1988, we can capture the survey wave the degree was earned but not the month. In such cases, we code the month as May if the degree is a college degree (when they are typically conferred) and June (likewise) if it is a high school diploma. This assignment has implications for only a small number of cases in which the birth occurred the same year (8 %). In cases of inconsistent reporting of education (e.g., mother reported 12 years, then 10 years, then 12 years), we recoded the outlying year (10) with the modal report (12).

**Table 1** Characteristics of sample (means and percentages) ( $N = 8,627$ )

|   | Means           | Percentages |
|---|-----------------|-------------|
| Mother Additional Education             |                 |             |
| Increased degrees                       | —               | 13          |
| Mother Education at Birth               |                 |             |
| Less than high school                   | —               | 16          |
| High school diploma/GED                 | —               | 56          |
| Associate's degree                      | —               | 7           |
| Bachelor's degree                       | —               | 21          |
| Mother Background Characteristics       |                 |             |
| White                                   | —               | 74          |
| Black                                   | —               | 18          |
| Hispanic                                | —               | 9           |
| Grandmother some college                | 11.20<br>(0.03) | —           |
| Grandfather college degree              | 11.19<br>(0.05) | —           |
| Age at first birth                      | 26.94<br>(0.07) | —           |
| Foreign language spoken in home         | —               | 15          |
| Mother foreign-born                     | —               | 5           |
| Percentage of high school poor          | —               | 22          |
| Grandmother employed                    | —               | 52          |
| Family of origin received welfare       | —               | 13          |
| Early sexual debut                      | —               | 15          |
| Adolescent alcohol use                  | —               | 61          |
| Number of siblings                      | 3.74<br>(0.03)  |             |
| Newspaper in home growing up            | —               | 80          |
| Grew up in single-parent home           | —               | 28          |
| Expected years of education             | 13.70<br>(0.03) | —           |
| Self-efficacy                           | 3.21<br>(0.00)  | —           |
| Armed Forces Qualification Test score   | 46.24<br>(0.35) | —           |
| Mother Characteristics at Child's Birth |                 |             |
| Married                                 | —               | 77          |
| Divorced                                | —               | 7           |
| Unmarried                               | —               | 16          |
| Economic hardship                       | —               | 27          |
| Employed                                | —               | 36          |
| Weeks out of labor market               | 30.91<br>(0.36) | —           |
| Number of jobs since age 18             | 0.54<br>(0.00)  | —           |

**Table 1** (continued)

|                                      | Means                   | Percentages |
|--------------------------------------|-------------------------|-------------|
| Household income                     | 42,812.03<br>(1,306.45) | —           |
| Net wealth                           | 68,865.00<br>(3,264.00) | —           |
| Urban                                |                         | 76          |
| Administrative/managerial occupation | —                       | 22          |
| Service occupation                   | —                       | 40          |
| Manual occupation                    | —                       | 24          |
| Other occupation                     | —                       | 13          |
| Child Skill Outcomes                 |                         |             |
| Reading                              | 106.90<br>(0.10)        | —           |
| Math                                 | 103.83<br>(0.10)        | —           |
| Comprehension                        | 105.03<br>(0.25)        | —           |
| Internalizing problems               | 101.63<br>(0.09)        | —           |
| Externalizing problems               | 102.26<br>(0.12)        | —           |

Notes: Estimates are based on the weighted sample. Standard errors are shown in parentheses.

### *Child Outcome Measures*

Children's cognitive skills and noncognitive skills were assessed biennially using two instruments administered repeatedly to children starting at age 4 or 5, and up through age 14. Children's cognitive skills were assessed by three subtests for math, reading, and comprehension skills of the Peabody Individual Achievement Test (PIAT). The PIAT is a widely used, highly reliable untimed test of academic knowledge and skills that was administered by a trained examiner at each wave to all children between the ages of 5 and 14 (Dunn and Markwardt 1970). For each subtest, raw scores were standardized to a mean of 100 and standard deviation of 15 and were normed to reflect the average score of a U.S. child the same age. This metric (vs. raw scores) is advantageous for comparing scores of children of various ages while assessing changes in their abilities relative to children of the same age. Such properties also make this metric well suited for measuring inequalities in children's outcomes.

