The Effect of Parental Time Investments: Evidence from Natural Within-Family Variation

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Abstract

Firstborn children receive more parental time investments, and this difference is larger when children are spaced further apart in age. I use this natural within-family variation to estimate the effect of parental time investments on children's reading test scores. Having an instrumental variable for parent–child reading is crucial since parents invest more time with the lower-performing child, leading to downward bias of the effects of parental time investments. I find that an extra day per week of parent–child reading during the first ten years of life raises a child's performance on standardized reading tests by about half of a standard deviation.

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Parents face a number of decisions that involve a trade-off between spending time with their children and providing them with material resources. Extra work hours provide more income but leave less time for one's children. Housing decisions can involve a trade-off between a larger home and a shorter commute to work. The ability to make the decision that is best for the children in these cases requires knowing the relative impact of time and money on child outcomes.

Estimating the impact of parental time on child outcomes is a challenging empirical question. The challenge includes knowing the functional form of the production function of child outcomes (Todd and Wolpin 2003), knowing how to combine father and mother inputs in that production function (Pollak 2008), and being able to accurately measure parental time investments in children (Haveman and Wolfe 1995). In addition, unobserved heterogeneity is likely to be a problem since families with more income also invest more time in their children (Gronau and Hamermesh 2006; Guryan, Hurst, and Kearney 2008).

As a result, most of the economic research on the effect of parent-child time has focused on maternal employment. Maternal employment is easier to measure, and there are a number of government policies that influence a mother's work decision. However, policies that influence maternal employment affect both the amount of time and the amount of money that parents can provide their children. Because of this, maternal employment can be positive in some situations but negative in others (Blau and Grossberg 1992).

In this paper, I exploit within-family variation in the amount of resources siblings receive. These differences arise from a common pattern in how parents allocate time among their children. Parents spend more time with their firstborn child, and this difference is larger when children are spaced further apart (Price 2008). If parental time is an important factor in child outcomes, then birth order differences in child outcomes will be larger when children are spaced further apart and these birth order differences will be larger for the outcomes that are most directly influenced by parental time. I use data from the National Longitudinal Survey of Youth 1979 (NLSY) to show that these predictions are true. Firstborn children have higher reading scores and the birth order gap in reading scores is greater when the two children are further apart in age.

I use this natural variation in parental time investments as an instrument for how much mothers read to their children. Properly instrumenting for the measure of parental reading is important since mothers spend more time reading to the child who has lower achievement in reading, leading to a downward bias in estimates using mother fixed effects. Instrumental variable estimates indicate that increased mother–child reading time has large positive effects on reading achievement. For example, increasing mother–child reading by an additional day each week during the first ten years of the child's life raises the child's reading performance by more than half of a standard deviation.

I. Related Research

The empirical work in this paper is founded in the household production framework originally developed by Becker (1965). Parents receive satisfaction from raising happy, healthy, well-behaved, and high-achieving children. Parents allocate time and money to their children so as to maximize child outcomes subject to the constraints of income, time, and technology (Zick, Bryan, and Osterbacka 2001). While the exact nature of the production function for child outcomes is uncertain, it is likely to depend on a number of family characteristics, parenting styles, and the amount of time and money that parents invest in their children. In this paper, I compare children from the same family, thus controlling for many of the parenting styles or family characteristics that are difficult to measure.

A major challenge in estimating the impact of parental time investments is the lack of exogenous variation in how much time parents spend with their children. For example, maternal employment has received the most attention from researchers but is a situation in which the negative effects of a decrease in mother-child time may be offset the positive effects of the increase in family income (Blau and Grossberg 1992). In addition, mother's may minimize the change in the quality time spent with their children by rearranging other aspects of their lives (Bianchi 2000).

Paid maternity leave is one policy that can provide an increase in mother-child time, often with no change in family income. Baker and Milligan (forthcoming) examine a Canadian policy in 2000 that extended the length of job-protected, partially compensated maternity leave benefits from six months to one year. Although the program only provided a partial replacement of the mother's lost wages, a simulation exercise performed in the study indicates that, once taxes and child care costs are accounted for, a mother who took the maternity leave would experience no change in income. They find that the policy increased the amount of maternal care a child received during the first year of life by three months (mostly displacing unlicensed home-based care by non-relatives). However, they find that this large increase in maternal care had no effect on motor-social development (among infants and toddlers).

