The Early Origins of Birth Order Differences in Children's Outcomes and Parental Behavior*

Jee-Yeon K. Lehmann†
Department of Economics
University of Houston

Ana Nuevo-Chiquero‡
InstEAD
University of Sheffield

Marian Vidal-Fernandez§
School of Economics
University of New South Wales & IZA

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Abstract

We show that birth order effects in cognitive abilities in the first two years of life and that systematic changes in maternal behavior appear before children are born and continue through birth to the start of adolescence. Using the Children of the NLSY79, we document the start and evolution of birth order effects in cognitive and non-cognitive outcomes from birth to young adulthood. Relative to the immediately preceding sibling, latter-born children score 0.1 standard deviations lower on our cognitive summary index at ages 0 to 2. This gap reaches 0.18 to 0.2 standard deviations by age five to six and is somewhat mitigated by school entry. We report systematic shifts in maternal behavior and attitudes from the first-born to her latter-born children, even before any clear signs of child quality or incentives for strategic parenting appear. Compared to their first pregnancy, mothers are less likely to reduce alcohol and cigarette consumption and more likely to delay prenatal care visits. After birth, they are less likely to breastfeed, and provide less early cognitive stimulation at home for her latter-born children. A simple model of cognitive achievement production shows that variations in parental behavior explain most of the birth order differences in the cognitive summary index from ages 0 to 5 and at least a third of the difference after school-entry. Taken together, our findings suggest that a plausible explanation for the negative relation between birth order and education is a broad shift in parenting, especially in fostering early cognitive development.

JEL Classifications: J13, I19

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†jlehmann@uh.edu

‡a.nuevo-chiquero@sheffield.ac.uk

§m.vidal-fernandez@unsw.edu.au

1 Introduction

A growing number of studies find evidence of large differences in education and labor market outcomes of adults of varying birth order. The direction of the relation between birth order and individuals' outcomes is theoretically ambiguous. Parents and families face different temporal and financial constraints over time, which may prevent them from equally distributing inputs across children. These disparities may benefit the first- and last-born children who share the family resources with a smaller number of siblings (Birdsall 1991) or advantage latter-born children if parental earnings increase significantly over time (Parish and Willis 1993). Additionally, the presence of an older or younger siblings or changes in parental characteristics could also lead to dissimilar home environments for children within the same family. On one hand, latter-born children may face greater levels of cognitive stimulation by growing up with older siblings and better educated parents (Zajonc 1976). Yet if the level of intellectual stimulation at home is closely tied to constraints on parental time and attention, latter-born children may be disadvantaged by being part of a larger family. The impact of mother's age on the birth order effect is also ambiguous. While older mothers may become better caretakers as they gain experience in child rearing, benefitting the latter-born children, they are also more likely to face a greater number of complications during pregnancy and at birth.[1]

Despite the theoretical uncertainty about how birth order may impact key outcomes, most research on the commonly-termed "birth order effect" show a strong negative relation between birth order and adult outcomes, with individuals of higher birth order having lower educational attainment and earnings and even IQ in early adulthood compared to their older siblings (Behrman and Taubman 1986, Kessler 1991, Hanushek 1992, Iacovou 2001, Kantarevic and Mechoulan 2006, Black, Devereux and Salvanes 2005, Black, Devereux and Salvanes 2007b). Ejrnæs and Pörtner (2004) remains an important exception to these studies finding lower achievements and outcomes of latter-born individuals. Using data from the Philippines, they show that birth order is associated with a *positive* impact on years of completed education and time spent on school activities. Their

[1] Recently, more sophisticated optimal stopping or endogenous fertility models have shown that when the quality draw of the eldest child is less than expected, parents might either be less likely to have additional children or be motivated to continue having children until they reach an optimal stopping quality (Ejrnæs and Pörtner 2004). The former effect implies that earlier-born children will tend to have better outcomes, while the opposite is implied by the latter.

finding suggests that the worse outcomes of latter-born individuals in developed countries (U.S., U.K., Australia, and Norway) cannot be simply explained by a natural, biological phenomenon that advantages the first-born, but that they may be related to systematic differences in within-family resource allocations or child-rearing practices.

However, attempts to identify the sources of these birth order differences have not been very successful, especially in comparison to the growing body of research documenting the existence of birth order effects in cognitive outcomes. Price (2008) and Monfardini and See (2011) investigate the role of parental time investment and find that although parents do spend less quality time with children of higher birth order at any given age, birth order differences in cognitive assessments cannot be explained by variations in maternal or parental quality time. Using the British Household Panel Survey, Booth and Kee (2009) show that latter-born children have fewer books at home, but birth order differences in educational attainment are robust to controlling for variations in the availability of books. Similarly, Black et al. (2007b) find that the negative relation between birth order and IQ scores of young Norwegian adults cannot be explained by birth endowments such as birthweight, gestational period, and head size.

Although disparities in parental time or birth endowments are unable to explain birth order differences in education or labor market outcomes, some broad hints about the causes of these differences can be gleaned from recent studies on birth order effects in cognitive assessments of school-aged children. Several studies, including ours, find evidence of a negative relation between birth order and cognitive test scores as early as age five (Price 2008, Monfardini and See 2011, Heiland 2009, Hotz and Pantano 2013). Hotz and Pantano (2013) further demonstrate that latter-born children have lower grades at school and report findings that suggest parents are less strict with latter-born children. Compared to their first-born, parents have less rigid rules about television viewing and lower levels of homework monitoring and academic supervision for latter-born children. Hotz and Pantano (2013) suggest that such a pattern is consistent with a reputation model of strategic parenting in which parents try to establish household rules by behaving more strictly with the first-born child. However, it remains unclear whether behavior changes in parents are indeed driven by their desire to establish a reputation with the first-child or whether it is reflective of a broader and deeper shift in attitudes, expectations, and behaviors as parents gain experience and face greater constraints on their time and attention. Moreover, given that there are systematic differences in cognitive test scores even at the time of school entrance, it is difficult to dismiss the notion that these changes in parental behavior are more than merely endogenous responses to signs of latter-born children's worse academic potential that are unobservable to researchers.

In this paper, we take advantage of the rich and varied measures of cognitive and non-cognitive development and information parental behavior and home environment quality available in the Children of the National Longitudinal Survey of the Youth 1979 (CNLSY79) to document the start and the evolution of birth order differences in children's outcomes and parental behavior from birth to adolescence. We provide evidence that the birth order effect on cognitive abilities starts as early as in the first two years of life and that changes in maternal behavior and the quality of the cognitive stimulation at home appear well before there are clear signals of cognitive or developmental differences in children. We find that systematic shifts in parental behavior and home environment are able to explain most of the birth order differences in cognitives assessments before school entry and at least a third of the difference after school entrance. Taken together, our findings suggest that a plausible explanation of the negative relation between birth order and adult education and employment outcomes is a broad shift in parenting attitudes and focus from the first-born to their latter-born children that starts even before the children are born. These adjustments in parental behavior and inclinations – especially in their ability in provide active and child-focused cognitive stimulation at home – appear to set latter-born children on a lower path for human capital accumulation from an early age.

Specifically, our mother-fixed effects estimates show that at ages 0 to 2, latter-born children score about a tenth of a standard deviation lower on a summary index of cognitive assessments relative to the sibling born immediately before them. The size of this negative relation between birth order and cognitive index reaches 0.18 to 0.2 standard deviations by age five to six when the children enter school. Although school entry appears to reduce the size of the birth order effects by about 35 percent, it remains large and statistically significant. In contrast to popular notions of birth order effects on personalities, we do not find strong evidence of birth order differences in the non-cognitive summary index (as measured by behavior problems, temperament, or general self-perception), except with regard to how children perceive their scholastic abilities.

Second, we find that there are broad and systematic shifts in maternal behavior and attitudes from the first to her latter-born children, even before any clear signs of child quality or incentives for strategic parenting are present. Compared to the pregnancy of their first child, mothers are much less likely to reduce alcohol and cigarette consumption, more likely to delay her prenatal care visits in subsequent pregnancies, and less likely to breastfeed after giving birth. Additionally, even as early in the first year of life, latter-born children receive lower levels of cognitive stimulation at home despite receiving the same quality of emotional support from their parents. Finally, modeling the production of cognitive achievement in children as a cumulative process depending on both lagged and contemporaneous home inputs, we find that variations in parental behavior as measured by home environment scores in the CNLSY79 are able to explain most of the birth order differences in the cognitive summary index from ages 0 to 5 and at least a third of the difference after school-entry. All of these results are robust to controlling for various time-varying covariates such as maternal employment, presence of a father figure in the home, and family income at the time of assessment.

In summary, our paper makes a number of important contributions to the birth order literature and the study of within-family differences in labor and education outcomes and their sources. To our knowledge, our study is the first to identify the start and the evolution of birth order effects across a wide range of cognitive and non-cognitive assessments from birth to adolescence. Previous studies of birth order effects have largely focused on either outcomes of adult or in school-aged children. However, assessing whether significant birth order differences in development and cognitive achievement even at very early ages is important for unearthing their sources. Second, we show that there are no large differences in the temperament and attitudes of children by their birth order, with the exception of those that relate to their perceptions about their scholastic abilities. This finding suggests broad differences in non-cognitive abilities cannot be the main explanation for the lower educational achievement of latter-born children despite popular beliefs that suggest otherwise. Third, we show evidence of large and significant birth order differences in early parental inputs even during pregnancy and in the first year of life. The appearance of systematic shifts in parental behavior, attitudes, and focus before parents have much child-quality signals to which to respond and before they have any clear incentives to strategically establish their reputation suggest that parents are choosing to relax what they might deem as non-essential rearing practices for their latter-born children. The finding that parents appear provide the same level of emotional support to all their children – what most would consider to be the most essential part of parenting – but lowers levels of active cognitive stimulation is consistent with such an interpretation. Finally, we estimate a simple model of cognitive ability accumulation and show that these adjustments in parental behavior and styles can explain a great portion of the birth order differences in the cognitive achievement of children from ages 0 to 14.

The rest of the paper is organized as follows. Section 2 briefly describes the Children of the NLSY79 and our main estimating sample. Section 3 discusses the construction of the cognitive and non-cognitive summary indices and our main empirical specifications. Sections 4 and 5 present our main empirical findings on birth order effects in children's cognitive and non-cognitive summary indices and in early parental behavior and home environment. Finally, section 6 estimates model of cognitive ability accumulation using home inputs, and we conclude in section 7.

2 Data

The National Longitudinal Survey of Youth 1979 (NLSY79) is a nationally representative sample of 12,686 men and women between 14 and 21 years old who were first interviewed in 1979. Periodic surveys of these individuals have been conducted since then, collecting rich information on employment, income, welfare program participation, education, and other background variables. Starting in 1986, 11,420 children of the 6,283 female NLSY79 respondents have been interviewed bi-annually forming the Children of the NLSY79 (CNLSY79) sample.[2] The child survey includes information on scores from cognitive and non-cognitive assessments, prenatal investments, birth outcomes, early childhood parental investments and health, quality of the home environment, as well as additional demographic and development information collected from either the mother or the child. The CNLSY79 provides unique and detailed longitudinal information on a large nationally representative sample of mothers and their children. The availability of a thorough record of the mothers' employment and their background characteristics along with extensive data on children's prenatal and early childhood health and development indicators make the NLSY79 Children and Young Adults an ideal dataset to explore the start and the evolution of the birth order differences in child's cognitive and non-cognitive outcomes and parental behavior.

