BORN TO LEAD? THE EFFECT OF BIRTH ORDER ON NONCOGNITIVE ABILITIES

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Abstract—We study the effect of birth order on personality using Swedish population data. Earlier-born men are more emotionally stable, persistent, socially outgoing, willing to assume responsibility, and able to take initiative than later borns. Firstborn children are more likely to be managers and to be in occupations requiring leadership ability, social ability, and Big Five personality traits. We find a significant role for the sex composition within the family. When investigating possible mechanisms, we find that negative effects of birth order are driven by postnatal environmental factors. We also find evidence of lower parental human capital investments in later-born children.

I. Introduction

WHAT are the origins of personality? Are some people born leaders, while others are followers? Research has shown that personality—for example, leadership abilities or motivation—matters greatly for life success (see, e.g., Lindqvist & Vestman 2011; Heckman, Stixrud, & Urzua, 2006; Heckman & Rubinstein, 2001; Borghans et al., 2008; Bowles, Gintis, & Osborne 2001). While evidence shows that the family is important in the formation of personalities (Plomin & Daniels, 1987; Plomin, 2011; Grönqvist, Öckert, & Vlachos, 2016; Björklund & Jäntti, 2012; Anger, 2012), there are still large differences among children from the same family, with at least a third of the total variation being within family. The question then becomes: Where do these within-family differences come from? Is there a role for birth order in the formation of personalities?

As early as 1927 with the work of Alfred Adler, psychologists have hypothesized that at least some of these personality differences are systematically related to birth order, with the oldest child developing a taste for power.[1] Since that time, there has been much work on the topic, with a recent focus on evolutionary theory as the dominant explanation for birth order differences in personality (Sulloway, 1996). Siblings are thought to strategically compete for limited parental resources, and do so by differentiating themselves by filling different niches within the family. The firstborn is believed to be more responsible and focused on pleasing the parents, thus acting as a role model for the later-born children, while later-born children need to be more innovative in filling a family niche and are hypothesized to become more easygoing and sociable.[2]

To date, however, there is little conclusive evidence on this relationship. This is likely due to the stringent data requirements for estimating the relationship between birth order and personality. Later-born children exist only in larger families, and to the extent that parents who choose to have larger families are inherently different, calculating a simple correlation between birth order and measures of personality without conditioning on family size would spuriously attribute these differences to birth order. In addition, mothers tend to be older when they have later-born children, so estimates that do not control for mother's age might mistakenly attribute that effect to birth order. And later-born children are born in more recent cohorts than their siblings, so to the extent that there are trends in outcomes over time, estimation strategies that do not adequately control for cohort effects might again mistakenly attribute these trends to birth order. As a result, estimating the relationship between birth order and personality characteristics requires large data sets in order to control for all possible confounders.[3]

Recent research on the relationship between birth order and other child outcomes has been able to address these issues using administrative data sets that have become available. These studies have documented that firstborns have higher educational attainment and earnings, have a higher IQ, and are likely to be healthier (see, e.g., Barclay, 2015; Black, Devereux, & Salvanes 2005, 2011, 2016; Kristensen & Bjerkedal, 2007; Kantarevic & Mechoulan, 2006; Booth & Kee, 2008; Bu, 2014). However, there is little convincing evidence on the effect of birth order on personality.[4] This is

Received for publication June 6, 2016. Revision accepted for publication February 22, 2017. Editor: Brigitte C. Madrian.

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We have benefited from comments and suggestions from Helena Holmlund, Edwin Leuven, Stefan Schmukle, Frank Sulloway, Helena Svaleryd, participants at SOLE 2016 and Society for Institutional & Organizational Economics 2016, and at seminars at the Institute for Evaluation of Labour Market and Education Policy, University of Oslo, Stockholm University, and Linneaus University.

A supplemental appendix is available online at http://www.mitpressjournals.org/doi/suppl/10.1162/rest_a_00690.

[1] Alder's hypothesis was that the oldest child develops a taste for power but suffers from the dethronement at the arrival of siblings; the youngest is pampered with lack of independence and social empathy; the middle child is ambitious and competitive (Adler, 1927, 1928).

[2] Sulloway (1995, 1996) hypothesizes that firstborns rate higher than later borns in conscientiousness, neuroticism, and the dominance aspect of extraversion and lower on agreeableness, openness, and the sociability facet of extraversion.

[3] The previous psychological literature is mainly based on small data sets; see Black, Grönqvist, and Öckert (2017), fn. 6.

[4] There are some notable exceptions in the psychology and economics literature. A few studies use large data sets and a between-family strategy, but these studies are based on only one or a few cohorts (see Rohrer, Egloff, & Schmukle 2015; Damian & Roberts, 2015; Grinberg, 2015; Averett, Argys, & Rees 2011; Silles, 2010; Argys et al., 2006). By implicitly conditioning on cohort, they introduce a potential bias since children with different birth order who are born the same year also have mothers who are either born in different years, initiated their fertility at different ages, or have different spacing. Other studies use a within-family strategy but with smaller samples (see Rohrer, Egloff, & Schmukle, 2015; Lehmann, Nuevo-Chiquero, & Vidal-Fernandez, 2018). These studies do not find any birth order effects. Sulloway (1999, 2001) uses a within-family strategy with survey data and finds birth order effects on the big five domains of personality, but the sample is nonrepresentative, and with only one respondent per family rating themselves as well as their closest sibling's personalities, the result may capture contrast effects and stereotype bias. Breining et al. (2017) find birth order effects for delinquency using register data and a within-family strategy. See section III for a methodological discussion.

The Review of Economics and Statistics, May 2018, 100(2): 274–286
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doi:10.1162/rest_a_00690

primarily due to the difficulty in obtaining measures of an individual's personality in a large representative data set.

To address this issue, we use data on the population of men in Sweden, where personality is measured in an evaluation by a certified psychologist conducted on enlistment in the military, as well as revealed by occupational sorting. In the economics literature, personality traits are often referred to as *noncognitive abilities* and denote traits that can be distinguished from intelligence (Borghans et al., 2008). Even if cognitive abilities and personality traits can be unrelated from a theoretical perspective, empirical measures of cognitive abilities and personality traits are likely correlated. However, we are able to address this by controlling for measures of cognitive ability as well.

This is the first study using representative population data from multiple cohorts on objective measures of personality assessed at the same age and exploiting within-family variation in birth order to account for confounders (e.g., socioeconomic). We also examine the underlying causes of the relationships we observe. More generally, this paper relates to the literature on how malleable noncognitive abilities are to influences in childhood and adolescence.[5] In addition, we propose an alternative, less data-demanding estimator that yields the same results as a family fixed-effects model.

We find that firstborn children are advantaged on noncognitive dimensions capturing emotional stability, persistence, social outgoingness, willingness to assume responsibility, and ability to take initiative, and these conclusions are robust to the inclusion of family fixed effects. Third-born children have noncognitive abilities that are 0.2 standard deviations below firstborn children. Importantly, we also demonstrate that occupational sorting is systematically related to birth order. Firstborn children are almost 30% more likely to be top managers compared to third-borns, and managerial positions tend to require higher noncognitive abilities. We also find that firstborn children are more likely to be employed in occupations requiring all big five domains of personality: openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability. Later-born children are more likely to be self-employed.

We are also able to examine how birth order interacts with sibling sex composition. Interestingly, we find that birth order patterns vary depending on the sex composition of the older children: effect sizes are exacerbated when the later-born son has older brothers relative to older sisters.

There are a number of possible explanations as to why birth order may be related to noncognitive abilities. There could be biological reasons: as the mother has more children, her womb becomes more effective at nurturing the fetus (Khong, Adema, & Erwich, 2003), or successive children may be hypomasculinized by maternal immunization to the H-Y antigen (Beer & Horn 2000).

Beyond biology, parents could have other influences. Childhood inputs, especially in the first years of life, are considered crucial for skill formation (Cunha & Heckman 2007; Heckman et al., 2006). Firstborn children have the full attention of parents, but as families grow, the family environment is diluted and parental resources become scarcer (Zajonc, 1976; Zajonc & Marcus, 1975; Price, 2008). In contrast, parents are more experienced and tend to have higher incomes when raising later-born children. In addition, for a given amount of resources, parents may treat firstborn children differently from second- or later-born children.[6] Parents may have incentives for stricter parenting practices toward the firstborn so as to gain a reputation for toughness necessary to induce effort among later-born children (Hotz & Pantano, 2015).

Children may also act strategically in competing for parental resources. Rivalry and conflict are common features of sibling dynamics (Furman & Buhrmester, 1985; Dunn, 1993; Shantz & Hartup, 1992), where such conflicts, at least in early childhood, tend to center around possession, personal property, and access to the mother (Dunn & Munn, 1987). Older siblings take a more dominant role in such conflicts and engage in more elaborate conflict strategies (Howe et al., 2002; Phinney, 1986). In this context, Havnes (2010) proposes an economic model where conflict between siblings causes parents to optimally invest more in the dominant, older sibling. Sulloway (1996) offers a similar argument for birth order effects, based on evolutionary psychology, suggesting that firstborns have an advantage in following the status quo, while later borns, by having incentives to engage in investments aimed at differentiating themselves, become more sociable and unconventional in order to attract parental resources. This also implies that the peer environment that each child grows up in is different: firstborn children have no role models aside from parents but may themselves act as role models, while later-born children can learn from their older siblings.