The impact of family income is easier to estimate since there are a number of policies that provide changes in family income but do not have direct effects on child outcomes. Dahl and Lochner (2008) exploit changes in the earned income tax credit and find that an additional $1,000 in family income raises combined math and reading test scores by about 6% of a standard deviation, with a larger positive impact for disadvantaged families. Milligan and Stabile (2008) use variation in Canadian child benefits and find that among families with mothers with no more than a high school degree, an additional $1,000 raises math scores by 7.4% and reading scores by 6.8% of a standard deviation. Shea (2006) uses changes in family income that result from plant closings and finds that this drop in income leads to lower child outcomes but only for families with less-educated fathers. Other studies document that higher family income is correlated with higher test scores, fewer behavioral problems, lower chance of teenage pregnancy, greater educational attainment, and higher earnings (Brooks-Gunn and Duncan 1997).

II. Data

Most of the analysis in this paper is based on data about the children of the original respondents to the 1979 National Longitudinal Survey of Youth (NLSY). The NLSY is a nationally representative sample of 12,686 young men and women who were 14–22 years old when first surveyed in 1979. These individuals were interviewed annually through 1994 and biennially since then. The NLSY contains extensive information of each respondent’s age, education, income, work history, marital status, and fertility. Starting in 1986, information was collected on all children of the female respondents to the NLSY. As measures of child outcomes, I use the Peabody Individual Achievement Tests (PIAT) of reading and math and Peabody Picture Vocabulary Test (PPVT). I standardize all of the outcome measures to have a mean of zero and standard deviation for the children who are part of the nationally representative sample in the NLSY (i.e. excluding the oversampled observations).

The NLSY data also includes a mother-reported measure of how often they read to each of their children. Possible responses include never, several times a year, several times a month, once a week, about three times a week, or daily. In figure 1, I plot the distribution of how often mothers read to their children based on the child's age and birth order. For children ages 0–3, about 35% of mothers report reading to the child every day and the difference between a firstborn and second-born child is ten percentage points. The reading variables are recorded every two years, so this birth order difference is based on comparing siblings at the same age rather than at the same point in time. For children ages 4–6, the fraction whose mothers read to them daily drops to 28% and then for children ages 7-8 the daily reading rate drops to about 14%.

I use this mother–child reading question to construct two measures for which the interpretation of the results will be more straightforward. The first measure is whether the mother reports reading daily to the child and the second converts the 1–6 scale into a measure of days per month that the mother reads to the child.[1] In Figure 2, I compare how two of these measures vary based on the child's age. The frequency of mother–child reading increases during the infant years and peaks at age two (when 40% of mothers read daily to their child and the average days per month across the sample is 17). The

[1] The specific options of the 1–6 scale in the NLSY provides a measure that is very similar to a logarithmic scale (Gruber and Hungerman 2008).

frequency of reading steadily decreases as the child becomes older such that by age ten there are no mothers who report reading to their child daily and the average days per month across the sample is six.

Past research documents that single-item questions about the frequency of parent-child reading suffer from a social-desirability bias (Hoffereth 2006). To address this concern, I also use data from the American Time Use Survey (ATUS). This data is based on a time diary completed by one adult from a random sample of households from the outgoing group of the Current Population Survey. This person reports all of their activities for one day along with starting and ending times and everyone else who was present for each activity. I use this information to construct a measure of how much time parents spend with each of their children. I focus specifically on parent-child activities that involve a high degree of interaction and have the greatest impact on child development such as reading, talking, and helping with homework (Bianchi and Robinson 1997).

To provide some additional insight about birth order differences in material inputs, I use data from the 2000 US Decennial Census 1% Public Use Microdata Sample. I construct measures of birth order and birth spacing based on ages of the children currently in the household. I focus specifically on children ages 4–13, to reduce the likelihood of misclassifying a child's birth order for families where children have left the home. The measures of material well-being in the census data include the family's income, whether the child lives in a home, and the size of the home (in terms of the number of bedrooms). As additional controls, I use information on the child's age and gender, as well as the mother's age, education, marital status, and work status.

III. Differences in Parental Inputs

In Table 1, I use these three datasets to examine how time and money investments differ across siblings based on their birth order and birth spacing.[2] The first two columns examine differences in the amount of quality time a parent spends with each child using data from the American Time Use Survey. Since there is only one respondent per household, I report the time-use estimates separately for father-child time and mother-child time. Second-born children receive 22 fewer minutes a day of quality time with their father than the firstborn child, and this difference increases by five minutes for each additional year apart in age between the two children. Similarly, for mother-child time the birth order gap is 25 minutes of quality time a day and increases by seven minutes for each additional year apart in age.