Noncognitive skills were measured by two subscales of the Behavior Problem Index (BPI), a survey of 28 questions about children's age-appropriate behavior and social functioning (e.g., shy, cries) over the past three months administered at each wave to mothers whose children were aged 4–14. Scores based on one of three response categories (often, sometimes true, never) were summed to create two separate indices of children's noncognitive skills: *internalizing problems* (e.g., withdrawal, difficulty coping with stressful situations) and *externalizing problems* (e.g., acting out, aggression)

(Peterson and Zill 1986). Like the PIAT, scores from both indices were age norm-referenced, with a mean of 100 and standard deviation of 15.

### *Time-Invariant Covariates*

Measures of child-level factors that may confound the associations between mothers' increased education and children's outcomes included in the analysis are gender (male = 1, female = 0), whether the child had a health limitation (1 = yes, 0 = no), whether the child had low birth weight (1 = yes, 0 = no), and the birth year. Mother-level factors included in the analysis are her race/ethnicity (white, Hispanic, black), her mother's and father's highest year of schooling (measured continuously), indicators for whether she lived in a single-parent household at any time from birth to age 18 (1 = yes, 0 = no), her household of origin ever received welfare (1 = yes, 0 = no), she was born outside the United States (1 = yes, 0 = no), she had early sex (i.e., before age 16; 1 = yes, 0 = no), her mother was employed during her adolescence (1 = yes, 0 = no), she had a health limitation (1 = yes, 0 = no), and she drank alcohol as an adolescent (1 = yes, 0 = no). We also included baseline reports of the highest grade or year of school she expected to complete, her score on the Rosenberg Self-Esteem Scale (RSE; Rosenberg 1965), her score on the adapted locus of control scale, and an assessment of her cognitive skills based on the Armed Forces Qualification Test (AFQT).

### *Time-Varying Covariates*

We included time-varying confounders, in which each panel of data corresponded the child's age at interview: the mother's occupational sector (based on U.S. Census Bureau's occupational codes and coded as 1 = professional or managerial, 0 = all others); total family income earned the prior year; the mother's reports of family wealth, whether the mother was employed in the past year (0 = no, 1 = yes, where 1 = employed 75 % of the year or more); the mother's marital status (0 = unmarried, 1 = married); the number of children in the home (continuous); the mother's region of residence (dummy variable for Northeast, Midwest, South, and West Coast); and whether the mother lived in an urban area (1 = urban, 0 = other). For descriptive analyses, we also included a measure of economic hardship, in which children were assigned a value of 1 if their family received welfare support (e.g., TANF, food stamps) or had incomes that fell below the federal poverty line. In addition, we created a time-invariant version for each of these measures that corresponded to the child's birth year.

### **Analytic Plan**

For the multivariate analyses, we used two longitudinal modeling techniques: random effects and fixed effects. Both methods pool the data across all observations of the dependent variables (i.e., the time-varying measure of children's outcomes) and independent variables (i.e., the time-varying measures of mother's education) and nest these observations within individuals (i.e., children). As such, they are both considered a class of hierarchical models that adjust for autocorrelation, nonindependence, and repeated measurement error in the repeated measures of the dependent variable by correlating the errors within children. They also provide a framework for

incorporating and taking advantage of multiple panels of data. Each technique, however, is appropriate for analyzing different questions and making different inferences about the results.

In particular, random-effects models allow the error term to vary across children (Laird and Ware 1982). As such, they can be used to examine time-invariant factors and both study questions. Fixed-effects models, on the other hand, rely on within-child variability; therefore, they do not allow for the modeling of time-invariant factors or the examination of the second study question, which involves estimating skills among children whose mothers did not increase their education. We thus use random effects—which also allow us to generalize our results beyond the sample and estimate the effect of additional education for children whose mothers increased their education prior to the assessment period (ages 4–5)—as our initial strategy. We then use fixed effects to test a key assumption of the random-effects model—namely, that all sources of unobserved heterogeneity are orthogonal to the predictors—to a modeling approach that better adjusts for unmeasured, stable sources of variation in children's skills that may violate this assumption and bias the results (such as a maternal personality trait predisposing children to greater developmental gains; Allison 2009b).

