

Maternal Education, Parental Investment, and Noncognitive Characteristics in Rural China

JESSICA LEIGHT

International Food Policy Research Institute

ELAINE M. LIU

University of Houston, National Bureau of Economic Research,
and Institute of Labor Economics

I. Introduction

In recent years, both research and policy debates have placed increasing emphasis on the importance of noncognitive skills in determining long-term economic outcomes. Data primarily from industrialized countries have suggested that noncognitive skills have a large impact on adult economic welfare, measured as earnings and labor productivity (Heckman and Rubinstein 2001; Cunha, Heckman, and Lochner 2006; Heckman, Stixrud, and Urzua 2006; Carneiro, Crawford, and Goodman 2007). Particularly relevant for this analysis, evidence from the sample of rural Chinese youth employed here suggests that noncognitive skills as measured in adolescence are predictive of school-to-work transitions in early adulthood (Glewwe, Huang, and Park 2017). There are many causal pathways through which stronger noncognitive skills may lead to improved educational and economic outcomes. Individuals with enhanced skills may be more persistent in achieving strong academic outcomes or building professional expertise, more resilient in the face of setbacks, or better able to forge useful professional relationships. One particularly important channel, however, is the relationship forged much earlier in life between children and their parents.

Thanks to Doug Almond, Flavio Cunha, Janet Currie, Rebecca Dizon-Ross, Benjamin Feigenberg, Paul Frijters, Paul Glewwe, Lucie Schmidt, Kevin Schnepel, Chih-Ming Tan, and Andy Zuppann for helpful conversation and suggestions. We are also grateful for feedback from seminar and conference participants at the University of Minnesota (Department of Applied Economics), Williams College, American Society of Health Economists, the Allied Social Science Association meetings, the Chinese Economists' Society conference, the Western Economic Association conference, the University of North Dakota, the University of Montreal Centre interuniversitaire de recherche en économie quantitative conference, and the Society of Labor Economists 2016 meeting. Previous drafts of this work were circulated under the title "Maternal Bargaining Power, Parental Compensation, and Noncognitive Skills in Rural China." We declare no conflict of interest. Contact the corresponding author, Jessica Leight, at j.leight@cgiar.org.

Variation in noncognitive characteristics may affect parental investments in several ways. First, this variation could alter the weight that a parent places on a child's welfare. Parents could favor a child with whom they forge a stronger relationship or a child who exhibits more behavioral challenges if the child requires more nurturing. Second, even if the weights parents place on their children's welfare are unchanged, variation in noncognitive characteristics could affect children's future income and may affect the returns to human capital investment in a given child. Depending on whether parents emphasize efficiency or equality, they may invest more or less in human capital development for a child who is struggling or flourishing.

Ultimately, we may observe investment that is compensatory, defined as a pattern in which parents invest more in a relatively weaker child or investment that is reinforcing, defined as a pattern in which parents invest more in a stronger child. Needless to say, the question of whether investment is, in general, compensatory or reinforcing is important in family economics going back to Becker and Tomes (1976); Almond and Mazumder (2013) provide a recent review.

The objective of this paper is to analyze whether noncognitive characteristics measured in childhood and adolescence have a significant impact on the within-household allocation of educational expenditure in rural Gansu Province, China. We employ a panel data set (the Gansu Survey of Children and Families) that provides a detailed set of outcome measures for a large cohort of children in one of the poorest provinces in China. Noncognitive characteristics are measured via direct surveys of the children and are defined as the inverse of externalizing challenges (behavioral problems and aggression) and internalizing challenges (withdrawal and anxiety); accordingly, our measure effectively captures an absence of behavioral or socioemotional problems (Chorpita and Barlow 1998; Evans 2004; Achenbach and Edelbrock 2006). Focusing on a sample of two-children families, our primary specification examines how parents respond to differences in noncognitive characteristics conditional on household fixed effects and whether this response varies based on parental education.

Our results suggest that while parents are not responsive to differences in noncognitive characteristics on average—neither reinforcing nor compensating for these differences—there is significant heterogeneity with respect to characteristics of the parents and particularly the mother. Households with more-educated mothers show evidence of significantly more compensatory investment compared with households with less-educated mothers. In a household characterized by a cross-sibling gap in noncognitive skills of 0.8 standard deviations, corresponding to the average magnitude observed in the sample, an increase in maternal education from the 25th to the 75th percentile would,

ceteris paribus, result in an increase in discretionary educational expenditure directed to the weaker child of around 34%. Discretionary expenditure comprises all educational expenditure excluding tuition, and it accounts for nearly 40% of total education expenditure; there is no parallel effect observed for tuition.¹ While we do not necessarily interpret this pattern as direct evidence that more-educated mothers use the additional educational expenditure to strengthen noncognitive skills, it is consistent with the hypothesis that educated mothers aim to compensate for a child's observed noncognitive deficits by enhancing the child's skills more broadly. We find very little evidence of comparable heterogeneity with respect to the education of the father.

The primary challenge faced in this analysis is that noncognitive characteristics may, in fact, be endogenous to or partly an outcome of previous parental investment. If there is some serial correlation in parental investment, this will generate bias toward the detection of a reinforcing pattern of expenditure. We address this challenge in several ways. First, as already noted, we observe a heterogeneous pattern only for maternal education, not for paternal education; this renders less plausible the hypothesis that the observed pattern simply reflects a different distribution of noncognitive skills in households of higher socioeconomic status (SES). Second, we demonstrate that bias on the interaction effect including maternal education arises given specific assumptions that, in general, do not seem to be supported by the empirical evidence, though we are also cautious in interpreting these tests. Third, we present evidence that the results are robust to several alternate specifications, including the use of earlier measurements of noncognitive characteristics and the inclusion of control variables for past educational expenditure.

In the final section of the paper, we analyze whether this variation in compensatory vis-à-vis reinforcing behavior results in the reduction of noncognitive deficits over time for children in households with more-educated mothers—where struggling children receive greater investment—compared with children in households with less-educated mothers. While the second-born child in this data is observed only once, the firstborn child is observed three times. Analyzing the longitudinal data observed for the firstborn child, we do find evidence of significantly reduced persistence in noncognitive challenges for children of more-educated mothers.

¹ We also find some evidence of a similar pattern for cognitive skills, as captured by test scores on a Chinese achievement test: less-educated mothers invest more in children with stronger cognitive skills, while more-educated mothers compensate children characterized by weaker skills. However, we preferentially focus on noncognitive skills, given our feeling that this is a more significant contribution to the existing literature.

As a result, the correlation between maternal education and noncognitive characteristics becomes more pronounced as children age. In the first wave, the observed cross-household correlation between a dummy variable for a highly educated mother (a woman above the median level of education) and noncognitive characteristics is essentially 0. By the third wave, this correlation has increased in magnitude to 0.151. This result is consistent with the hypothesis that maternal education may be relevant in shaping the formation of noncognitive skills, consistent with the broader literature on the importance of maternal education in child development (Currie 2009; Carneiro, Meghir, and Pary 2013). Moreover, if the economic returns to noncognitive skills are significant, differential parental compensation could be a channel through which inequality across households can widen over time.

Our paper contributes to several related literatures on intrahousehold allocation and human capital investment. There is an extensive literature examining parental responses to differences in children's endowment, and the evidence has been mixed. Royer (2009), Almond and Currie (2011), and Bharadwaj, Løken, and Neilson (2013) find little or no evidence of either compensatory or reinforcing behavior. Almond, Edlund, and Palme (2009), Rosenzweig and Zhang (2009), Aizer and Cunha (2012), Akresh et al. (2012), Frijters et al. (2013), and Adhvaru and Nyshadham (2014) find that parents exhibit reinforcing behavior in Burkina Faso, China, Sweden, Tanzania, and the United States, while Del Bono, Ermisch, and Francesconi (2012) find evidence of compensatory behavior in breastfeeding decisions and birth weight, and Black, Devereux, and Salvanes (2010) provide some indirect evidence of compensatory behavior in a robustness check. Bharadwaj, Eberhard, and Neilson (2018) find compensatory investment with respect to initial health comparing across siblings, but comparing across twins, there is no evidence of either compensatory or reinforcing behaviors. Leight (2017) finds evidence of compensatory behavior with respect to height for age using the same sample as this paper.

This literature, however, focuses primarily on parental responses to children's health endowment and cognitive ability. Our paper is one of the first to examine whether parents respond to children's noncognitive characteristics in the allocation of human capital investment such as educational expenditure.² While we will also provide some evidence of heterogeneity across households characterized by different maternal education levels in their response to cognitive

² The only other relevant paper is Gelber and Isen (2013). While it is not the focus of their work, they report in their appendix that parents respond positively to a child with greater observed noncognitive abilities, but they do not further investigate the heterogeneity with respect to maternal education.

skills, we focus primarily on the response to noncognitive skills, given the absence of evidence in this area and conceptual predictions (outlined below) that suggest that the parental response to noncognitive skills may be particularly large.

Our paper finds that maternal education plays an important role in determining the allocation of parental investment. This is similar to the results reported in Hsin (2012) and Restropo (2016), who conclude that households with less-educated mothers generally exhibit reinforcing investment behavior, while households with more-educated mothers exhibit compensatory behavior. However, neither of these papers examine the father's education level; instead, they analyze maternal education as a proxy for household SES. In light of these findings, a recent review by Almond and Currie (2011) suggests that the observed pattern could be due to credit constraints in low-SES households or a high elasticity of substitution between consumption and human capital investment in these households.

In our context, the evidence is generally inconsistent with these two channels, given the absence of any evidence of heterogeneity with respect to the father's education and a number of proxies for household SES, including income, assets, and average household expenditure. Accordingly, our paper provides some suggestive evidence that there may be another channel through which maternal education affects the allocation of expenditure between children (i.e., different maternal preferences or greater maternal bargaining power).

There is growing evidence that early intervention and investment can mitigate initial deficits in children's endowments (Cunha and Heckman 2007; Kling, Liebman, and Katz 2007; Bleakley 2010; Cunha, Heckman, and Schennach 2010; Gould, Lavy, and Paserman 2011; Almond, Hoynes, and Schanzenbach 2016; Bhalotra and Venkataramani 2016). However, this literature primarily focuses on children's health and cognitive outcomes. To the best of our knowledge, we are the first to show evidence that would be consistent with the narrowing of noncognitive deficits as a result of parental investment.

The remainder of the paper proceeds as follows. Section II describes the data and conceptual framework. Section III describes the empirical strategy and the primary results, and Section IV examines the longitudinal evidence. Section V concludes.

II. Data and Conceptual Framework

A. Data

The data set used in this paper is the Gansu Survey of Children and Families (GSCF), a panel study of rural children conducted in Gansu Province, located in northwest China, one of the poorest and least developed provinces in the

country. The description of the data here draws substantially on the description in Leight, Glewwe, and Park (2015).

The first wave of the GSCF was conducted in 2000 and surveyed a representative sample of 2,000 children aged 9–12 in 20 rural counties, supplementing these surveys with additional surveys of mothers, household heads, teachers, principals, and village leaders. These children are denoted the “index children.” All but one of the index children have complete information in the first wave.