When looking at the frequency of mother-child reading, I find a similar pattern. The firstborn child is read to 2.6 days per month more often than the second-born child, and this difference increases by 0.55 days for each additional year apart in age. When I examine whether the mothers read to the child each day (which is true for 22.3% of children in the sample), firstborn children are 7.9 percentage points more likely to have mothers who read to them daily, and this gap increases by 0.2 percentage points for each additional year apart in age.

In contrast to the patterns in pare-child time, the second-born child experiences higher levels of material well-being. For example, when siblings are three years apart the second-born experiences an average of $3,600 more family income each year, is 1.5

[2] In each regression, I re-center the measure of birth spacing at three years so that the coefficient on the second child is the birth order gap for the typical family in the sample.

percentage points less likely to be below the poverty line, is 3.7 percentage points more likely to live in a house, and lives in a home with more bedrooms. These gaps are all larger when the children are spaced further apart.

IV. Differences in Child Outcomes

These large differences in parent-child time investments provide a potential test of the relative impact of parental time investments. If parent-child time is an important determinant of child outcomes, then firstborn children will have better outcomes and these birth-order differences will be larger when children are spaced further apart. In addition, if parental time is the source of these birth order differences, we should see larger differences for the outcomes that parental time inputs are more likely to directly influence.

In Table 2, I examine differences in three cognitive outcomes. Each of the regressions includes mother fixed-effects and controls for both the child's gender and whether the child was born when the mother was a teenager (less than 19 years old). All of the test scores have been normalized to have a mean of zero and a standard deviation of one. A major advantage of the data in the NLSY is that it provides observations at multiple points in time for each child making it possible to compare siblings at the same age rather than just at the same point in time .

One concern about these estimates is that birth spacing may be correlated with the endowment of the firstborn child. In particular, if parents have a child with a lower initial endowment, they may wait longer to have a second child. This would bias the coefficients of the interaction between birth order and birth spacing downward, since the families with larger birth spacing would have firstborn children with lower outcomes (absent any effect of parental time investments). I address this issue by instrumenting for birth spacing using whether or not the mother experienced a miscarriage in between the first and second birth.

Among the mothers in my NLSY sample of two-child families, 6.5% of the mothers experienced a miscarriage between the births of the two children (of these mothers, about 10% had more than one miscarriage in this period)[3]. Having a miscarriage increases the average birth-spacing for these mothers by 0.742 years (with a standard error of 0.116). The F-statistic of this instrument is 46.8, and Miller (forthcoming) provides arguments for the validity of this instrument.[4] This estimate is nearly identical whether or not I control for other characteristics of the mother, such as education, marital status, or labor status, providing additional evidence that this instrument is exogenous.[5]

In addition, when I compare the characteristics of mothers based on whether they have had a miscarriage or not, the only observable difference is that black mothers are less likely to have had a miscarriage (or report having a miscarriage). All of the other important characteristics, such as education, income, marital status, and age at first birth are similar across the two groups.

[3] The IV results presented in Table 3 using whether the mother had a miscarriage are very similar to the results from using the number of miscarriages.

[4] Some of the concerns about this instrument are that miscarriages may be related to smoking or alcohol use during pregnancy and that even in the absence of a miscarriage the baby may have been aborted. This first issue is potentially problematic when using this instrument to examine the impact of age of first birth on female earnings since the unobserved characteristics that lead women to engage in these behaviors may influence their earning potential directly (Hotz, Mullin, and Sanders 1997). These two issues may be less of a problem when looking at the birth spacing between the first and second birth and using mother fixed effects.

[5] When including these additional controls, the estimated coefficient on having a miscarriage is 0.739 with a standard error of 0.115.

Consistent with the expected bias in the non-IV results (based on parents waiting longer after having a firstborn child with a lower endowment), I find that the coefficient on the interaction between birth order and birth spacing is much larger when properly instrumenting for birth spacing. For example, the IV results indicate that a firstborn child will have a PIAT reading score that is 19.5% of a standard deviation higher, and this birth order gap increases by 19.8 percentage points for each additional year of birth spacing (compared to only 2.6 percentage points in the non-IV results). The interaction terms for the PPVT results are not statistically significant in the IV results, but the coefficient is roughly the same size as the PIAT reading results and is consistent with a downward bias in the non-IV results.