All models used linear regression to predict the five child skill measures; the time-varying covariates, including child age; and the robust cluster variance estimator to adjust for the fact that some children were born to the same mother. Random-effect models also included time-varying factors, and the fixed-effects models incorporated the survey weight (which random effects could not). The baseline formula is shown in Eq. (1) for the random-effects model and in Eq. (2) for the fixed-effects model.

$$Y_{it} = \beta \mathbf{x}_{it} + \beta \mathbf{z}_i + \beta T_{it} + \alpha_t + \varepsilon_{it} + u_i. \quad (1)$$

$$Y_{it} = \beta \mathbf{x}_{it} + \beta \mathbf{z}_i + \beta T_{it} + \alpha_t + \varepsilon_{it}. \quad (2)$$

For both equations,  $Y$  represents the child outcome for child  $i$  at time (i.e., child age)  $t$ ;  $\mathbf{x}$  represents the time-varying variables, including additional maternal education;  $\mathbf{z}$  represents the time-invariant covariates;  $T$  is the time-varying measure for child age;  $\alpha$  is the intercept;  $\varepsilon$  is the within-child error term; and, in Eq. (1),  $u$  is the between-child error term.

To answer our first research question—whether additional education is associated with higher cognitive scores and fewer behavioral problems compared with similar children whose mothers did not increase their education—we used random effects to estimate the association between the time-varying binary measure of increased maternal education and each of the five measures of children's skills, net of mothers education at the child's birth and other covariates. To answer our second question (whether any observed gains are enough to equalize differences compared to children whose mothers completed the same level of education prior to their birth), using the same modeling framework, we interacted the time-varying measure of increased education with the time-varying measure of highest level of education and calculated average marginal effects for children with varying combinations of additional maternal education (i.e., 0, 1). This step allowed us to test whether the postnatal attainment of a degree rendered the differences in scores statistically insignificant compared with children whose mothers earned the same degree before their birth (i.e., did not increase their education).

As the third step, we examined whether the associations between an increase in maternal education and children's skills were robust to a more stringent causal framework by reestimating the first model using fixed effects. We also estimated models that substituted the binary time-varying measure of additional degree attainment with a time-varying measure of highest degree attained, which allowed us to explore whether associations varied by the types of increases (by rotating the reference category). Finally, in both modeling frameworks, we explored potentially modifying factors, including child gender, racial/ethnic background, age when the mother completed the degree, the mother's education at the time of the child's birth, and time since degree completion.

We estimated all models using Stata. Problems of item-level missing and attrition were addressed by using multiple imputation techniques (i.e., the user-written program *ice*) to generate 20 complete data sets (done in wide format), which were analyzed using Stata's *mi estimate* suite of commands (Royston 2009). Assuming that data are missing at random (MAR), multiple imputation is an unbiased strategy for addressing missingness, including missing data on dependent variables (Allison 2001). Imputing missing data on dependent variables is also a recommended practice when the imputation model includes auxiliary variables (e.g., other time-varying versions of the same variable, variables not in the analysis model) (Allison 2009a), as our model does. Results from models omitting cases with missing values on the dependent variable, however, were similar to the results we present. In the multivariate models, imputed estimates for children who had not reached the child age being observed (e.g., 7 % of the sample who had not reached age 14) were censored for that child-year, resulting in a total of 64,457 observations nested within 7,839 children.

## Results

### Summary Statistics of Mothers Who Increased Their Education and Their Children's Outcomes

We begin by describing the key patterns of additional maternal education. Overall, 13 % of children in our sample had mothers who increased their level of education between childbirth and the child's age 15. Among children born to mothers without a high school level of education, 33 % had mothers who went on to complete a degree. Among children born to mothers with a high school level of education, 8 % had mothers who increased their education. Among children born to mothers with an associate's degree, 12 % had mothers who increased their education. Overall, among children whose mothers increased their education, 61 % ( $n = 795$ ) had mothers who earned a high school diploma/GED, 23 % ( $n = 303$ ) had mothers who earned an associate's or two-year degree, and 16 % ( $n = 215$ ) had mothers who earned a bachelor's degree.