Even if we are unable to disentangle many of these possible mechanisms, we do attempt to understand the differential roles of family environment and biology. Taking advantage of the distinction between social and biological birth order induced by adoption or the death of older siblings combined with the richness of our data set, we first show that the negative birth order patterns we observe are driven by postnatal environmental differences. In fact, we find that biological factors tend to favor later-born children. We then augment our data with a survey of children at age 13 and their parents to identify differences in children's study behavior and parental investments. We find that later-born children spend substantially less time on homework and more time watching TV. Interestingly, parents are less

[5] This literature has focused on the acquisition of skills in childhood (Cunha et al., 2006; Cunha & Heckman, 2007, 2008; Fredriksson, Öckert, & Oosterbeek 2013) and adolescence (Grönqvist & Lindqvist, 2016) or used data on twins or adoptees to separate nature and nurture in the transmission of noncognitive abilities (Cesarini, 2009; Grönqvist et al., 2017).

[6] See Becker and Tomes (1976) and Yi et al. (2015) for discussions on how parents differentiate resources across children.

likely to discuss schoolwork with later-born children, suggesting that lower parental investment and attention may be one driving force behind the negative birth order effects.

The paper unfolds as follows. Section II describes the data we are using. Sections III and IV describe our estimation strategy and present our main results, along with heterogeneous effects by sex composition. Section V discusses possible mechanisms, including biological differences and parental time investment. Section VI concludes.

II. Data

To analyze the impact of birth order on personality and occupational choice, we combine information from a variety of Swedish data registers. We begin with the Swedish population register compiled by Statistics Sweden that includes all individuals born in Sweden since 1932. The population register contains information on birth year, a link to biological (and adoptive) parents, and a link to biological (and adoptive) siblings. We use this information to define birth order on the maternal side.

The population register is combined with military enlistment data from the Swedish War Archive. Until 2010, all Swedish men were required by law to enlist in the military. The enlistment consists of a series of physical, psychological, and intellectual tests and evaluations. In most cases, the enlistment took place the year a man turned 18. In our sample, over 85% percent of all men in each cohort are represented; only the physically and mentally disabled were exempted.[7] These data are available for Swedish male citizens born between 1952 and 1982. From these data, we extract information on noncognitive and cognitive abilities. These abilities have been shown to be highly correlated with later outcomes such as employment and earnings.[8]

We also incorporate information on employment and occupation. Annual data on employment and self-employment are available from 1985 to 2009 from Statistics Sweden. Employment is measured during a specific week in November and defined in accordance with ILO's employment definition of at least one hour of paid work during the measurement week. Self-employment is defined according to occupational status at the workplace where an individual receives the highest income in November.[9] We use the information at age 45; if employment and self-employment are not observed at age 45, we take the observation closest to age 45.

Occupation data are available for 1996 to 2009 and include individuals between the ages of 16 and 74 who are in the labor market. This data set covers the population of public sector workers and approximately 50% of workers in the private sector. In particular, the private sector data cover all firms with more than 500 employees and a stratified random sample of smaller firms by industry. In most cases, the information is provided by the employers' organizations (including employers in the public sector) as part of an agreement between unions and the employer organizations. Firms not covered by this agreement are surveyed by Statistics Sweden. To make the most of the occupational data, we take the five observations closest to age 45 but restrict the window to ages 35 to 55. We then calculate the average of each individual's yearly observations, weighted by the inverse of the sampling probability.

A. *Outcome Variable: Noncognitive Abilities*

Our measure of noncognitive abilities is based on a standardized psychological evaluation aimed at determining the conscripts' capacity to fulfill the requirements of military duty and armed combat. Central to this are the abilities to cope with stress and to contribute to group cohesion. The evaluation is performed by a certified psychologist, who conducts a 20- to 30-minute interview with the conscript.[10] The interview follows a specific, and confidential, manual that states topics to discuss and also how to grade different answers. A conscript is given a high score if he is considered to be emotionally stable, persistent, socially outgoing, willing to assume responsibility, and able to take initiative. The noncognitive abilities are graded by the psychologist in four subscores measured on a 1 to 5 scale, which are transformed to an overall measure of noncognitive abilities on a 1 to 9 (stanine) scale. In the analysis, we use the full interaction of the four submeasures standardized by year.

The conscript's cognitive ability is also evaluated. This consists of several subtests of logical, verbal, and spatial abilities, as well as a test of technical comprehension. The cognitive tests are speeded multiple-choice tests[11] and were

[7] The consequences of refusing military service included up to one year in prison (SFS, 1994:1809). Importantly, the probability of having valid enlistment records is unrelated to birth order in our main (family fixed) effects specification.

[8] Lindqvist and Vestman (2011) show that noncognitive ability is a stronger predictor of unemployment, having low annual earnings, as well as having a managerial position, than cognitive ability, while cognitive ability is a stronger predictor for higher earnings. Furthermore, Grönqvist et al. (2017) find that both parents' cognitive and noncognitive abilities are strongly related to the educational and labor market outcomes of their offspring. In particular, parental cognitive abilities are more important for schooling outcomes, while parental noncognitive abilities are particularly important for labor force participation.

[9] Income from self-employment is scaled up by a factor 1.6 to account for underreporting of income from business; for details, see Statistics Sweden (2009).

[10] As a basis for the interview, the psychologist has information about the conscript's results on the tests of cognitive ability, physical endurance, and muscular strength, as well as grades from school and the answers from a questionnaire on friends, family, and hobbies, but the questionnaire does not ask for birth order. The former chief psychologist at the Swedish National Service Administration, Johan Lothigius, who constructed and oversaw the implementation of the instrument, states (telephone interview February 16, 2016) that while relationships with parents and friends were covered in the interview, there was no focus on the relationships with siblings or birth order. It is highly unlikely that the psychologist knew the birth order of the draftee.

[11] The logic test contains verbally formulated instructions as to which answer the test taker should mark, created to test logical reasoning. The verbal test asks for the synonym of a given word out of four alternatives. The spatial test asks for the three-dimensional object that corresponds to a two-dimensional unfolded piece of paper. Finally, the technical test consists of illustrated technical and physical problems. See Carlsson et al. (2015) for an example of the test questions.

subject to minor revisions in 1980, 1994, and 2000. The raw test scores on these four subtests are combined to a discrete variable of general cognitive ability on a 1 to 9 (stanine) scale, which has been found to be a good measure of general intelligence (Carlstedt, 2000). We use the sum of the four subscores, standardized by enlistment year, as a measure of cognitive ability.

B. *Outcome Variable: Occupation*

We also use occupation as an additional measure of personality independent from the measurement at enlistment. While both cognitive and noncognitive abilities determine occupational choice, research shows that noncognitive abilities can be more important for having a managerial position (Lindqvist & Vestman, 2011).

We first break occupations into a number of broad categories that are generally associated with particular personality characteristics and then relate birth order to the likelihood of being in one of these occupations. At the broadest level, occupations are divided into ten groups. One such group is classified as managerial work, and we define managers as individuals belonging to this group.[12] This category contains a broad range of managerial positions, from top-level managers to middle- and lower-level management. We then characterize top managers in the private and public sector using three-digit codes that include directors and chief executives (ISCO 121) and legislators and senior government officials (ISCO 111). About 8% of the individuals in our population are managers and 0.6% are top managers. We contrast managers to creative occupations since the psychological literature suggests that later borns are more creative and open to experience (Sulloway, 1995, 1996). Using the four-digit level occupational codes, we define architects, writers, painters, musicians, and actors, among others, as creative occupations.[13] In our data, we see that individuals who are managers have substantially higher cognitive and noncognitive abilities than nonmanagers, and there is a marked difference in noncognitive abilities between individuals in managerial positions and creative occupations (see appendix table A1).

We also use detailed information on skill requirements and abilities of incumbents in specific occupations, using the Occupational Information Network (O*NET) to create measures of personality based on the importance of particular personality characteristics in the daily functioning of jobs. In particular, we construct variables capturing the importance of social abilities and leadership abilities in performing the tasks required in occupations. We also categorize the personal attributes into the big five domains of personality: conscientiousness, agreeableness, emotional stability, extraversion, and openness. (See appendix C for details.)

C. *Outcome Variable: Parental Investments*

We examine parental investment behavior using self-reported data on human capital investments at age 13 from the Evaluation-Through-Follow-up (ETF) study in which children are surveyed about their effort outside school and parents are asked about their investments in their children.[14] The ETF data consist of 10% stratified samples of the cohorts born in 1967, 1972, 1982, 1987, and 1992 and a 5% stratified sample of the cohort born in 1977.

