Strategic Parenting, Birth Order and School Performance*

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Abstract

Interest on the effects of birth order on human capital accumulation has recently re-emerged. The debate about its existence seems to be settled, but identification of the main mechanisms remains somewhat elusive. While the latest research aims at rediscovering dilution theory, we advance complementary economic hypotheses regarding the causal mechanisms underlying birth order effects in education. In particular, we entertain theories of differential discipline in which those who are born later face more lenient disciplinary environments. In such contexts, the later born sibling will be likely to exert lower school effort, thus reaching lower performance levels. We provide robust empirical evidence on substantial attenuation parental restrictions for those with higher birth order (born later). We speculate this may arise a) as a result of parental reputation dynamics and/or b) because of the changing relative cost of alternative monitoring and punishment technologies available to parents as well as increasing enforcing costs that must be afforded when multiple children must be monitored at the same time.

1 Introduction and Motivation

Interest on the effects of birth order on human capital accumulation has been reinvigorated by several recent studies (Black, Devereux and Salvanes, 2005; Conley and Glauber, 2006; Gary-Bobo, Prieto and

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Picard, 2006) which present new empirical evidence of birth order effects. For example, Black, Devereux and Salvanes (2005) (BDS, hereafter) find large and robust effects of birth order on educational attainment with Scandinavian data. However, despite the convincing results, the underlying causal mechanisms generating such findings remain somewhat unknown. Indeed, BDS acknowledge:

"...One important issue remains unresolved: what is causing the birth order effects we observe in the data? Our findings are consistent with optimal stopping being a small part of the explanation. Also, the large birth order effects found for highly educated mothers, allied with the weak evidence for family size effects, suggest that financial constraints may not be that important. Although a number of other theories (including time constraints, endowment effects, and parental preferences) have been proposed in the literature, we are quite limited in our ability to distinguish between these models...."

In thinking about children's behavior it is important to remember that parents can resort to a variety a mechanisms to influence it. In particular, they can limit or grant access to important sources of utility for children.

This paper advances two channels of influence that have not been previously considered in the generating process for birth order effects in educational outcomes: we consider differential parental disciplining schemes arising from a) the dynamics of a parental reputation mechanism and/or b) the changing constraints in the technologies associated with enforcement of parenting rules and the implementation of punishment schemes. One channel that can generate birth order effects is characterized in Hao, Hotz and Jin (2008). A key insight of this paper is that birth order effects arise endogenously as the result of viewing parent-child interactions as a reputation game in which parents "play tough" when their older children engage in bad behavior – tougher than caring, or altruistic, parents would prefer – in an attempt to establish a reputation of toughness in order to deter bad behavior amongst their younger children. Thus, we hypothesize that one mechanism that give rise to birth order effects is this form of strategic parenting and responses by their children implied by game-theoretic models of reputation in repeated games, where, in the context of this paper, parents invest in developing a reputation of severe parenting with those born earlier in the hope of inducing their (paternalistic) preferred school effort levels on those born later.

We also consider a second mechanism of parenting that can generate birth order effects. In this case, parents differentially treat children of different ages because the technology of punishment available to parents might change as children grow up. This can happen because older children, who are initially reared alone, are able to interact with their younger siblings, once the latter are born, and such interactions can change the relative costs of alternative punishment schemes that parents might wish to employ. Similarly, their ability to monitor and enforce compliance with parenting rules may diminish when several children need to be overseen at the same point in time.

2 Related Literature

In this section we briefly review the literature on birth order effects and on the links between the effort of students in school and their academic performance and achievement.

There is a substantial literature on birth order effects in education. Zajonc (1976), Olneck & Bills (1979), Blake (1981), Hauser & Sewell (1985), Behrman & Taubman (1986), Kessler (1991), among others, found mixed results that provide support for a variety of birth order theories ranging from the "no-one-to-teach" hypothesis to the theory of differential genetic endowments. However, with the strong birth order effects found in Behrman & Taubman (1986) and, more recently, in Black, Devereux & Salvanes (2005), the literature seems to be settling on the issue of existence and moving towards consideration and sophisticated testing of alternative mechanisms. Indeed, Price (2008) finds empirical support in time use data for a modern version of dilution theory: at least for a limited time, the first born doesn't have to share the available stock of parental quality time input with other siblings whereas those born later usually enjoy more limited parental input as parents are not able to match the increased demand for their "quality" time.[1]