Next, we compared the characteristics of mothers who increased their level of education after focal child's birth with mothers who did not, stratified by the mother's education at the child's birth. Characteristics are organized around measures of mothers' background (e.g., family of origin received welfare), individual traits (e.g., AFQT scores), and resources available around the time when the child was born (e.g., mother's marital status). Results appear in Table 2, with significant differences in means notated in the "Additional Education" column.



**Table 2** (continued)

|   | Mother's Education at First Child's Birth |                      |                         |                      |                         |                      |
|---|---|----------------------|-------------------------|----------------------|-------------------------|----------------------|
|   | (1)                                       |                      | (2)                     |                      | (3)                     |                      |
|   | Less Than High School                     |                      | High School Diploma/GED |                      | Associate's Degree      |                      |
|   | No Additional Education                   | Additional Education | No Additional Education | Additional Education | No Additional Education | Additional Education |
| Managerial job at child's birth (%)       | 2   | 2                    | 11                      | 19**                 | 29                      | 37                   |
| Weighted Percentage Within Degree (%)     | 69  | 31                   | 92                      | 8                    | 89                      | 11                   |
| Raw <i>n</i> of Total Sample <sup>a</sup> | 1,371                                     | 543                  | 4,852                   | 451                  | 518                     | 60                   |

Notes: Significant differences between prefertility and postfertility groups within each education strata are indicated in the postfertility column. Estimates are based on the weighted sample.

<sup>a</sup> Figure does not total to sample size because of missing data on maternal education.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

Column 1 provides comparisons between mothers without a high school diploma/GED at the time of the study child's birth. Mothers who increased their education after the child's birth were less disadvantaged on multiple socioeconomic background indicators compared with their counterparts who did not. For example, they were less likely to have received welfare growing up (25 % vs. 43 %), and their parents had more schooling (9.56 vs. 8.43 years for their mothers; 9.34 vs. 7.99 years for their fathers). Their traits also reflected more advantage. For example, they expected to complete more schooling (11.96 vs. 11.09 years), were less likely to have had sex prior to age 16 (33 % vs. 41 %), and scored higher on the AFQT (25.14 vs. 15.34). At the same time, not all factors followed this pattern of positive selection. Mothers who increased their education were also younger (20.86 vs. 21.96).

The patterns in column 2 reveal that the mothers with a high school diploma/GED at the time of the study child's birth who increased their education had mothers and fathers with more years of schooling (11.39 vs. 10.99 years; 11.28 vs. 10.71 years), had higher educational expectations (14.27 vs. 13.4 years) and AFQT scores (51.07 vs. 41.77), and were more likely to have worked in a managerial or administrative sector of the job market (19 % vs. 11 %) compared with mothers who did not increase their education. At the same time, they were *more* likely to have grown up in a single-parent home (33 % vs. 27 %), to have had sex prior to age 16 (16 % vs. 12 %), and to have been unmarried at the child's birth (27 % vs. 22 %). In column 3, we observe fewer significant differences in the characteristics of the mothers with a two-year degree at the time of the child's birth, although the number of children with mothers with a two-year degree who increased their education was fairly small ( $n = 60$ ). Nevertheless, compared with mothers who did not return to school, mothers who did had mothers with more years of schooling (12.83 vs. 11.82 years) and labor force involvement (79 % vs.

55 %), were less likely to have lived in a family that received welfare (1 % vs. 6 %), and had higher AFTQ scores (67.66 vs. 58.96).

Broadly, these results suggest that mothers who increased their education after the birth of a child were select in many ways, but the direction of the mechanisms reflect both positive and negative selection into additional education. They also vary by mother's level of education at the time of child's birth. Such results highlight the need to adjust for not only a wide set of observed factors but also unobserved factors, which are likely to vary across groups in complex ways.