D. *Analysis Sample*

In order to observe completed family size, we consider children whose mother was born between 1917 and 1964. We restrict attention to families with at least two children and at most five children.[15] We also exclude all families with twins, as twinning confounds birth order designations. Because we only have military enlistment data for men, our main analyses focus on them. In analyses of noncognitive abilities from military enlistment, we retain individuals from our underlying population with a valid enlistment record. Moreover, since we want to use the within-family variation, we also restrict attention to families with at least two sons. In total, we observe 564,789 boys from 260,807 families.[16] When we consider occupations, we again limit our sample to individuals for whom we observe a valid occupation for at least two sons in the same family.[17]

In the birth order analyses on human capital investments at age 13, we retain boys and girls with data from the ETF survey. In total, we observe 36,799 individuals (in the analyses, the number of observations varies between 11,833 and 32,639, as some questions are not asked for all cohorts and there are some missing data).

[12] The occupation data are coded according to the Swedish modification of the International Standard for Classifications of Occupations 1988 (ISCO88); at the three-digit level, the Swedish occupational codes are more or less identical to ISCO88.

[13] The creative occupations comprise the following ISCO88 codes: architects, town and traffic planners (2141), writers and creative or performing artists (245), photographers (3131), image and sound recording equipment operators (3132), decorators and commercial designers (3471), radio, television, and other announcers (3472), street, nightclub, and related musicians, singers, and dancers (3473), clowns, magicians, acrobats, and related professionals (3474), and fashion and other models (5210).

[14] The survey is run by the Department of Education at the University of Gothenburg; see Härnquist (2000) for a description of the data. For some of the cohorts, a few of the questions that we use were answered not at age 13 but at age 10 or 16. In these cases, we use this alternative information.

[15] We lose about 3% of the families by including only families with fewer than six children.

[16] Appendix table A2 compares mean values for the full population of males to those of our analysis sample.

[17] The cognitive abilities and personality traits measured at enlistment or as manifested in occupational choice are strongly and independently related to midlife wages; see appendix table A3. In appendix table A4a–b, we also report the correlation between the noncognitive and cognitive ability scores and the different measures of personality traits.

TABLE 1.—DESCRIPTIVE STATISTICS: MAIN DATA

	Full Sample	First Child	Second Child	Third Child	Fourth Child	Fifth Child
Outcome variable						
Noncognitive ability	0.032	0.124	0.035	−0.065	−0.190	−0.302
	(0.989)	(0.978)	(0.983)	(0.996)	(0.994)	(0.994)
Background variables						
Family size	2.974	2.708	2.748	3.430	4.265	5.000
	(0.897)	(0.799)	(0.815)	(0.639)	(0.441)	(0.000)
Age, 2010	43.387	45.268	42.444	41.904	42.645	42.642
	(7.853)	(7.460)	(7.985)	(7.827)	(7.427)	(6.661)
Mother's age at first birth	23.180	23.511	23.457	22.522	21.776	21.243
	(3.898)	(3.967)	(3.956)	(3.610)	(3.371)	(3.160)
Mother's years of schooling	10.064	10.303	10.191	9.756	9.039	8.460
	(2.720)	(2.717)	(2.719)	(2.698)	(2.480)	(2.147)
Observations	564,788	205,619	215,913	103,845	31,851	7,560

The table presents mean values for the full sample and birth order. Standard deviations are within parentheses. The sample is restricted to men in families with at least two boys born between 1952 and 1982 with valid draft records. Noncognitive abilities are measured at approximately age 18 and standardized by year of draft in the full sample of draftees. Family size is the number of children to whom the mother has given birth. Mother's years of schooling are measured at age 45.

Table 1 presents summary statistics for our main data (in appendix tables A5 and A6, we report descriptive statistics for the employment and occupation data and the ETF data). Column 1 shows the means for the full sample and columns 2 to 6 break them down by birth order. For most outcomes, there is a clear pattern by birth order, for example, that later-borns have lower noncognitive ability. However, these simple descriptive statistics can be misleading. When one looks at background variables by birth order, one sees the same patterns: characteristics such as mother's education and mother's age at first birth are declining with birth order and average family size is increasing, which suggests the need for a more rigorous analysis.

III. Empirical Strategy

It may be conceptually hard to think about causal effects of birth order, since the birth order of siblings cannot easily be manipulated. The hypothetical experiment we have in mind, however, is to randomly assign the order in which two fertilized eggs are placed in a woman's womb. Although this thought experiment is more or less infeasible, with the possible exception of IVF treatments, it makes clear that birth order effects should capture any difference in prenatal or postnatal environment between siblings but hold the genetic makeup constant. As it turns out, nature provides a close-to-ideal experiment for studying birth order effects. At conception, each child receives a random half of each parent's genes, which makes them share on average half their genes. Thus, the genetic makeup is not expected to differ systematically between siblings in general or by birth order in particular. The effect of birth order can thus be identified by simply comparing the personalities of siblings within the same family.

In practice, most studies of birth order estimate versions of the following parsimonious model for individual i in family j:

$$\begin{aligned} Y_{ij} = \alpha + \sum_{k=2}^{5} \beta_k I\big(BO_{ij} = k\big) + \sum_{l=3}^{5} \gamma_l I\big(FSIZE_j = l\big) \\ + \sum_{m=2}^{M} \delta_m I\big(YOB_{ij} = m\big) + \sum_{n=2}^{N} \theta_n I\big(MYOB_j = n\big) \\ + \sum_{o=2}^{O} \pi_o I\big(MAGE_j = o\big) + \tau X_j + \varepsilon_{ij}, \qquad (1) \end{aligned}$$

where Y_{ij} is a measure of noncognitive abilities, BO_{ij} is birth order (the omitted category is firstborn child), $FSIZE_j$ is family size, YOB_{ij} is the child's year of birth, $MYOB_j$ is mother's year of birth, $MAGE_j$ is mother's age at first birth, and X_j is a vector with family background variables.

The family size controls address the fact that later-born children are more likely to be observed in larger families and that outcomes of children may differ by family size. When data include all siblings in a family, any time-invariant family characteristic (e.g., mother's year of birth and mother's education) is balanced by birth order once family size is controlled for.[18] More generally, family background for a given sibship size is expected to be balanced by birth order in random samples of the population. In studies based on nonrepresentative samples, conditioning on family size does not, per se, break the correlation between birth order and family background.

With representative data, it is sufficient to control for family size to estimate the reduced-form effects of birth order. But in order to get a more structural interpretation of the estimates, many studies on birth order also control for the child's year of birth (or age). This is because children with a higher birth order come from more recent cohorts,

[18] To see this, assume there are 1,000 families with two children. Then the 1,000 firstborn children will on average have the same parental background as the 1,000 second-born children since they all come from the same 1,000 families.

and the birth order estimates may therefore pick up cohort trends in noncognitive abilities.[19] An unintended consequence of adding these controls is that it introduces imbalances in family background by birth order. This is because children of higher parity, who are born the same year as children with lower birth order, on average, have mothers who are born earlier, started to have children at a younger age, and have shorter child spacing. This tends to bias the estimates downward.[20]

It is common that studies also condition on the mother's year of birth, which both accounts for cohort differences in mothers' socioeconomic status and mother's age at a child's birth. But this may exacerbate the negative bias. In addition, some studies control for mother's age at first birth to account for the correlation between birth order and early childbearing. Much of the remaining between-family variation in birth order then comes from differences in child spacing. To the extent that spacing between children is related to unobserved family characteristics, the estimates of birth order may still be biased. In an attempt to reduce any remaining bias, most studies on birth order add socioeconomic controls.

In our main specification, we include family fixed effects, thereby differencing out any time-invariant characteristics within a family. This will eliminate any remaining association between birth order and family background. Formally we estimate the following model,

$$Y_{ij} = \alpha' + \sum_{k=2}^{5} \beta'_k I\big(BO_{ij} = k\big) + \sum_{l=2}^{L} \gamma'_l I\big(YOB_{ij} = 1\big) + \lambda_j + \varepsilon'_{ij}, \tag{2}$$

where λ_j is a family fixed effect. We are thus comparing siblings within the same family to estimate our birth order effects. Note that we are still including indicators for children's year of birth, although family size, mother's year of birth, mother's age at first birth, and mother's education drop out.

Estimating family fixed effects is not feasible in many data-sets, since it requires repeated observations of siblings from the same family along with a family identifier. We therefore propose a third, less data-demanding, specification that yields the same results as the family fixed effects. The defining characteristic of the family fixed-effects estimator is that it exploits only the variation in birth order within families of the same type. In particular, it compares differences in outcomes by birth order in families of the same size and with children born in specific years. This can, however, also be obtained by adding fixed effects for all combinations of family size and sibling's year of birth. Formally, we would estimate the following family-type fixed-effects model,

$$\begin{aligned} Y_{ij} = {} & \alpha'' + \sum_{k=2}^{5} \beta''_k I\big(BO_{ij} = k\big) + \sum_{l=2}^{L} \gamma''_l I\big(YOB_{ij} = 1\big) \\ & + \sum_{m=2}^{M}\sum_{n=2}^{N}\sum_{o=2}^{O}\sum_{p=2}^{P}\sum_{q=2}^{Q} \kappa_{mnopq} I\Big(YOB^1_j = m, \\ & YOB^2_j = n, YOB^3_j = o, YOB^4_j = p, YOB^5_j = q\Big) + \varepsilon''_{ij}, \end{aligned} \tag{3}$$

where YOB^k_j is the year of birth for a sibling with birth order k in family j.[21] Although this estimator has less stringent data requirements than the family fixed-effects estimator, it still balances family background by birth order.[22] It also reduces the number of fixed effects substantially.[23] We will use the family-type fixed-effects estimator when studying possible mechanisms behind the effects in the smaller ETF-data set.