The second wave, implemented in 2004, resurveyed the first sample of children at ages 13–16 and added a survey of their fathers. Of the original sample, 1,872 children, or 93.6%, were reinterviewed in the second wave. In addition, surveys were added of the oldest younger sibling of the index child. These additional children are denoted “younger siblings.” Surveys were conducted directly with the younger siblings, as well as with their homeroom teachers; in addition, mothers and fathers reported limited supplementary information about the younger siblings.

In early 2009, a third wave of surveying was conducted, reinterviewing the index children during Spring Festival, a period at which many of them had returned to their natal villages. For cases in which the sampled individual was not available, parents were asked to provide information about their child’s education and employment status. Of the original sample, 1,437 individuals, or 72%, were interviewed directly in this wave, and information was collected in parental interviews for an additional 426 sample children.

The household surveys in waves 1 (2000) and 2 (2004) included extensive questions about schooling outcomes, household expenditure on education for each child, time investments in education by parents and teachers, and child and parental attitudes, as well as more standard socioeconomic variables. The index children also completed a number of achievement and cognitive tests. Younger siblings completed these tests in wave 2. While scores on these tests presumably partly reflect noncognitive strengths as well as cognitive skills, we follow the existing literature in using these test scores measures as a proxy for cognitive skills (Cunha and Heckman 2006; Cunha, Heckman, and Lochner 2006; Heckman, Stixrud, and Urzua 2006).

In addition, each wave of data collection included survey questions posed to the sample children that were designed to measure their noncognitive characteristics. In the first and second waves, the survey measured both internalizing and externalizing behavioral challenges (Chorpita and Barlow 1998; Evans 2004; Achenbach and Edelbrock 2006): the former refers to intrapersonal problems (e.g., withdrawal and anxiety) and the latter to interpersonal problems (destructive behavior, aggression, hyperactivity). Both measures of noncognitive

characteristics are constructed by recording the respondent's (child's) agreement or disagreement with a series of statements and applying item response theory (IRT) to generate internalizing and externalizing scores. Accordingly, our measures do not rely on parental assessments.³ The measures are identical across waves 1 and 2, and the scores are standardized to have a mean of 0 and a standard deviation of 1. In the third wave, a Rosenberg self-esteem index and a depressive index were used. Further detail about the construction of the noncognitive measures can be found in Glewwe, Huang, and Park (2017), and a detailed overview of the use of IRT in the context of psychometric measurement and the methodology employed here is included in this paper's appendix (available online).

A number of other papers have employed variables capturing internalizing and externalizing challenges, including Heckman, Pinto, and Savelyev (2013), who analyzed the long-term effect of the Perry preschool program, and Neidell and Waldfogel (2010), who analyzed cognitive and noncognitive peer effects in preschool education. Similarly, Bertrand and Pan (2013) and Cornwell, Mustard, and Van Parys (2013) document gender differences in a number of noncognitive measures, including internalizing and externalizing indexes; Juhn, Rubinstein, and Zuppann (2015) employ a behavioral problems index in analyzing quality-quantity trade-offs. The terminology used to describe these measures varies, but given that we are not measuring a noncognitive skill per se (e.g., self-esteem, negotiating ability), we will follow the other authors noted here and preferentially use the term "noncognitive characteristics."⁴

Noncognitive characteristics of the younger siblings were measured only in wave 2, and thus wave 2 will be the primary source of the data employed. For ease of interpretation, the internalizing and externalizing indexes have been inverted for analysis; in the original index, a higher value indicates more challenges, but in our index, a higher value indicates fewer challenges.

Our analysis uses a subsample of the families in the survey: those with two children in the household where both children have reported measurements for noncognitive and cognitive skills in the second-wave survey. The measures of cognitive skills employed are scores on grade-specific mathematics and Chinese achievement tests that were developed, administered, and scored by the survey management team. (Data on grades received by the sample children

³ We also conduct an additional robustness check in which we employ a measure of noncognitive characteristics derived from teacher assessments; the primary empirical results are consistent when using this alternate measure. These results are reported in table 6, panel B, cols. 4 and 8.

⁴ Evidence in psychology suggests that positive attributes such as conscientiousness, agreeableness, and openness to experience are negatively correlated with the internalizing and externalizing behaviors we analyze here (Ehler, Evans, and McGhee 1999).

in school are also available, but we find that there is little variation in these reported grades, consistent with qualitative evidence that grades are not a meaningful signal of achievement in Chinese primary schools in rural areas.) Accordingly, we use the achievement test scores as a proxy for cognitive skills.⁵

If the index children and the younger sibling are the only children in the household, then the surveys provide a complete overview of parental allocations and child endowment. Complete data are available for 816 children (408 households) drawn from 90 localities in 20 counties, and these households constitute the relevant subsample. In our sample, only 6.5% of households have one child. The remaining households are excluded because the index child has two or more siblings or has one older sibling for whom noncognitive characteristics are not reported. In the robustness checks reported in Section III.B, we will also present results employing a larger sample including households where these two children (the index child and the younger sibling) are part of a larger family.⁶ Figure 1 summarizes the structure of the sample, including the years in which data are collected, the children observed in each wave, and their ages at the point of data collection.

Panel A of table 1 reports summary statistics for the subsample of two-child families and the overall sample for key demographic indicators, as well as a *t*-test for equality between the two means; the covariates reported are measured in the second wave of the survey, the wave in primary use here. It is evident that there are no significant differences in income or parental education between the sample and the subsample. However, households in the subsample are slightly younger and have younger children. This primarily reflects the exclusion of larger families or families in which the index child is the younger child, as these families are generally headed by older parents. Importantly, there are also no significant differences detected in the index child's noncognitive characteristics.

The dependent variable of interest is educational expenditure per child per semester, reported by the head of household in six categories: tuition, educational supplies, food consumed in school, transportation and housing, tutoring,

⁵ While performance on achievement tests may also reflect noncognitive skills, we follow the literature in using test scores primarily as a proxy for cognitive skills, while variables derived from psychometric data capture primarily noncognitive skills. In their review chapter on skill formation, Cunha, Heckman, and Lochner (2006) similarly employ the Peabody Individual Achievement Test and related test scores as measures of cognitive skills, while self-reported psychometric measures are used as measures of noncognitive skills.

⁶ While China's One-Child Policy was in effect during the period in which these children were born, many rural households could nonetheless have two children legally under various exemptions to the policy (Gu et al. 2007). It is not possible using this data set to accurately identify for each household whether it was in technical compliance with the policy.

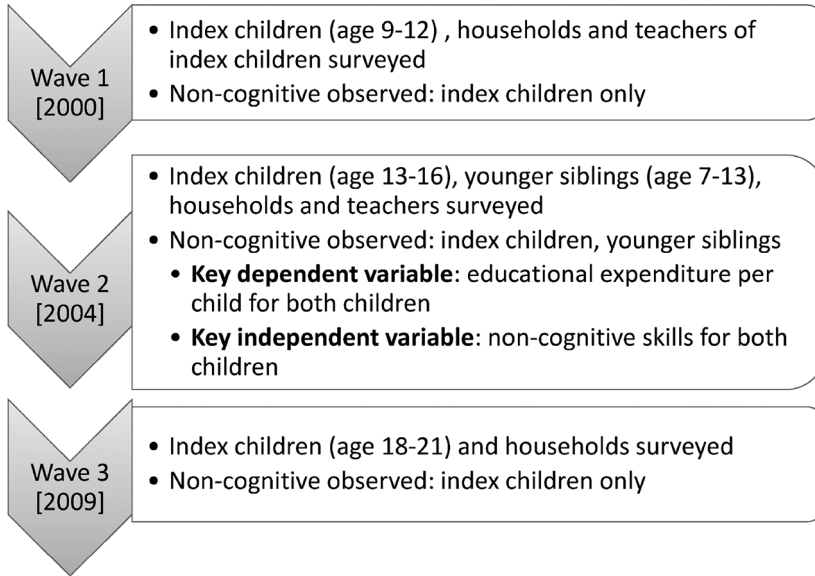


Figure 1. Data structure.

and other fees.⁷ Each household separately reports expenditure for each child in each of these categories. Our analysis will focus on tuition and discretionary expenditure, defined as the sum of all expenditure excluding tuition. Summary statistics for average expenditure per child for the subsample of families analyzed can be found in panel B of table 1. Total educational expenditure averages around ¥360 per child per semester, and an average of 20% of household income is allocated to educational expenditure in total for both children.

We focus on educational expenditure, given that it is the primary form of child-specific expenditure reported in this data set. The other type of child-specific expenditure reported is medical expenditure over the past year; only 25% of households report any positive medical expenditure for either child over the past year, and unsurprisingly, this expenditure is highly correlated with reported illness (i.e., it is reasonable to assume that very little corresponds to preventive care). Given that we are primarily interested in human capital investments with long-term returns, we do not focus on medical expenditure. In addition, while parents report the amount of time they invest in childcare in aggregate, they do not report the division of this time between children; accordingly, time investment cannot be used as a dependent variable.

⁷ In China, textbook fees are mandatory and levied as part of the overall tuition, and here they are likewise reported in the tuition category. “Educational supplies” are supplies other than textbooks.

TABLE 1
SUMMARY STATISTICS

	A. Demographic Data		
	Sample (1)	Subsample (2)	p-Value (3)
Net income	6,848.56	6,534	.642
Income per capita	1,717.76	1,583.68	.378
Mother's education	4.31	4.25	.662
Father's education	7.12	7.01	.488
Mother's age	39.19	36.95	.000
Father's age	42.57	38.89	.063
Index child's age	15.09	14.99	.047
Internalizing index	.01	-.01	.727
Externalizing index	-.03	.02	.241
Observations	1,918	408	

	B. Educational Expenditure per Child		
	Mean	Standard Deviation	Maximum
Discretionary	98.651	169.23	1660
Tuition	165.667	159.21	2000
Supplies	36.434	38.29	300
Transportation	11.553	39.03	500
Food	35.047	105.38	1200
Tutoring	5.923	16.9	110
Other fees	9.695	28.09	360

Note. The sample encompasses the full sample of households that report income data; this is 1,914 out of the full sample of 2,000 households in the survey. The subsample is households with two-children families in which both children report data on noncognitive characteristics as well as height for age. There are 408 households in the subsample of interest and 816 children. Income is reported in yuan; internalizing and externalizing indexes have been standardized to have means equal to 0 and standard deviations equal to 1, and a higher internalizing or externalizing index is indicative of fewer noncognitive challenges. Column 3 reports the *p*-value for a test of equality of means across the sample and subsample. Educational expenditure is reported in yuan per semester for the subsample, and discretionary expenditure is the sum of all expenditure categories excluding tuition.

Finally, it may be useful to briefly comment on the advantages and disadvantages of this data source and the external validity of results examining families with more than one child in China. Clearly, the average size of a household is significantly lower in China than in other developing countries. However, recent evidence indicates that average fertility per woman in rural China is 2.1, suggesting that the majority of households do have more than one child, and in that sense, our sample of two-child families is by no means unusual (Ding and Hesketh 2006). In addition, there are very few panel data sets in developing countries that report noncognitive and cognitive skill measures for multiple children in the same household (enabling the use of a household fixed effects specification) as well as some measures of noncognitive skills over time. The richness of the human capital measurement in the GSCF renders this data uniquely valuable for our analysis.