In another strand of research, mostly in Psychology, the issue of birth order effects in IQ has been examined. In particular, Rodgers et al. (2000, 2001) have consistently sided against the existence of such a relationship and they have criticized studies for confounding "within-family" and "between-family" processes and by attributing to the former, patterns that are actually shaped by the latter. More recently, Black, Devereux & Salvanes (2007) and Bjerkedal, et al. (2007) find strong and significant effects of birth order on IQ within families in a large dataset from Norway but Whichman, Rodgers & McCallum (2006) insist, using a multilevel approach, that the effects only arise between families and they disappear within the family. The debate remains open as Zajonc & Sulloway (2007) criticize Whichman, Rodgers & McCallum (2006) on several grounds and reach the opposite conclusion. Finally, Whichman, Rodgers & McCallum (2007) address the issues raised by Zajonc & Sulloway (2007) and confirm their previous findings.

There is also a sizeable literature on the links between students' effort in school and their academic

[1] See Lindert (1977) for a related approach exploiting time use data.

performance (see, for example, Natriello and McDill (1986); Wolters (1999); and Covington (2000); Stinebrickner and Stinebrickner (2006)), in which a common measure of student effort is self-reports of number of hours spent on homework. There appears to be a fairly clear consensus in this literature that greater student effort improves academic performance. For example, Stinebrickner & Stinebrickner (2006) show the importance of actual school effort on school performance. But our understanding of how the factors that lead to greater student effort and how such effort interacts with other features of a student's home and school environments is less clear. Relevant to this paper, there is a literature on the relationship between parenting and parental involvement and student effort and, ultimately, performance (see Trautwein and Koller (2003); Fan and Chen, (2001); Hoover-Dempsey, et al. (2001)). Most of this literature does not model or account for the endogenous nature of how the amount of school effort exerted by children is affected by parental incentives and policy instruments (i.e. whether it can be manipulated by the more economic, incentive-based side of parenting in the same way that criminal behavior can be influenced by the criminal justice system or savings and labor supply can be manipulated by different tax schemes). An exception to this shortcoming of the literature is a recent paper by De Fraja, D'Oliveira and Zanchi (2005). These authors develop an equilibrium model in which parents, schools and students interact to influence the effort of students and their performance and test this model using data from the British National Child Development Study. At the same time, the De Fraja, D'Oliveira and Zanchi (2005) does not characterize the potential informational problems that parents have in monitoring their children's input and the potential role of strategic behavior on the part of parents in attempting to influence the children's effort. Our paper attempts to fill this deficit in the literature.

As noted above, we draw on the game-theoretic literature on reputation models. Such models were initially developed in the industrial organization literature in response to the chain store paradox of Selten (1978). In particular, Kreps and Wilson (1982) and Milgrom and Roberts (1982) developed models in which the introduction of a small amount of incomplete information gives rise to a different, more intuitive type of equilibrium. Hao, Hotz & Jin (2008) pioneered the use of this type of models in a family context to analyze teenage risk-taking behavior.

3 Theories of Birth Order Effects

There are several alternative causal hypotheses in the literature trying to explain the relationship between birth order and schooling. First, there could be parental time dilution. Under this hypothesis, the earlier born siblings enjoy more parental time than later-born siblings. This may explain why earlier-borns do better in school. Second, there could be genetic endowment effects. Indeed, later-born siblings are born to older mothers so they are more likely to receive a lower quality genetic endowment. Third, first-borns may "reveal" the utility from parenting. According to this theory, a bad draw (i.e. a difficult to raise, problematic child) may lead to fertility stoppage. This will induce selection in the quality of the last child, being of lower quality than the average. Fourth, closely related to the "confluence model" of Zajonc, the "no one to teach" hypothesis postulates that the last born will not benefit from teaching a younger sibling. Without this pedagogic experience, the last born will not develop strong learning skills. Fifth, it may well be possible that the later-born siblings are more affected by family breakdown. BDS (2005) re-estimate their models in a sample of intact families and find no support for such hypothesis.[2]. Last, but not least, first-borns may enjoy higher parental investment for insurance purposes or simply because parents are more likely to enjoy utility from observing their eventual success in life.