One identifying assumption that we implicitly are imposing, which we share with all other studies on birth order effects, is that family size is predetermined, or at least not endogenous to children's realized outcomes. For example, if parents followed an optimal stopping rule where they stopped having children when they had a "bad draw," we would find negative effects of being later born even if there were no such birth order effects. We attempt to check how sensitive our estimates are to violations of the assumption of predetermined family size by making the alternative extreme assumption: that all families ideally want to have the same family size but are following the optimal stopping rule and, because of that, some stop before reaching that size. For these families, we then impute the "missing"—or unobserved—child and estimate birth order effects; we are thus bounding the potential bias induced by our original assumption.

More specifically, we take advantage of the fact that in Sweden, there is a strong two-child norm, and we therefore investigate how the effect of being second born would have changed if single-child families had not deviated from this norm.[24] To do so, we randomly draw a hypothetical second child for single-child families under the assumption of no birth order effects.[25] The observed sample of firstborn chil-

[19] Standardizing outcomes by birth cohort (or age) may not be enough to account for cohort effects, since standardization does not hold family size or birth order constant.

[20] In our data, mothers to third-born children are on average born 7.3 years earlier, had their first child 0.9 years earlier, and have 0.8 years less schooling than mothers of firstborn children, after controlling for dummy variables for family size and child's year of birth.

[21] We set year of birth to 0 when birth order exceeds family size.

[22] For example, for the family type with two children born in 1970 and 1973, the firstborn children, born in 1970, will on average have the same background as the second-born children, born in 1973. Since the dummy variables for birth order and year of birth are exactly collinear with the same family type, the cohort effects are identified by comparing the within-family difference in personality by birth order for families with different combinations of children's year of birth.

[23] In our data, the number of fixed effects is reduced by more than 90% in the family-type fixed-effects estimator compared to the family fixed-effects estimator.

[24] In Sweden, about 80% of all families have at least two children, and almost 50% have exactly two children.

[25] In practice, we divide families into different strata defined by the interaction between mother's year of birth (ten classes), mother's age at first birth (thirty classes), mother's highest educational level (seven classes), and father's income (twenty classes). Within each stratum, the missing second-born children are randomly drawn from the outcome distribution of firstborn children.

TABLE 2.—EFFECTS OF BIRTH ORDER ON CHILDREN'S NONCOGNITIVE ABILITY

	All Families	Two-Child Families	Three-Child Families	Four-Child Families	Five-Child Families	All Families: With Control for Cognitive Ability
Second child	−0.115***	−0.111***	−0.114***	−0.093***	−0.126***	−0.061***
	(0.004)	(0.008)	(0.006)	(0.010)	(0.018)	(0.004)
Third child	−0.199***		−0.224***	−0.194***	−0.193***	−0.109***
	(0.007)		(0.011)	(0.014)	(0.022)	(0.007)
Fourth child	−0.247***			−0.290***	−0.248***	−0.135***
	(0.012)			(0.022)	(0.031)	(0.011)
Fifth child	−0.302***				−0.334***	−0.172***
	(0.019)				(0.043)	(0.018)
R^2	0.008	0.009	0.010	0.008	0.009	0.091
Observations	564,788	195,852	226,469	103,574	38,893	564,788

The sample is restricted to men in families with at least two boys born between 1952 and 1982 with valid draft records. Noncognitive abilities are measured at approximately age 18 and standardized by year of draft in the full sample of draftees. All regressions control for family fixed effects and dummy variables for child's year of birth. The omitted category is the first child. Robust standard errors are in parentheses. Estimates are Significantly different from 0 at a level of confidence of ***1%, **5%, and *10%.

dren, along with the randomly drawn second-born children in single-child families, is then added to the observed sample of first- and second-born children in larger families, and the effect of being second born is reestimated. We repeat this procedure 1,000 times and report the average point estimates and standard errors.

It is likely that this exercise tends to bias the estimates toward 0 for two reasons. First, we draw the potentially missing children from the outcome distribution of firstborn children, implicitly assuming that there are no birth order effects. Second, we assume that all single-child families would have had another child if the outcome of the first child had been different. In practice, all single-child families cannot get a second child for biological reasons even if they want more children. To restrict the number of missing children somewhat, we also draw second-born children only until we reach women's age-specific fertility (Eijkemans et al., 2014).

Under the assumption that all single-child families would have had another child and assuming no birth order effects in the imputation of "missing" children, the estimated effect of being second born falls by roughly 30%.[26] Thus, even under extreme assumptions, the lion's share of the effect of the birth order remains. If we instead impose the restriction that older women are less likely to have additional children, the estimated effects of being second born fall by about 20%. Analogously, if we were to reduce the share of "missing" second-born children further, we would slowly come back to our baseline estimate. In sum, this exercise suggests that the birth order effects may be somewhat overstated if families determine family size in response to the realization of their offspring's outcomes. Still, it is not possible to rule out quite substantial birth order effects even in the extreme case that all observed single-child families had endogenously decided to stop having children.

[26] See appendix table A7.

IV. Results

In table 2, column 1, we estimate the relationship between the standardized noncognitive ability measure and birth order using the family fixed-effects model presented in equation (2), with the firstborn as the omitted category. Columns 2 to 5 then estimate the birth order effects by family size to allow for heterogeneous effects by family size. Two things are clear from these results. First, noncognitive ability is monotonically declining by birth order, with second borns performing worse than firstborns and third borns performing worse than second borns, and so on. Moving from a firstborn to a third-born child will result in approximately 0.20 standard deviation lower noncognitive ability. Second, the results are similar when estimated by family size.[27]

Given that cognitive and noncognitive abilities are correlated (they have a correlation of 0.38 in our data), an obvious issue is whether the effect of birth order on noncognitive abilities merely reflects the effect of cognitive abilities. Table 2, column 6, addresses this issue by examining the effects of birth order on noncognitive abilities, controlling for cognitive ability. The effects of birth order on noncognitive ability are reduced by almost 40% with the inclusion of controls for cognitive ability. However, there remain sizable effects of birth order on noncognitive ability, with a move from firstborn to third born resulting in 0.11 standard deviation decline in noncognitive ability.[28]

[27] In appendix table A8, we also the report the results from family size fixed-effects model in equation (1), controlling for dummy variables for family size, child's year of birth, mother's year of birth, mother's age at first birth, and mother's educational level. The patterns are very similar to the family fixed-effects model although the magnitudes are 15% to 30% smaller. Appendix table A9 presents the corresponding results for cognitive abilities.

[28] Since cognitive abilities is an outcome variable, the results should be interpreted with some caution. However, if we instead use the correlation between the skill measures (0.38) and reduce the estimates with this share, we find very similar results.

TABLE 3.—EFFECTS OF BIRTH ORDER ON CHILDREN'S EMPLOYMENT AND OCCUPATION

	Employed	Self-Employed	Top Managers	Managers	Creative Occupations
Second child	−0.010***	0.006***	−0.0017***	−0.010***	−0.0002
	(0.002)	(0.001)	(0.0005)	(0.002)	(0.0005)
Third child	−0.017***	0.008***	−0.0020**	−0.015***	−0.0001
	(0.003)	(0.002)	(0.0008)	(0.003)	(0.0008)
Fourth child	−0.020***	0.007***	−0.0018	−0.016***	−0.0003
	(0.004)	(0.003)	(0.0011)	(0.004)	(0.0012)
Fifth child	−0.022***	0.006	−0.0026*	−0.021***	−0.0006
	(0.007)	(0.004)	(0.0015)	(0.007)	(0.0018)
R^2	0.005	0.001	0.001	0.006	0.001
Observations	727,111	727,111	521,779	521,779	521,779

The sample is restricted to men in families with at least two boys born between 1941 and 1974. Columns 3 to 5 are based on occupational data, 1996 to 2009. We calculate the weighted average of the five observations closest to age 45 (within ages 35 to 55) for each individual and weight the regressions by the inverse of the sampling probability. All regressions control for family fixed effects and dummy variables for child's year of birth. Omitted category is the first child. Robust standard errors are in parentheses. Estimates are Significantly different from 0 at a level of confidence of ***1%, **5%, and *10%.

These birth order effects are larger and more stable than those found by Damian and Roberts (2015) but smaller than the estimates reported in the meta-analysis by Sulloway (2010).[29]

A. *Occupation*

Another metric of personality is reflected in occupational sorting.[30] Before considering occupation, we first examine employment probabilities. Table 3, column 1, shows the estimated relationship between birth order and employment. Note that in all models we are estimating linear probability models. There is a clear pattern of declining employment with increasing birth order, with third-born children almost 1 percentage point less likely to be employed, from a mean of 0.88. This is consistent with noncognitive abilities being especially important for explaining outcomes in the lower end of the distribution (e.g., Lindqvist & Vestman, 2011).[31]

We next consider the probability of self-employment. Because of the uncertainty in earnings, self-employment is often considered a decision undertaken by more risk-loving individuals. We find that later-born children are more likely to be self-employed than firstborn children. Note, however, that while self-employment may be viewed as a risk-loving choice, we cannot distinguish whether the higher likelihood of self-employment is a response to worse labor market prospects or a lower level of risk aversion.