As a final descriptive step, we pooled all values of children's cognitive and noncognitive skills to compare the average skills of children whose mothers increased their education with those of children whose mothers did not, stratified by mother's education at the time of the child's birth. These results appear in Table 3. Across all educational strata, the results revealed that children whose mothers increased their education after their birth had higher test scores, although the comprehension scores for children born to mothers with an associate's degree were only marginally significant. The results also reveal that children born to mothers without a high school education who increased their education after childbirth had fewer internalizing and externalizing problems. These patterns thus suggest that additional education might be associated with an improvement in cognitive outcomes for these children and in noncognitive outcomes for children of the least-educated mothers. However, drawing such

**Table 3** Comparing cognitive and noncognitive outcomes of children whose mothers returned to school to earn additional education with children whose mothers did not, stratified by the mother's education at the time of the child's birth ( $N = 7,839$ )

|                                      | Mother's Education at Child's Birth |                      |                         |                      |                         |                      |
|--------------------------------------|-------------------------------------|----------------------|-------------------------|----------------------|-------------------------|----------------------|
|                                      | Less Than High School               |                      | High School Diploma/GED |                      | Associate's Degree      |                      |
|                                      | No Additional Education             | Additional Education | No Additional Education | Additional Education | No Additional Education | Additional Education |
| <b>Child Outcomes</b>                |                                     |                      |                         |                      |                         |                      |
| Reading test scores                  | 97.92                               | 101.29***            | 104.92                  | 106.77***            | 107.83                  | 111.08**             |
| Math test scores                     | 94.42                               | 97.06***             | 101.41                  | 103.13**             | 104.86                  | 107.30*              |
| Comprehension test scores            | 98.13                               | 101.11***            | 103.24                  | 105.10**             | 105.55                  | 107.70 <sup>†</sup>  |
| Internalizing problems               | 106.66                              | 105.35***            | 102.23                  | 102.99               | 100.79                  | 99.69                |
| Externalizing problems               | 107.79                              | 106.23***            | 102.92                  | 103.31               | 100.55                  | 99.15                |
| Raw $n$ of Total Sample <sup>a</sup> | 1,371                               | 543                  | 4852                    | 451                  | 518                     | 60                   |

*Notes:* Significant differences exist between the pre-fertility and post-fertility groups within each education strata indicated in the post-fertility column. Estimates are based on the weighted sample.

<sup>a</sup> Figure does not total to the sample size because of missing data on maternal education.

<sup>†</sup>  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

conclusions requires accounting for differential selection into additional selection, which we turn to next.

### Random-Effects and Fixed-Effects Models Predicting Children's Outcomes

In Table 4, we present the results of the random-effects models predicting the five child outcomes: reading, math, comprehension, internalizing problems, and externalizing problems (Model 1). In the table, we present the model coefficients for the time-varying measure of additional education and the time-invariant measure of mother's education at the time of the child's birth. Estimates of other model coefficients are available upon request. Looking across the five columns reveals a well-documented pattern. Each increase in mother's level of education is associated with significantly higher cognitive test scores and fewer behavioral problems. Net of this association, however, among the five child outcomes, an increase in mother's educational attainment is significantly associated only with higher reading scores ( $B = .96$ ,  $SE = .37$ ). This coefficient is also small, translating to 6 % of a standard deviation increase (Borenstein 2009). Results remain the same if we eliminate children born to mothers with a bachelor's degree from the models, as well as time-varying confounds (which were intended to reflect mother's circumstances while she was in school but could be capturing effects endogenous to additional maternal education).

Based on these results, we next investigated whether additional education was enough to help children's reading scores "catch up" to those of children born to mothers who had earned the same level of education prior to childbirth. We did so by adding

**Table 4** Random-effects models predicting children's Peabody Individual Achievement Test scores and behavioral problems, by increased maternal educational degree

|                                      | Model Coefficients |                   |                   |                        |                        |
|--------------------------------------|--------------------|-------------------|-------------------|------------------------|------------------------|
|                                      | Reading            | Math              | Comprehension     | Internalizing Problems | Externalizing Problems |
| Time-Varying Education Measure       |                    |                   |                   |                        |                        |
| Increased educational degree         | 0.96**<br>(0.36)   | 0.34<br>(0.35)    | 0.25<br>(0.61)    | -0.14<br>(0.41)        | -0.24<br>(0.37)        |
| Time-Invariant Education Measure     |                    |                   |                   |                        |                        |
| High school diploma at child's birth | 1.91***<br>(0.36)  | 1.64***<br>(0.30) | 1.61***<br>(0.41) | -1.23**<br>(0.41)      | -1.40***<br>(0.41)     |
| Associate's degree at child's birth  | 2.77***<br>(0.62)  | 2.50***<br>(0.55) | 2.36**<br>(0.72)  | -1.45*<br>(0.65)       | -2.24***<br>(0.67)     |
| Bachelor's degree at child's birth   | 4.17***<br>(0.66)  | 4.46***<br>(0.54) | 3.29***<br>(0.88) | -1.60*<br>(0.65)       | -2.81***<br>(0.67)     |