While all the above theories predict that earlier born siblings will do better, it is worth noting that it is possible that the effect can go in the other direction. For example, parents might learn to teach better. In this case, parents commit mistakes with those born earlier but they are more proficient, experienced parents when the later born siblings need to be raised. It also can be the case that, if there are financial constraints, the later-born siblings might be raised at time in which parental resources are more abundant.

Without taking away the merits of the previous literature, below we provide a novel, complementary mechanism that can induce birth order effects in school performance. This channel is more economic, in that it highlights the role of incentives faced by children to perform well in school as well as the reputation concerns of lenient parents.

4 A Dynamic Model of Parental Reputation and Child School Performance

Consider a finite horizon game between parents and children being played in families with more than one child. Consider a long lived player (the parent) facing a new short lived player (the child) in every round of the game. In each round, the parent and the child observe the entire history of play. In particular, they observe the choices made by earlier born-siblings and the punishment decisions made by the parents when older siblings realized low levels of school performance. Parents can be of one of two types. With some prior probability, $\widehat{\mu}^T$, the parent is a commitment type (tough parent) that will always punish low

[2] See Ginther & Pollak (2003) for an analyis of the relation between family structure and education outcomes.

school performance. With probability $1 - \widehat{\mu}^T$, the parent is lenient and dislikes punishing the children. Of course, the history observed at any given point in time will not be informative about parental type if older siblings have always done well in school and $\widehat{\mu}^T$ will go unrevised. If $\widehat{\mu}^T$ is sufficiently small, the first-born child would prefer to exert low school effort if she is certain that a lenient parent would not punish such behavior. The prior beliefs about parental type are updated sequentially in a Bayesian fashion by siblings that come later in the birth order. In round t, the parent is believed to be tough with probability $\widehat{\mu}^t$.

It can be shown that a sequential equilibrium for this finitely repeated game exists. The critical event in the game is the observation of leniency upon low school performance at any given round t. If parents reveal themselves to be of the lenient type by not punishing the poor school performance of one of their children, $\widehat{\mu}^t$ drops to zero and remains there until the end of the game. From then on, the parents' children will fear no punishment from their revealed-to-be-lenient parent whose threats are no longer credible.

The equilibrium gives rise to 3 phases of the repeated game. In the first phase, played by earlier born siblings, uncertainty about parental type and threat of punishment induces these children to exert high levels of effort in school to deliver good school performance and prevent the triggering of potential punishments coded in the parenting rule. In this phase, bad grades will translate into loss of privileges anyway. If a parent is tough, he will punish by principle. If the parent is lenient, he will punish to invest in and/or maintain a reputation for toughness to prevent later born children from taking advantage of his leniency. As a result, we expect earlier born children playing mostly through this initial phase of the equilibrium to do better in school.[3] As the rounds of the game proceed, the number of remaining children at risk to play the game declines. At some point, the reputation benefits of punishment for a lenient parent do not cover the disutility of witnessing their child's suffering. Depending on how small $\widehat{\mu}^T$ is and how few children remain in the sequence, it will be likely for some children in the middle of the sequence to "test the waters" by exerting low school effort and exploring what happens in response. After the first parental accommodating-behavior is observed, the final phase is triggered in which later born siblings do not put effort in school and go unpunished.

The model delivers some predictions that can be taken directly to the data. In particular, according to the model, earlier-born siblings are more likely to put more effort in school and should end up doing

[3] Here we rely on results from Stinebrickner & Stinebricker (2006) that emphasize the importance of study effort in determining school performance.

better. Moreover, parents are more likely to establish rules of behavior with the earlier-born, engage in a more systematic monitoring of earlier-born's schoolwork, increase supervision and limit privileges of the earlier-born in the event of low school performance.

5 The Data

We exploit data from the Children of NLSY79 female respondents (NLSY-C). In particular, we are able to observe the whole fertility history of NLSY79 females so we can potentially observe all of their children. Crucially, many of these females have 2 or more children so we are able to directly explore birth order effects that arise in these families. Due to limited sample sizes, however, we limit most of our analysis to families that have between 2 and 4 children.

TV watching and, more recently, video gaming are time intensive activities that usually crowd-out, at least partially, the time that could be used for homework or study. Indeed, there exist a vast literature in psychology documenting the detrimental effects of TV watching on school performance. Therefore TV viewing and videogaming are natural places to look for parental discipline schemes. Children value these activities highly and parents may be able to enforce and monitor restrictions on their access.