For the outcome measure that is less likely to be influenced directly by parental time investments (math skills), I find only small and statistically insignificant birth order differences. This does not mean that parents have no influence on their children's math performance. In fact, when I use variation across families, I find that children of mothers with a college degree score 117% of a standard deviation higher than children whose mothers didn't graduate from high school, and those whose mothers graduated from high school scored 52% of a standard deviation higher. The within-family estimates in Table 2 suggest that the impact of parents on their children's math performance results from fixed inputs (genetics, parental education, etc) rather than changes in parental time investments. This is consistent with the fact that much more parent-child time is directed towards reading than towards math.

The results in Table 2 are all consistent with a positive effect of parental time investments. With respect to those outcomes for which parental time investments are most likely to have a direct impact (verbal and reading skills), the firstborn children have higher outcomes and these birth order differences are larger when the children are spaced further apart in age.

V. Impact of Mother–child reading

I now turn to a more direct approach using data in the NLSY about how often mothers read to each child. I start by examining the contemporaneous effect of parental time investments on child's performance on reading tests. First I run a simple regression in which I test whether children who are read to more have higher reading scores. I include as additional controls in this regression: log household income, the child's gender and age (in months) at the time of the test, the mother's relationship status (married, cohabiting, or single), the mother's work status (full-time, part-time, or not working), the mother's education (college, high school, or less than high school), log family income, whether the child was born when the mother was a teenager (<19 years old), and the child's birth weight.

The results in Table 3 indicate that children ages 3–6 whose mother reads to them daily score about 33% of a standard deviation higher on the PPVT test (with similar results when using the other two scales of parent–child reading). The OLS coefficient is much smaller for older children (ages 5–9) using the PIAT reading test scores, where the children who are read to daily score 3% of a standard deviation higher (which is not statistically significant).

A major concern with these results is that differences in the frequency of parent–child reading may be due simply to unobserved heterogeneity across households. One solution used in similar settings is to include family fixed effects. When I include the mother fixed effects, the correlation between parent–child reading and reading test scores shrinks considerably, and is sometimes negative (and statistically significant in one case).

The mechanical bias underlying these fixed effect results relates to the motivations that drives parental investments. The traditional intra-household allocation model of Becker and Tomes (1976) suggests that parents will invest in the child with the highest return and assume that initial endowments and parental investments are complements in the production of child outcomes. Aizer and Cunha (2010) provide evidence that the quality of early mother-child interactions and the likelihood of being enrolled in a preschool are greater for children with a higher initial endowment. In contrast, the results in Table 3 suggest that instead parents engage in compensatory investments by reading more to the child who is doing worse at reading.

As further evidence that these results reflect compensatory investments, I estimated the results in Table 3 using the 1–6 scale separately for children 5–6 and children 7–9. By age seven, nearly all of these children would be enrolled in first grade and would start to receive formal assessment of their reading ability. For the 5–6 year-old sample (as well as the 3–4-year-olds already in Table 3), I find a positive within-family correlation between parent–child reading and reading test scores that are not statistically significant.[6] It is only when I look at the children who are older than age six that I find the strong negative correlation between parent–child reading and reading test scores (the coefficient for this group is -0.039 with a standard error of 0.019).

[6] For the 5-6 year olds, the coefficient on reading scale is 0.041 (with a standard deviation of 0.053).

These results suggest that as parents receive feedback about the reading performance of each of their children, they adjust the frequency of parent–child reading to provide more time to their children that have lower performance. These results also indicate that, in addition to controlling for family-level unobserved heterogeneity using mother fixed effects, it is also important to properly instrument for parent time investments to each child to address the problem of reverse causality.

To deal with this second problem, I exploit the natural variation in time investments discussed earlier as an instrument for how often the mother reads to each child. The results in Table 1 indicate that mothers spend more time reading to their firstborn child at any given age (even for those ages when more than one child is present) and that this birth order gap is larger when the children are spaced further apart. Since the occurrence of a miscarriage, I use birth order and birth order interacted with the occurrence of a miscarriage as instruments for mother-child reading time.

Since birth order may influence child reading performance through other channels besides just differences in parental time investments, I control for the other documented channels through which birth order is likely to affect early child outcomes. For example, first born children are more likely to be born to a teen mother and then generally have a lower birth weight and the second-born child experiences a higher level of family income at each age. In addition, there are small birth order differences in the likelihood of living in a two-parent household or having a mother who works full-time at particular ages. I control for all of these differences in all of the regressions that follow. However, the results only change slightly whether or not these additional controls are included.