B. Conceptual Framework: Parental Allocations and Noncognitive Skills

In order to provide structure for the empirical analysis, we will map out a general conceptual framework that can be employed to understand parental decisions around allocations of expenditure between children. We assume that parents seek to maximize some function of their children's welfare, including income and happiness. Both income and happiness are flexible functions of the child's characteristics, including demographic characteristics (e.g., age, gender, parity) and human capital (e.g., cognitive and noncognitive skills, health). Moreover, human capital investments can evolve over time as a function of parental investment. Note that we do not assume that parents seek to maximize the sum of both children's welfare; parents may seek to minimize the difference in welfare, promoting equity, or maximize the welfare of the worst-off child.

This general framework allows us to capture a number of different channels through which children's characteristics may lead to a reallocation of parental expenditure. First, a certain characteristic may cause a parent to change directly the weight on a given child's welfare in the parental utility function. This pattern is particularly common for characteristics such as gender and parity; if there is a systematic preference for male children or firstborn children, parents may consistently upweight that child's welfare. Second, a certain characteristic may shift parents' expectation of the child's future welfare and thus generate a shift in parental utility weights. Parents might place more weight on the utility of a child expected to be better off in the future, *ceteris paribus*, if they expect or hope for financial or emotional support from that child. Third, the projected shift in welfare may not generate any shift in utility weights but nonetheless generate a reallocation of expenditure for parents. For example, if parents are sensitive to equity, they might reallocate expenditure away from the child with higher projected welfare. Fourth, a child's characteristics may directly shape the returns to investing expenditure in this child. Depending on the parents' objective function, they might then reallocate expenditure.

Given this broad framework, it is also useful to highlight specific predictions that may differentiate the response to noncognitive skills *vis-à-vis* other human capital characteristics. There are several reasons to hypothesize that the parental response may be different, independent of the parents' specific objectives. First, noncognitive skills may be particularly salient. Parents can easily observe their child's disposition and behavior, while they may have relatively little information about cognitive skills, particularly if the parents' own education is limited. Recent evidence has suggested that parents in developing countries do have limited information *ex ante* about their children's cognitive skills (Dizon-Ross 2019).

Second, noncognitive skills may directly shape the relationship between parent and child more than other characteristics, given that they plausibly affect

how the child interacts with the family. This factor may render it particularly probable that variation in noncognitive skills leads parents to place a differential weight on a child's welfare. In principle, this difference could be observed in either direction: parents might be less invested in a child experiencing noncognitive challenges if the child is challenging to manage or more invested in the child due to the desire to provide nurturing. Third, the relationship between cognitive skills and future welfare is plausibly different from the relationship between noncognitive skills and projected welfare. Here, as previously noted, very little evidence exists of the returns to noncognitive skills in a developing-country context in terms of income. However, parents might reasonably conclude that noncognitive skills not only shape their children's future income but could also substantially affect their happiness in other dimensions (e.g., their value in the marriage market, the quality of their future relationships). If parents particularly value their children's welfare along these other, nonincome dimensions, they may be more likely to respond to differences in noncognitive skills vis-à-vis other human capital characteristics.

In addition, it is reasonable to hypothesize that parents having different characteristics—and particularly varying levels of education—may also respond differently to their children's characteristics, including demographic characteristics and cognitive and noncognitive skills. More-educated parents could have different functional forms for their preferences—that is, they may differentially value efficiency relative to equity—or may have distinct beliefs or levels of information about the returns to human capital investment and how those returns interact with child characteristics. These differences could, in turn, generate varying patterns of investment in households with more-educated parents. Moreover, even within a family, mothers and fathers may have different preferences; in this case, the household's allocation of resources between children may be determined by a process of intrahousehold bargaining, a process that is not modeled here.

III. Empirical Strategy and Results

A. Empirical Strategy

Our empirical strategy entails evaluating whether parental expenditure on education for children is correlated with measures of noncognitive characteristics, conditional on household fixed effects.⁸ In other words, our primary specification

⁸ Given that our primary interest is examining how parents allocate resources between children with different noncognitive characteristics, it is necessary to include family fixed effects, since we are examining within-household variation. Also, the use of fixed effects addresses the challenge of unobserved household-level heterogeneity.

identifies whether parents are more likely to invest in a child who has desirable noncognitive characteristics relative to a sibling.

The child's observed noncognitive characteristics will be denoted Ncog_{ibct} for child i in household b , living in county c and born in year t ; the noncognitive variables employed will include the externalizing and internalizing indexes, as well as a summary measure that is the mean of the two indexes. All noncognitive variables have been standardized to have means equal to 0 and standard deviations equal to 1. Again, to facilitate interpretation, the indexes have been inverted so that a higher value indicates fewer noncognitive challenges.

The dependent variable, educational expenditure, is denoted Y_{ibct} . The specification includes household fixed effects η_b , year-of-birth fixed effects ν_t , fixed effects for each gender–sibling gender composition, and a vector of child covariates X_{ibct} , including birth parity (i.e., whether a child is born first or second), height for age, and achievement test scores. The inclusion of birth parity is particularly important, given the evidence presented by Black, Devereux, and Salvanes (2005a) that birth order is an important determinant of children's outcomes. Our sample was 60% boys and 40% girls.

This specification is estimated with and without interactions with parental education S_{bct} . Standard errors are clustered at the village level in all specifications; our sample includes 90 villages. See the following equation:

$$Y_{ibct} = \beta_1 \text{Ncog}_{ibct} + \beta_2 \text{Ncog}_{ibct} \times S_{bct} + X_{ibct} + \nu_t + \eta_b + \epsilon_{ibct}. \quad (1)$$

The identification assumption for this family of specifications requires that noncognitive characteristics are uncorrelated with other unobservable variables that determine parental allocations. This assumption would be violated, for example, if parents invest more in a favored child, who is subsequently observed to score highly on the noncognitive indexes employed. (Alternatively, parents could identify a favored child who would be exposed to more parental pressure and who would, in fact, show evidence of more noncognitive challenges.)

In order to present some preliminary evidence about the relationship between noncognitive characteristics and child characteristics conditional on household fixed effects, the following specifications can be estimated, regressing the internalizing and externalizing indexes on child covariates X_{ibct} conditional on household fixed effects:

$$\text{Ncog}_{ibct} = \beta_1 X_{ibct} + \eta_b + \epsilon_{ibct}. \quad (2)$$

The results can be found in table 2; panel A reports the correlations with sibling parity, age, gender, and grade level, and panel B reports the correlations with various measures of the child's endowment. Interestingly, in panel A, there

TABLE 2
NONCOGNITIVE CHARACTERISTICS AND CHILD CHARACTERISTICS

	Internal (1)	External (2)	Internal (3)	External (4)	Internal (5)	External (6)	Internal (7)	External (8)	Internal (9)	External (10)
A. Child Characteristics										
Sibling parity	-.005 (.059)	-.124** (.062)							.173 (.142)	.167 (.137)
Age			.013 (.018)	.044** (.018)					.030 (.048)	-.045 (.044)
Female					.030 (.076)	.333*** (.077)			.029 (.081)	.305*** (.077)
Grade level							.018 (.020)	.074*** (.019)	.034 (.038)	.143*** (.038)
B. Cognitive Skills and Health										
Height for age	.043 (.037)	.077** (.036)					.040 (.038)	.078** (.037)		
Chinese test score			-.012** (.005)	-.007 (.004)			-.008 (.005)	-.003 (.004)		
Math test score					-.009** (.004)	-.006 (.004)	-.006 (.004)	-.005 (.004)		
Observations	816	816	816	816	816	816	816	816	816	816

Note. Dependent variables are the internalizing and externalizing indexes. A higher internalizing or externalizing index is indicative of fewer noncognitive challenges. The independent variable is the specified child characteristic, all measured in the second wave; all specifications include household fixed effects and standard errors (in parentheses) clustered at the village level.

** Significance at the 5% level.

*** Significance at the 1% level.

is no evidence of any significant correlation between the internalizing index and any child characteristic. However, for the externalizing index, we observe that noncognitive measures are lower—suggestive of more behavioral challenges—for second-born children, younger children, boys, and children enrolled in lower grades in school. There is, of course, a high degree of correlation among these covariates: second-born children are, on average, younger, enrolled in lower grades, and more likely to be boys.⁹ Columns 9 and 10 show the results of a multiple regression including all four covariates; there is some evidence here that the most robust correlations are between gender and grade level and the externalizing index.

Panel B shows that there is little evidence of significant correlations among noncognitive characteristics and height for age, on the one hand, and math and Chinese test scores, on the other, though there are weakly significant and negative correlations between the Chinese and mathematics test scores and the internalizing index as well as a weakly significant and positive correlation between height for age and the externalizing index.¹⁰ In addition, table A1 (tables A1–A7 are available online) reports parallel specifications in which interactions with maternal education are included. In general, there is little evidence that these correlations significantly differ for more- or less-educated mothers. The only exceptions are the positive interaction terms between maternal education and age and maternal education and sibling parity, significant at the 10% level in the multivariate specification employing the internalizing index as a dependent variable.

In light of these results, the primary specifications all include fixed effects for year of birth and gender–sibling gender, as well as controls for birth parity, height for age, and mathematics and Chinese test scores, as measured in the second wave, contemporaneously with noncognitive characteristics.¹¹ The inclusion of grade fixed effects is more complex, given that grade level can plausibly be considered an outcome. However, we will demonstrate that the primary results are robust to the inclusion of grade fixed effects.

Given that the primary specifications are estimated conditional on household and year-of-birth fixed effects, it is also useful to examine how much variation in the child characteristics of interest is observed within a given household

⁹ The implications of gender selection for this analysis will be explored in greater detail in Sec. III.C.

¹⁰ Test scores are normalized to have a mean of 0 and standard deviation of 1 employing the grade-specific mean and standard deviation. These specifications also include controls for gender, sibling parity, and grade fixed effects.

¹¹ For test scores, we include both the raw test score and the score normalized by grade level to have a mean of 0 and standard deviation of 1.

and within a given birth year. In table A2, we report the R^2 from a series of simple regressions, including only the specified fixed effects as explanatory variables and various child covariates as the dependent variable. In general, between 50% and 60% of the variation in noncognitive characteristics is explained by household fixed effects, suggesting there is still considerable within-household variation.

B. Primary Results

Table 3 presents the results of estimating equation (4) without the interaction terms with parental education. The objective is to test whether parental allocations of educational expenditure are responsive, on average, to variation in noncognitive characteristics between siblings; the measures of expenditure employed are tuition and discretionary expenditure. Enrollment is near universal in the core sample (only 3% of children are reported not enrolled), and thus school enrollment is not reported as an outcome. Each specification is estimated both with and without control variables and employing the internalizing and

TABLE 3
PARENTAL ALLOCATIONS AND NONCOGNITIVE CHARACTERISTICS

	Discretionary				Tuition			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index	-13.103 (8.723)	-18.162** (8.536)	-4.909 (7.344)	-8.450 (7.217)	2.075 (5.234)	-3.421 (4.708)	2.075 (5.234)	.457 (5.674)
Chinese	104.342* (56.801)		109.077* (58.384)		45.817 (56.537)		45.817 (56.537)	
Math	-24.507 (27.996)		-26.993 (28.211)		-13.933 (26.767)		-13.933 (26.767)	
Height for age	-1.156 (5.963)		-1.338 (6.121)		.695 (4.649)		.695 (4.649)	
Index employed	Internalizing		Externalizing		Internalizing		Externalizing	
Observations	816	816	816	816	816	816	816	816
Mean (dependent variable)	98.651	98.651	98.651	98.651	165.667	165.667	165.667	165.667
Standard deviation (dependent variable)	169.227	169.227	169.227	169.227	159.211	159.211	159.211	159.211

Note. Dependent variables are discretionary educational expenditure and tuition expenditure per semester per child; discretionary expenditure is the sum of all categories of expenditure enumerated in table 1, excluding tuition. The independent variable is the specified index of internalizing or externalizing behavior. A higher internalizing or externalizing index is indicative of fewer noncognitive challenges. Specifications in cols. 1, 3, 5, and 7 include controls for sibling parity; height for age and cognitive skills measured contemporaneously with noncognitive characteristics; a dummy for middle school; and fixed effects for household, year of birth, and gender–sibling gender. Specifications reported in cols. 2, 4, 6, and 8 include only household fixed effects, year-of-birth fixed effects, and a dummy for middle school. Standard errors (in parentheses) are clustered at the village level.