In order to document the start and the evolution of birth order differences in children's outcomes from birth to young adulthood across a relatively consistent sample of children, we make several

[2]Some children born before or in 1972 never belonged to the CNLSY79, because once they turn fifteen years old, they leave the sample and start the NSLY79 Young Adults survey, which resembles the NLSY79 questionnaire.

sample restrictions. First, we restrict the sample to children in the CNLSY79 who were at least 14 years old at the time of the 2010 survey, the latest survey year available. This restriction ensures that we are able to track the children's outcomes from birth to their early teens. Second, because we estimate a mother-fixed effects model, we necessarily drop all children without siblings in our dataset. Third, we remove families with more than four kids or with twin births, because unusually large families or families with twins may face systematically different types of constraints or environments.[3] Fourth, we drop military families and the oversample of low-income whites who were not surveyed after 1990 for budget issues. Fifth, because we want to assess whether early parental behaviors are present among children for whom we see early outcome differences, we restrict our sample to those children with non-missing information on our pre- and postnatal input variables of interest as well as our two key controls at birth – mother's education and the presence of the father at birth. Finally, in order to test for birth order differences in both cognitive and non-cognitive outcomes in a consistent sample of children, we limit our sample to those children with at both non-missing cognitive and non-cognitive test indices before the age of 15. Section 3.1 provides a detailed description of how these indices were created. Together, these restrictions yield a sample size of 4,850 children in our main estimating sample.[4]

Table 1 provides basic descriptive statistics of the main estimating sample. The average mother in our sample has about 2.7 children. About 43% of the children in our sample are first-borns and 39% are second-borns. 14% of the children are born third while only 3% are born fourth, demonstrating that most of the children our in sample do not have more than two siblings. The great majority of our sample of children are born to white mothers, 15% percent are born to black mothers and only 6% of the children have Hispanic background. At the time of birth, mothers in our sample are, on average, about 25 years old and have completed high school. About 60% of children have a father figure in the home during their first three years of life. Children in our sample are born about two years apart and 35% of the sample are first boys born to the mother.

[3]However, our results do not change do not change when including these larger families.

[4]In order to balance the need for a consistent sample of children across time with the concern for statistical power, we do not restrict our sample to children with non-missing information for all of the outcomes that we examine. Qualitative and order of magnitudes of the estimates are similar for other sample restrictions. These results are available upon request.

Table 1: Main Sample Descriptive Statistics

Variable	Mean	Std. Dev.	N (Children)
Family size	2.691	0.738	4850
Birth order			
1st born	0.439	0.496	4850
2nd born	0.385	0.487	4850
3rd born	0.144	0.351	4850
4th born	0.031	0.174	4850
Mother's race			
White	0.788	0.408	4850
Black	0.147	0.354	4850
Hispanic	0.065	0.246	4850
Male	0.521	0.500	4850
Age of mother (at birth)	24.843	4.714	4850
Mother's highest grade completed (at birth)	12.716	2.189	4850
Father figure present in household (age 0 to 2)	0.617	0.486	4850
Age difference with previous sibling	2.034	2.573	4850
Age difference with eldest sibling	2.684	3.413	4850
First boy born in family	0.350	0.477	4850

3 Empirical Strategy

3.1 Construction of Cognitive and Non-cognitive Summary Indices

3.1.1 Problems with Multiple Inference

To assess how birth order differences in children's cognitive and non-cognitive outcomes change across different age groups, we rely on several test scores across multiple years. However, the number of children with non-missing observations for all relevant outcomes across all age groups is relatively small. These requirements give rise to problems in statistical inference – most notably, concerns about multiple inference or the increased probability over-rejecting of the null hypothesis as additional outcomes are added. We follow the empirical strategy in Kling, Liebman and Katz (2007), Anderson (2008), and Deming (2009) and rely on summary index tests that are robust to problems of multiple inference. Furthermore, summary index tests have the advantage of providing a more potentially powerful test of a broad effect on the birth order effect on a multiple range of outcomes while mitigating problems associated with measurement error, especially when the sample size is small (Anderson 2008). To create these cognitive and non-cognitive ability indices, we first normalize each test score to have a mean of zero and a standard deviation of one within our main estimating sample. Next, we appropriately reverse the signs of outcomes for which higher scores indicate worse outcomes, such that all tests have the same directional interpretation. Finally, we take a simple average of all the relevant normalized outcomes to construct a single summary index variable. We construct two summary indices, one for cognitive outcomes and another one for non-cognitive outcomes.

3.1.2 Cognitive Summary Index

To create a cognitive summary index from birth to age 14, we rely on three different test scores: the Motor and Social Development score (MSD), the Peabody Picture Vocabulary Test (PPVT), and Peabody Individual Achievement Test - Mathematics (PIAT-M) and Reading (PIAT-R). All three assessments have been used extensively in a myriad of studies evaluating the cognitive development of young children.[5]

Developed by the National Center for Health Statistics to measure motor, social, and cognitive development of young children from birth to age 3, the MSD is based on the mother's answer to fifteen or sixteen age-appropriate questions about her child's social, motor and cognitive development. All questions on the MSD have dichotomous answers, and these "yes" or "no" responses are summed to create the age-appropriate MSD scale. MSD scores have been shown to be strongly associated with later cognitive test scores (Mott 1991).[6] The PPVT is a vocabulary test administered to children between the ages of 3 through 14 and is widely recognized to be a good measure of cognitive ability, especially of verbal intelligence. It has been found to be highly correlated with scores on other intelligence tests and is viewed to be an important indicator of early and middle school outcomes (Baker, Keck, Mott and Quinlan 1993). The PIAT-R: Reading Recognition assesses skills such as matching letters, naming names, and reading single words aloud.[7] PIAT-M assesses the knowledge and application of mathematical concepts and facts. Both the PIAT-R and the PIAT-M

[5]Descriptions of the cognitive and non-cognitive assessments, prenatal and postnatal inputs, and early home environment are drawn from the NLSY79 online guides to Child and Young Adult Data available at: `http://www.nlsinfo.org/childya/nlsdocs/guide/topicalTOC.html`. Accessed on April 28, 2012.

[6]Some examples of the questions on the MSD include "Child rolled over alone on purpose" (0 to 3 months), "Child has pulled to standing position with no help" (4 to 6 months), "Child knows names of common objects" (7 to 9 months), "Child says words other than mama/dada" (10 to 12 months), "Child has said names of at least 4 colors" (19 to 21 months).

[7]The second part, PIAT-R: Reading Comprehension measures the child's ability to derive meaning from sentences that are read silently. However, because the reading comprehension portion of the PIAT-R test was only administered to children scoring above a certain threshold on the reading recognition portion, we choose to focus on PIAT-R: Reading Recognition.

tests are administered to children between 5 to 14 years old. Given that math and reading tests might caputure different types of cognitive abilities, we also construct an additional index without the PIAT-M scores to assess whether birth order effects are more prominent in verbal abilities.

3.1.3 Non-Cognitive Summary Index

While cognitive assessments are important measures of children's early development and achievement, they, by themselves, may fail to capture critical differences in the children's mental and social development (Heckman, Stixrud and Urzua 2006). To investigate whether there are birth order differences in non-cognitive outcomes from ages 0 to 14, we focus on three types of assessments found in the CNLSY79: the difficult temperament index, the behavior problem index (BPI), and the self-perception index (SPPC).

The temperament index is constructed using the temperament scales, designed to assess the child's usual behavior in areas such as activity level, attachment styles, compliance or sociability. Ten different scores measure dimensions of temperaments for children between ages 0 to 6, although not all scores are appropriate for all ages.[8] The index is constructed by averaging the scores available for each age, with a higher score meaning a more difficult temperament. The difficult temperament index is a unique source for the personality and social adjustment of children at the earliest ages. We have chosen to use the difficult temperament index rather than other sub-indices available for the same age group – compliance and attachment, because the difficult temperament index utilizes the most number of questions addressed on the temperament scale measurement. We have, however, created the non-cognitive summary index using the compliance and the attachment indices. [9]. The Behavioral Problem Index measures the incidence and severity of behavioral problems for children of four years and older. The specific set of questions varies according to the age of the child. In our analysis, we examine the BPI Total Score which is based on responses from mothers to 28 questions regarding specific behaviors that her children may have exhibited in the previous three months. The higher the score, the greater the level of behavioral problems.

The CNLSY79 also includes scores from the Self-Perception Profile for Children (SPPC). The

[8] The temperament scales were adapted from Rothbart's Infant Behavior Questionnaire and Kagan's compliance scale, measured by a set of age-appropriate, maternal-report items and interviewer ratings. Description of the items are available at: `http://www.nlsinfo.org/content/cohorts/nlsy79-children/topical-guide/assessments/temperament-how-my-child-usually-acts`. Accessed on September 20, 2013.

[9] Our results are robust to the inclusion of these different temperament indices (available upon request)

SPPC is a measure of a child's sense of general self-worth and self-competence in his/her academic skills based on self-reported answers to the interviewer's verbal questions. The score is divided into two sub-scores: a scholastic competence score and a global self-worth score. In each item of the SPPC survey, the child is given a choice to select the former or the latter part of a two-part statement that describes him or her the best and indicate the extent to which the description is true for them.[10] The SPPC is completed by children eight years and older in the survey years 1986 to 1994, and beginning in 1996, the assessment was limited to children who were 12 years and older.

3.2 Empirical Specifications

Given these summary indices, we exploit the linked mother-child structure of the CNLSY79 and rely on a family fixed effects model to measure the effect of birth order on early inputs and outcomes. Specifically, we first estimate the following equation:

$$Y_{iafrc} = \beta \text{Birth Order}_{iafrc} + \gamma X_{iafrc} + \kappa_a + \upsilon_f + \gamma_r + \xi_c + \varepsilon_{iafrc}. \tag{1}$$

where i denotes child, a age at assessment, f family, r region, c birth cohort, and Y_{iafrc} the outcome of interest. Our baseline specification additionally controls for child-specific characteristics X_{iafrc} that may affect mother's choices and children's outcomes: gender, age of the mother at birth and its quadratic, and age difference with his/her oldest and precedent siblings. κ_a are the child's age of assessment fixed effects, υ_f are family (mother) fixed effects, γ_r the regional fixed effects, and ξ_c the birth cohort fixed effects. The coefficient β can be interpreted as the average effect of birth order on the outcome of interest of the child and his/her sibling immediately preceding him/her across all age groups.

To allow for a more flexible specification that allows for non-linearity in the birth order effect, we next estimate a model with separate indicators for the second-, the third-, and the fourth-born:

$$Y_{iafrc} = \sum_{k=2}^{4} \beta_k [\text{Birth Order} = k]_{iafrc} + \gamma X_{iafrc} + \kappa_a + \upsilon_f + \gamma_r + \xi_c + \varepsilon_{iafrc}. \tag{2}$$

Hence, β_k can be interpreted as the difference in the variable of interest of the k-th born child with

[10] For example, a statement on the SPPC part of the survey declares, "Some kids feel like they are just as smart as other kids their ages, *but* other kids aren't so sure and wonder if they are as smart."

his/her first-born sibling.

We also take advantage of the panel structure of the CNLSY79 to assess how the size of the birth order effects in cognitive and non-cognitive outcomes evolve across different age groups. We impose a linearity in the birth order effect but allow the estimates to change for different ages by estimating the following specification:

$$Y_{iafrc} = \sum_{g=1}^{G} \beta_g [\text{Birth Order} * 1^*(a \in \text{Age group}_g)]_{iafrc} + \gamma X_{iafrc} + \kappa_a + \upsilon_f + \gamma_r + \xi_c + \varepsilon_{iafrc}. \quad (3)$$

In this case, β_g measures the average difference in outcomes or inputs between a child and his or her immediate older sibling, for a given age group. All estimates are weighted and standard errors are clustered at the family level.