Columns 3 and 4 consider the likelihood that an individual will be in a management position, with the first column ("Top Managers") the most narrowly defined to include only CEOs and top executives and the second column to include a broader definition of managers. It is interesting to note that in both cases, we see that later-born children are less likely to be in a management position, regardless of definition. In fact, firstborns are 28% more likely to be a top manager compared to third borns. Finally, when we examine creative occupations (column 5), we see no such pattern.[32]

To more directly relate occupations to noncognitive abilities, we next consider the probability of being in an occupation where success is dependent on certain personality traits, with these personality traits taken from the O*NET data set and measured on a scale of 1 to 5 (with 5 being most important) and then standardized. The traits we consider are sociability, leadership ability, conscientiousness, agreeableness, emotional stability, extraversion, and openness. The five latter characteristics correspond to the big five personality traits, which psychologists often use to describe personality. When we examine birth order patterns, we see in table 4 that there are very strong birth order effects, with firstborn children being in occupations with the highest requirements along all these dimensions. Interestingly, the magnitudes of the coefficients are quite similar across characteristics. Openness and conscientiousness appear to have the strongest relationship to birth order.

Given our earlier findings, it is not surprising that later-born children are in jobs requiring less conscientiousness or leadership ability. However, it *is* surprising that later borns are sorted into occupations that require less social ability, agreeableness, emotional stability, and openness to experience—characteristics that are associated with later-born children by Sulloway (1995, 1996). The pattern that first-

[29] To compare our estimates with Damian and Roberts (2015) and Sulloway (2010), we have estimated the partial correlations for firstborns versus later borns. Damian and Roberts find the partial correlation for firstborns versus later borns in the range between 0.00 (Vigor dimension of Extraversion) and 0.04 (Mature personality dimension of Conscientiousness). The correlations reported by Sulloway are in the range 0.00 to 0.18, but these estimates may be inflated by contrast effects and stereotype effects since subjects explicitly rate their personality relative to their older or younger sibling. We find the correlation for birth order to be 0.041 for overall noncognitive ability, and we find almost identical birth order effects for each of the noncognitive submeasures, which suggests that there may not be any significant cost to considering the aggregate measures of noncognitive abilities.

[30] While we report results only for men in the text, the corresponding results for women are qualitatively the same. These results are available in appendix B.

[31] In appendix table A1, we see that a 1 standard deviation increase in noncognitive skills is associated with 4.25 percentage points higher employment probability in our data. The corresponding number for cognitive abilities is 3 percentage points.

[32] For women (see appendix table B2), however, we find that birth order is positively related to the likelihood of being in a creative occupation, thus suggesting that later-born daughters may be more creative and open to new experiences than older sisters are. (See Sulloway 1995, 1996.)

TABLE 4.—EFFECTS OF BIRTH ORDER ON SORTING INTO JOBS WITH DIFFERENT SKILL REQUIREMENTS

	Social Ability	Leadership Ability	Conscientiousness	Agreeableness	Emotional Stability	Extraversion	Openness
Second child	−0.064***	−0.048***	−0.071***	−0.048***	−0.050***	−0.064***	−0.075***
	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)
Third child	−0.101***	−0.084***	−0.116***	−0.080***	−0.085***	−0.102***	−0.122***
	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Fourth child	−0.141***	−0.111***	−0.155***	−0.102***	−0.105***	−0.142***	−0.161***
	(0.022)	(0.025)	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)
Fifth child	−0.141***	−0.086**	−0.145***	−0.095***	−0.090**	−0.137***	−0.155***
	(0.034)	(0.038)	(0.035)	(0.034)	(0.036)	(0.035)	(0.036)
R^2	0.007	0.008	0.006	0.004	0.003	0.008	0.009
Observations	375,540	375,540	375,540	375,540	375,540	375,540	375,540

The sample is restricted to men in families with at least two boys born between 1941 and 1974. The occupational data cover 1996 to 2009 and are matched to the O*NET database. All measures are standardized in the full sample of workers. We calculate the weighted average of the five observations closest to age 45 (within ages 35 to 55) for each individual and weight the regressions by the inverse of the sampling probability. All regressions control for family fixed effects and dummy variables for child's year of birth. The omitted category is first child. Robust standard errors are in parentheses. Estimates are significantly different from 0 at a level of confidence of ***1%, **5%, and *10%.

TABLE 5.—EFFECTS OF BIRTH ORDER AND SIBLINGS' GENDER COMPOSITION ON CHILDREN'S ABILITIES, EMPLOYMENT, AND OCCUPATION

	Noncognitive Ability	Employed	Self-Employed	Top Managers	Managers	Creative Occupations
Birth order						
Second child	−0.052***	−0.001	0.003*	−0.0020**	−0.009***	−0.0025***
	(0.009)	(0.003)	(0.002)	(0.0009)	(0.003)	(0.0009)
Third child	−0.101***	−0.001	0.005	−0.0020	−0.014**	−0.0031**
	(0.014)	(0.005)	(0.003)	(0.0014)	(0.005)	(0.0015)
Fourth child	−0.121***	0.001	0.001	−0.0018	−0.014*	−0.0040*
	(0.020)	(0.007)	(0.004)	(0.0019)	(0.007)	(0.0020)
Fifth child	−0.141***	0.002	−0.002	−0.0026	−0.017*	−0.0049*
	(0.027)	(0.010)	(0.006)	(0.0024)	(0.010)	(0.0026)
Birth order among boys						
Second boy	−0.071***	−0.010***	0.003	0.0003	−0.001	0.0026***
	(0.009)	(0.003)	(0.002)	(0.0009)	(0.003)	(0.0009)
Third boy	−0.109***	−0.020***	0.004	−0.0005	−0.002	0.0028*
	(0.014)	(0.005)	(0.003)	(0.0015)	(0.006)	(0.0015)
Fourth boy	−0.147***	−0.030***	0.014***	0.0006	−0.004	0.0043*
	(0.023)	(0.008)	(0.005)	(0.0021)	(0.008)	(0.0023)
Fifth boy	−0.257***	−0.009	−0.001	−0.0011	−0.012	0.0058
	(0.052)	(0.019)	(0.011)	(0.0033)	(0.017)	(0.0060)
R^2	0.009	0.005	0.001	0.001	0.006	0.001
Observations	564,788	727,111	727,111	521,779	521,779	521,779

The sample in column 1 is restricted to men in families with at least two boys born between 1952 and 1982 with valid draft records, while the remaining columns are restricted to men in families with at least two boys born between 1941 and 1974. Columns 4 to 6 are based on occupational data from 1996 to 2009. We calculate the weighted average of the five observations closest to age 45 (but within ages 35 to 55) for each individual and weight the regressions by the inverse of the sampling probability. Noncognitive abilities are measured at approximately age 18 and standardized by year of draft in the full sample of draftees. All regressions control for family fixed effects and dummy variables for child's year of birth. Omitted category is the first child. Robust standard errors are in parentheses. The estimates are significantly different from 0 at a level of confidence of ***1%, **5%, and *10%.

borns are stronger in all big five dimension is, however, consistent with the overall findings by Damian and Roberts (2015) [33]

B. Heterogeneous Effects

The next question that we consider is whether the effects of birth order differ depending on the sex composition of the family. For example, a third-born son who is the first boy in the family may have a different experience, and outcome, from a third-born son who is the third boy in the family. Research has been mixed as to the effect of the sex composition of siblings on children's outcomes. Work by Dahl and Moretti (2004), Butcher and Case (1994), Conley (2000), and Deschenes (2007) all find some evidence of sex-composition effects, while Kaestner (1997) and Hauser and Kuo (1998) find no evidence for such heterogeneities.

Table 5 addresses this issue by allowing for heterogeneous effects of birth order depending on the sex composition of the family. We parameterize the gender composition of the siblings by allowing for two birth order variables: the standard measure and then a measure of the birth order among the boys in the family.[34] When we estimate this new specification, again including family fixed effects and cohort effects, we find differential effects for being born late when there are more boys among the older siblings. In column 1, we see that for the composite measure of noncog-

[33] The partial correlations for firstborns versus later borns with our data are 0.025 for social ability, 0.024 for leadership ability, 0.029 for conscientiousness, 0.021 for agreeableness, 0.024 for emotional stability, 0.025 for extraversion, and 0.033 for openness.

[34] Using a measure of the share of boys among the older siblings generated very similar results.

nitive ability, the negative effects of birth order are more than twice as large if one is a later-born boy with older brothers.[35] Birth order among boys is also strongly related to employment, as shown in column 2. When we examine occupational outcomes in columns 3 to 6, the effects are less consistent. However, it is notable that when we consider creative occupations, later-born boys are less likely to enter these occupations if they have older sisters and more likely to enter these occupations if they have older brothers.[36] Unfortunately, we cannot determine whether these effects are due to parental investments or male peer influence such as increased sibling competition where younger brothers have problems competing with older brothers.