Notes: Models include all time-varying controls and time-invariant controls (including child's age) and cluster on the mother's ID. Standard errors are shown in parentheses.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

interactions between the time-varying measure of additional education and the time-varying measure of highest level of maternal education (Model 2) to predict reading scores. None of the interaction terms are statistically significant, suggesting that children with mothers who increased their education may catch up to their peers born to mothers who completed the same level of education prior to the child's birth. Calculations of average marginal effects provide more direct evidence of this conclusion by allowing us to estimate, for example, the average test score for children whose mothers increased their education (additional education = 1) to a high school diploma/GED (highest degree = high school diploma/GED) and test whether it is significantly different from the average test scores of children born to mothers who attained a high school education (highest degree = high school diploma/GED) prior to childbirth (additional education = 0). None of the pairwise comparisons are significant. At the same time, such results may still reflect unmeasured selection into postnatal degree attainment. Thus, we next turned to the fixed-effects framework, which offers a more robust causal test of the effect of additional maternal education and the conclusions of both Model 1 and Model 2. It also allows a more precise estimation of the effects of different types of educational increases.

The results of fixed-effects models, which appear in Table 5, suggested that there was no statistically significant association between an increase in a child's mother's educational attainment and any of the five outcomes, including reading scores. In Model 2, we substituted the binary time-varying measure of additional degree with the time-varying measure of additional education. By rotating the reference category, we were able to capture different types of changes (e.g., from less than high school to an associate's

**Table 5** Fixed-effects models predicting children's Peabody Individual Achievement Test scores and behavioral problems, by increased maternal educational degree

| Time-Varying Education Measures   | Model Coefficients |                 |                 |                        |                        |
|---|--------------------|-----------------|-----------------|------------------------|------------------------|
|   | Reading            | Math            | Comprehension   | Internalizing Problems | Externalizing Problems |
| Model 1: Increased Educational Degree                                   | 0.81<br>(0.61)     | -0.14<br>(0.61) | -1.77<br>(2.11) | -0.61<br>(0.72)        | -0.08<br>(0.62)        |
| Model 2: Highest Educational Degree<br>(ref. = high school diploma/GED) |                    |                 |                 |                        |                        |
| Less than high school diploma/GED                                       | -0.81<br>(0.96)    | -0.03<br>(0.88) | 3.14<br>(1.81)  | 1.61<br>(1.12)         | 0.35<br>(0.90)         |
| Associate's degree  | 0.56<br>(1.02)     | -0.53<br>(0.84) | -0.73<br>(0.99) | -0.04<br>(1.02)        | 0.03<br>(0.96)         |
| Bachelor's degree   | 0.69<br>(1.50)     | -0.58<br>(1.18) | -0.74<br>(1.53) | -0.11<br>(1.52)        | 0.04<br>(1.07)         |

*Notes:* Models control for all time-varying covariates (including child's age), cluster on the mother's ID, and apply the child-level weight. The sample is restricted to children who were not in a National Longitudinal Survey oversample and had coresided with the mother semicontinuously up through age 14 using the *subpop* feature in Stata, which provides correct standard errors when sample weights are used. Standard errors are shown in parentheses.

degree; from a high school diploma/GED to a bachelor's degree). This strategy, however, also failed to reveal any significant association between changes in mothers' highest level of attainment and changes in children's cognitive or noncognitive skills.