The mother-fixed effects models ensures that time invariant family covariates such as family annual income and maternal characteristics such as AFQT do not bias the estimates. However, we recognize that there may be time-variant covariates such as mother's employment status and changes in parental presence that may influence one sibling differently than the other. Because time-varying family-level covariates may be endogenously determined with child outcomes, our baseline specification does not include them as controls. However, throughout the paper, we present results that are robust to controlling for family income at the time of birth and average lifetime family income (average family income from birth to the time of outcome measurement), maternal employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at child's birth, as well as the presence of a father figure in the household during the first three years of life.[11]

4 Birth Order Differences in Children's Outcomes

4.1 Adult Outcomes

Before examining birth order differences in early cognitive and non-cognitive outcomes, we first demonstrate the existence of the birth order effects in several important adult outcomes in our estimating sample. Because the sample of individuals in the CNLSY79 is still relatively young and

[11] Results available upon request to the authors.

Table 2: Adult Outcomes

	HS Graduate	Education (Years)	Crime	Teen Childbearing
Sample Restriction:	*Age 20 and above*	*Age 22 and above*	*Age 20 and above*	*Women Age over 20*
	(1)	(2)	(3)	(4)
2nd Born	-0.031**	-0.519**	0.057**	0.074
	(0.016)	(0.205)	(0.024)	(0.051)
3rd Born	-0.094***	-1.057***	0.072	0.202**
	(0.036)	(0.385)	(0.049)	(0.085)
4th Born	-0.175**	-1.594**	0.084	0.425**
	(0.077)	(0.628)	(0.083)	(0.181)
N (Children)	3449	2603	3402	2041
R^2	0.164	0.474	0.230	0.270

Notes: All regressions are weighted and include family fixed effects. Standard errors clustered at the family level in parentheses. *10%,** 5%, ***1%. Sample restricted to non-twin children with complete prenatal input information and at least one cognitive assessment before the age of 14. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent siblings, age at assessment, and a series of dummies for year of birth. "HS Graduate" is a variable equal to 1 if the respondent received a high school diploma and 0 otherwise. "Crime" is a variable equal to 1 if the respondent was ever jailed, convicted of a crime, served probation, or sentenced, and zero otherwise. "Teen Childbearing" is a variable equal to 1 if the respondent gave birth when younger than 18 years old and 0 otherwise.

to minimize censoring bias, we further restrict the sample to individuals who were at least 20 years old in 2010 (22 in the case of years of education), the last year observed in our data. We present results for the probability of high school graduation, years of education, criminal activity[12] and teenage childbearing in Table 2.

Consistent with previous findings in the U.S. and in other developed countries, higher birth order is associated with lower likelihood of high school graduation and fewer years of completed of education. Compared to their first-born sibling, individuals who are born second are 3 percentage points (or 0.17 standard deviations) less likely to be a high school graduate and complete about 0.5 years (or 0.22 standard deviations) of less education. Third-borns have worse education outcomes still, with 9 percentage points less likely to have graduated from high school and complete a year less of education. The size of these birth order effects on educational attainment is comparable to what Kantarevic and Mechoulan (2006) find using the Panel Study of Income Dynamics (PSID) with first-borns completing 0.4 to 0.9 years of more education compared to latter-born children.

We also examine adult outcomes that previous studies on birth order effects have not studied. Column 3 shows that individuals of higher order of birth are also more likely to have been involved in criminal activity, with latter-borns about 6 to 8 percentage points more likely to have been

[12] Criminal activity is defined as a dummy variable that takes a value of 1 if ever convicted, been on probation, sentenced by a judge or in prison, and 0 otherwise.

convicted of a crime. We also find a positive relation between birth order and likelihood of giving birth as a teen in column 4. Note that teenage childbearing is defined for women only. Therefore, the identification of the birth order effects rely on families with at least two daughters which explains the lower precision of the estimates. These results are robust to restricting the sample to individual who were at least 25 years old by 2010. It is also worth noting that these birth order effects cannot be explained by simple cohort effects, because we control for birth cohort fixed effects in all of our regressions.

4.2 Birth Order Differences in Cognitive and Non-Cognitive Outcomes

Having established that higher birth order is associated with worse educational and social outcomes as adults in our estimating sample, we now turn our attention to our main objective of documenting the start and the evolution of birth order effects from birth to early teens. Table 3 reports our findings on birth order differences in cognitive and non-cognitive summary indices.

Panel A shows our estimates for equation (1), the pooled linear effect of birth order on cognitive and non-cognitive abilities from ages 0 to 14. Compared to the sibling born just before him/her, latter-born children score about 0.14 standard deviations lower on cognitive tests. Excluding the PIAT-Math score to focus on reading abilities in columns 4 through 6, we find that birth order effects slightly increase in size, with children scoring about 0.17 standard deviation lower than his/her sibling born immediately before him/her. Both the size and the statistical significance of the point estimates are robust to controlling for different sets of time-varying covariates.

In contrast to the large birth order effects in cognitive abilities, we do not find evidence of systematic differences in non-cognitive outcomes. Across varying sets of time-varying controls in columns 7 through 9, we find neither large nor statistically significant effect of birth order on non-cognitive outcomes from birth to adolescence. Column 10 additionally controls for cognitive index scores, because we use measures of one's perceptions about his/her scholastic abilities to construct the non-cognitive summary index. Therefore, failing to account for systematic variations in cognitive abilities may bias our estimates of birth order effects downwards. However, accounting for cognitive outcome differences does not change our results.

Table 3: Birth Order Differences in Cognitive and Non-Cognitive Indices from Age 0 to 14

	Cognitive Index (with Math)			Cognitive Index (without Math)			Non-Cognitive Index			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A:										
Birth Order	-0.141***	-0.142***	-0.137***	-0.172***	-0.172***	-0.167***	-0.036	-0.037	-0.036	-0.025
	(0.030)	(0.030)	(0.030)	(0.030)	(0.031)	(0.031)	(0.028)	(0.028)	(0.028)	(0.028)
Panel B:										
2nd Born	-0.170***	-0.171***	-0.166***	-0.200***	-0.200***	-0.195***	-0.065*	-0.066**	-0.064*	-0.052
	(0.035)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.033)	(0.033)	(0.033)	(0.033)
3rd Born	-0.248***	-0.250***	-0.238***	-0.309***	-0.311***	-0.299***	-0.030	-0.031	-0.029	-0.001
	(0.064)	(0.064)	(0.064)	(0.066)	(0.067)	(0.066)	(0.061)	(0.061)	(0.060)	(0.062)
4th Born	-0.335***	-0.339***	-0.321***	-0.427***	-0.431***	-0.413***	-0.030	-0.033	-0.030	-0.010
	(0.102)	(0.103)	(0.103)	(0.103)	(0.104)	(0.104)	(0.105)	(0.105)	(0.104)	(0.109)
Panel C:										
Birth Order (Age 0 to 2)	-0.102**	-0.103**	-0.098**	-0.121***	-0.121***	-0.117***	-0.016	-0.017	-0.019	0.003
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.039)	(0.039)	(0.038)	(0.040)
Birth Order (Age 3 to 4)	-0.148***	-0.149***	-0.143***	-0.160***	-0.160***	-0.155***	0.073*	0.073*	0.075*	0.115**
	(0.036)	(0.037)	(0.037)	(0.036)	(0.036)	(0.036)	(0.044)	(0.044)	(0.043)	(0.046)
Birth Order (Age 5 to 6)	-0.196***	-0.197***	-0.191***	-0.221***	-0.221***	-0.216***	-0.011	-0.012	-0.011	-0.001
	(0.034)	(0.034)	(0.034)	(0.034)	(0.035)	(0.035)	(0.032)	(0.032)	(0.031)	(0.032)
Birth Order (Age 7 to 10)	-0.128***	-0.130***	-0.124***	-0.170***	-0.171***	-0.165***	-0.046	-0.046	-0.045	-0.038
	(0.030)	(0.031)	(0.031)	(0.032)	(0.032)	(0.032)	(0.030)	(0.030)	(0.029)	(0.030)
Birth Order (Age 11 to 14)	-0.141***	-0.142***	-0.136***	-0.176***	-0.177***	-0.171***	-0.061**	-0.061**	-0.059**	-0.049
	(0.032)	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)	(0.030)	(0.030)	(0.029)	(0.030)
N (Children)	4850	4850	4850	4850	4850	4850	4850	4850	4850	4850
Maternal Controls	N	Y	Y	N	Y	Y	N	Y	Y	Y
Father Figure & Family Income	N	N	Y	N	N	Y	N	N	Y	Y
Cognitive Index	N	N	N	N	N	N	N	N	N	Y

Notes: All regressions are weighted and include mother fixed effects. Standard errors clustered at the mother-level are in parentheses. *10%,** 5%, ***1%. All assessments are age-standardized scores that have been renormalized to have a mean of 0 and a standard deviation of 1. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent sibling, age of the child at assessment (in months), and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

Figure 1: Birth Order Effects in Cognitive Index (with Math)

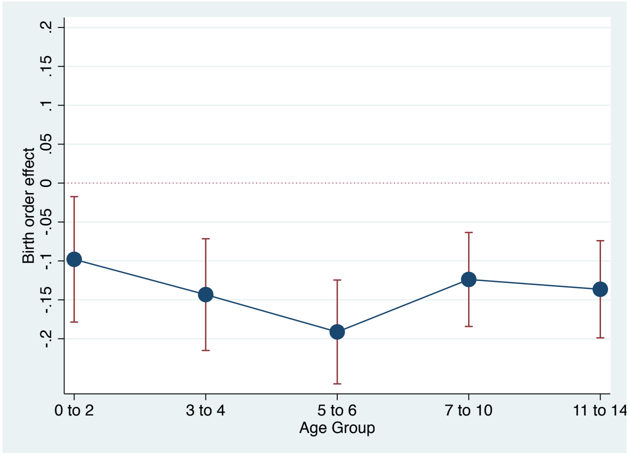


Figure 2: Birth Order Effects in Cognitive Index (without Math)

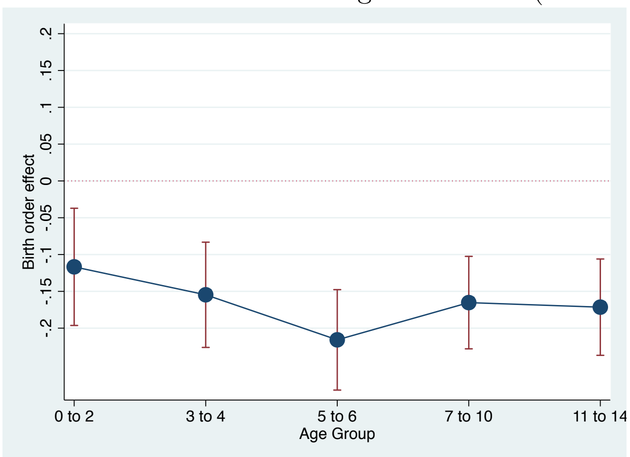
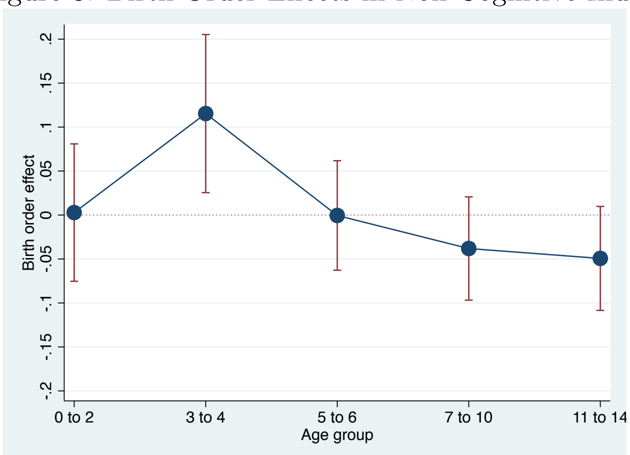