V. Mechanisms

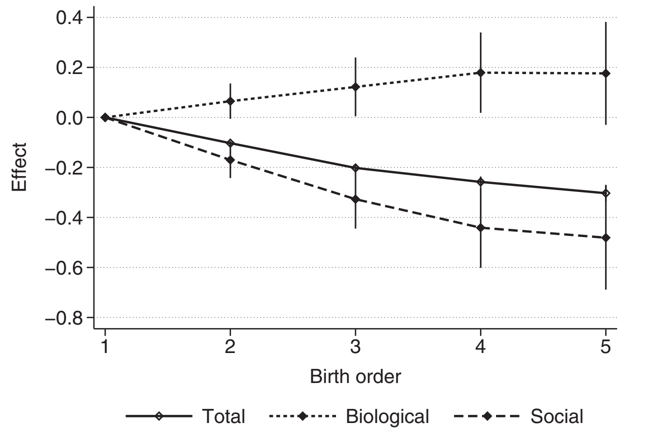
Given the patterns we observe, we next attempt to disentangle possible underlying mechanisms.

A. *Nature versus Nurture*

There are a number of possible explanations for birth order effects in noncognitive abilities. The first is biological. Is there something about the experience in utero that affects the development of a child's personality?

To attempt to isolate this mechanism, we exploit two features of our data that allow us to distinguish biological from social birth order. Building on work by Kristensen and Bjerkedal (2007), we exploit the fact that some families experienced the death of an older sibling or if an older sibling was put up for adoption—as a result, the biological birth order is different from the social birth order in these families. Figure 1 presents coefficients (with 95% confidence intervals) from a model where the effects of biological and social birth order on noncognitive abilities are allowed to vary.[37] It also includes the results from our earlier specification for the overall birth order. The results support the idea that the negative effect of birth order works entirely through social birth order, suggesting that earlier-born children have better outcomes as a result of their postnatal experiences. In fact, we find evidence for a positive effect of biological birth order, which is consistent with studies documenting higher birth weight and better placenta for later-born children (e.g., Brenøe & Molitor, 2015; Juntunen, Laara, & Kauppila, 1997; Khong et al., 2003; Wilcox, Chang, & Johnson, 1996). The overall effect is thus an underestimate of the social influence of the family, as it also incorporates the positive biological impact of birth order on noncognitive abilities.

Figure 1.—Effects of Biological and Social Birth Order on Children's Noncognitive Abilities, Exploiting Older Siblings' Vital and Adoption Status



Displayed are coefficients and 95% percent confidence intervals from (a) regressing noncognitive abilities on overall birth order and (b) regressing noncognitive abilities on social and biological birth order. Social birth order is the birth order of the child excluding older siblings who have been put up for adoption or who died within three months of birth. Both models control for family fixed effects, dummy variables for year of birth, and a dummy variable for the sixth biological birth order. Omitted category is the first child. The analysis is restricted to families with at least two boys born between 1952 and 1982 with valid draft records and with a family size of three to six children. Noncognitive abilities are measured at approximately age 18 and standardized by year of draft in the full sample of draftees. All families are weighted to match families where at least one child has died or been put up for adoption with respect to family size, sibling's gender composition, mother's year of birth, mother's age at first birth, and mother's highest educational level.

B. *Parental Investment Behavior*

Given the environmental nature of birth order effects, we next incorporate survey data of children at age 13 to examine how parental investments and children's study habits relate to birth order.

While there has always been much interest in parental investment in children, there is surprisingly little compelling work on differences in parental behavior by birth order of children, most likely due to the stringent data requirements. One of the first convincing studies was done by Price (2008), who used data from the American Time Use Survey to examine the relationship between parental time with children and birth order. He finds that parental quality time with children declines with birth order. Unfortunately, he is limited in that he does not observe time spent with each child and is unable to look within families. Monfardini and See (2012) also find significant birth order effects in parental time, although these differences cannot explain the differences in cognitive abilities across birth order. Hotz and Pantano (2015) document that later-born children are treated differently in that parents are stricter with firstborns, and the authors provide a model of reputation in which

[35] Appendix table A10 reveals that the effects of birth order among brothers are smaller for cognitive abilities than for noncognitive abilities.

[36] Appendix table A11 presents heterogeneity by sex composition for job skill requirements. Point estimates suggest that the negative effects of birth order tend to be exacerbated among boys with older brothers, but the results are not statistically significant.

[37] To separate social and biological birth order, we use families where either a child has died before 3 months of age or a child was put up for adoption. For most adopted children, we unfortunately cannot observe the exact date when they were given up. However, for children born in 1960, 87% (94%) percent of adopted children were given up before they were 3 (6) months old. Families receiving an adopted child are excluded from the analysis. Stillborns are not included in the analysis as they never enter the population registers. However, children who are born alive but die short after delivery—possibly the same day—are included in the analysis. About 2.5% of the families in our sample have either lost a child or given one up for adoption. The regression results when separating biological and social birth order are reported in appendix table A12 for both cognitive and noncognitive abilities.

Table 6.—Effects of Birth Order on Pupil Effort and Parental Investments

	Homework (hours/week)	Read Books (SD)	Watch TV or Play Computer (hours/week)	Parents Help with Homework (incidence)	Parents Talk about School (SD)	Parents' Expectations (SD)
Second child	−0.132	−0.353***	0.193**	0.011	−0.178**	−0.082
	(0.085)	(0.069)	(0.085)	(0.022)	(0.083)	(0.170)
Third child	−0.282**	−0.500***	0.418***	0.013	−0.326**	0.076
	(0.133)	(0.111)	(0.133)	(0.036)	(0.136)	(0.279)
Fourth child	−0.482**	−0.513***	0.287	0.015	−0.509**	−0.033
	(0.205)	(0.172)	(0.213)	(0.054)	(0.205)	(0.432)
Fifth child	−0.996***	−0.769***	1.025***	−0.077	−0.689**	−0.300
	(0.318)	(0.285)	(0.353)	(0.091)	(0.290)	(0.618)
R^2	0.048	0.147	0.095	0.024	0.027	0.029
p-value of F-test	0.033	0.000	0.003	0.660	0.121	0.395
Observations	31,908	26,145	30,799	32,636	23,034	11,829

The sample is restricted to individuals born 1967, 1972, 1977, 1982, 1987, or 1992 in the ETF data. All regressions control for the full interaction between all siblings' year of birth and dummy variables for child's year of birth and gender. Omitted category is the first child. Robust standard errors are in parentheses. The reported p-value is for an F-test of the joint significance of the birth order dummy variables. The estimates are significantly different from 0 at a level of confidence of ***1%, **5%, and *10%.

strict rules for earlier born children spill over into the behavior of later-born children. In the same vein, Avarett et al. (2011) find that later-born children receive less adult supervision. Most recently, work by Lehmann et al. (2018) uses data from the Children of the National Longitudinal Survey of Youth 1979 (NLSY79) and documents differences in parental behavior and home environment that they argue can explain a substantial fraction of the early birth order effects they document.

We examine the issue of parental investment behavior in the Swedish context using the ETF survey, a substantially larger data set than earlier studies used. The ETF survey samples one individual from each household, which makes it impossible to estimate our preferred specification that includes family fixed effects. However, we can still obtain balance in family background by birth order by including fixed effects for all possible combinations of the siblings' year of birth. For example, if a particular family has children born in 1993, 1995, and 1997, we would create an indicator equal to 1 if there were three children in the family and those three children were born in 1993, 1995, and 1997. Although we are not looking within families, we are still comparing children of different birth order but whose family birth composition, including children's ages and child spacing, is exactly the same.[38]

The results on children's effort and parental investments are presented in table 6. Not surprising, given our results on noncognitive abilities and the literature on the effects of birth order on education, earnings, and cognitive abilities, we find that the number of hours per week doing homework declines significantly with birth order, with later-born children spending almost an hour less per week on homework. They are also much less likely to read books, and they spend substantially more time watching TV or playing on the computer. Interestingly, parents report that they spend less time discussing schoolwork with later-born children, suggesting that parental investment falls by birth order. We find no consistent difference in whether parents help with homework or in parental expectations by birth order.

Taken together, we think these results suggest that parents invest less in later borns—for example, being less strict and providing less parental supervision, as suggested by Hotz and Pantano (2015) and Avarett et al. (2011). An alternative interpretation is that birth order affects children's personality through sibling rivalry and that parents adapt and treat children differently.

VI. Conclusion

The popular press is replete with articles and books touting the relationship between birth order and personality. However, due to data limitations, there is very little convincing evidence documenting these relationships. Using unique registry data from Sweden on a large sample of men, we are able to estimate the relationship between birth order and measures of noncognitive ability and occupational characteristics, all of which serve as reasonable proxies for individual personalities.

Consistent with the literature on earnings and IQ, we find evidence that noncognitive abilities decline with birth order. This is true across a variety of measures of abilities, including the big five dimensions of personality. These results are somewhat at odds with the psychology literature, where later borns are expected to be more emotionally stable, open to experience, and social. We also find systematic differences in occupational sorting by birth order: firstborn children are more likely to be managers, while later-born children are more likely to be self-employed. This occupational sorting is consistent with predictions from evolutionary psychology where firstborns are

[38] To verify that this is equivalent to family fixed-effects specifications, appendix table A13 presents the results when we estimate the relationship between birth order and noncognitive abilities using the two specifications: the first panel presents our preferred specification with family fixed effects and the second uses the family-type fixed effects described above. Because we are so precisely controlling for family type, the results are identical, suggesting that this approach is sufficient to avoid concerns about omitted variable bias. We have also verified that covariates are balanced when we run the alternative specification.

suggested to dominate younger siblings, whereas later borns are assumed to use more unorthodox strategies to attract attention.