* Significance at the 10% level.

** Significance at the 5% level.

externalizing indexes, in turn, as independent variables, as indicated in the final row of the table.

The results show coefficients that are small in magnitude, varying in sign, and generally insignificant. This suggests that parents are neither systematically compensating children characterized by more internalizing and externalizing challenges nor systematically reinforcing these differences. (A similar pattern is observed if we estimate these specifications without household fixed effects.)

In light of this evidence, we then examine whether parents who themselves have certain characteristics are more likely to respond to measured differences in the noncognitive traits of their children. The most obvious relevant characteristic is education, particularly given that evidence from Hsin (2012) and Restrepo (2016) suggests that maternal education is an important determinant of parental allocation of expenditure. While the average level of education reported is relatively low—4 years for mothers and 7 years for fathers—there is considerable variation. Around 75% of mothers report completing at least 1 year of formal schooling, and 16% report completing junior high school. For fathers, around 90% report completing at least 1 year of formal schooling, and 10% report completing senior high school.

Figure 2 shows histograms of the distribution of both maternal and paternal education. The correlation between maternal and paternal education is positive but low in magnitude (around 0.3). In addition, the appendix reports figures showing the distribution of intrahousehold (between-sibling) differences in noncognitive characteristics and in normalized expenditure residuals for households at different levels of maternal education. The mean absolute difference in noncognitive characteristics between siblings is around 0.8 standard deviations, and this level is roughly constant across households of different levels of maternal education; the mean absolute difference in expenditure is around 0.4 standard deviations, and this seems to be larger at higher levels of maternal education.¹²

To identify whether there is any heterogeneity with respect to parental education, we then reestimate equation (4), including interaction terms between noncognitive indexes and parental education. Again, we estimate a specification that includes controls for a wide range of child characteristics, as well as the interactions of gender, age, sibling parity, height for age, and Chinese and mathematics scores with the specified measure of parental education. We also report a simpler specification that is unconditional on child characteristics.

¹² These results are reported in fig. A1. Normalized expenditure residuals are calculated by regressing expenditure on child characteristics (gender, birth parity, cognitive skills, height for age), generating the residuals, and standardizing them to have a mean of 0 and standard deviation of 1.

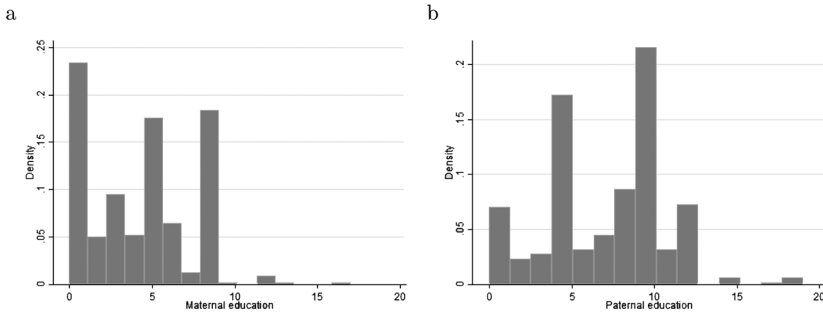


Figure 2. Histograms of maternal and paternal education as reported in the analysis sample.

The results are reported in table 4 for maternal education and table 5 for paternal education. We observe a robust pattern in which households where mothers have low levels of education (approximately fewer than 3 years of schooling) allocate more discretionary educational expenditure to children with higher noncognitive scores, reinforcing the preexisting differences, while households with more-educated mothers seem to engage in compensatory behavior, allocating more expenditure to children characterized by lower scores and thus by more behavioral and socioemotional challenges. This result is evident in the negative coefficients on the interaction term between noncognitive indexes and maternal education in columns 1–4 of table 4.¹³

By contrast, there is no compensatory effect observed for tuition in columns 5–8 of the same table, consistent with the intuition that tuition is not easily manipulable; though the coefficients are negative, they are small in magnitude and insignificant.¹⁴ Comparing the estimated coefficients for the interaction effect in columns 1 and 5, we observe that, relative to the mean of the dependent variable, the magnitude of the coefficient on tuition in column 5 is around 5% of the magnitude of the coefficient on discretionary expenditure in column 1. A similar pattern is observed when comparing the coefficients estimated in the other parallel specifications.

Turning to paternal education, the interaction terms reported in table 5 are small in magnitude, heterogeneous in sign, and generally insignificant. In addition, it is evident in both tables that the results from the specifications including a full set of control variables and the more parsimonious specifications are

¹³ Aizer and Cunha (2012) find that the degree of parental reinforcing behaviors increases with family size. However, our finding cannot be explained by variation in family size, since the sample is restricted to only two-child households.

¹⁴ Approximately 12% of students attend schools that are private or publicly assisted private institutions; accordingly, it is possible that there is some variation in tuition and some potential for parents to select a higher-tuition school for their children.

highly consistent. (To further test the robustness of these results, we report in tables A3 and A4 a series of regressions in which additional control variables are serially added to the main specification, employing both discretionary expenditure and tuition as the dependent variables. The results are entirely consistent, independent of the control variables employed.) Thus, while there may be some concern that contemporaneous measures of cognitive skills and health are endogenous relative to parental investments, there is no evidence that including these variables as controls generates systematic bias. We also report in both tables p -values adjusted for multiple hypothesis testing, estimated using the method proposed by Simes (1986); the results are generally consistent.¹⁵

The bottom row of table 5 reports p -values testing the equality of the estimated coefficients on the interaction terms for maternal and paternal education for the two noncognitive indexes, respectively.¹⁶ These coefficients are denoted β_2^m and β_2^f , where β_2^m refers to the coefficient on the interaction term for maternal education, and β_2^f refers to the analogous coefficient for paternal education. We can reject the hypothesis that β_2^m and β_2^f are equal in all specifications employing discretionary expenditure as the dependent variable. We also report results from a joint test of the hypotheses $\beta_1^m = \beta_1^f$ and $\beta_2^m = \beta_2^f$ and find parallel results.

Examining the coefficients on the interaction terms for other child characteristics, we can observe that they are generally insignificant. For cognitive skills as captured by the test score in Chinese, there is a pattern parallel to that observed for noncognitive skills: the coefficient on the level term is positive, and the coefficient on the interaction term is negative, though both are noisily estimated. For the test score in mathematics and height for age, by contrast, the coefficients are heterogeneous in sign and generally insignificant. We hypothesize that this difference primarily reflects the fact that Chinese language ability may be easier for parents to observe, while ability in mathematics may be largely unobservable; in addition, parents may not receive an accurate signal of their children's ability based on their school performance, given the evidence previously presented that there is very little variation in grades. Accordingly, their ability to respond to their children's mathematics proficiency may be limited.

Finally, the magnitudes of the implied effects for noncognitive characteristics are substantial. The mean household in the sample shows evidence of an

¹⁵ Focusing on the specifications estimated without control variables, we implement the correction procedure for all specifications employing the internalizing index (using discretionary expenditure and tuition as dependent variables and including interactions with maternal and paternal education); we then implement a parallel procedure for all specifications employing the externalizing index. The adjusted p -values are estimated in Stata using the command `qqvalue`.

¹⁶ This test is implemented by estimating the two specifications simultaneously in a seemingly unrelated regression framework.

TABLE 4
HETEROGENEOUS EFFECTS WITH RESPECT TO MATERNAL EDUCATION

	Discretionary				Tuition			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index	17.616** (8.606)	15.464* (9.317) [.387]	17.106** (7.857)	15.835** (7.300)	2.223 (6.885)	2.530 (7.501) [.591]	11.092 (9.581)	11.034 (7.284)
Adjusted p-value (internal)				[.098]*				[.183]
Adjusted p-value (external)				-6.600** (2.628)				-2.874 (2.636)
Index × mother's education	-7.524*** (2.736)	-8.003*** (2.687) [.023]**	-6.427** (2.839)		-.595 (1.664)	-1.416 (1.593) [.797]	-2.572 (2.929)	
Adjusted p-value (internal)				[.096]*				[.098]
Adjusted p-value (external)								
Chinese	126.974** (57.081)		121.137** (59.663)		65.410 (67.134)		66.621 (66.104)	
Chinese × mother's education	-4.609* (2.573)		-4.795* (2.553)		-4.934 (5.139)		-4.861 (5.200)	
Math	-21.588 (28.270)		-29.462 (29.197)		-21.445 (29.596)		-19.374 (29.094)	
Math × mother's education	1.686 (2.039)		2.025 (2.039)		3.336 (2.929)		3.312 (2.942)	
Height for age	-13.595 (10.119)		-13.995 (10.006)		3.250 (5.884)		2.683 (5.917)	

Height × mother's education	2.308 (2.099)	2.430 (2.175)	-.992 (1.393)	- .818 (1.390)
Gender × mother's education	-7.289* (4.119)	-5.381 (4.121)	-2.663 (5.636)	-1.664 (5.413)
Parity × mother's education	11.038 (10.495)	10.580 (10.913)	-2.221 (5.953)	-2.094 (5.878)
Age × mother's education	6.873* (3.740)	6.692* (3.883)	1.420 (1.455)	1.513 (1.510)
Index employed				
Observations	816	816	816	816
Mean (dependent variable)	98.651	98.651	165.667	165.667
Standard deviation (dependent variable)	169.227	169.227	159.211	159.211

Note. Dependent variables are educational expenditure per semester per child in the specified category; discretionary expenditure is the sum of all categories of expenditure enumerated in table 1, excluding tuition. The independent variable is the specified index of internalizing or externalizing behavior as well as the index interacted with maternal education in years. A higher internalizing or externalizing index is indicative of fewer noncognitive challenges. Specifications in cols. 1, 3, 5, and 7 include controls for sibling parity; height for age and cognitive skills measured contemporaneously with noncognitive characteristics; a dummy for middle school; and fixed effects for household, year of birth, and gender-sibling gender. Specifications reported in cols. 2, 4, 6, and 8 include only household fixed effects, year-of-birth fixed effects, and a dummy for middle school. Standard errors (in parentheses) are clustered at the village level. Using the procedure proposed by Simes (1986), adjusted *p*-values (in brackets) are estimated for the four specifications employing the internalizing index without additional control variables (using discretionary expenditure and tuition as dependent variables and employing interactions with maternal and paternal education); a parallel adjustment is estimated for the four specifications employing the externalizing index without additional control variables.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