Figure 3: Birth Order Effects in Non-Cognitive Index



This absence of any strong birth order effects in non-cognitive outcomes may be surprising when considering strong assertions in popular culture about the influence of birth order on one's personal and social development. However, our finding is consistent with recent research in psychology that utilize robust, within-family analysis to estimate the impact of birth order on personality or non-cognitive abilities.[13]

Panel B allows for non-linearity in the average birth order effect across age groups including separate indicators for the 2nd, 3rd, and 4th born child and corresponds to estimating equation (2). We find even more compelling evidence of a monotonically decreasing relation between birth order and cognitive ability. Compared to the first-born, second-born children score 0.17 to 0.20 standard deviations lower on the cognitive summary index. Third- and fourth-born children fare even worse, with test scores 0.24 to 0.41 standard deviations lower than their first-born siblings. However, we do not see strong evidence of a large and statistically significant birth order effect on the non-cognitive summary index except for a mild negative effect on second-born children. Nonetheless, the effect is no longer statistically significant at the 10-percent level when controlling for differences in cognitive assessments (column 10).

Finally, in Panel C, we allow the size of the birth order effects to vary across five different age groups in an effort to identify any growth or changes in the magnitude of birth order differences from birth to adolescence (equation (3)). Figures 1 to 3 show the age trends in the estimated point estimates from regressions with the full set of controls (columns 3, 6, and 10, respectively) and the corresponding 95-percent confidence intervals. The results are surprising. Even in the first three years of life, higher birth order is associated with lower scores on cognitive tests, with latter-born children scoring about a tenth of a standard deviation lower than his/her sibling born before her. The size of birth order effects on cognitive scores becomes larger over time, with each increase in birth order being associated with 0.19 to 0.22 standard deviations lower scores by the children enter primary school (age 5 to 6).[14] Primary school entrance (age 7 to 10) significantly reduces the negative relation between birth order and cognitive scores by about 35-percent.[15] This level of

[13]See Bleske-Rechek and Kelley (2014) and references therein. Bleske-Rechek and Kelley (2014) find weak to no impact of birth order on temperament.

[14]Test of equivalence of coefficients on Birth Order (Age 3 to 4) and Birth Order (Age 5 to 6) has a p-value of 0.067.

[15]Test of equivalence of coefficients on Birth Order (Age 5 to 6) and Birth Order (Age 7 to 10) has a p-value of 0.0002

birth order effect is maintained even at adolescence (age 11 to 14), with latter-born children still scoring about 0.14 to 0.17 standard deviations lower on cognitive tests than their immediately older sibling. As Figures 1 and 2 illustrate, there are no significant differences in the age-trends of birth order effects in the cognitive summary index (with or without the PIAT-Math scores).

We do not find similar age-trends in the relation between birth order and the non-cognitive summary index. Examining the impact of birth order across time in columns 7 through 10 of Panel C and Figure 3 reveal a *positive* birth order effect on non-cognitive outcomes at age 3 to 4 which reverses by the children reach their adolescence (age 11 to 14). Examining the individual outcomes that make up the summary index sheds some light behind this reversal. Tables A.1 and A.2 in the Appendix show birth order differences in the difficult temperament index and the behavior problem index, and the self-perception profile scores separately. Table A.1 reveals that at age 3 to 4, higher birth order is associated with a more difficult temperament but better overall behavior, thus showing evidence of mixed relation between birth order and personality and behavior at early ages. At adolescence, however, Table A.2 reveals that the negative effect of birth order on non-cognitive outcome is primarily driven by lower levels of self-perception in scholastic competence. While children of higher birth order do not exhibit more behavior problems at this age, their perception of their scholastic abilities is significantly lower than their older siblings. Even accounting for their lower cognitive test scores, column 4 shows that higher birth order is associated with a decrease of 0.2 standard deviations on the scholastic competence self-perception scale.[16]

4.3 Summary of Findings

In summary, results in Tables 3 reveal several important findings.[17] First, there is a strong negative relation between birth order and cognitive outcomes of children. On average, each unit increase

[16]We find similar patterns in the child's and the mother's expectations for the child's education attainment. We also examine the Rosenberg Self-Esteem Scale and the Pearlin Mastery Scale and find no evidence that birth order is significantly related to variations in either of these non-cognitive measures. Table A.3 in the Appendix reports these results on the Pearlin and the Rosenberg scales. These results demonstrate the robustness of our finding and reduce the concern that our results are driven by our choice of particular assessments that make up the non-cognitive summary index.

[17]Because parenting styles and attitudes and/or constraints on family resources may differ across various population subgroups, we also tested for heterogeneity in the effect of birth order on cognitive outcomes by maternal race and AFQT subgroups. We do find clear and consistent differences in birth order effects across AFQT or race groups. Generally, birth order effects appear to be stronger in families with white mothers when compared to children born to black mothers. The negative relation between birth order and cognitive outcomes is also slightly weaker among children born to high AFQT (greater than 1 standard deviation from the mean) mothers. However, these results are not very consistent across various specifications. The results are available upon request.

in birth order is associated with a decrease of about 0.14 to 0.17 standard deviations on cognitive tests from birth to age 14. The magnitudes of these birth order effects are substantial. Using the same data, Lang and Sepulveda (2007) find a black-white gap in cognitive tests ranging from 0.2 to 0.5 standard deviations after controlling for a myriad of mother and family controls, including mother's AFQT, parental interactions and the home environment score, pregnancy and early life history, and family structure. Similarly, Fryer and Levitt (2004) report a black-white gap in the PIAT-Reading scores of 0.3 to 0.4 at grade 5. Using the Fryer and Levitt (2004) estimates and focusing on the point estimates of the birth order effect at ages 7 to 10 on the cognitive index without the PIAT-Math scores, we calculate that the gap between the second-born and the first-born is about 40 to 50 percent of the black-white gap in cognitive outcomes. For the third-born, the difference in cognitive assessment scores from their first-born siblings reach about 60 to 80 percent of the estimated black-white gap.

Second, we do not find a strong relation between birth order and non-cognitive outcomes with the exception of how individuals perceive their scholastic competence. Even conditional on having the same cognitive test scores, latter-born children report having worse perceptions about their scholastic abilities. However, older children do not report having better views about their general sense of self-worth apart from opinions about their academic competence. Contrary to popular perceptions about how birth order is closely related to personalities, our findings show only weak to non-existing birth order effects on temperament. Rather, any differences in views of self are closely tied to the latter-born children's perceptions about their cognitive abilities. Studies in psychology and education show a statistical significant correlation between measures of scholastic self-worth as an adolescence and educational attainment (Bachman and O'Malley 1977, Ross and Broh 2000). These systematic differences in how children of different birth order view their academic abilities and promise may hint at a channel through which birth order effects in early cognitive achievement and home environments impact adult outcomes.

Third, birth order effects on cognitive test scores are slightly larger when excluding math scores. This finding may be consistent with the evidence on time use in American families as summarized in Hofferth (2009). Using the American Time Use Survey, Hofferth (2009) shows that parents spend considerably more time reading with children than studying any particular subject at home. In turn, specific mathematical skills may be more likely to be acquired in the classroom rather than at home, suggesting that the negative relation between birth order and cognitive assessment scores may be related to home environments.

Finally, latter-born children perform worse on cognitive assessments from a very early age, well before they enter school. Even in the first two years of life, higher birth order is associated with lower scores on development indicators. Hence, this early appearance of birth order effects together with the findings that school entrance appears to mitigate the effect of birth order suggest that early parental involvement and investments in children at home may play an important role in the appearance of birth order effects in early cognitive achievement and their persistence on later outcomes.

5 Birth Order Differences in Early Parental Behavior and Home Environment

Motivated by our finding that large birth order differences in cognitive assessments appear as early as in the first year of life and these gaps widen over time until primary school entrance, we investigate whether there are corresponding patterns of disparities in parental behavior and home environments that can explain these early differences in cognitive development.

5.1 Birth outcomes

Before we examine birth order differences in parental behavior patterns and cognitive and emotional environment at home, we show that latter-born children do not appear to be born disadvantaged developmentally when considering key birth outcomes that have been shown to be predictive of later cognitive outcomes.

Table 4 shows results on how birth order is related to key physical birth outcomes: gestational length and birth weight and length. As before, Panel A in each row presents the average linear birth order effect while Panel B reports the non-linear estimates. Across all outcomes, we find no evidence that older siblings are born with health or developmental advantages at birth. Compared to their older siblings, latter-born children have similar average gestational length and are no more likely to be born premature. In fact, birth weight and length appear to slightly favor children of higher birth order, with first-borns weighing about 3 to 4 ounces less than their younger siblings, controlling for gestational length.[18] Black, Devereux and Salvanes (2007a) find that a 10% increase in birth weight is associated with a 1 percentage point increase in the probability of graduating from high school. Using their estimates, a 4 ounce difference for the average child in our sample with an average birth weight of 7.5 pounds implies an increase of 0.3 percentage points for the second-born individuals compared to their first-born sibling.[19]

We corroborate these findings on birth outcomes in the general U.S. population using the birth records and data from the National Maternal and Infant Health Survey in the 5-percent random sample of the National Vital Statistics (NVS) from 1990 to 2000, and Table A.4 in the Appendix presents our results. Because we are unable to identify siblings in the National Vital Statistics, we cannot employ maternal/family fixed effects to estimate the causal impact of birth order on birth outcomes. We control for all available and relevant covariates of birth outcomes, including mother and father's race, education, marital status, age at birth, and maternal weight gain during pregnancy and its squared, type of delivery (vaginal or caesarean), population size in the metropolitan area, and birth year, month, state, and resident status fixed effects. We restrict our sample to children who were not part of multiple births, born to mothers between the ages 14 to 45 and whose fathers were 14 to 60 at the time of the child's birth.

Compared to our CNLSY79 results, the larger sample size in the NVS leads to much greater precision in the point estimates, but all of our previously findings are confirmed. Latter-born children are actually less likely to be born premature and at low weight. As in the CNLSY79, latter-born children have higher birth weight. Relative to first borns, second born children are born about 122 grams or 4 oz heavier. Latter-born children also have higher 5-minute Apgar scores. Apgar scores summarize the health of newborn children immediately after birth on a scale of 0 to 10, and higher scores indicate better overall health and lower need for medical attention for the newborn.

The absence of a relation between birth order and worse birth outcomes suggests that birth order effects in early cognitive assessments cannot be attributed to significant disadvantages in key health or developmental endowments with which latter-born children start their lives.[20] Rather,

[18]This result is consistent with reports from the medical literature (see, for instance, Wilcox, Chang and Johnson (1996)). We have repeated the analysis using BMI rather than birth weight. We do not find significant differences in BMI by birth order.