The patterns vary by the sex composition of the children: later-born boys are particularly affected when their older siblings are brothers. For noncognitive ability, the effects of birth order are more than twice as large if one is later born with older brothers. However, when we consider creative occupations, later-born boys are less likely to enter these occupations if they have older sisters, while later-born boys are more likely to enter these occupations if they have older brothers.

When we examine possible mechanisms underlying the observed birth order patterns, we find support for postbirth environmental factors driving the negative birth order effects, while biological factors go in the other direction. Additionally, we find that study behaviors vary by birth order; teenagers are more likely to read books, spend more time on homework, and spend less time watching TV if they are firstborn. We also find that some parental investments decline by birth order, which could partly explain the negative effects of birth order on noncognitive abilities. However, this does not rule out that other factors, including parental resources or sibling competition, can help to explain these patterns.

REFERENCES

Adler, Alfred, *Menschenkenntnis* (Leipzig: Fischer, 1927).

——— "Characteristics of the First, Second, and Third Child," *Children* 3(1928), 14–52.

Anger, Silke, "Intergenerational Transmission of Cognitive and Non-Cognitive Skills," in John Ermisch, Markus Jäntti, and Timothy Smeeding, eds., *From Parents to Children: The Intergenerational Transmission of Advantage* (New York: Russell Sage Foundation, 2012).

Argys, Laura M., Daniel I. Rees, Susan L. Avarett, and Benjamin Witoonchart, "Birth Order and Risky Adolescent Behavior," *Economic Inquiry* 44 (2006), 215–233.

Averett, Susan L., Laura M. Argys, and Daniel I. Rees, "Older Siblings and Adolescent Risky Behavior: Does Parenting Play a Role?" *Journal of Population Economics* 24 (2011), 957–978.

Barclay, Kieron J., "A Within-Family Analysis of Birth Order and Intelligence Using Population Conscription Data on Swedish Men," *Intelligence* 49 (2015), 134–143.

Becker, Gary S., and Nigel Tomes, "Child Endowments and the Quantity and Quality of Children," *Journal of Political Economy* 84 (1976), S143–S162.

Beer, Jeremy M., and Joseph M. Horn, "The Influence of Rearing Order on Personality Development within Two Adoption Cohorts," *Journal of Personality* 68 (2000), 789–819.

Björklund, Anders, and Markus Jäntti, "How Important Is Family Background for Labor-Economic Outcomes?" *Labour Economics* 19 (2012), 465–474.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes, "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education," *Quarterly Journal of Economics* 120 (2005), 669–700.

——— "Older and Wiser? Birth Order and IQ of Young Men," *CESifo Economic Studies* 57 (2011), 103–120.

——— "Healthy (?), Wealthy and Wise: Birth Order and Adult Health," *Economics & Human Biology* 23 (2016), 27–45.

Black, Sandra E., Erik Grönqvist, and Björn Öckert, "Born to Lead? The Effect of Birth Order on Non-Cognitive Abilities," IZA discussion paper 10560 (2017).

Booth, Allison L., and Hiau Joo Kee, "Birth Order Matters: The Effect of Family Size and Birth Order on Educational Attainment," *Journal of Population Economics* 22 (2008), 367–397.

Borghans, Lex, Angela Lee Duckworth, James J. Heckman, and Bas ter Weel, "The Economics and Psychology of Personality Traits," *Journal of Human Resources* 43 (2008), 972–1059.

Bowles, Samuel, Herbert Gintis, and Melissa Osborne, "The Determinants of Earnings: A Behavioral Approach," *Journal of Economic Literature* 39 (2001), 1137–1176.

Breining, Sanni, Joseph Doyle, David Figlio, Krzysztof Karbownik, and Jeffrey Roth, "Birth Order and Delinquency: Evidence from Denmark and Florida," NBER working paper 23038 (2017)

Brenøe, Anne Ardila, and Ramona Molitor, "Birth Order and Health of Newborns: What Can We Learn from Danish Registry Data?" CINCH working paper 13 (2015).

Bu, Feifei, "Sibling Configurations, Educational Aspiration and Attainment," ISER working paper 2014–11 (2014).

Butcher, Kristin F., and Anne Case, "The Effect of Sibling Sex Composition on Women's Education and Earnings," *Quarterly Journal of Economics* 109 (1994), 531–563.

Carlsson, Magnus, Gordon B. Dahl, Björn Öckert, and Dan-Olof Rooth, "The Effect of Schooling on Cognitive Skills," this REVIEW 97 (2015), 533–547.

Carlstedt, Berit, *Cognitive Abilities: Aspects of Structure, Process, and Measurement* (Göteborg: Acta Universitatis Gothoburgensis, 2000).

Cesarini, David, "Family Influence on Productive Skills, Human Capital and Lifecycle Income," unpublished manuscript, MIT (2009).

Conley, Dalton, "Sibling Sex Composition: Effects on Educational Attainment," *Social Science Research* 29 (2000), 441–457.

Cunha, Flavio, and James J. Heckman, "The Technology of Skill Formation," *American Economic Review* 97 (2007), 31–47.

——— "Formulating, Identifying, and Estimating the Technology of Cognitive and Noncognitive Skill Formation," *Journal of Human Resources* 43 (2008), 729–737.

Cunha, Flavio, James J. Heckman, Lance Lochner, and Dimitriy Masterov, "Interpreting the Evidence on Life Cycle Skill Formation," in Eric Hanushek and Finis Welch, eds., *Handbook of the Economics of Education*, vol. 1 (Amsterdam: North-Holland, 2006).

Dahl, Gordon. B., and Enrico Moretti, "The Demand for Sons: Evidence from Divorce, Fertility, and Shotgun Marriage." NBER working paper 10281 (2004).

Damian, Rodica Ioana, and Brent W. Roberts, "The Associations of Birth Order with Personality and Intelligence in a Representative Sample of U.S. High School Students," *Journal of Research in Personality* 58 (2015), 96–105.

Deschenes, Olivier, "Estimating the Effects of Family Background on the Return to Schooling," *Journal of Business & Economic Statistics* 25 (2007), 265–277.

Dunn, Judy, *Young Children's Close Relationships: Beyond Attachment* (Newbury Park, CA: Sage, 1993).

Dunn, Judy, and Penny Munn, "Development of Justification in Disputes with Mother and Sibling," *Developmental Psychology* 23 (1987), 791–798.

Ejikemans, Marinus, Frans van Poppel, Dik Habbema, Ken Smith, Henri Leridon, and Egbert te Velde, "Too Old to Have Children? Lessons from Natural Fertility Populations," *Human Reproduction* 29 (2014), 1304–1312.

Fredriksson, Peter, Björn Öckert, and Hessel Oosterbeek, "Long-Term Effects of Class Size," *Quarterly Journal of Economics* 128 (2013), 249–285.

Furman, Wyndol, and Duane Buhrmester, "Children's Perceptions of the Personal Relationships in their Social Networks," *Developmental Psychology* 21 (1985), 1016–1024.

Grinberg, Alice, "The Effect of Birth Order on Occupational Choice," *Atlantic Economic Journal* 43 (2015), 463–476.

Grönqvist, Erik, and Erik Lindqvist, "The Making of a Manager: Evidence from Military Officer Training," *Journal of Labor Economics* 34 (2016), 869–898.

Grönqvist, Erik, Björn Öckert, and Jonas Vlachos, "The Intergenerational Transmission of Cognitive and Non-Cognitive Abilities," *Journal of Human Resources* 52 (2017), 887–918.

Härnquist, Kent, "Evaluation through Follow–Up: A Longitudinal Program for Studying Education and Career Development," in

Carl-Gunnar Janson, ed., *Seven Swedish Longitudinal Studies in Behavioral Science* (Stockholm: Forskningsrådsnämnden, 2000).

Hauser, Robert M., and Hsiang-Hui Daphne Kuo, "Does the Gender Composition of Sibships Affect Women's Educational Attainment?" *Journal of Human Resources* 33 (1988), 644–657.

Havnes, Tarjei, "Sibling Rivalry over Parental Care: Intra-Household Conflict and Child Investment," unpublished manuscript, University of Oslo (2010).

Heckman, James J., and Yona Rubinstein, "The Importance of Noncognitive Skills: Lessons from the GED Testing Program," *American Economic Review* 91 (2001), 145–149.

Heckman, James J., Jora Stixrud, and Sergio Urzua, "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior," *Journal of Labor Economics* 24 (2006), 411–482.

Hotz, V. Joseph, and Juan Pantano, "Strategic Parenting, Birth Order and School Performance," *Journal of Population Economics* 28 (2015), 911–936.