TABLE 5
HETEROGENEOUS EFFECTS WITH RESPECT TO PATERNAL EDUCATION

	Discretionary				Tuition			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index	-21.192 (18.932)	-22.975 (18.797)	-22.507 (16.109)	-26.877* (15.941)	1.360 (9.034)	3.835 (8.006)	-.457 (11.851)	-3.738 (15.707)
Adjusted p -value (internal)		[.797]				[.797]		
Adjusted p -value (external)				[.207]				[.811]
Index \times father's education	.106 (2.450)	.611 (2.378)	2.669 (1.893)	4.302** (2.064)	-1.058 (1.803)	-1.106 (1.315)	.610 (1.411)	1.458 (1.822)
Adjusted p -value (internal)		[.641]				[.641]		
Adjusted p -value (external)				[.367]				[.484]
Chinese	76.239 (62.389)		77.234 (63.330)		-30.083 (75.312)		-31.026 (78.632)	
Chinese \times father's education	1.077 (2.695)		.761 (2.594)		4.570 (5.529)		4.577 (5.475)	
Math	-47.282 (36.927)		-50.435 (37.510)		-9.928 (46.015)		-11.764 (45.992)	
Math \times father's education	2.832 (2.670)		2.466 (2.623)		-1.033 (4.545)		-1.119 (4.525)	
Height for age	7.103 (13.608)		8.628 (13.490)		13.068* (7.766)		13.021* (7.641)	
Height \times father's education	-1.499 (1.896)		-1.667 (1.877)		-1.722* (1.008)		-1.724* (.989)	
Gender \times father's education	1.193 (4.068)		.980 (3.950)		5.412 (5.283)		5.718 (4.778)	
Parity \times father's education	7.415 (8.848)		7.625 (8.815)		-.070 (5.514)		.014 (5.503)	
Age \times father's education	2.576 (2.760)		2.532 (2.724)		.010 (1.202)		.042 (1.208)	
Index employed	Internalizing		Externalizing		Internalizing		Externalizing	
Observations	806	806	806	806	806	806	806	806
Test $\beta_2^m = \beta_2^f$.007	.012	.016	.012	.828	.854	.743	.378
Joint test	.006	.018	.022	.036	.259	.697	.478	.499
Mean (dependent variable)	98.651	98.651	98.651	98.651	165.667	165.667	165.667	165.667
Standard deviation (dependent variable)	169.227	169.227	169.227	169.227	159.211	159.211	159.211	159.211

Note. Dependent variables are educational expenditure per semester per child in the specified category; discretionary expenditure is the sum of all categories of expenditure enumerated in table 1, excluding tuition. The independent variable is the specified index of internalizing or externalizing behavior, as well as the index interacted with paternal education in years. A higher internalizing or externalizing index is indicative of fewer noncognitive challenges. Specifications in cols. 1, 3, 5, and 7 include controls as described in table 4; specifications reported in cols. 2, 4, 6, and 8 include only household fixed effects, year-of-birth fixed effects, and a dummy for middle school. Standard errors (in parentheses) are clustered at the village level. Using the procedure proposed by Simes (1986), adjusted p -values (in brackets) are estimated for the four specifications employing the internalizing index without additional control variables (using discretionary expenditure and tuition as dependent variables and employing interactions with maternal and paternal education); a parallel adjustment is estimated for the four specifications employing the externalizing index without additional control variables.

* Significance at the 10% level.

** Significance at the 5% level.

(absolute) gap of 0.8 standard deviations in noncognitive scores between the two siblings (i.e., the mean cross-sibling gap is 0.8). The coefficient on the interaction term suggests that an increase in maternal education from the 25th to the 75th percentiles, or from one-half to 6 years—conditional on other household characteristics—would yield an increase in discretionary educational expenditure for the relatively weaker child in this sibling pair of 34%. The magnitudes are similar for the coefficients estimated for the externalizing index. While our identification strategy does not allow us to distinguish between a reallocation of the educational budget to favor the child with greater noncognitive challenges vis-à-vis an increase in the overall household educational budget, in either case this is an effect of substantial magnitude.

We can also reestimate the main specifications using the variables capturing disaggregated categories of expenditure; these results are reported in table A5 and show that the largest effects are observed for transportation and food, with some evidence of an effect for tutoring. Expenditure on food at school and transportation to school may correspond to a decision to allow the child to spend more time at school or attend a school that is farther away from home, enhancing exposure to peers and teachers. While the evidence of a significant effect for tutoring may be somewhat surprising, engaging children in supplementary tutoring may be a viable strategy to ensure that they engage in constructive activities when the parents are unavailable for supervision. In addition, the coefficient on tutoring, while significant, is very small in magnitude. Nonetheless, it is important to highlight again that we cannot conclude based on the available evidence that parental compensation represents a strategy to enhance noncognitive skills specifically; rather, parents may seek to use educational expenditure to compensate children with an observed weakness in one domain (noncognitive skills) by building their skills endowment more broadly.

Alternate Specifications

To explore the robustness of these results, we estimate a number of alternate specifications. For concision, all robustness checks use the summary noncognitive measure that is the mean of the internalizing and externalizing indexes and report the specification including all controls. We also focus on the specifications including the interaction term with maternal education.

First, we employ the full sample of all households where the number of children is greater than or equal to two, rather than restricting to households in which the index child and the child's younger sibling are the only children.¹⁷

¹⁷ We preferentially employ the restricted sample in the primary results, given that failing to observe the endowment of the third sibling may lead to attenuation bias in the primary results if parents are compensating the unobserved sibling.

(Fewer than 10% of the sample of interest are households with only one child.) Second, we restrict the sample to households reporting a firstborn son. It should be noted that gender cannot be considered to be exogenous in this sample; nearly 70% of second-born children are boys. However, consistent with existing anthropological evidence, there is little evidence of sex selection prior to the first birth or after the birth of a son, as the gender ratios observed among firstborn children and second-born children following a son are not significantly different from 0.5 (Gu et al. 2007). Accordingly, the distribution of gender within households with firstborn sons is plausibly exogenous.

The results can be found in table 6, panel A. Columns 1 and 2 report the estimated coefficients for discretionary expenditure, and columns 5 and 6 report the results for tuition. We can observe that the interaction terms on maternal education are consistently negative and of roughly equal magnitude in the specifications using discretionary expenditure for both the restricted and larger samples, while there is again no significant heterogeneity in the specifications employing tuition. While the estimated coefficient is smaller using the larger sample, mean expenditure per child is also around 10% lower in the pooled sample (corresponding to expenditure per child that is 27% lower in the subsample of three-child families), consistent with the hypothesis that households with more children may be more resource constrained.

Households in which the index child has only an older sibling are still not observed in the larger sample due to the absence of data on this sibling. However, again the evidence presented in table 1 suggests that there is no significant difference in household characteristics or the index child's noncognitive characteristics when comparing the subsample to these excluded households.¹⁸

Second, in table 6, panel B, we reestimate the primary specification including grade fixed effects, use log expenditure as the dependent variable, reformulate the noncognitive index as a percentile rank variable, and use an alternate measure of noncognitive skills derived from teacher assessments.¹⁹ In all specifications,

¹⁸ We also explore whether there is evidence of a correlation between birth spacing (between the first-born child and the second-born child) and maternal education that could be an alternate channel for the detected pattern. There is no evidence of any correlation between birth spacing and maternal or paternal education and no evidence that parents respond differentially to noncognitive characteristics in households with different spacing between the two siblings.

¹⁹ The other relevant measure of noncognitive skills available in our data is drawn from surveys of the children's teachers, who are asked to report whether a child possesses a series of eight characteristics, both positive and negative. This series includes whether the child is smart, conscientious, reasonable/well-mannered, clean, enjoys work, is lively/imaginative, gets along with others, likes to cry, or lacks confidence. Given the limited variation in this measure, which has only eight unique values, we construct a dummy variable equal to 1 if the teacher's reports of the child's characteristics places the child in the top half of all children, denoted $T\text{cog}_{\text{hct}}^D$. Teacher surveys are not available for a small number of sampled children.

TABLE 6
ROBUSTNESS CHECKS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. Alternate Samples							
	Discretionary				Tuition			
Index	35.395** (14.802)	15.803*** (6.048)			6.189 (11.106)	7.611 (5.235)		
Index × mother's education	-10.016** (4.769)	-5.446** (2.312)			-.717 (2.820)	-2.238 (1.723)		
Sample	Firstborn sons	Larger sample			Firstborn sons	Larger sample		
Observations	404	1226			404	1226		
	B. Alternate Specifications							
	Discretionary				Tuition			
Index	19.902** (9.447)	.108 (.079)	21.105 (13.417)	50.231** (25.583)	8.023 (7.076)	-.021 (.073)	7.171 (15.580)	16.233 (21.645)
Index × mother's education	-8.108** (3.212)	-.034** (.017)	-12.009*** (4.063)	-21.080** (8.378)	-1.494 (2.072)	.003 (.013)	-.783 (3.928)	-3.319 (6.363)
Specification	Grade fixed effects	Log expenditure	Percentile measure	Teacher report	Grade fixed effects	Log expenditure	Percentile measure	Teacher report
Observations	816	816	786	816	816	816	786	816

Note. Dependent variables are educational expenditure per semester per child in the specified category; discretionary expenditure is the sum of all categories of expenditure enumerated in table 1, excluding tuition. The independent variable is a summary of index of noncognitive characteristics, equal to the mean of the internalizing and externalizing index, as well as the index interacted with maternal or paternal education in years. A higher noncognitive index is indicative of fewer noncognitive challenges. All specifications include the full set of control variables described in the notes to tables 4 and 5. Standard errors (in parentheses) are clustered at the village level. In panel A, the specifications estimated in cols. 1 and 5 include all families reporting data on two children. Specifications in cols. 2 and 6 include only families reporting a firstborn son. In panel B, four robustness checks are reported. The main specification is reestimated including grade fixed effects (cols. 1, 5), using log expenditure as the dependent variable (cols. 2, 6), controlling the child noncognitive measures to a percentile rank measure (cols. 3, 7), and using teacher reports of noncognitive skills (cols. 4, 8).
** Significance at the 5% level.
*** Significance at the 1% level.

the results are consistent in both sign and significance. In the appendix, we report additional specifications in which we use the difference between maternal and paternal education interacted with the noncognitive index as the primary independent variable and estimate a fully saturated specification including both maternal and parental education (reported in table A6, panel A, cols. 3, 4, 7, and 8). In both cases, the empirical results are consistent.

C. Bias Due to Serial Correlation and Socioeconomic Status

The primary challenge for our empirical results is that measured noncognitive skills may be endogenous to previous parental investment: children who have previously been favored with more parental investment may show evidence of higher noncognitive skills. If there is some serial correlation in investment, this may be a source of bias in our results. Consider the following simple specification as an example, where the dependent variable is educational expenditure and $Y_{i,t-1}$ denotes previous parental investment:

$$Y_{it} = \beta_1 \text{Ncog}_{it} + \beta_2 Y_{i,t-1}. \quad (3)$$

If we assume that prior investment is unobserved and positively correlated with expenditure today, then $\text{cov}(\text{Ncog}_{it}, Y_{i,t-1}) > 0$, generating upward bias on the coefficient β_1 . If β_1 is positive (i.e., if investment is higher for children with higher noncognitive scores), then we will overestimate the degree of reinforcing investment. If β_1 is negative (i.e., if investment is higher for children with lower noncognitive scores), then the coefficient will be biased toward 0. The bias can be captured by the familiar term for omitted variables, $\beta_2 \text{cov}(Y_{i,t-1}, \text{Ncog}_{it}) / \text{var}(\text{Ncog}_{it})$, where β_2 captures the degree of serial correlation in investment.