Useful for our purposes, the NLSY-C includes some detailed information on parenting. Several questions ask the mother and/or the children about different features about the parent-child relationship. We also exploit other parenting rules as reported by the children and/or the mother. Crucially, we are able to observe multiple self-reports from the same mother about all of her kids, and we observe those at two and sometimes three points in time. We restrict the analysis to children between the ages of 10 and 14. Since birth order is time invariant, we do not exploit the longitudinal nature of the data in our analysis. However, having repeated observations of parenting rules applied to each child over time allows us to identify changing parenting strategies.

On the other hand, the NLSY-C does not have systematic information on grades except for a specific supplemental school survey fielded in 1995-96 about school years 1994-95. However, the NLSY-C includes a self-report about how the mother thinks each of her children is doing in school. The specific question is: "Is your child one of the best students in class, above the middle, in the middle, below the middle, or near the bottom of the class?" Useful for our purposes the same questions are asked of the mother separately for each child and in several waves. Note that even when these self-reports could be validated against school transcripts, it can be argued that it is the parental subjective belief about the child's performance what really matters at the end. We do, however, validate mother's perceptions below, exploiting limited transcript data from the 1995-96 School Supplement.

6 Birth Order Effects in (Perceptions of) Academic Success

Table 1 and Figure 1 show that there exists a clear association between school performance (as perceived by the mother) and birth order. Since the NLSY-C has very few observations coming from families with more than four siblings we focus our analysis on families with 2, 3 or 4 children. The table shows that while 33% of first born children are considered "one of the best in the class" only 25% of those 4th in the birth order reach such recognition. On the other hand, only 7.5% of first-borns are considered "below the middle or at the bottom of the class", while 12.2% of 4th-borns are classified in such manner by their mothers.

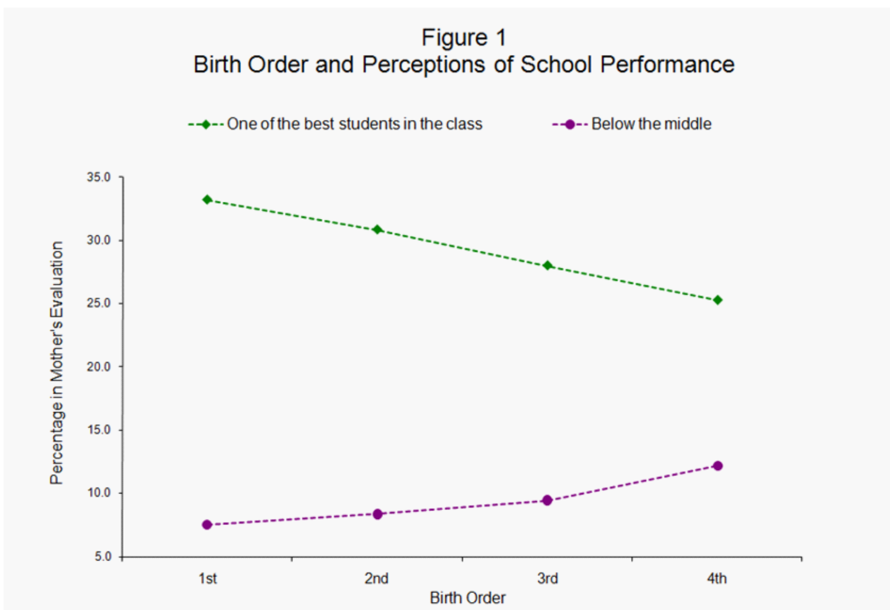
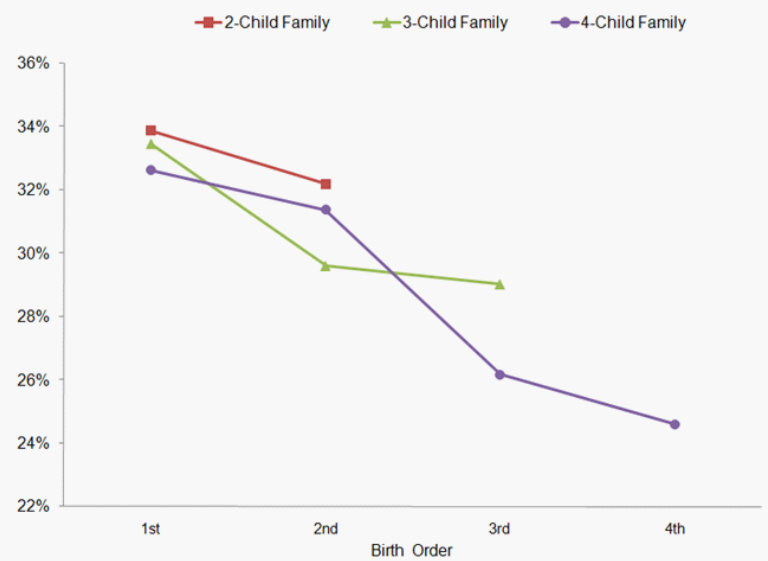