[19]While there is some weak evidence children of higher birth order are more likely to be born with "high birth weight," Rosenzweig and Zhang (2009) show that increases in birth weight among low birth weight babies have significant labor market payoffs, but not among babies with normal or high birth weight.

[20]In previous versions of this paper, we also examined birth order differences in early health outcomes: asthmatic

Table 4: Birth Outcomes

	Gestational length (weeks)			Born premature (< 37 weeks)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	-0.033	-0.030	-0.047	-0.004	-0.004	-0.003
	(0.107)	(0.106)	(0.106)	(0.021)	(0.021)	(0.021)
Panel B:						
2nd Born	-0.017	-0.011	-0.028	-0.022	-0.022	-0.021
	(0.125)	(0.124)	(0.124)	(0.025)	(0.025)	(0.025)
3rd Born	-0.040	-0.036	-0.070	-0.002	-0.001	0.003
	(0.224)	(0.222)	(0.222)	(0.044)	(0.044)	(0.045)
4th Born	-0.221	-0.217	-0.271	0.067	0.066	0.070
	(0.429)	(0.426)	(0.430)	(0.082)	(0.081)	(0.083)
	Birth weight (oz)			Low birth weight (< 5.5 lbs)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	2.821***	2.780***	2.864***	-0.015	-0.015	-0.014
	(0.798)	(0.801)	(0.810)	(0.010)	(0.010)	(0.011)
Panel B:						
2nd Born	4.269***	4.250***	4.324***	-0.015	-0.015	-0.015
	(0.892)	(0.901)	(0.912)	(0.012)	(0.012)	(0.012)
3rd Born	4.396**	4.375**	4.559**	-0.025	-0.025	-0.024
	(1.907)	(1.902)	(1.912)	(0.024)	(0.024)	(0.025)
4th Born	3.015	2.839	3.102	-0.047	-0.045	-0.044
	(3.067)	(3.053)	(3.076)	(0.042)	(0.041)	(0.043)
	High birth weight (> 8.75 lbs)			Length at birth (inches)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	0.021	0.021	0.025	0.084	0.091	0.099
	(0.018)	(0.018)	(0.018)	(0.070)	(0.070)	(0.070)
Panel B:						
2nd Born	0.037*	0.037*	0.040*	0.134*	0.147*	0.157*
	(0.020)	(0.020)	(0.020)	(0.081)	(0.082)	(0.082)
3rd Born	0.026	0.027	0.036	0.143	0.158	0.166
	(0.042)	(0.041)	(0.041)	(0.156)	(0.157)	(0.156)
4th Born	0.010	0.008	0.019	0.036	0.036	0.058
	(0.066)	(0.065)	(0.064)	(0.282)	(0.283)	(0.282)
N (Children)	4850	4850	4850	4850	4850	4850
Maternal Controls	N	Y	Y	N	Y	Y
Father Figure & Family Income	N	N	Y	N	N	Y

Notes: All regressions are weighted and include family fixed effects. Standard errors clustered at the family level in parentheses. *10%,** 5%, ***1%. Sample restricted to children with complete prenatal input information and from non-twin families. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent siblings, and a series of dummies for year of birth. Birth weight, low birth weight and overweight at birth also control for gestational age at birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

we propose that the appearance of large gaps in early cognitive test performances may be tied systematic shifts in parenting style and attitudes and home environment that children of different birth order may face.

5.2 Early Prenatal and Postnatal Parental Behavior

In this section, we present evidence that there are indeed significant shifts in maternal behavior from the first-born to their latter-born children, well before clear incentives for strategic parenting or strong signals about the cognitive abilities of the child are present. Table 5 reports birth order differences in maternal choices and behavior in the while the child is *in utero* and in the months following birth, and we find evidence that mothers become more lenient on following strict health guidelines for fetal health during their pregnancy. As before, Panel A in each row presents the average linear effect of birth order, while Panel B reports the non-linear effects.

First, restricting our sample to those who had consumed alcohol before pregnancy in the first row, we find that mothers are less likely to reduce their alcohol intake (compared to their pre-pregnancy consumption levels) during their latter pregnancies even though we do not find differences in the average number of alcoholic drinks consumed per week. Compared to the first-born pregnancy, mothers are 12 percentage points less likely to reduce their alcohol consumption with their second-born child and 15 to 17 percentage points less likely with their third-born child. Unfortunately, our data does not allow identification of the size of the reduction. Similarly, while we do not find differences in the average number of cigarettes consumed per day across birth order, we find that mothers are much less likely to curb their smoking habits during the latter pregnancies, on average by 20-percentage points per pregnancy.[21] Because most of the births in our data occurred between 1980 and 1994 when the negative effects of smoking or drinking during pregnancy were already well established, these differences in mother's willingness to strictly follow these medical recommendations suggest a systematic shift in maternal attitude and behavior towards their latter pregnancies and children.

episodes, types of illness or health limitations preventing him/her from participating in school or regular activities, number of doctor/clinic visits, and access to private health insurance (as a proxy for the quality of general health care). We do not find evidence of birth order differences in any of these variables showing that latter-born children do not have worse early health outcomes that would contribute to lower scores on cognitive tests.

[21] Fingerhut, Kleinman and Kendrick (1990) report a relapse ratio of 70 percent within a year of birth in the mid 1980s.

In the third row, we also find evidence that mothers tend to delay seeking prenatal care in second and latter pregnancies. Compared to the pregnancy of the first-born child, the probability of postponing their first prenatal visit until their fourth month of pregnancy is larger by about 5 percentage points for the second pregnancy and by 11 percentage points for the third pregnancy. These differences are reflected in the timing of the first prenatal visit even among those who do not delay their visit beyond their third month of pregnancy. Although prior experience with pregnancy and birth could help identify and manage latter pregnancies better, women tend to postpone their care. While we do not see a significant effect for the second-born, by the pregnancy of their third-child, mothers delay seeking prompt prenatal care by about a week.[22]

As in the previous section, we can corroborate these findings on maternal behavior during pregnancy in the general U.S. population using data from the National Vital Statistics. Table A.5 in the Appendix reports our findings in the 5-percent random sample. Compared to their pregnancy with their first-born child, mothers are more likely to have smoked during their latter-pregnancies. The results on alcohol use are weaker in the National Vital Statistics data which may arise from the fact that we cannot restrict our sample to mothers who were regular consumers of alcohol before their pregnancy as we do in the CNLSY79. We also find that in mothers in the general U.S. population are more likely to delay seeking prenatal care with their latter pregnancies. Compared to their first pregnancy, mothers are about 3-percentage points more likely to have their first prenatal care visit after the 4th month of pregnancy with their second pregnancy. The likelihood of belated prenatal care increases with each pregnancy.

The bottom row of Table 5 includes the results on a key maternal choice variable after birth. Our estimates show that mothers are significantly less likely to breastfeed their latter-born children, although if they choose to breastfeed, there are no differences in the duration. Compared to their first-born sibling, second-born children are about 9 percentage points less likely to be breastfed and, for the third or fourth children, about 12 to 17 percentage points less. These results are robust to dropping the sample of women who breastfed for a very short time (a week or less) and did not continue afterwards.[23] As can be seen in the columns 2 and 3, they are also robust to controlling

[22]The absence of statistically significant differences in our dataset may be due to the relatively small size of our sample. Using a larger sample of birth certificates, Lewis, Mathews and Heuser (1996) report a positive correlation between delayed prenatal care and pregnancies after the second live birth.

[23]Rates of breastfeeding increased steadily from 1970s in the U.S. We control for cohort effects in all of our specifications. Moreover, changing attitudes about the benefits of breastfeeding in medicine or in society should bias

Table 5: Early Prenatal and Postnatal Inputs

	# alcoholic drinks per week (if previous drinker)			Reduction of alcohol intake (if previous drinker)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	0.057	0.159	0.197	-0.104***	-0.101***	-0.107***
	(0.580)	(0.592)	(0.613)	(0.034)	(0.033)	(0.033)
Panel B:						
2nd Born	-0.125	-0.045	0.003	-0.124***	-0.120***	-0.123***
	(0.617)	(0.613)	(0.623)	(0.040)	(0.039)	(0.039)
3rd Born	0.467	0.684	0.769	-0.158**	-0.156**	-0.172**
	(1.221)	(1.260)	(1.315)	(0.075)	(0.075)	(0.074)
4th Born	0.995	1.416	1.546	-0.246*	-0.241*	-0.261**
	(2.345)	(2.378)	(2.471)	(0.132)	(0.135)	(0.130)
N	2219	2219	2219	2219	2219	2219
	# cigarettes per day (if previous smoker)			Reduction in smoking (if previous smoker)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	0.264	0.216	0.290	-0.190***	-0.195***	-0.196***
	(0.497)	(0.505)	(0.495)	(0.043)	(0.044)	(0.044)
Panel B:						
2nd Born	0.046	-0.044	0.003	-0.166***	-0.175***	-0.177***
	(0.585)	(0.601)	(0.586)	(0.048)	(0.051)	(0.051)
3rd Born	0.951	0.871	1.072	-0.382***	-0.386***	-0.385***
	(0.945)	(0.955)	(0.952)	(0.092)	(0.093)	(0.092)
4th Born	1.631	1.666	2.026	-0.749***	-0.738***	-0.740***
	(1.714)	(1.707)	(1.714)	(0.159)	(0.161)	(0.159)
N	1613	1613	1613	1613	1613	1613
	Delayed prenatal care (4th gestational month or later)			Month of first prenatal care (if not delayed)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	0.053**	0.049**	0.050**	0.069	0.072	0.076*
	(0.022)	(0.022)	(0.022)	(0.046)	(0.045)	(0.045)
Panel B:						
2nd Born	0.051*	0.046*	0.047*	0.076	0.077	0.080
	(0.026)	(0.026)	(0.026)	(0.051)	(0.051)	(0.051)
3rd Born	0.114**	0.108**	0.109**	0.174*	0.178*	0.187*
	(0.051)	(0.051)	(0.051)	(0.105)	(0.104)	(0.103)
4th Born	0.153*	0.149*	0.151*	0.139	0.150	0.167
	(0.082)	(0.082)	(0.082)	(0.173)	(0.171)	(0.169)
N	4850	4850	4850	4014	4014	4014
	Ever breastfed			Weeks breastfed (if ever breastfed)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	-0.073***	-0.071***	-0.076***	-0.239	-0.540	-0.717
	(0.017)	(0.018)	(0.018)	(1.243)	(1.256)	(1.290)
Panel B:						
2nd Born	-0.091***	-0.088***	-0.093***	-0.422	-0.679	-0.934
	(0.020)	(0.019)	(0.020)	(1.384)	(1.426)	(1.447)
3rd Born	-0.126***	-0.122***	-0.133***	-0.415	-0.998	-1.199
	(0.039)	(0.040)	(0.040)	(2.883)	(2.872)	(2.929)
4th Born	-0.153**	-0.154**	-0.171***	0.258	-0.904	-1.324
	(0.063)	(0.064)	(0.064)	(5.603)	(5.549)	(5.580)
N	4850	4850	4850	2224	2224	2224
Maternal Controls	N	Y	Y	N	Y	Y
Father Figure & Family Income)	N	N	Y	N	N	Y

Notes: All regressions are weighted and include family fixed effects. Standard errors clustered at the family level in parentheses. *10%,** 5%, ***1%. Sample restricted to children with complete prenatal input information and from non-twin families. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent sibling, and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

for maternal employment and education (column 2) as well as the presence of a father figure and variations in family income at the time of birth (column 3).