When I instrument for how often the mother reads to the child, I find that reading generally has a positive effect on reading scores (though the precision of these estimates are such that only one of them is statistically significant). For example, an extra day of reading each month would raise reading scores by 3.8% of the standard deviation. These estimates based on contemporaneous effects may fail to capture the real impact of parental time investments if the important result of these investments develops as a cumulative effect on child outcomes.

In Table 4, I use measures of reading time based on the average frequency of the mother reading to each child across during the first ten years of life and an outcome measure is based on the child's performance during the ages of ten through thirteen[7]. I use the same controls as Table 3, but replace the contemporaneous measures of the mother's relationship, work status, and log family income with averages of these measures over the same ten-year window as the reading measures.

As before, the fixed effect results without instruments indicate a small or negative relationship between this parental time investment and the child's reading performance. When I instrument for parent–child reading time, I find that these parental time investments have a large and significant positive impact on reading performance. The results indicate that an additional year of daily mother–child reading would increase children's reading tests score by 41% of a standard deviation. Alternatively, if the mother increases the frequency of reading to her child by one day per week during the first ten years of the child's life, the child's reading test scores would increase by about half of a standard deviation.

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[7] These results based on cumulative parental time investments also help deal with the small-window problem that has often been an issue in research on child outcomes (An, Ginther, Haveman, and Wolfe 1996).

IV. Discussion

The results in this paper provide causal estimates of the effect of parent–child reading on the child's performance in reading. While these results are limited to just one type of parental time investment and one type of child outcome, the specific input is thought to be one of the most important parent-child activities and the outcome is one of the most important predictors of how well students will do in school.

The results in this paper provide support for programs designed to increase the number of parents who read books to their children each day. The results also provide insight about the marginal rate of technical substitution between time and money in producing child outcomes. While there have been many studies that estimate the effect of various factors on child outcomes, very few apply the results of their model to estimate the marginal rate of technical substitution between time and money inputs. One example, a study by Hill and O'Neil (1994), uses NLSY data to examine some of the factors that influence PPVT scores. The coefficients Hill and O'Neill report suggest that an extra day each week of mother-child reading is equivalent to about $5,000 extra family income.[8] On days that parents read to their children, they read on average for about 30 minutes (Price 2008). Thus the estimates from Hill and O'Neil imply that an hour of reading produces the same amount of child outcomes as an additional $192 in family income. This rough estimate, though, ignores the unobserved heterogeneity across families.

The results in this paper indicate that adding an extra day per week of parent–child reading in one year (or about an extra 26 hours of parent–child reading) would raise

[8] The coefficient on days/week reading is 1.935, the coefficient on family income is 0.3958, and the coefficient on family income squared is -0.0034.

children's PIAT reading scores by about 5% of a standard deviation. Dahl and Lochner (2008), who use the EITC as an instrument for family income using NLSY data, estimate that an extra $1,000 in family income in one year leads to an increase in PIAT reading scores of 6% of a standard deviation. Combining these estimates suggests that an hour of mother–child reading produces the same change in reading test scores as an additional $32 in family income.[9]

One limitation of this estimate is that the NLSY only provides a measure of mother-child reading. This measure is likely to be a proxy for other parent-child investments that will also have an impact on reading scores. Since this measure provides an underestimate of the amount of parental time investment in the child, the estimate of the value of parental time will be biased upwards.

Another important caveat is that the group of families that provides the identification for the local average treatment effect for these two estimates is quite different. When I restrict the analysis sample to just the set of mothers without a college degree, I find that the estimated coefficient on days per month of reading in the fixed effect IV specification is 0.163 (with a standard error of 0.069). This would provide an implied value of mother–child reading of about $41 per hour for this group.

This calculation of the relative value of parent-child time may be a slight underestimate based on the time horizon of interest. Dahl and Lochner (2008) only found that family income had a contemporaneous effect on child test scores with little evidence that income has a long-run effect on math and reading achievement test scores. The results in this paper suggest that the effects of parent–child reading investments during the first years of life carry over into increased performance even after the mother stops

[9] The $32 per hour comes from ($1,000/6%) divided by (26 hours/5%).

reading to the child. Early childhood reading investments may affect long-run achievement through both a skills-beget-skills channel (Cunha and Heckman 2007) or by increasing the enjoyment that children associate with reading thus increasing their desire to develop better reading skills.[10]

V. Conclusion

Estimating the impact of parental time on child outcomes is a challenge because measures of parental involvement are likely correlated with unobservable parental characteristics that directly influence child outcomes. In addition, parents may adjust their investments to each child in response to a child's achievement. Estimates of family income have a similar problem. Past researchers have dealt with these issues using variation in family income due to tax policies or plant closings.