Table 1: Mother´s Evaluation of Child´s Academic Standing by Birth Order

	Birth Order			
	1st	2nd	3rd	4th
One of the best students in the class	33.2	30.9	28.0	25.3
Above the middle	24.9	24.3	24.5	23.1
In the middle	34.4	36.5	38.0	39.5
Below the middle	5.7	6.3	7.3	8.8
Near the bottom of the class	1.9	2.0	2.1	3.4
Total	100	100	100	100

One possible concern with the results in Table 1 is that there is that they may confound birth order and family size effects, an issue that has been recognized very early in the development of the birth order literature. Figure 2 below explores birth order effects within family of specific sizes. Higher birth orders, by construction, belong in families of bigger size. As pointed out by Berhman & Taubman (1986), such families locate themselves at a different locus of the quantity-quality trade-off. Therefore we risk attributing to birth order what really comes from family size. As can be seen in the figure, birth order effects appear to persist in all these families, regardless of size.

Figure 2
Birth Order, Family Size and % Perceived at the Top of the Class



A second concern with the results above is that they show clear evidence of inflation in perceived school performance (i.e her assessments appear to show a mother's Lake Wobegon effect about their own children. However, this need not be a problem, per se, as long as the sign and magnitude of these misperceptions do not vary with birth order. In Table 2 below, we validate maternal perceptions. Higher GPAs of children obtained in the School Supplement are associated with significantly lower chances of being perceived to be at the bottom of the class and significantly higher chances to be classified as one of the best students in the class. Re-estimating the same models including birth order measures show that misperceptions (the differences between perceived and actual performance) are not correlated with birth order. Therefore, to the extent that mothers are too optimistic about their own children performance but they are so for all of their own children, we account for this mother specific bias when we include family fixed effects in our models of perceived school performance.

Table 2: Validating Mother's Perception of School Performance

	Ordered Probit		Probit		LPM by OLS	
	linear	non-parametric	linear	non-parametric	linear	non-parametric
GPA	-0.499***		0.188***		0.168***	
	[0.092]		[0.041]		[0.034]	
GPA=2		-0.902***		0.357**		0.191**
		[0.257]		[0.177]		[0.082]
GPA=3		-0.976***		0.423***		0.266***
		[0.259]		[0.158]		[0.079]
GPA=4		-1.870***		0.678***		0.557***
		[0.304]		[0.119]		[0.101]
Birth Order	0.063	0.074	-0.062	-0.065	-0.043	-0.051
	[0.114]	[0.119]	[0.054]	[0.055]	[0.046]	[0.047]
Observations	180	180	180	180	180	180

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Ordered Probit uses 1=Top, 2=Above Middle, 3=Middle, 4=Below Middle, 5 =Bottom. Probit and LPM use 1=Best, 0=otherwise. Controls include Age and Gender. In non-parametric specifications GPA=1 is the ommited category.

More formally, we follow BDS (2005) and explore birth order effects in academic performance by estimating the following two linear models for the probability that the child i in family h is being considered by his/her mother to be one of the best students in the class. The first specification imposes linearity while the second is more non-parametric in the sense that it allows different effects for different birth orders

$$\text{Best Student}_{ih} = NYG_i + X_i\beta + \lambda_h + \varepsilon_i \qquad (1)$$

$$\text{Best Student}_{ih} = \sum_k \alpha_k \text{ Birth Order}_{ki} + X_i\beta + \lambda_h + \varepsilon_{ih} \text{ k=2,3,4}$$

where X_i includes controls for child's age, survey year (and family size when pooling all families). NYG_i is the number of younger siblings, a measure of birth order that imposes linearity. Birth Order_{ki} is a dummy variable which equals one when respondent i is the k^{th} child born in the the family, and equals zero otherwise. λ_h denote family fixed effects.