Howe, Nina, Christina M. Rinaldi, Melissa Jennings, and Harriet Petrakos, "No! The Lambs Can Stay Out Because They Got Cozies: Constructive and Destructive Sibling Conflict, Pretend Play, and Social Understanding," *Child Development* 73 (2002), 1460–1473.

Juntunen, Kaisa, Esa Laara, and Antti Kauppila, "Grand Grand Multiparity and Birth Weight," *Obstetrics & Gynecology* 90 (1997), 495–499.

Kaestner, Robert, "Are Brothers Really Better? Sibling Sex Composition and Educational Achievement Revisited," *Journal of Human Resources* 32 (1997), 250–284.

Kantarevic, Jasim, and Stéphane Mechoulan, "Birth Order, Educational Attainment, and Earnings: An Investigation Using the PSID," *Journal of Human Resources* 41 (2006), 755–777.

Khong T. Y., E. D. Adema, and J. J. Erwich, "On an Anatomical Basis for the Increase in Birth Weight in Second and Subsequent Born Children," *Placenta* 24 (2003), 348–353.

Kristensen, Petter, and Tor Bjerkedal, "Explaining the Relation between Birth Order and Intelligence," *Science* 316 (2007), 1717.

Lehmann, Jee-Yeon K, Ana Nuevo-Chiquero, and Marian Vidal-Fernandez, "The Early Origins of Birth Order Differences in Children's Outcomes and Parental Behavior," *Journal of Human Resources* 53 (2018), 123–156.

Lindqvist, Erik, and Roine Vestman, "The Labor Market Returns to Cognitive and Noncognitive Ability: Evidence from the Swedish Enlistment," *American Economic Journal: Applied Economics* 3 (2011), 101–128.

Monfardini, Chiara, and Sarah Grace See, "Birth Order and Child Outcomes: Does Maternal Quality Time Matter?" IZA discussion paper 6825 (2012).

Phinney, Jean S., "The Structure of 5-Year Olds' Verbal Quarrels with Peers and Siblings," *Journal of Genetic Psychology* 147 (1986), 47–60.

Plomin, Robert, "Commentary: Why Are Children in the Same Family so Different? Non-Shared Environment Three Decades Later," *International Journal of Epidemiology* 40 (2011), 582–592.

Plomin, Robert, and Denise Daniels, "Why Are Children in the Same Family so Different from Each Other?" *Behavioral Brain Science* 10 (1987), 1–16.

Price, Joseph, "Parent-Child Quality Time: Does Birth Order Matter?" *Journal of Human Resources* 43 (2008), 240–265.

Rohrer, Julia M., Boris Egloff, and Stefan C. Schmukle, "Examining the Effects of Birth Order on Personality," *Proceedings of the National Academy of Sciences* 1128 (2015), 14224–14229.

Shantz, Carolyn U., and Willard W. Hartup, "Conflict and Development: An Introduction. Conflict in Child and Adolescent Development," in Carolyn U. Shantz and Willard W. Hartup, eds., *Conflict in Child and Adolescent Development* (New York: Cambridge University Press, 1992).

SFS 1994: 1809, Lag am totalförsvarplikt (Stockholm: Försvarsdepartementet). www.riksdgen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-199441809-om-totalforsvarsplikt_sfs-194-1809.

Silles, Mary A., "The Implications of Family Size and Birth Order for Test Scores and Behavioral Development," *Economics of Education Review* 29 (2010), 795–803.

Sulloway, Frank J., "Birth Order and Evolutionary Psychology: A Meta-Analytic Overview," *Psychological Inquiry* 6 (1995), 75–80.

——— *Born to Rebel: Birth Order Family Dynamics, and Creative Lives* (New York: Pantheon, 1996).

——— "Birth Order," in Mark A. Runco and Steven R. Pritzker, eds., *Encyclopedia of Creativity*, vol. 1 (San Diego: Academic Press, 1999).

——— "Birth Order, Sibling Competition, and Human Behavior," in Harmon R. Holcomb III, ed., *Conceptual Challenges in Evolutionary Psychology* (Dordrecht: Kluwer, 2001).

——— "Why Siblings Are Like Darwin's Finches: Birth Order, Sibling Competition, and Adaptive Divergence within the Family," in Patricia H. Hawley, ed., *The Evolution of Personality and Individual Differences* (New York: Oxford University Press, 2010).

Statistics Sweden, *Longitudinell integrationsdatabas för sjukförsäkrings—och arbetsmarknadsstudier (LISA) 1990–2011* (Stockholm: SCB, 2009).

Wilcox, Mark A., Allan M. Z. Chang, and Ian R. Johnson, "The Effects of Parity on Birth Weight Using Successive Pregnancies," *Acta Obstetricia et Gynecologica Scandinavica* 75 (1996), 459–463.

Zajonc, Robert B., "Family Configuration and Intelligence," *Science* 192 (1976), 227–236.

Zajonc, Robert B., and Gregory B. Markus, "Family Configuration and Intellectual Development," *Psychological Review* 82 (1975), 74–88.

Yi, Junjian, James J. Heckman, Junsen Zhang, and Gabriella Conti, "Early Health Shocks, Intra-Household Resource Allocation and Child Outcomes," *Economic Journal* 125 (2015), F347–F371.

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1. Weidong Wang, Yongqing Dong, Xiaohong Liu, Yunli Bai, Linxiu Zhang. 2020. The effect of parents' education on the academic and non-cognitive outcomes of their children: Evidence from China. *Children and Youth Services Review* **117**, 105307. [Crossref]
2. Oded Gurantz, Michael Hurwitz, Jonathan Smith. 2020. Sibling effects on high school exam taking and performance. *Journal of Economic Behavior & Organization* **178**, 534-549. [Crossref]
3. Xianfang Xiong, Lanfang Deng, Hongyi Li. 2020. Is Winning at the Start Important: Early Childhood Family Cognitive Stimulation and Child Development. *Children and Youth Services Review* 105431. [Crossref]
4. Sandra E Black, Sanni Breining, David N Figlio, Jonathan Guryan, Krzysztof Karbownik, Helena Skyt Nielsen, Jeffrey Roth, Marianne Simonsen. 2020. Sibling Spillovers*. *The Economic Journal* **126**. . [Crossref]
5. Sven Oskarsson, Christopher Dawes, Richard Ã–hrvall, Karl-Oskar Lindgren. 2020. Big brother sees you, but does he rule you? The relationship between birth order and political candidacy. *The Journal of Politics* . [Crossref]
6. Bernt Bratsberg, Christopher T. Dawes, Andreas Kotsadam, Karl-Oskar Lindgren, Richard Öhrvall, Sven Oskarsson, Oddbjørn Raaum. 2020. Birth Order and Voter Turnout. *British Journal of Political Science* **31**, 1-8. [Crossref]
7. Karen Bluth, Jinyoung Park, Christine Lathren. 2020. Is parents' education level associated with adolescent self-compassion?. *EXPLORE* **16**:4, 225-230. [Crossref]
8. Cláudia Custódio, Stephan Siegel. 2020. Are chief executive officers more likely to be first-borns?. *PLOS ONE* **15**:6, e0234987. [Crossref]
9. Sara Kalucza, Anna Baranowska-Rataj, Karina Nilsson. 2020. Not all the same: Swedish teenage mothers' and fathers' selection into early family formation trajectories. *Advances in Life Course Research* **44**, 100326. [Crossref]
10. Weidong Wang, Xiaohong Liu, Yongqing Dong, Yunli Bai, Shukun Wang, Linxiu Zhang. 2020. Son Preference, Eldest Son Preference, and Educational Attainment: Evidence From Chinese Families. *Journal of Family Issues* **41**:5, 636-666. [Crossref]
11. Lanfang Deng, Tingting Tong. 2020. Parenting style and the development of noncognitive ability in children. *China Economic Review* 101477. [Crossref]
12. Young-Joo Kim. 2020. Born to be more educated? Birth order and schooling. *Review of Economics of the Household* **18**:1, 165-180. [Crossref]
13. Rita Ginja, Jenny Jans, Arizo Karimi. 2020. Parental Leave Benefits, Household Labor Supply, and Children's Long-Run Outcomes. *Journal of Labor Economics* **38**:1, 261-320. [Crossref]
14. Sanni Breining, Joseph Doyle, David N. Figlio, Krzysztof Karbownik, Jeffrey Roth. 2020. Birth Order and Delinquency: Evidence from Denmark and Florida. *Journal of Labor Economics* **38**:1, 95-142. [Crossref]
15. Giovanni Peri, Aline Buetikofer. 2020. How Cognitive Ability and Personality Traits Affect Geographic Mobility. *Journal of Labor Economics* . [Crossref]
16. Qian Weng, Xia Gao, Haoran He, Shi Li. 2019. Family size, birth order and educational attainment: Evidence from China. *China Economic Review* **57**, 101346. [Crossref]
17. N.M. Lapteva, E.A. Valueva, E.A. Shepeleva. 2019. The Problem of Influence of Children's Birth Order in the Family on Their Intellectual Abilities and Personality Traits. *Journal of Modern Foreign Psychology* **8**:2, 83-94. [Crossref]
18. Claudia Custodio, Stephan Siegel. 2018. Are CEOs More Likely to Be First-Borns?. *SSRN Electronic Journal* . [Crossref]