This paper documents an important pattern in differences in the type of resources received by children in the same family. The firstborn child receives more parental time inputs while the second-born child experiences a higher level of family income at each age. This birth order difference is even larger when the two children are spaced further apart in age. I find evidence that parental time plays an important role in child outcomes since firstborn children have higher reading test scores and birth order differences are larger when the children are further apart in age. In addition, when I use a direct measure of parental time investment (reading aloud to the child) and instrument for this measure using the natural variation due to birth order and birth spacing, I find that reading aloud to children has very large positive effects on their reading test scores.

[10] The development of pleasure connections is similar to the endogenous formation of preferences (Becker and Mulligan 2007).

While the specific findings of this paper should not surprise most parents or educators, the results highlight that conventional approaches to estimating the effect of parental reading can create misleading results. Cross-sectional estimates of the effects of parent–child reading ignore unobserved heterogeneity across families. The traditional solution to this problem (fixed effects) will also be biased since parents invest more time in children who have lower performance. The empirical strategy in this paper provides a way to deal with both problems, allowing researchers to estimate the causal effect of parental time investments. Another advantage of the strategy used in this paper is that this pattern of parent-child time appears to be common across most family types, leading to estimates that provide a fairly general local average treatment effect.

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Table 1. Differences in Inputs by Birth Order and Birth Spacing (two-child families)

A. Time Resources

	ATUS (2003–2008)		NLSY79 (1986–2004) How often mother reads to child.	
	Father Time	Mother Time	Days/Month	Daily reading
second child	-22.070**	-25.193**	-2.595**	-0.079**
	[1.174]	[0.957]	[0.168]	[0.006]
second · spacing	-4.606**	-4.873**	-0.545**	-0.017**
	[0.649]	[0.560]	[0.102]	[0.004]
spacing	1.884**	2.403**	0.090	0.003
	[0.701]	[0.577]	[0.124]	[0.004]
R-squared	0.133	0.173	0.164	0.115
Mean	95.5	113.2	11.3	0.185
N	9,368	14,182	12,613	

B. Money Resources

	Census PUMS (2000)			
	Family Income	<Poverty Line	Lives in a House	#Bedrooms
second child	3,585.7**	-0.0148**	0.0366**	0.1167**
	[137.1]	[0.0007]	[0.0009]	[0.0021]
second · spacing	1,387.7**	-0.0060**	0.0132**	0.0408**
	[78.2]	[0.0005]	[0.0007]	[0.0014]
spacing	-1,077.8**	0.0001	-0.0070**	-0.0236**
	[81.4]	[0.0005]	[0.0007]	[0.0013]
R-squared	0.212	0.282	0.151	0.223
Mean	63,000	0.154	0.762	3.02
N	238,142			

Notes: The ATUS and Census samples are restricted to children ages 4–13 and NLSY sample is restricted to children 0–9. Each regression includes controls for the child's age and gender, as well as the parent's age, race, ethnicity, education, marital status, and work status. The ATUS regression includes a control for weekend/weekday. Birth-spacing has been re-centered at three years. The * and ** indicate statistical significance at 5% and 1% levels, respectively.

Table 2. Differences in Child Outcomes by Birth Order and Birth Spacing.

A. Mother-Fixed Effects

	PIAT reading (ages 5–13)		PPVT (ages 3–6)		PIAT math (ages 5–13)	
second child	-0.148**	-0.154**	-0.133**	-0.146**	-0.018	-0.021
	[0.023]	[0.024]	[0.039]	[0.041]	[0.022]	[0.023]
second · spacing		-0.026		-0.066*		-0.012
		[0.016]		[0.029]		[0.015]
R^2	0.600	0.601	0.820	0.821	0.550	0.550
N	14,560		3,612		14,600	

B. IV Results

	PIAT reading		PPVT		PIAT math	
second child	-	-0.195**	-	-0.186**	-	-0.042
		[0.021]		[0.041]		[0.022]
second · spacing		-0.198**		-0.263		-0.102
		[0.071]		[0.153]		[0.073]
N	14,560		3,612		14,600	

Notes: The outcome measures have been normalized to have a mean of zero and a standard deviation of one. Each regression includes mother fixed effects and controls for the mother's marital status and work status, the child's gender and age, and whether the child was born when the mother was a teenager. Birth-spacing has been re-centered at three years. In the IV results, the instrument for birth spacing is whether the mother experienced a miscarriage between her first and second birth. The first stage of this instrument has an F-statistic of 46.8. The * and ** indicate statistical significance at 5% and 1% levels, respectively.