The causal effect of early prenatal care on later outcomes of children is not well-established,[24] and there are some debates about the risks associated with moderate alcohol consumption during pregnancy.[25] Moreover, the plethora of studies showing that breastfeeding, when compared to formula-feeding, is associated with better early health and cognitive outcomes[26] are balanced by more recent literature showing more moderate levels or even absence of benefits depending on the statistical methods used to mitigate the selection bias in the choice to breastfeed (for example, see Rothstein (2013)).[27] However, while the direct effect of these maternal choices are open to debate, these systematic differences in prenatal and postnatal maternal behavior by birth order suggest an important and broad shift in their mothers' attitudes and investments toward their latter-born children.

5.3 Early Home Environment for Cognitive Stimulation and Emotional Support

These changes in maternal/parental behavior towards children of higher birth order are not isolated to pregnancy or early life. We take advantage of the information on the children's home environment in the CNLSY79 found in the Home Observation Measurement of the Environment (HOME) scores to show that they represent a broad and persistent shift in parenting style and environment provided to latter-born children. The level and the quality of parental investment and interaction with children as proxied by the HOME scores have been used widely in economics and child development literature, and they have been shown to be significant correlates of later cognitive achievement,

us against finding a negative relation between rates of breastfeeding and birth order.

[24]Currie and Grogger (2002), and others, such as Smith-Conway and Deb (2005), report that for normal pregnancies, a delay of one week in first prenatal visit is associated with a decrease of 1 to 1.2 ounces in birth weight.

[25]For a review and references, see summary in British Journal of Obstetrics and Gynecology at `http://www.bjog.org/details/news/2085661/Danish_studies_suggest_low_and_moderate_drinking_in_early_pregnancy_has_no_adver.html` accessed July 19, 2014.

[26]For example, see Belfield and Kelly (2010), Oddy, Kendall, Blair, De Klerk, Stanley, Landau, Silburn and Zubrick (2003), Chung, Raman, Chew, Magula, Trikalinos and Lau (2007), Horwood and Fergusson (1998). Note that none of these studies assess results from a randomized controlled study or utilize a natural experiment in the choice to breastfeed or not. All of the studies attempt to mitigate the problem of selection in the choice to breastfeed by including a large set of controls on family or child characteristics or performing propensity score matching using these sets of controls.

[27]Rothstein (2013) uses three different longitudinal U.S. datasets to investigate the impact of breastfeeding on children's early cognitive outcomes. She finds that breastfeeding six months or more is associated with about one-tenth of a standard deviation increase in cognitive test scores when using propensity score matching methods. However, within-sibling results do not show any statistically significant impact of breastfeeding.

health, and non-cognitive development (Todd and Wolpin 2007, Strauss and Knight 1999, Carlson and Corcoran 2001, Fryer and Levitt 2004, Cunha and Heckman 2008).

We focus on the total score as well as on the two sub-scores summarizing cognitive stimulation and emotional support in the household. The HOME questionnaire is divided into four parts to accommodate different age groups' needs (0-2, 3-5, 6-9 and 10-14 years old). It includes age-appropriate questions about whether the mother reads to the child or helps with homework, availability of toys, books or musical instruments, interaction with parents, parental attentiveness, discipline patterns, and frequency of outings.[28] The responses to these questions are either answered by the mother or recorded from observations of an official home visitor, and the composite HOME scores are reported as simple summations of the scores from individual items in the questionnaire, with higher scores signifying a better home environment. We normalize the HOME scores to have mean of zero and standard deviation of one for easier interpretation of the results. Because HOME scores are missing for a large fraction of the children in our main estimating sample, our sample size for the HOME score estimates shrinks considerably (from 4850 to 2632). In Table 6, we report our estimates of birth order differences in home environments from age 0 to 14 for those children for whom we have non-missing observations for all age groups. However, results in which we replace a missing score with zero, with the age-specific mean of our estimating sample, or with imputed scores using back maternal characteristics while controlling for indicators of missing are *Marian:* NOT? significantly different from those shown in Table 6.

The first three columns in Table 6 report the results for the total score and the next six columns show the estimates for the cognitive and the emotional sub-scores, respectively. Children of higher birth order receive lower home environment scores, with each parity increase associated with about a tenth of a standard deviation reduction in the HOME score, on average. Panel B shows the non-linear birth order effects. Compared to the first-born, home environment scores for the second-born children are lower by about 0.14 standard deviations and for the third-born children by about 0.13 standard deviations when controlling for maternal covariates and father figure presence and family income in column 3. As Panel C reports, there are no discernible age trends in birth order

[28] A detailed description of the items and its coding can be found at `https://www.nlsinfo.org/content/cohorts/nlsy79-children/other-documentation/codebook-supplement/appendix-home-sf-scales`. Accessed on October 1, 2013.

differences in the overall HOME score.[c1]

Examining the two sub-scores in columns 4 through 9, we find some interesting results. The bulk of the relation between birth order and overall home environment score can be attributed to differences in the level of cognitive stimulation at home (columns 4 through 6) rather than emotional support (columns 7 through 9). Children of higher birth order receive lower levels and quality of cognitive stimulation at home, with each parity being associated with about a 0.13 standard deviation decrease in the cognitive sub-score. Similar to the total HOME scores, Panel C reveals no age-trends in the level of cognitive stimulation at home from birth to adolescence. From age 0 to 14, latter-born children consistently receive lower levels of cognitive stimulation at home. In contrast, we do not find strong evidence of birth order differences in the quality of emotional support at home. When controlling for time-varying maternal covariates and the presence of father figure and family income in column 9, we find weak to no evidence that latter-born children receive worse emotional support from parents in the household at age from birth to adolescence.

These results on the quality of cognitive and emotional support at home are consistent with our findings on the negative relation between birth order and cognitive test scores and the absence of birth order effects in the overall non-cognitive except for those related to self-perceptions about scholastic abilities. While parents provide the same level of emotional support for all their children – what most would deem to be the most essential part of parenting – they appear to be unable to provide the same level of deliberate cognitive stimulation for their latter-born children. Examining individual items that make up the cognitive sub-score of the HOME score inventory at ages 0 to 5, we find that parents spend less time reading to their latter-born children, lower active provision of appropriate toys or activities for the child, and lower frequency of active teaching of basic concepts (numbers, alphabet, colors, shapes) at home.

[c1] Test for Birth Order (Age 0 to 2) = Birth Order (3 to 5) has a p-value of 0.23.

Table 6: Home Observational Measure of Environment Scores: Age 0 to 14

	HOME Score: Total			HOME: Cognitive			HOME: Emotional		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A:									
Birth Order	-0.111***	-0.113***	-0.091***	-0.136***	-0.136***	-0.127***	-0.049**	-0.050**	-0.022
	(0.019)	(0.019)	(0.019)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Panel B:									
2nd Born	-0.143***	-0.145***	-0.124***	-0.169***	-0.170***	-0.162***	-0.062***	-0.064***	-0.038*
	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.022)	(0.022)	(0.023)
3rd Born	-0.177***	-0.180***	-0.134***	-0.226***	-0.228***	-0.209***	-0.081*	-0.082*	-0.023
	(0.042)	(0.042)	(0.041)	(0.044)	(0.044)	(0.044)	(0.047)	(0.047)	(0.045)
4th Born	-0.242***	-0.244***	-0.174**	-0.308***	-0.309***	-0.280***	-0.105	-0.106	-0.012
	(0.073)	(0.074)	(0.070)	(0.078)	(0.078)	(0.078)	(0.084)	(0.085)	(0.080)
Panel C:									
Birth Order (Age 0 to 2)	-0.088***	-0.089***	-0.072***	-0.137***	-0.138***	-0.130***	-0.014	-0.015	0.008
	(0.028)	(0.028)	(0.027)	(0.030)	(0.030)	(0.030)	(0.033)	(0.033)	(0.032)
Birth Order (Age 3 to 5)	-0.122***	-0.123***	-0.100***	-0.133***	-0.134***	-0.125***	-0.072***	-0.073***	-0.043*
	(0.023)	(0.023)	(0.022)	(0.026)	(0.026)	(0.026)	(0.027)	(0.027)	(0.026)
Birth Order (Age 6 to 9)	-0.121***	-0.122***	-0.099***	-0.142***	-0.143***	-0.134***	-0.060***	-0.060***	-0.031
	(0.021)	(0.021)	(0.021)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.022)
Birth Order (Age 10 to 14)	-0.104***	-0.106***	-0.084***	-0.131***	-0.131***	-0.122***	-0.036	-0.037	-0.009
	(0.021)	(0.021)	(0.021)	(0.022)	(0.023)	(0.023)	(0.024)	(0.025)	(0.024)
N (# Children)	2632	2632	2632	2632	2632	2632	2632	2632	2632
Maternal Controls	N	Y	Y	N	Y	Y	N	Y	Y
Father Figure & Family Income	N	N	Y	N	N	Y	N	N	Y

Notes: All regressions are weighted and include family fixed effects. Standard errors clustered at the family level in parentheses. *10%,** 5%, ***1%. Sample restricted to children with complete prenatal input information and from non-twin families. All assessments are age-standardized scores that have been renormalized to have a mean of 0 and a standard deviation of 1. All specifications control for regional dummies, maternal age, gender of the child, age of the child at assessment, and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

Figure 4: Birth Order Effects in HOME Score: Total

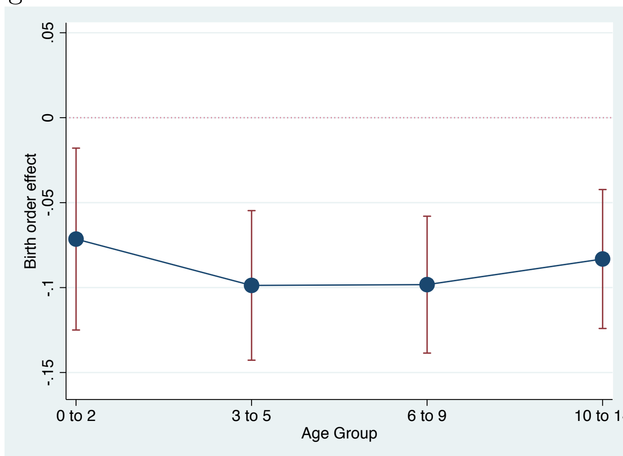


Figure 5: Birth Order Effects in HOME Score: Cognitive

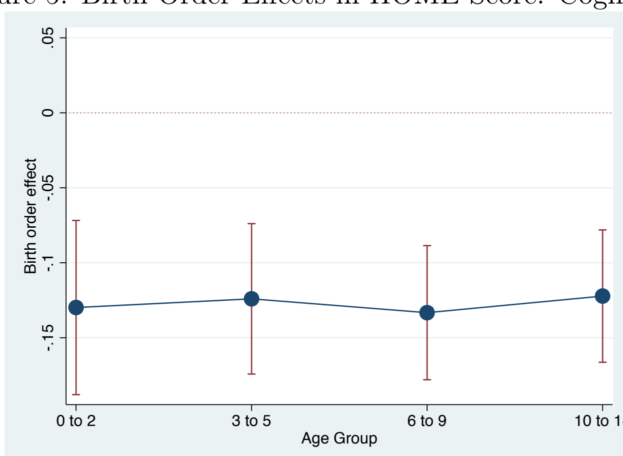
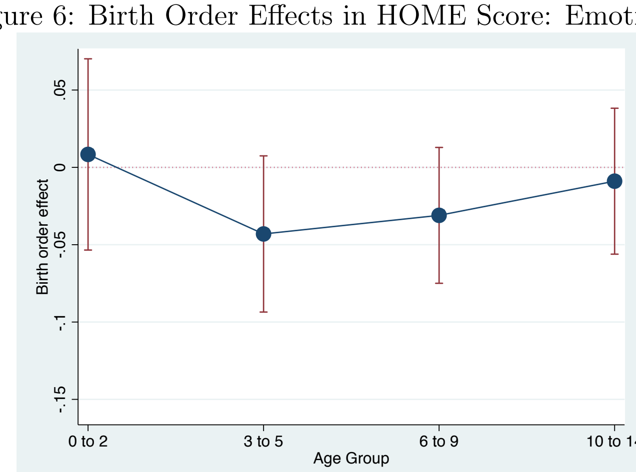


Figure 6: Birth Order Effects in HOME Score: Emotional



6 Early Inputs and Birth Order Differences in Cognitive Outcomes

In the last two sections, we have shown that 1) birth order differences in cognitive achievement start very early, even from early infancy, and 2) there are broad changes in parental behavior during pregnancy and in the early cognitive stimulation they provide at home. We now ask whether these early parenting differences as measured by home environment scores and early parental behaviors can explain a significant portion of cognitive outcome differences across siblings.