### Robustness Tests

As a final step, we conducted a series of robustness tests. First, we examined whether there may be certain conditions or groups for which we observe an association. We tested for subgroup differences by child's gender, child's race and ethnic background, and mothers' education at the time of the child's birth. We examined conditions by exploring whether (1) effects of additional education were more pronounced if the increase occurred at earlier stages of children's development, when skills have been found to be more malleable (Alexander and Entwisle 1988) and sensitive to environmental influences (Guo 1998; Heckman 2016); (2) whether mother's new educational status may take time to affect children's outcomes (i.e., a duration effect); or (3) whether an effect exists in the short term, as found by Gennetian and colleagues (2008), but later fades. Each of these models predicted all five child outcomes, used random effects as an initial step, and was followed up by fixed effects to check for consistency in results. In short, the results did not reveal groups or conditions under which additional maternal education was significantly associated with children's skills.

Second, we explored whether the results of our fixed-effects models were negatively biased because the subgroup of children whose mothers increased their education may be less likely to benefit. We did so using a general "falsification test," in which we associated child low birth weight—a well-accepted indicator for child and mother disadvantage—with additional maternal education using a linear probability model, net of the time-varying and time-invariant covariates. We were interested in whether there was a significant association in either direction. There was not, thus providing additional confidence that the sample of children whose mothers returned to school were not selected in a way that affected the results.

### Discussion

The status attainment model (Blau and Duncan 1967)—the theoretical cornerstone of decades of social science research on intergenerational mobility—tends to view parental education as a stable socioeconomic predictor (e.g., Sirin 2005). Yet, we are now in an era when a substantial share of women return to school to increase their education after having children (e.g., Augustine 2016; Gault et al. 2014). Thus, as the life course perspective indicates, we must examine the potential for heterogeneity in the intergenerational returns to education based on the sequencing of parenthood and education, as well as the life course penalties that may arise as a result of the sequencing of these two central life course roles (Elder 1998). Indeed, our results support the existence of such penalties: we did not find a significant association between any pattern of educational increases (e.g., from less than high school to a high school diploma/GED; from a high school diploma/GED to a bachelor's degree) and changes in children's skills. Based on these results, our answers to both of the questions we originally posed in this study—whether increased postnatal maternal educational attainment can improve children's skill

development and whether these gains are enough to reduce inequalities in skills compared with children whose mothers completed the same degree before childbirth—are “no.”

Such results stand in contrast to previous studies, which have found that increases in mothers' postfertility education are associated with increases in children's cognitive skills (and increases in behavioral problems in one study; Harding 2015); they also contrast with the status attainment literature more broadly. Yet, our results are not inconsistent with research in other subfields. For example, a recent study found that adults who entered parenthood before the completion of schooling suffered greater physical health consequences compared with those who followed the traditional sequence (Miech et al. 2015). Another study found that sequencing motherhood before marriage was associated with worse health at midlife (Williams et al. 2011). More essentially, given the arguments about life course penalties presented in our study, this latter study also found that this health reduction was not mitigated by later marriage or cohabitation. As such, our findings also contribute to a broader body of literature about life course sequencing and its effect on various life course outcomes.

They also raise a question that is critical for theories on socioeconomic mobility: *why* sequencing the completion of schooling after the transition to motherhood diminishes the power of maternal educational attainment to affect children's skill development. We offer several tentative explanations. First, the labor market returns may be smaller because mothers may be penalized for their age and lack of work experience or because they lack access to the types of social networks that connect them to good jobs (Elman and O'Rand 2004; Felmlee 1988; Light 1995). In an auxiliary analysis predicting mother's labor force participation using the fixed-effects framework, we did find that children whose mothers increased their education had an 11 % increased probability of having a mother who was employed 85 % of the prior year; however, these jobs may still be of lower quality. For example, the results of a qualitative study revealed that many mothers who returned to school were disappointed with their labor market prospects upon graduation; these mothers also experienced continued financial hardships as they struggled to pay off debts they accrued while in school (Seefeldt 2016), which may further help explain the lack of significant effects in the current study.

Second, other aspects of mothers' lives—their neighborhoods, the people with whom they interact, whether and to whom they are married or partnered, the quality of the schools their children attend—are “sticky” features of people's lives that may remain largely unchanged after having children (Laumann 1973), regardless of whether they increase their education.