The question of primary interest for our specification is whether there will be bias in the interaction term between noncognitive indexes and maternal education—and, if the bias does exist, why we observe this pattern only for maternal education but not paternal education. If we estimated equation (3) separately for low-education and high-education mothers and then calculated the difference in the estimated correlations β_1 as a proxy for the interaction term, the bias would cancel unless $\beta_2 \text{cov}(Y_{i,t-1}, \text{Ncog}_{it}) / \text{var}(\text{Ncog}_{it})$ is different for the two samples. This could arise if either the variance in noncognitive scores or the degree of serial correlation in investment is different for more- and less-educated mothers (i.e., if β_2 is not the same) or if the relationship between past investment and current noncognitive characteristics is different for more- and less-educated mothers (i.e., if the returns to investment are not the same).

We can present some evidence on these points using data reported in the first wave for the restricted sample of firstborn children only. We estimate a

specification in which expenditure in the second wave as well as noncognitive measures in the second wave are regressed on expenditure in the first wave and the interaction of expenditure and maternal education; the same control variables included in the primary specification equation, (4), are included here, but household fixed effects are replaced with county fixed effects given the absence of within-household variation:

$$Y_{ibct} = \beta_1 \text{exp}_{ibc,t-1} + \beta_2 \text{exp}_{ibc,t-1} \times S_{hct} + X_{ibct} + \nu_t + \kappa_c + \epsilon_{ibct}. \quad (4)$$

The results are reported in table 7, panel A. We can observe in columns 1 and 2 that serial correlation in investment is positive for discretionary expenditure and insignificant for tuition; the interaction terms with maternal education are positive, albeit statistically significant only for tuition. In columns 3 and 4, we observe that the dependence of noncognitive skills on past investment is generally 0, though there is some evidence that the relationship is positive for more-educated mothers, as evidenced by the positive interaction term in column 3. In addition, there is no evidence that $\text{var}(\text{Ncog}_{it})$ is statistically different between the two groups; the p -value on the Levene test of equal variances comparing across households above and below the median of maternal education is 0.741.

These results must be considered suggestive, as they use cross-household variation, and there is clearly the potential for simultaneous determination of wave 1 noncognitive skills and wave 1 expenditure. If interpreted directly, the evidence suggests that the upward bias on β_1 would be larger in the sample of more-educated mothers, generating upward bias on the interaction term of interest; this is in the opposite direction of the observed effect. A more conservative interpretation simply suggests that the available evidence is consistent with the hypothesis that the risk of downward bias on the interaction term may be minimal. We also explore in more detail in the appendix the hypothesis that serial correlation could arise in a scenario in which the ex ante favored child in fact experiences more noncognitive challenges (e.g., due to excessive parental pressure) and then continues to receive higher investment. There is no robust evidence of this pattern.²⁰

²⁰ We explore this hypothesis using information provided in the first wave, in particular, who is designated the favorite child by the mother and what parenting methods the mother reports using. Our objective is to focus on two types of households. The first is households in which there is an ex ante favorite in wave 1 who shows noncognitive skills equal to or stronger than the child's sibling in wave 2 (i.e., there is no evidence that the favorite child has been adversely affected by parental pressure). The second is households with relatively positive and less harsh parenting methods, in which excessive parental pressure is presumably a lower risk. We can restrict the sample to households in which these conditions do not hold (the favorite subsequently does not show weaker noncognitive skills or parenting methods are not punitive)—presumably households in which this form of reverse causality is less plausible—and find that the primary results are consistent; these results are reported in table A6, panel A.

TABLE 7
SERIAL CORRELATION AND ENDOGENEITY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. Tests for Serial Correlation							
	Discretionary		Noncognitive					
Expenditure wave	1.373*		-.002					
	(.207)		(.001)					
Expenditure wave 1 × mother's education	.013		.0003*					
	(.061)		(.0002)					
Tuition		-.047		.004				
		(.301)		(.002)				
Tuition wave 1 × mother's education		.120*		-.0003				
		(.073)		(.0003)				
Observations	401	401	401	401				
	B. Endogeneity Tests							
	Discretionary				Tuition			
Index	3.798	22.353**	19.016**	19.854**	13.387	8.508	9.348	9.816
	(3.680)	(9.238)	(9.317)	(9.431)	(11.592)	(8.378)	(8.611)	(9.399)
Index × mother's education	-2.181**	-9.061***	-8.038***	-8.831***	-1.524	-1.948	-2.194	-2.034
	(1.077)	(3.165)	(3.113)	(3.122)	(1.066)	(2.249)	(2.282)	(2.298)
Index × income			-9.664				2.441	
			(6.237)				(4.048)	
Index × assets			-17.574					9.261
			(14.659)					(14.041)
Specification	Primary measure	Lagged control	Income heterogeneity	Assets heterogeneity	Primary measure	Lagged control	Income heterogeneity	Assets heterogeneity
Observations	802	816	816	816	802	816	816	816
Mean (dependent variable)	48.754	98.651	98.651	98.651	110.020	165.667	165.667	165.667
Standard deviation (dependent variable)	79.261	169.227	169.227	169.227	89.347	159.211	159.211	159.211

Note. In panel A, the dependent variable is as specified; the independent variable is discretionary expenditure or tuition as reported in wave 1 for the firstborn child and expenditure interacted with maternal education. A higher noncognitive index is indicative of fewer noncognitive challenges. All specifications include the full set of control variables described in the notes to tables 4 and 5. Standard errors (in parentheses) are clustered at the village level. In panel B, the dependent variables are educational expenditure per semester per child in the specified category; discretionary expenditure is the sum of all categories of expenditure enumerated in table 1, excluding tuition. The independent variable is a summary of the index of noncognitive characteristics, equal to the mean of the internalizing and externalizing index, as well as the index interacted with maternal or paternal education in years. A higher noncognitive index is indicative of fewer noncognitive challenges. All specifications include the full set of control variables described in the notes to tables 4 and 5. The main specification is reestimated using wave 1 measures of noncognitive skills (cols. 1, 5), controlling for lagged educational expenditure (cols. 2, 6), adding an interaction term between the noncognitive index and household income (cols. 3, 7), and adding an interaction term between the noncognitive index and household assets (cols. 4, 8).

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

Finally, we conduct additional tests to evaluate the potential for bias in the primary specifications due to serial correlation in investment and other sources of endogeneity. First, we presume that there is limited scope for parental investment to affect noncognitive characteristics prior to primary school and thus construct a new variable $\text{Ncog}_{ibct}^{\text{prim}}$ that is defined as noncognitive characteristics at primary school age, as observed in wave 1 for the older sibling or wave 2 for the younger. (We similarly define expenditure at primary school age Y_{ibct}^{prim} .) We can then reestimate a specification parallel to the main specification employing the primary school noncognitive variable as the independent variable.²¹ Second, we reestimate our primary specification controlling directly for lagged expenditure.

The results are reported in table 7, panel B. We observe that the empirical pattern is relatively consistent. While the coefficients estimated when employing the primary school measures of noncognitive skills (cols. 1 and 5) are generally smaller in magnitude, the mean levels of expenditure are also lower when we examine only children at primary school age. The estimated coefficients suggest that an increase of 1 standard deviation in maternal education generates an increase in discretionary expenditure directed to a child characterized by a noncognitive index that is 0.8 standard deviations lower than the child's sibling (corresponding to the average cross-sibling gap) of around 20%, compared with an effect size of 34% using the original specification. The coefficients in the other specifications reported here are consistent with the primary results.

Another potential source of bias is the fact that maternal education may proxy for household SES. As suggested by Almond and Currie (2011) and Conley (2008), low-SES households may invest more in better-endowed children due to credit constraints; alternatively, the elasticity of substitution between consumption and human capital investment could be higher for low-SES households. These hypotheses are somewhat less plausible in our context given that there are no parallel effects for paternal education. Both maternal and paternal education are (unsurprisingly) highly correlated with income in this context, and accordingly, if the primary channel for the observed effect is variation in household SES, it seems implausible that the specifications employing maternal and paternal education would show such disparate results.

In addition, we can test this channel by including additional interaction terms with measures of household SES in our primary specifications. We report the specifications for household income and assets in panel B of table 7; in addition, we estimate additional tests employing measures of household income

²¹ Rather than year-of-birth fixed effects, we use fixed effects for the age of the child in the survey year.

per capita, fixed capital, total estimated household expenditure, and home value in the appendix.²² We observe the same pattern for the interaction on maternal education, and the interaction terms for the additional household characteristics are consistently insignificant. Again, this evidence should be interpreted cautiously, as measurement error in these variables may pose a challenge, and maternal education may also be correlated with unobservable dimensions of household SES. However, there does not seem to be any strong evidence for the hypothesis that maternal education is proxying for income in this analysis.

IV. Persistence in Noncognitive Challenges over Time

Given the evidence about compensatory investment in households with educated mothers, it is plausible to hypothesize that over time, children of educated mothers should exhibit reduced persistence of noncognitive challenges relative to children of less-educated mothers. In this data, the younger sibling is only observed once (in the second wave of the survey employed here), while the older sibling is observed in all three survey waves. Accordingly, to test whether there is a differential pattern of persistent noncognitive challenges in more-educated households, we examine whether the longitudinal correlation in child characteristics for the older child is weaker in households with a more-educated mother.²³ More specifically, we regress various measures of noncognitive characteristics observed in 2009 and 2004 on earlier measures for the same child. In 2009, the psychometric measures include a Rosenberg index of self-esteem and an index of depression.²⁴ In 2004, internalizing and externalizing indexes are reported as already noted; in 2000, the internalizing and externalizing indexes are reported, as well as a self-esteem measure.

In the psychology literature, it is also common to use rank-order measures for personality traits (Roberts and DelVecchio 2000; Shiner and Caspi 2003). This technique is particularly relevant when employing longitudinal data in which subjects are observed at very different ages. For this analysis, we convert the noncognitive measures into percentile measures ranking the child with respect

²² These results can be found in table A6, panel B.

²³ Another possible test would be to examine whether the absolute difference in human capital characteristics between the firstborn and second-born children is narrower in wave 2 in households with more-educated mothers. This outcome would be consistent with compensatory investment already successfully leading to enhanced outcomes for the (originally) weaker sibling. This test shows no significant differences in the absolute difference comparing across households with more- or less-educated mothers. Results are reported in the appendix.