Following Todd and Wolpin (2007), we model the production of cognitive achievement in children as a cumulative process in which both the lagged and contemporaneous home inputs contribute to the acquisition of cognitive skills. Specifically, we estimate the following model where Y_{ifrca} is the cognitive test summary index observed for individual i in family f in region r in birth cohort c at age a:

$$\begin{aligned} Y_{ifrca} &= \sum_{g=1}^{G} \beta_g [\text{Birth Order} * 1 * (a \in \text{Age group}_g)]_{ifrca} + \gamma X_{ifrca} \\ &+ \delta_a Z_{ifrca} + \delta_{a-1} Z_{ifrca-1} + \delta_{a-2} Z_{ifrca-2} \\ &+ \kappa_a + \upsilon_f + \gamma_r + \xi_c + \varepsilon_{iafrc}. \end{aligned} \tag{4}$$

X_{ifrca} is the complete set of the time-varying covariates for which we control in Table 3 (specification in columns 3 and 6) which presents our results on birth order differences in cognitive outcomes: maternal age, education, and employment controls, age difference, presence of father figure, and birth and lifetime average family income. Z_{ifrca} are the home environment sub-scores (cognitive stimulation and emotional support) and $Z_{ifrca-1}$ and $Z_{ifrca-2}$ are the lagged sub-scores.[c0] As before, κ_a are child's age of assessment fixed effects, υ_f are family (mother) fixed effects, γ_r the regional fixed effects, and ξ_c the birth cohort fixed effects.

[c0]We limit our lag to two periods in order to keep the sample of children consistent with the estimating sample in Table 3. Because the CNLSY79 is administered bi-annually, the contemporaneous HOME scores and its two-period lags cover a period of about six years for a typical child in the sample. As we noted in the previous section, the HOME scores are missing for a large fraction of the children in our main estimating sample. We replace missing scores with zero and control for indicators of missing scores. Other imputation methods do not change our results.

Table 7: Inputs and Birth Order Differences in Cognitive Summary Index

	Cognitive Index (with Math)				Cognitive Index (without Math)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Birth Order	-0.137***	-0.138***	-0.130***	-0.091***	-0.167***	-0.169***	-0.160***	-0.134***
	(0.030)	(0.030)	(0.030)	(0.033)	(0.031)	(0.031)	(0.031)	(0.034)
Panel B:								
2nd Born	-0.166***	-0.171***	-0.157***	-0.103***	-0.195***	-0.202***	-0.187***	-0.146***
	(0.036)	(0.036)	(0.036)	(0.040)	(0.036)	(0.036)	(0.036)	(0.041)
3rd Born	-0.238***	-0.239***	-0.229***	-0.172**	-0.299***	-0.302***	-0.290***	-0.256***
	(0.064)	(0.064)	(0.064)	(0.069)	(0.066)	(0.067)	(0.066)	(0.073)
4th Born	-0.321***	-0.312***	-0.310***	-0.242**	-0.413***	-0.405***	-0.403***	-0.374***
	(0.103)	(0.102)	(0.104)	(0.116)	(0.104)	(0.104)	(0.105)	(0.119)
Panel C:								
Birth Order (Age 0 to 2)	-0.098**	-0.072*	-0.065	0.005	-0.117***	-0.090**	-0.082*	-0.037
	(0.041)	(0.044)	(0.043)	(0.093)	(0.041)	(0.043)	(0.043)	(0.091)
Birth Order (Age 3 to 4)	-0.143***	-0.140***	-0.132***	-0.071*	-0.155***	-0.152***	-0.143***	-0.089**
	(0.037)	(0.037)	(0.037)	(0.043)	(0.036)	(0.036)	(0.037)	(0.044)
Birth Order (Age 5 to 6)	-0.191***	-0.190***	-0.182***	-0.130***	-0.216***	-0.214***	-0.206***	-0.162***
	(0.034)	(0.034)	(0.034)	(0.039)	(0.035)	(0.035)	(0.035)	(0.039)
Birth Order (Age 7 to 10)	-0.124***	-0.125***	-0.117***	-0.077**	-0.165***	-0.166***	-0.158***	-0.127***
	(0.031)	(0.031)	(0.031)	(0.033)	(0.032)	(0.032)	(0.032)	(0.034)
Birth Order (Age 11 to 14)	-0.136***	-0.139***	-0.131***	-0.095***	-0.171***	-0.174***	-0.166***	-0.139***
	(0.032)	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)	(0.035)
Input Controls	None	Birth Outcomes	Pregnancy Maternal Behavior	Home Environment	None	Birth Outcomes	Prenatal Maternal Behavior	Home Environment
N (Children)	4850	4850	4850	4850	4850	4850	4850	4850

Notes: All regressions are weighted and include family fixed effects. Standard errors clustered at the family level in parentheses. *10%,** 5%, ***1%. Sample restricted to children with complete prenatal input information and from non-twin families. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent siblings, a series of dummies for year of birth, family income and mother's employment status year after birth (employed, unemployed, out of labor force, or in active force), mother's highest grade completed at the child's birth, and presence of father figure at birth and time of assessment.

Table 7 presents our results. Columns 1 and 5 repeat the estimates from Table 3 controlling for the full set of time-varying maternal controls, presence of father figure, and family income (columns 3 and 6). The remaining columns in Table 7 add controls for birth outcomes, maternal prenatal behavior and breastfeeding choices, and home environment scores and their two-period lagged scores, respectively. One can see in columns 2 and 6 that birth outcomes cannot explain birth order differences in early cognitive outcomes. This finding is not surprising given our results in Table 4 that showed latter-born children do not appear to be born disadvantaged developmentally compared to their older siblings. Similarly, controlling for variations in prenatal and early maternal behavior in columns 3 and 7 do not affect the size of the average birth order effects when pooled across all ages (Panel A). However, examining the time trends in Panel C, we find that controlling for early maternal behavior reduces the size of the birth order effect for zero to two year olds by about a third. Yet, these early behavior patterns as measured by smoking and alcohol usage during pregnancy, prenatal care, and breastfeeding choices do not have a significant impact on birth order effects after age two.

Finally, we ask whether systematic variations in home environment can explain a significant portion of early birth order differences in cognitive outcomes. Columns 4 and 8 show that controlling for home environment scores reduces the absolute size of birth order effects significantly. Home environment reduces birth order differences at ages 0 to 2 to zero and halves the point estimates of birth order effects for ages 3 to 4. The direct effect of the home environment is diminished by school entrance, however, even at ages 11 to 14, variations in the quality of the home environment can account for about a third of the birth order differences in cognitive outcomes. We hypothesize that the "true" effect of home environment at post-school entrance is larger when one accounts for the interaction of school inputs and the worse cognitive preparation with which latter-born children start school.

The existence of large and significant differences in early inputs and outcomes across children of varying birth order are particularly important in light of the research demonstrating that early life conditions have a significant impact on adult outcomes. Both theoretical and empirical studies on skill formation show that early childhood inputs, especially in the first five years of life, are critical in explaining later accumulation of human capital (Knudsen, Heckman, Cameron and Shonkoff 2006, Cunha and Heckman 2007, Heckman et al. 2006, Heckman and Masterov 2007). Results from these studies highlight the consequential nature of the early change in parental behavior that we find and buttress our finding that systematic variations in early home environment and parental behavior can explain a large portion of the birth order effects that we find. More generally, our results suggest that a plausible explanation for the the negation relation between birth order and cognitive and educational achievement is a broad change in parenting style and focus, especially with regard to the quality of cognitively enriching environment that parents can provide to their latter-born children relative to the first-born.

7 Conclusion

In this paper, we show that the negative relation between birth order and educational achievement starts very early, even in the cognitive outcomes measured in the first few years of life. These early birth order effects in cognitive achievement are sustained well after the children enter school. However, contrary to popular perception, non-cognitive outcomes and personalities do not appear to be systematically different across children of different birth order, with the exception of how they feel about their scholastic abilities. To our knowledge, our study is the first to paper to document the start and the evolution of birth order effects from birth to early adolescence across a wide range of cognitive and non-cognitive outcomes.

In an effort to explain these early differences in cognitive achievement, we first show that there are corresponding patterns of disparities in parental behavior and the home environment that parents provide to their children. Although latter-born children are not born disadvantaged in their health or developmentally, we find that parents are unable to provide them with the same level of cognitive support as they do with their first-born. We also find that there are systematic differences in maternal behavior during pregnancy and in the first year of life with regard to alcohol and tobacco consumption and the decision to breastfeed, indicating a broad shift in maternal attitudes and choices toward their latter-born children before parents have any child-quality signals to which they may respond. Variations in parenting styles and inputs as measured by home environment scores are able to explain most of the birth order differences in cognitive outcomes before school entrance about a third of the birth order effects after the children start school.

Taken together, our findings suggest that a plausible explanation for the negative relation between birth order and educational achievement is a broad shift in parenting style, especially with respect to parents' ability to foster early cognitive development. The significant variation in parental behavior during pregnancy and in the first few years of life, as well as the absence of any differences in the quality of emotional support, are consistent with the interpretation that parents are choosing to relax what they might deem as non-essential rearing practices for their latter-born children.

For most, it is probably not difficult to understand how and why one's parenting focus and abilities may change with his/her latter children. Lessons from past experiences as parents, and additional constraints on time, resources, and attention necessitate adjustments in their attitudes and updates to their beliefs about what may be possible to accomplish as parents. These broad shifts in parental behavior appear to set their latter-born children on a lower path for cognitive development and academic achievement, with lasting impact on adult outcomes.