Tables 3 and 4 show the results of estimating the model in (1) for all families and then for families with 2, 3 or 4 children separately. In column one the specification imposes linearity of birth order and uses the number of younger siblings as a measure of birth order. In columns 2 to 5, all birth order coefficients are relative to the first born, which is the omitted category. As can be seen in Table 3, there exist strong birth order effects in all families.

Table 3: Effect of Birth Order on the Probability of Being Perceived as One of the Best Students. OLS.

	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	0.054***				
	[0.006]				
Second Child		-0.057***	-0.053***	-0.066***	-0.053**
		[0.010]	[0.014]	[0.017]	[0.026]
Third Child		-0.107***		-0.089***	-0.140***
		[0.015]		[0.020]	[0.028]
Fourth Child		-0.158***			-0.178***
		[0.026]			[0.031]
Observations	11532	11532	4809	4433	2290

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. The specifications pooling all families include family size indicators. Linear Probability Models. Dependent Variable =1 if Mother thinks child is one of the best students in the class, =0 otherwise.

Moreover, when we estimate (1) controlling for family fixed effects the birth order results remain. See Table 4 below.

Table 4: Effect of Birth Order on the Probability of Being Perceived as One of the Best Students. Family Fixed Effects

	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	0.041***				
	[0.011]				
Second Child		-0.049***	-0.072***	-0.037*	-0.049*
		[0.014]	[0.024]	[0.021]	[0.029]
Third Child		-0.085***		-0.027	-0.120***
		[0.024]		[0.034]	[0.042]
Fourth Child		-0.110***			-0.151***
		[0.037]			[0.056]
Observations	11532	11532	4809	4433	2290
Number of Families	2693	2693	1391	915	387

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications pooling all families include family size indicators. Linear Probability Models. Dependent Variable =1 if Mother thinks child is one of the best students in the class, =0 otherwise.

7 Birth Order Effects in Incentives

In this section, we explore at a descriptive level whether birth order effects may arise because of differential parental treatment. We ask whether the data shows any sign of differential parental toughness by birth order. First, we estimate ordered probit models for our categorical variable on the likelihood of getting TV time limited by parents[4]

$$\text{Limit TV time}_i = \begin{cases} \text{Never} & \text{if} & & \text{Limit}_i^* & < \mu_0 \\ \text{Rarely} & \text{if} & \mu_0 < & \text{Limit}_i^* & < \mu_1 \\ \text{Sometimes} & \text{if} & \mu_1 < & \text{Limit}_i^* & < \mu_2 \\ \text{Often} & \text{if} & \mu_2 < & \text{Limit}_i^* & \end{cases} \qquad (2)$$

where

$$\text{Limit}_i^* = \sum_k \gamma_k \text{Birth Order}_{ki} + \delta X_i + \varepsilon_i \qquad (3)$$

Table 5 shows estimates from this ordered probit model for parental toughness.

Table 5: Effect of Birth Order on the Frequency TV limitations (Ordered Probit)

	All Families	All Families	2-child Family	3-child Family	4-child Family	All Families (Family Random Effects)
# of Younger Sibs	0.109***					0.112***
	[0.019]					[0.022]
Second Child		-0.138***	-0.151***	-0.088	-0.221**	
		[0.031]	[0.041]	[0.055]	[0.099]	
Third Child		-0.216***		-0.168***	-0.303***	
		[0.044]		[0.058]	[0.099]	
Fourth Child		-0.306***			-0.392***	
		[0.077]			[0.105]	
Observations	6684	6684	2911	2518	1255	6684

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Categorical Dependent Variable with 4 categories: Never, Rarely, Often, Always. All models include indicators for child's age and survey year. Specification pooling all families includes family size indicators.

As can be seen in the table, the frequency of TV time limitations declines with birth order. Those born first tend to face stricter disciplinary standards regarding this activity (i.e. parents tend to be

[4] OLS and Fixed Effects estimates for models with dichotomous versions of the same dependent variable generate the same pattern of birth order effects.

more tough/severe on them when it comes to the child's TV time) . Similarly, parents seem to be increasingly lenient with those born later. Column 6 includes estimates from the same ordered model for all families but allowing for family random effects. The estimated birth order effects and its precision is little changed.