²⁴ We invert the depression index, such that a higher depression index is indicative of a lower level of depression.

to children of the same gender and the same age group; the child with the strongest noncognitive characteristics is assigned the highest percentile of 1.²⁵

These measures will be denoted Psych_{ibct} for child i in household h in county c born in year t , and the superscript will indicate the year in which the data was observed. Thus the primary equations of interest can be written as follows, regressing noncognitive outcomes on outcomes from the previous wave and the interaction of the previous outcome with a household-level input, I_{bct} , which can be a dummy variable for the mother or father having a high level of education (above the median) or reported discretionary educational expenditure on the child in the previous wave. The specifications of interest are

$$\begin{aligned} \text{Ncog}_{ibct}^{2009} &= \beta_1 \text{Ncog}_{ibct}^{2004} + \beta_2 \text{Ncog}_{ibct}^{2004} \times I_{bct} \\ &+ \beta_4 X_{bct} + \nu_t + \kappa_c + \epsilon_{ibct} \end{aligned} \quad (5)$$

and

$$\begin{aligned} \text{Ncog}_{ibct}^{2004} &= \beta_1 \text{Ncog}_{ibct}^{2000} + \beta_2 \text{Ncog}_{ibct}^{2000} \times I_{bct} \\ &+ \beta_4 X_{bct} + \nu_t + \kappa_c + \epsilon_{ibct}. \end{aligned} \quad (6)$$

Here X_{ibct} denotes a vector of child- and household-level controls, and standard errors are clustered at the village level. The control variables are drawn from the same set of covariates employed in the earlier analysis: math and Chinese test scores as measured in 2004, height for age as measured in 2004, household net income, fixed capital and assets as measured in 2004, paternal and maternal education dummies, the number of siblings in the family, gender, gender of the younger sibling, sibling gender interacted with the number of siblings, and county and year-of-birth fixed effects. We also include an interaction term with household net income as measured in 2004. In the specifications including an expenditure interaction effect, additional controls include linear and quadratic terms for total and discretionary educational expenditure and a dummy for discretionary expenditure above the median.

The results of estimating equations (5) and (6) for maternal and paternal education dummies and educational expenditure are reported in table 8. Note a positive coefficient β_1 can be interpreted as evidence of persistence of noncognitive characteristics over time, and a negative coefficient β_2 can be interpreted as a reduced persistence in noncognitive challenges in households with higher levels of parental education or more educational expenditure. The

²⁵ The primary results are similar when estimated employing the original variables, though more noisily estimated.

TABLE 8
PERSISTENCE OF NONCOGNITIVE SKILLS IN PERCENTILE AND PARENTAL EDUCATION

	Internal 2004		External 2004		Rosenberg 2009		Depression 2009	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Psychometric index 2000	.010 (.083)	.070 (.060)	-.004 (.081)	.042 (.060)				
Mother's education 2000 internal	-.153* (.088)		-.105 (.104)					
Father's education 2000 internal	.160 (.108)		.140 (.108)					
Expenditure 2000 internal		-.002*** (.0006)		-.0009* (.0005)				
Psychometric index 2004					.108 (.069)	.091 (.066)	.129* (.073)	.162** (.065)
Mother's education 2004 internal					-.183* (.103)		-.0006 (.096)	
Father's education 2004 internal					.124 (.089)		-.023 (.102)	
Expenditure 2004 internal						-2.24e-06 (.0002)		-.0004** (.0002)
Observations	550	550	550	550	408	408	410	410

Note. Dependent variables are the specified measure of noncognitive skills from waves 2 and 3, calculated in percentile terms. A higher index in internalizing or externalizing behavior is indicative of fewer noncognitive challenges. A higher percentile in the Rosenberg index is associated with higher self-esteem. The depression index is inverted; thus, a higher percentile in the depression index is indicative of a lower level of depression. The independent variables include the psychometric index, the mean of internalizing and externalizing indexes from waves 1 and 2, calculated in percentile terms. The psychometric index is also interacted with dummy variables for the mother's (father's) education being above the median and for discretionary educational expenditure. All specifications include controls for cognitive skills measured in waves 1 and 2; height for age; the parental education dummy variables; net income, assets, and fixed capital in the household; the number of siblings, sibling gender, and sibling gender interacted with the number of siblings; and county and year-of-birth fixed effects. The specifications including an interaction effect with expenditure also include linear and quadratic terms for total and discretionary educational expenditure and a dummy for discretionary expenditure above the median. Standard errors (in parentheses) are clustered at the village level.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

interaction terms with maternal and paternal education are included in the same specification.

First, it is useful to note that noncognitive characteristics at ages 9–12 (measured in 2000) do not seem to be particularly strongly correlated with the measures collected at ages 13–16 (measured in 2004); β_1 is positive but not always statistically significant. There appears to be greater evidence of persistence between ages 13–16 and young adulthood, or between 2004 and 2009.

Second, and more important, we also find evidence, albeit somewhat noisy, of a reduced persistence of earlier noncognitive deficits for children of more-educated mothers (as reported in table 8, cols. 1, 3, 5, and 7) and for children who receive more educational expenditure (cols. 2, 4, 6, and 8). This result is observed both between 2000 and 2004 and between 2004 and 2009 and is consistent with compensatory investment by mothers facilitating some remediation of early noncognitive challenges.²⁶ This pattern is also consistent with the existing literature suggesting noncognitive skills are more malleable for a longer period into adolescence and young adulthood than cognitive skills (Borghans et al. 2008). (We must, however, be cautious in interpreting these results as evidence of returns to the specific investments observed: more-educated mothers may also make additional, unobserved investments targeting children with greater noncognitive challenges that have positive returns.)

The interaction terms with paternal education, by contrast, are generally positive and insignificant. Given that there was little evidence that more-educated fathers compensated children experiencing more noncognitive challenges with additional investment, this result is unsurprising.

An alternate test that captures the same fundamental empirical pattern examines the cross-household correlation between noncognitive characteristics and a dummy variable for the household being characterized by high maternal education, conditional on the same set of control variables. This correlation is increasing in magnitude in each wave: in the first wave, it is essentially 0. In the second wave, the correlation has increased in magnitude to 0.028; by the third wave, it has increased to 0.151. The difference between the first- and third-wave coefficients is statistically significant at the 5% level. There is no evidence of a comparable pattern for paternal education.

Given this pattern, it is also useful to briefly reconsider our primary results of heterogeneous response to variation in noncognitive characteristics with respect to parental education. The longitudinal evidence suggests that in households with more-educated mothers, compensatory investments may already have succeeded in reducing noncognitive deficits among firstborn children

²⁶ We found no evidence of any differential persistence of challenges in cognitive skills.

who exhibited significant challenges in wave 1. However, we have already presented evidence in Section III.C (table 7) that the primary results are robust to employing the initial, first-wave measure of noncognitive characteristics for the older child. In addition, any such pattern prior to wave 2 would lead to a narrowing of the gap in noncognitive scores between children of an educated mother and thus lead us to underestimate the compensatory behavior engaged in by these mothers. We see no obvious source of bias that would lead us to erroneously conclude that educated mothers are compensating when in fact they are reinforcing.

Considering the long-term effect of the observed patterns, we can again compare a child with a mother below the median level of education to a child with a mother above the median level of education. For the former child, a decrease of 1 standard deviation in the noncognitive percentile rank in adolescence is correlated with a 0.23 decrease in the Rosenberg percentile rank in young adulthood (i.e., the child has lower self-esteem).²⁷ For the latter child, however, the same decrease in the noncognitive index in adolescence does not show any statistically significant relationship with measured self-esteem in adulthood.

These results may have meaningful implications if there are positive returns in the labor market to noncognitive skills such as self-esteem. While the literature on the returns to noncognitive skills in developing country contexts is still nascent, previous evidence reported in Glewwe, Huang, and Park (2017) using the same sample as observed in a later survey wave suggests that noncognitive skills are, in fact, correlated with the probability of remaining in school. Analyzing the relationship between noncognitive skills and wages is challenging given that less than half the sample was employed at the point of the third-wave survey (ages approximately 17–21); with this caveat, the authors did not find a significant relationship between noncognitive skills and wages. However, recent evidence from other developing countries suggests that noncognitive skills are predictive of yields for individuals primarily engaged in agriculture (Macours and Laajaj 2019). Accordingly, it is reasonable to hypothesize that the pattern observed here of differential persistence of noncognitive challenges over time may have meaningful economic implications.

V. Conclusion

The decisions that parents make about how to allocate educational investments among children have major implications for policies targeting human capital

²⁷ We assume that the father is also above the median level of education, and thus the relevant coefficient is the sum of 0.110 and 0.118, as reported in table 8, col. 5.

accumulation. As greater emphasis is placed on the development of noncognitive skills as well as cognitive skills as a strategy for increasing long-term welfare, it is even more important to understand how parents may respond to observed differences in noncognitive skills and whether they seek to address any detectable deficits.

The evidence in this paper suggests that in a rural context in a developing country, households with more-educated mothers may engage in more compensatory behavior, targeting expenditure to children with greater noncognitive deficits, when compared with households with less-educated mothers. Over time, this leads to greater persistence in noncognitive challenges in households with less-educated mothers, while children with more-educated mothers show evidence of reduced persistence. Moreover, it is arguably unlikely that this pattern reflects simply higher SES for households with more-educated mothers, given that there is no evidence of heterogeneity with respect to paternal education, income, or assets. One suggestive hypothesis generated by our results is that more-educated mothers may have other characteristics—different preferences or greater bargaining power—that lead them to differentially invest in relatively weaker children.

Why is a reallocation of educational expenditure observed in response to differences in noncognitive characteristics rather than other forms of expenditure? First, it is important to highlight that we cannot assume that parents seek to specifically reverse the noncognitive deficit observed in the weaker child; they could seek to compensate for this challenge by investing broadly and potentially enhancing the child's skills along other dimensions. Second, we cannot rule out that parents are simultaneously making other, targeted investments in expenditure or in time. As previously highlighted, educational expenditure is the only type of child-specific investment reported in this survey other than medical care. However, given that these are relatively resource-constrained households, forms of expenditure that might be considered appropriate for addressing noncognitive deficits in a developed county (e.g., therapeutic interventions) may be unavailable, leading households to use educational expenditure as a preferred mechanism of compensation.

There is an extensive literature that finds substantial intergenerational transmission linking maternal educational attainment and children's educational outcomes (Black, Devereux, and Salvanes 2005b).²⁸ Our findings suggest that one potential channel for the intergenerational transmission of education may be the impact of maternal education on children's noncognitive characteristics. These characteristics in turn affect their educational outcomes. This pattern

²⁸ See Björklund and Salvanes (2011) for a review of this literature.

may also have implications for interventions targeted to strengthen noncognitive skills. Given that a number of evaluations have found that targeted early intervention can affect these skills, understanding how parents respond when allocating household resources may be a useful contribution to this policy debate.²⁹ If more-educated mothers respond to such interventions by redirecting expenditure away from the child whose skills have been strengthened, this mechanism may decrease the long-term benefits for the targeted child. There may, however, be positive spillovers for other siblings.

It is important to note that our sample is relatively small and drawn from only one province in China, and we should be cautious in concluding that the observed phenomenon is a general one. Gansu is one of the poorest regions of China; our sample is characterized by per capita income of only slightly more than US\$200 in 2004, comparable to the poorer regions of sub-Saharan Africa. Accordingly, while this sample cannot plausibly be considered to be representative of higher-income areas of China, our results do suggest that compensatory behavior by parents may be found even in resource-constrained settings in the developing world. Thus the question of whether differential household responses to child variation in noncognitive skills widen cross-household inequality in human capital over time may merit further analysis.