A Appendix

Table A.1: Birth Order Differences in Difficult Temperament and Behavior Problem Index

	Higher Score Indicates Better Behavior							
	Difficult Temperament				Behavior Problem Index			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Birth Order	-0.078	-0.082	-0.081	-0.074	0.022	0.018	0.021	0.025
	(0.085)	(0.084)	(0.084)	(0.090)	(0.036)	(0.036)	(0.036)	(0.035)
Panel B:								
2nd Born	-0.170*	-0.173*	-0.171*	-0.130	-0.005	-0.010	-0.006	-0.001
	(0.090)	(0.089)	(0.089)	(0.094)	(0.041)	(0.040)	(0.040)	(0.040)
3rd Born	-0.005	-0.011	-0.007	-0.031	0.101	0.095	0.099	0.113
	(0.175)	(0.173)	(0.173)	(0.192)	(0.082)	(0.082)	(0.081)	(0.081)
4th Born	-0.024	-0.044	-0.041	-0.124	0.116	0.109	0.117	0.110
	(0.308)	(0.308)	(0.307)	(0.335)	(0.146)	(0.146)	(0.143)	(0.146)
Panel C:								
Birth Order (Age 0 to 2)	-0.078	-0.082	-0.081	-0.067				
	(0.085)	(0.084)	(0.084)	(0.092)				
Birth Order (Age 3 to 4)	-0.596***	-0.641***	-0.662***	-0.747***	0.130***	0.128***	0.132***	0.161***
	(0.163)	(0.171)	(0.172)	(0.177)	(0.049)	(0.049)	(0.049)	(0.052)
Birth Order (Age 5 to 6)					0.030	0.027	0.029	0.034
					(0.038)	(0.038)	(0.038)	(0.038)
Birth Order (Age 7 to 10)					0.011	0.008	0.011	0.012
					(0.037)	(0.037)	(0.037)	(0.037)
Birth Order (Age 11 to 14)					0.015	0.011	0.014	0.020
					(0.037)	(0.037)	(0.037)	(0.038)
N (Children)	2471	2471	2471	2471	4628	4628	4628	4628
Mother Controls	N	Y	Y	Y	N	Y	Y	Y
Father Figure & Family Income	N	N	Y	Y	N	N	Y	Y
Cognitive Index	N	N	N	Y	N	N	N	Y

Notes: All regressions are weighted and include mother fixed effects. Standard errors clustered at the mother-level are in parentheses. *10%,** 5%, ***1%. All assessments are age-standardized scores that have been renormalized to have a mean of 0 and a standard deviation of 1. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent sibling, age of the child at assessment, and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

Table A.2: Birth Order Differences in Self-Perception Profile: Scholastic Competence and Global Self-Worth (Ages 8 to 14)

	Scholastic Competence				Global Self-Worth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Birth Order	-0.240***	-0.238***	-0.234***	-0.189***	-0.097**	-0.095**	-0.102**	-0.089**
	(0.054)	(0.054)	(0.054)	(0.050)	(0.045)	(0.045)	(0.045)	(0.045)
Panel B:								
2nd Born	-0.289***	-0.286***	-0.283***	-0.235***	-0.140***	-0.137**	-0.141***	-0.129**
	(0.063)	(0.064)	(0.064)	(0.059)	(0.053)	(0.053)	(0.054)	(0.053)
3rd Born	-0.486***	-0.485***	-0.472***	-0.390***	-0.161	-0.157	-0.173*	-0.148
	(0.115)	(0.115)	(0.114)	(0.108)	(0.100)	(0.100)	(0.100)	(0.100)
4th Born	-0.385*	-0.388*	-0.367*	-0.243	-0.079	-0.081	-0.106	-0.065
	(0.200)	(0.199)	(0.198)	(0.190)	(0.188)	(0.188)	(0.189)	(0.189)
Panel C:								
Birth Order (8 to 10)	-0.254***	-0.253***	-0.249***	-0.211***	-0.155***	-0.152***	-0.158***	-0.141***
	(0.059)	(0.059)	(0.059)	(0.056)	(0.054)	(0.054)	(0.054)	(0.053)
Birth Order (11 to 14)	-0.233***	-0.232***	-0.227***	-0.192***	-0.073	-0.071	-0.077	-0.061
	(0.056)	(0.057)	(0.057)	(0.053)	(0.047)	(0.047)	(0.047)	(0.047)
N (Children)	3794	3794	3794	3794	3794	3794	3794	3794
Mother Controls	N	Y	Y	Y	N	Y	Y	Y
Father Figure & Family Income	N	N	Y	Y	N	N	Y	Y
Cognitive Index	N	N	N	Y	N	N	N	Y

Notes: All regressions are weighted and include mother fixed effects. Standard errors clustered at the mother-level are in parentheses. *10%,** 5%, ***1%. All assessments are age-standardized scores that have been renormalized to have a mean of 0 and a standard deviation of 1. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent sibling, age of the child at assessment, and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

Table A.3: Birth Order Differences in Pearlin and Rosgen Test Scores (Age 14 to 20)

	Pearlin			Rosgen		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Birth Order	0.085	0.079	0.071	-0.025	-0.032	-0.046
	(0.069)	(0.069)	(0.068)	(0.078)	(0.078)	(0.077)
Panel B:						
2nd Born	0.080	0.073	0.065	-0.026	-0.031	-0.045
	(0.080)	(0.082)	(0.081)	(0.088)	(0.090)	(0.089)
3rd Born	0.152	0.147	0.126	-0.112	-0.122	-0.155
	(0.142)	(0.143)	(0.141)	(0.151)	(0.152)	(0.149)
4th Born	0.321	0.300	0.278	0.029	-0.004	-0.046
	(0.235)	(0.240)	(0.239)	(0.266)	(0.269)	(0.264)
Panel C:						
Birth Order (Age 14 to 16)	0.115	0.110	0.101	-0.007	-0.013	-0.028
	(0.070)	(0.071)	(0.070)	(0.078)	(0.078)	(0.077)
Birth Order (Age 17 to 20)	0.011	0.004	-0.003	-0.070	-0.077	-0.089
	(0.081)	(0.081)	(0.081)	(0.090)	(0.091)	(0.090)
N (Children)	3215	3215	3215	3215	3215	3215
Mother Controls	N	Y	Y	N	Y	Y
Father Figure & Family Income	N	N	Y	N	N	Y

Notes: All regressions are weighted and include mother fixed effects. Standard errors clustered at the mother-level are in parentheses. *10%,** 5%, ***1%. All assessments are age-standardized scores that have been renormalized to have a mean of 0 and a standard deviation of 1. All specifications control for regional dummies, maternal age, gender of the child, age difference with oldest and precedent sibling, age of the child at assessment, and a series of dummies for year of birth. Mother controls include family income and employment status year after birth (employed, unemployed, out of labor force, or in active force) and highest grade completed at the child's birth.

Table A.4: Birth Outcomes in the 5% Random Sample of the National Vital Statistics

	Gestational Length (weeks)	Born Premature	Birth Weight (grams)	Low Birth Weight ($\leq$ 2,500 g)	Overweight at Birth ($\geq$ 4,000 g)	5-Minute Apgar Score (0 to 10)
	(1)	(2)	(3)	(4)	(5)	(6)
2nd Born	0.007	-0.016***	122.493***	-0.027***	0.038***	0.079***
	(0.005)	(0.001)	(1.090)	(0.000)	(0.001)	(0.002)
3rd Born	0.009	-0.013***	148.077***	-0.030***	0.051***	0.095***
	(0.006)	(0.001)	(1.423)	(0.001)	(0.001)	(0.002)
4th Born	0.004	-0.005***	162.636***	-0.030***	0.061***	0.102***
	(0.009)	(0.001)	(2.192)	(0.001)	(0.001)	(0.003)
5th Born	0.024	-0.004	179.267***	-0.029***	0.075***	0.104***
	(0.016)	(0.002)	(3.670)	(0.001)	(0.002)	(0.005)
6th Born	0.062**	-0.005	197.946***	-0.027***	0.089***	0.101***
	(0.026)	(0.004)	(5.975)	(0.002)	(0.004)	(0.008)
7th Born	0.151***	-0.003	242.206***	-0.035***	0.108***	0.120***
	(0.039)	(0.006)	(8.752)	(0.003)	(0.005)	(0.012)
8th Born	0.278***	-0.029***	274.696***	-0.046***	0.119***	0.114***
	(0.052)	(0.008)	(12.600)	(0.005)	(0.008)	(0.019)
9th Born	0.117	-0.017	284.213***	-0.036***	0.119***	0.090***
	(0.084)	(0.012)	(19.492)	(0.007)	(0.011)	(0.029)
10th Born	0.008	-0.009*	131.173***	-0.021***	0.061***	0.083***
	(0.034)	(0.005)	(8.089)	(0.003)	(0.005)	(0.013)
N	1,422,544	1,422,544	1,423,666	1,423,666	1,423,666	1,297,506
F-stat	187.255	137.470	828.359	154.475	315.736	154.591
R^2	0.030	0.019	0.104	0.029	0.041	0.025

Notes: Sample restricted to children who were not part of multiple births, to mothers between the ages 14 to 45 and fathers between ages 14 to 60 at the time of the child's birth. All regressions control for mother and father's race, education, marital status, age at birth, and maternal weight gain during pregnancy and its squared, type of delivery (vaginal or caesarean), population size in the metropolitan area, and birth year, month, state, and resident status fixed effects. *10%,** 5%, ***1%.

Table A.5: Maternal Behavior during Pregnancy in the 5% Random Sample of the National Vital Statistics

	Smoked During Pregnancy	Number of Cigarettes (per day)	Number of Alcoholic Drinks (per week)	Used Alcohol During Pregnancy	Month of 1st Prenatal Visit	Belated Prenatal Visit ($\geq$ 4th month)
	(1)	(2)	(3)	(4)	(5)	(6)
2nd Born	0.024***	0.363***	-0.004***	-0.000	0.115***	0.030***
	(0.001)	(0.009)	(0.001)	(0.000)	(0.002)	(0.001)
3rd Born	0.041***	0.662***	0.003*	0.001***	0.273***	0.066***
	(0.001)	(0.013)	(0.002)	(0.000)	(0.003)	(0.001)
4th Born	0.051***	0.880***	0.009***	0.002***	0.447***	0.112***
	(0.001)	(0.023)	(0.003)	(0.001)	(0.006)	(0.002)
5th Born	0.056***	0.901***	0.008	0.001	0.627***	0.158***
	(0.002)	(0.040)	(0.006)	(0.001)	(0.010)	(0.003)
6th Born	0.047***	0.895***	0.036**	0.004**	0.798***	0.198***
	(0.004)	(0.067)	(0.017)	(0.002)	(0.018)	(0.004)
7th Born	0.015***	0.385***	0.019	0.003	0.990***	0.255***
	(0.005)	(0.093)	(0.013)	(0.002)	(0.029)	(0.007)
8th Born	0.001	0.255*	0.061**	0.004	1.110***	0.281***
	(0.007)	(0.133)	(0.028)	(0.004)	(0.042)	(0.010)
9th Born	-0.020*	-0.149	0.001	0.005	1.304***	0.342***
	(0.011)	(0.190)	(0.015)	(0.005)	(0.061)	(0.015)
10th Born	-0.007*	-0.076	0.000	0.002	0.524***	0.138***
	(0.004)	(0.060)	(0.007)	(0.002)	(0.026)	(0.006)
N	1,330,746	1,320,711	1,382,631	1,388,698	1,405,740	1,405,740
F-stat	850.349	565.297	16.563	62.795	781.536	660.153
R^2	0.116	0.100	0.003	0.014	0.110	0.095

Notes: Sample restricted to children who were not part of multiple births, to mothers between the ages 14 to 45 and fathers between ages 14 to 60 at the time of the child's birth. All regressions control for mother and father's race, education, marital status, age at birth, and maternal weight gain during pregnancy and its squared, type of delivery (vaginal or caesarean), population size in the metropolitan area, and birth year, month, state, and resident status fixed effects. *10%,** 5%, ***1%.

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