Table 3. Contemporaneous Effect of Parent–child reading and Children's Reading Scores

A. PPVT (ages 3–6, N=3,056)

	OLS		IV
Daily Reading	0.333***	0.020	4.162
	[0.043]	[0.085]	[7.622]
Days per month	0.019***	0.004	0.096
	[0.002]	[0.004]	[0.127]
1–6 Scale	0.156***	0.051	0.210
	[0.015]	[0.039]	[0.572]
Mother fixed effects	no	yes	yes

B. PIAT reading (ages 5–9, N=6,689)

	OLS		IV
Daily Reading	0.030	-0.011	1.605
	[0.037]	[0.042]	[0.987]
Days per month	0.001	-0.003	0.038*
	[0.002]	[0.002]	[0.023]
1–6 Scale	-0.008	-0.037***	0.235
	[0.011]	[0.013]	[0.145]
Mother fixed effects	no	yes	yes

Notes: The outcome measures have been normalized to have a mean of zero and a standard deviation of one. Each regression includes year fixed effects and controls for the mother's marital status, work status, and education; the household's log income; the child's gender, age, weight at birth; and whether the child was born when the mother was a teenager. The * and ** indicate statistical significance at 5% and 1% levels, respectively.

Table 4. Cumulative Effect of Parent-Child Reading and the Child's PIAT Reading Scores

All mothers (N=5,163)

	OLS		IV
Daily Reading	0.223***	0.101	4.058***
	[0.068]	[0.186]	[1.485]
Days per month	0.008***	-0.000	0.131***
	[0.003]	[0.008]	[0.046]
1-6 Scale	0.041**	-0.069	0.930***
	[0.019]	[0.052]	[0.347]
Mother fixed effects	no	yes	yes

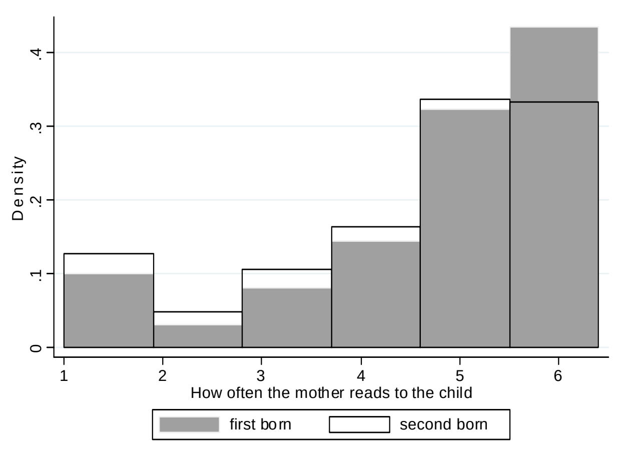
Mothers without a college degree (N=4,320)

	OLS		IV
Daily Reading	0.156**	0.165	5.085**
	[0.077]	[0.227]	[2.109]
Days per month	0.007**	0.002	0.167**
	[0.003]	[0.009]	[0.066]
1-6 Scale	0.035*	-0.062	1.130**
	[0.020]	[0.055]	[0.479]
Mother fixed effects	no	yes	yes

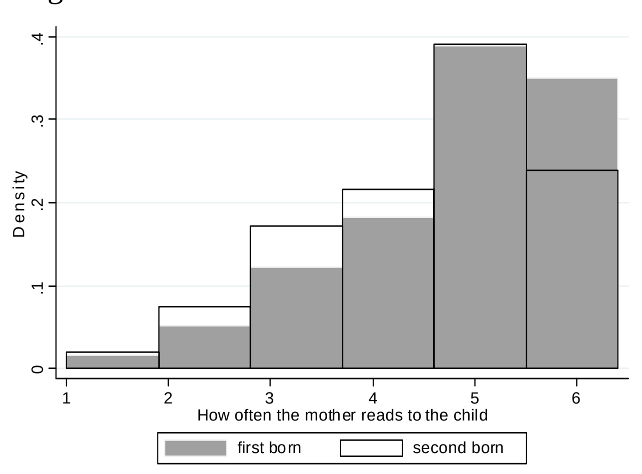
Notes: The outcome measures have been normalized to have a mean of zero and a standard deviation of one. All of the parent-reading measures are averaged across years the child was ages 0-9 and the test scores are based on when the child was ages 10-13. Each regression includes year fixed effects and controls for the mother's education, the child's gender and age, weight at birth, and whether the child was born when the mother was a teenager. Each regression also includes the fraction of years the mother was married, cohabiting, working full-time, and working part-time and the average log income during the child's first 10 years of life. The * and ** indicate statistical significance at 5% and 1% levels respectively.