References

- Achenbach, Thomas, and Craig Edelbrock. 2006. "Within-Child Associations between Family Income and Externalizing and Internalizing Problems." *Psychological Bulletin* 42, no. 2:237–52.
- Adhvaryu, Achyuta, and Anant Nyshadham. 2014. "Endowments at Birth and Parents' Investments in Children." *Economic Journal* 126, no. 593:781–821.
- Aizer, Anna, and Flavio Cunha. 2012. "The Production of Human Capital: Endowments, Investments and Fertility." NBER Working Paper no. 18429 (September), National Bureau of Economic Research, Cambridge, MA.
- Akresh, Richard, Emilie Bagby, Damien de Walque, and Harounan Kazianga. 2012. "Child Ability and Household Human Capital Investment in Burkina Faso." *Economic Development and Cultural Change* 61, no. 1:157–86.
- Almond, Douglas, and Janet Currie. 2011. "Human Capital Development before Age Five." *Handbook of Labor Economics* 4:1315–486.
- Almond, Douglas, Lena Edlund, and Mårten Palme. 2009. "Chernobyl's Subclinical Legacy: Prenatal Exposure to Radioactive Fallout and School Outcomes in Sweden." *Quarterly Journal of Economics* 124, no. 4:1729–72.

²⁹ The results from the Perry preschool study, as reported in Schweinhart et al. (2005), are among the best known in this respect.

- Almond, Douglas, Hilary Hoynes, and Diane Schanzenbach. 2016. "Long-Run Impacts of Childhood Access to the Safety Net." *American Economic Review* 106:903–34.
- Almond, Douglas, and Bhashkar Mazumder. 2013. "Fetal Origins and Parental Responses." *Annual Review of Economics* 5, no. 1:37–56.
- Becker, Gary S., and Nigel Tomes. 1976. "Child Endowments and the Quantity and Quality of Children." *Journal of Political Economy* 84, no. 4(2):S143–S162.
- Bertrand, Marianne, and Jessica Pan. 2013. "The Trouble with Boys: Social Influences and the Gender Gap in Disruptive Behavior." *American Economic Journal: Applied Economics* 5, no. 1:32–64.
- Bhalotra, Sonia, and Atheendar Venkataramani. 2016. "Shadows of the Captain of the Men of Death: Early Life Health, Human Capital Investment and Institutions." Working paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1940725.
- Bharadwaj, Prashant, Juan Eberhard, and Christopher Neilson. 2018. "Health at Birth, Parental Investments and Academic Outcomes." *Journal of Labor Economics* 36, no. 2:349–94.
- Bharadwaj, Prashant, Katrine Vellesen Løken, and Christopher Neilson. 2013. "Early Life Health Interventions and Academic Achievement." *American Economic Review* 103, no. 5:1862–91.
- Björklund, Anders, and Kjell G. Salvanes. 2011. "Education and Family Background: Mechanisms and Policies." *Handbook of the Economics of Education* 3:201–47.
- Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2005. "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education." *Quarterly Journal of Economics* 120, no. 2 (May): 669–700.
- . 2005. "Why the Apple Doesn't Fall Far: Understanding Intergenerational Transmission of Human Capital." *American Economic Review* 95, no. 1:437–49.
- . 2010. "Small Family, Smart Family? Family Size and the IQ Scores of Young Men." *Journal of Human Resources* 45, no. 1:33–58.
- Bleakley, Hoyt. 2010. "Malaria Eradication in the Americas: A Retrospective Analysis of Childhood Exposure." *American Economic Journal: Applied Economics* 122, no. 1:73–117.
- Bono, Emilia Del, John Ermisch, and Marco Francesconi. 2012. "Intrafamily Resource Allocations: A Dynamic Structural Model of Birth Weight." *Journal of Labor Economics* 30, no. 3:657–706.
- Borghans, Lex, Angela Duckworth, James Heckman, and Bas ter Weel. 2008. "The Economics and Psychology of Personality Traits." *Journal of Human Resources* 43, no. 4:972–1059.
- Carneiro, Pedro, Claire Crawford, and Alissa Goodman. 2007. "The Impact of Early Cognitive and Noncognitive Skills on Later Outcomes." Unpublished manuscript, Center for the Economics of Education, London School of Economics. <https://files.eric.ed.gov/fulltext/ED530081.pdf>.
- Carneiro, Pedro, Costas Meghir, and Matthias Peyer. 2013. "Maternal Education, Home Environments, and the Development of Children and Adolescents." *Journal of the European Economic Association* 11, suppl. 1:123–60.
- Chorpita, Bruce, and David Barlow. 1998. "The Development of Anxiety: The Role of Control in the Early Environment." *Psychological Bulletin* 2:3–21.

- Conley, Dalton. 2008. "Bringing Sibling Differences In: Enlarging Our Understanding of Transmission of Advantage in Families." In *Social Class: How Does It Work*, ed. Annette Lareau and Dalton Conley, 179–200. New York: Russell Sage Foundation.
- Cornwell, Christopher, David B. Mustard, and Jessica Van Parys. 2013. "Noncognitive Skills and the Gender Disparities in Test Scores and Teacher Assessments: Evidence from Primary School." *Journal of Human Resources* 48, no. 1:236–64.
- Cunha, Flavio, and James Heckman. 2006. "Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skills Formation." *Journal of Human Resources* 43, no. 4:738–82.
- . 2007. "The Technology of Skill Formation." *American Economic Review* 97, no. 2:31–47.
- Cunha, Flavio, James Heckman, and Lance Lochner. 2006. "Interpreting the Evidence on Life Cycle Skill Formation." In *Handbook of the Economics of Education*, ed. Erik Hanushek and Finis Welch, 697–812. Amsterdam: Elsevier.
- Cunha, Flavio, James Heckman, and Suzanne Schennach. 2010. "Estimating the Elasticity of Intertemporal Substitution in the Formation of Cognitive and Noncognitive Skills." *Econometrica* 78, no. 3:883–931.
- Currie, Janet. 2009. "Healthy, Wealthy, and Wise: Is There a Causal Relationship between Child Health and Human Capital Development?" *Journal of Economic Literature* 47, no. 1:87–122.
- Ding, Qu Jian, and Therese Hesketh. 2006. "Family Size, Fertility Preferences, and Sex Ratio in China in the Era of the One Child Family Policy: Results from National Family Planning and Reproductive Health Survey." *BMJ* 333, no. 7564:371–73.
- Dizon-Ross, Rebecca. 2019. "Parents' Beliefs about Their Children's Academic Ability: Implications for Educational Investments." *American Economic Review* 109, no. 8:2728–65.
- Ehler, David, J., Gary Evans, and Ron L. McGhee. 1999. "Extending Big-Five Theory into Childhood: A Preliminary Investigation into the Relationship between Big-Five Personality Traits and Behavior Problems in Children." *Psychology in the Schools* 36, no. 6:451–58.
- Evans, Gary. 2004. "The Environment of Childhood Poverty." *American Psychology* 59, no. 2:77–92.
- Frijters, Paul, David Johnston, Manisha Shah, and Michael Shields. 2013. "Intrahousehold Resource Allocation: Do Parents Reduce or Reinforce Child Ability Gaps?" *Demography* 50, no. 6:2187–208.
- Gelber, Alexander, and Adam Isen. 2013. "Children's Schooling and Parents' Behavior: Evidence from the Head Start Impact Study." *Journal of Public Economics* 101:25–38.
- Glewwe, Paul, Qiuqiong Huang, and Albert Park. 2017. "Cognitive Skills, Noncognitive Skills, and School-to-Work Transitions in Rural China." *Journal of Economic Behavior and Organizations* 134:141–64.
- Gould, Eric D., Victor Lavy, and M. Daniele Paserman. 2011. "Sixty Years after the Magic Carpet Ride: The Long-Run Effect of the Early Childhood Environment on Social and Economic Outcomes." *Review of Economic Studies* 78:938–73.
- Gu, Baochang, Wang Feng, Guo Zhigang, and Zhang Erli. 2007. "China's Local and National Fertility Policies at the End of the Twentieth Century." *Population and Development Review* 33, no. 1 (March): 129–47.

- Heckman, James, Rodrigo Pinto, and Peter Savelyev. 2013. "Understanding the Mechanisms through Which an Influential Early Childhood Program Boosted Adult Outcomes." *American Economic Review* 103, no. 6:2052–86.
- Heckman, James, and Yona Rubinstein. 2001. "The Importance of Noncognitive Skills: Lessons from the GED Testing Program." *American Economic Review* 91, no. 2:145–49.
- Heckman, James, Jora Stixrud, and Sergio Urzua. 2006. "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior." *Journal of Labor Economics* 24, no. 3:411–82.
- Hsin, Amy. 2012. "Is Biology Destiny? Birth Weight and Differential Parental Treatment." *Demography* 49, no. 4:1385–405.
- Juhn, Chinhui, Yona Rubinstein, and C. Andrew Zuppann. 2015. "The Quantity-Quality Trade-Off and the Formation of Cognitive and Non-Cognitive Skills." NBER Working Paper no. 21824 (December), National Bureau of Economic Research, Cambridge, MA.
- Kling, Jeffrey, Jeffrey Liebman, and Lawrence Katz. 2007. "Experimental Analysis of Neighborhood Effects." *Econometrica* 75:83–119.
- Leight, Jessica. 2017. "Sibling Rivalry: Ability and Intrahousehold Allocation in Gansu Province, China." *Economic Development and Cultural Change* 65, no. 3:457–93.
- Leight, Jessica, Paul Glewwe, and Albert Park. 2015. "The Impact of Early Childhood Shocks on the Evolution of Cognitive and Noncognitive Skills." Gansu Survey of Children and Families working paper, University of Pennsylvania.
- Macours, Karen, and Rachid Laajaj. 2019. "Measuring Skills in Developing Countries." *Journal of Human Resources*. <https://doi.org/10.3368/jhr.56.4.1018-9805R1>.
- Neidell, Matthew, and Jane Waldfogel. 2010. "Cognitive and Noncognitive Peer Effects in Early Education." *Review of Economics and Statistics* 92, no. 3:562–76.
- Restropo, Brandon. 2016. "Parental Investment Responses to a Low Birth Weight Outcome: Who Compensates and Who Reinforces?" *Journal of Population Economics* 29:969–89.
- Roberts, Brent W., and Wendy F. DeVecchio. 2000. "The Rank-Order Consistency of Personality Traits from Childhood to Old Age: A Quantitative Review of Longitudinal Studies." *Psychological Bulletin* 126, no. 1:3.
- Rosenzweig, Mark, and Junsen Zhang. 2009. "Do Population Control Policies Induce More Human Capital Investment? Twins, Birth Weight and China's 'One Child' Policy." *Review of Economic Studies* 76, no. 3:1149–74.
- Royer, Heather. 2009. "Separated at Girth: US Twin Estimates of the Effects of Birth Weight." *American Economic Journal: Applied Economics* 1, no. 1:49–85.
- Schweinhart, Lawrence J., Jeanne Montie, Zongping Xiang, William S. Barnett, Clive R. Belfield, and Milagros Nores. 2005. *Lifetime Effects: The High/Scope Perry Preschool Study through Age 40*. Ypsilanti, MI: Monographs of the High/Scope Educational Research Foundation.
- Shiner, Rebecca, and Avshalom Caspi. 2003. "Personality Differences in Childhood and Adolescence: Measurement, Development, and Consequences." *Journal of Child Psychology and Psychiatry* 44, no. 1:2–32.
- Simes, R. J. 1986. "An Improved Bonferroni Procedure for Multiple Tests of Significance." *Biometrika* 78, no. 3:751–54.