Third, the nonpecuniary returns to schooling may be less if mothers are less immersed in their schooling experience, have less time to invest in school work and education-related extracurricular activities, or are experiencing lower levels of well-being because of the challenges of balancing work, family, and schooling. Indeed, the results of our research using other data (available upon request) revealed that mothers who were enrolled in school spent less time with their children than similar mothers who were not in school and spent less time in schooling activities than other adult students without children. We also found that this time squeeze was associated with less happiness and more fatigue. Using the NLSY79 data and our fixed-effects framework, we also failed to find a significant association between increased maternal education and the quality of the home environment.

Finally, for some mothers, the factors precipitating their decision to return to school may include job loss or union dissolution. Thus, for some children, the benefits of an increase in their mother's education might be offset by the negative effects of the factors that preceded it.

As to the issue of policy that motivated the study, we offer two general recommendations. First, policies that help students complete their education prior to having children may be more effective at reducing inequality for future generations than those targeting the human capital of lower-educated mothers. This does not mean that additional education cannot help some families. Rather, similar to how marriage promotion is unlikely to curtail poverty at the population level (Lichter et al. 2003), moving mothers back into the educational system is unlikely to reduce population-level disparities in children's outcomes if steps are not taken to address the reasons *why* the benefits of additional maternal education for less-educated mothers may be low. This reasoning leads to our second suggestion—that is, that policies aiming to promote mothers' continued enrollment in school must be paired with efforts to address the factors that make it difficult for mothers to benefit from their new degree. This study, thus, points to an important new focus of research: understanding the challenges faced by mothers who pursue additional education.

Of course, our study is not without limitations. We did not explore many circumstances under which children may benefit from an increase in their mother's education—for example, when families have access to high-quality childcare (e.g., Harding 2015) or other forms of support, such as social or financial support from the family. We did not examine whether mothers benefit from additional education, even if the benefits do not trickle down to their children. We did not consider other pathways through which additional maternal education may affect children's mobility, such as their aspirations for their own futures. We did not examine whether children experience upward mobility even if their skills do not improve, although this would require an alternative approach to eliminate bias, such as the use of an instrumental variables approach, the viability of which is unknown (Angrist and Pischke 2009). We did not use more fine-grained measures of education that differentiate among the various types of diversity within these traditional strata of education (e.g., different types of vocational degrees and certificates; the emergence of for-profit and online schools; college major or quality of institution). Lastly, we did not delineate when in the educational process additional education might affect children's outcomes, given how the effect of degree attainment may matter more for economic mechanisms, but an additional year of schooling may matter for parenting. We leave each of these as topics for future research.

Furthermore, we relied on standardized measures of children's outcomes, which are useful when examining the stratification of children's skills. Yet, we recognize that some children may have gained in skills as a result of their mothers increased education, even if this gain was not enough to shift their position relative to other children. Some of the time-varying measures were also assessed at the same time as mothers' education. These measures were intended to reflect the life circumstances of mothers around the time they earned their degree—for example, mothers' current employment situation—but may also reflect the degree earned. Given the problems of using lagged measures in fixed-effects models (Nickel 1981), we cannot eliminate this potential endogeneity, although such time-varying factors were largely insignificant. Lastly, we acknowledge that when considering specific types of increases (e.g.,

from a high school diploma/GED to a bachelor's degree), our subsample sizes were reduced, resulting in an increased risk of committing a Type II error. At the same time, if the positive coefficients had been significant, they would have translated to an effect size no larger than 0.06. Thus, small subsamples do not seem to present a large risk of invalidating our overall conclusions, although they may still present a limitation of some of our moderation tests, which relied on interactions.

In sum, this study focused on an emerging yet understudied phenomenon, mothers' return to school to increase their education postfertility, to investigate the policy-relevant issue of whether mothers' completion of education after their children are born has the expected effect on children's skills and prospects for mobility. Contrary to much research and theory, our findings suggest that the answer, at least at the population level, is "no." This finding points to an important source of heterogeneity in the returns to education: the timing of degree attainment vis-à-vis the timing of children's births, which stratify the outcomes of children in a previously unrecognized way. These findings also speak to the limits of increasingly popular two-generation policies, point to alternative prescriptions for social policy, and highlight a new research frontier that explores the social and structural constraints that limit the returns to additional education among women with children.

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