Figure 1. Birth order differences in the distribution of how often the mother reads to the child

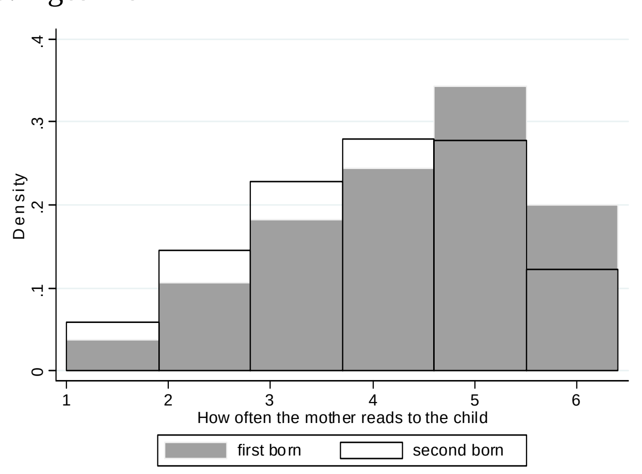
A. Ages 0-3



B. Ages 4-6

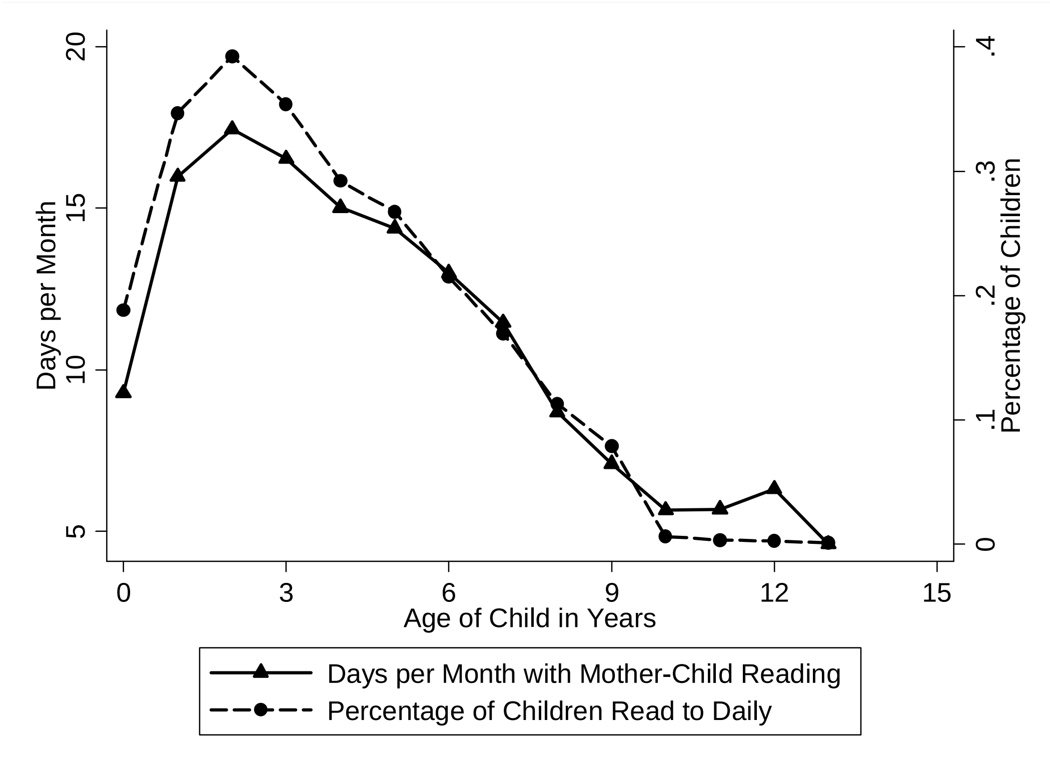


C. Ages 7-8



Notes: Frequency of mother-child reading is reported on a 6 point scale, where 1 indicates never and 6 is daily.

Figure 2. Change in reading time base on the child's age.



Notes: This data is based on the children from two-child families in the NLSY. Both of these measures are based on the 1-6 scale of how often the mother reads to each of her children.