Table 6 show OLS and Family Fixed Effects estimates of the same model with a dichotomous variable which equals one if parents often limit TV time, and equals zero otherwise. The OLS results are, again, strikingly similar. They support the existence of differential disciplinary schemes which are strongly linked to birth order. However, the fixed effect estimates show consistent signs but the effects are no longer significant.

Table 6: Effect of Birth Order on the Probability of Having TV time Limited (OLS and Family Fixed Effects)

	OLS					Family Fixed Effects				
	All Families	All Families	2-child Family	3-child Family	4-child Family	All Families	All Families	2-child Family	3-child Family	4-child Family
# of Younger Sibs	0.027***					0.016				
	[0.007]					[0.018]				
Second Child		-0.041***	-0.042***	-0.028	-0.082**		-0.029	-0.015	-0.02	-0.097**
		[0.011]	[0.015]	[0.020]	[0.036]		[0.020]	[0.036]	[0.031]	[0.047]
Third Child		-0.056***		-0.039*	-0.086**		-0.031		-0.002	-0.096
		[0.016]		[0.021]	[0.036]		[0.036]		[0.053]	[0.066]
Fourth Child		-0.068***			-0.093**		-0.042			-0.101
		[0.026]			[0.038]		[0.057]			[0.093]
Observations	6684	6684	2911	2518	1255	6684	6684	2911	2518	1255
Number of Families						2143	2143	1084	738	321

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All models include indicators for child's age and survey year. Specification pooling all families includes family size indicators. Linear Probability Models.
Dependent Variable =1 if parents always limit TV time, =0 otherwise

Below we provide additional evidence consistent with some of the predictions delivered by the reputation model and discussed in section 4. While evidence in Table 6 is somewhat mixed, Table 7 shows that there are strong birth order effects in the existence of rules about TV watching. In this case, the results are robust to the introduction of family fixed effects. Earlier-born siblings seem to grow up in a more regulated environment regarding TV relative to their later-born counterparts.

Table 7: Existence of Rules about Watching TV and Birth Order. (OLS and Family Fixed Effects)

	OLS					Family Fixed Effects				
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	0.047***					0.034**				
	[0.007]					[0.014]				
Second Child		-0.052***	-0.077***	-0.039**	-0.012		-0.028*	-0.014	-0.027	-0.02
		[0.012]	[0.016]	[0.019]	[0.030]		[0.017]	[0.029]	[0.026]	[0.035]
Third Child		-0.103***		-0.118***	0.001		-0.071**		-0.106**	-0.04
		[0.017]		[0.023]	[0.034]		[0.029]		[0.042]	[0.053]
Fourth Child		-0.110***			-0.042		-0.100**			-0.121*
		[0.032]			[0.039]		[0.048]			[0.072]
Observations	9665	9665	4004	3745	1916	9665	9665	4004	3745	1916
Number of Families						2548	2548	1298	874	376

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications for all families include family size indicators. Linear Probability Models. Dependent Variable =1 if there are rules about watching TV, =0 otherwise.

In Tables 8 and 9 we provide evidence of birth order effects in how intensely parents monitor a child's homework. Consistent with the reputation model, earlier born siblings face more intense, systematic parental scrutiny regarding homework. Parents who are prepared to punish in the event of low school performance are more likely to seek more information on how much effort is being exerted by their children on homework. Moreover, more intense monitoring conveys more credibility to the threat of punishment. Table 8 report results from Ordered Probit models that fully exploit all the variation in the categorical dependent variable. Table 9 shows OLS and Family Fixed Effects estimates based upon a binary version of the dependent variable which equals one when the monitoring is most intense (daily checks on homework)[5].

[5] The actual question is "*How often do your parents check on whether you have done your homework?*" Allowed answers include: Never, Less than once a month, 1-2 times a month, 1-2 times a week, Almost every day, Every day.

Table 8: Intensity of Homework Monitoring and Birth Order (Ordered Probit)

	How Often Parents Check Homework is Done?					
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families (Family Random Effects)
# of Younger Sibs	0.044**					0.052**
	[0.019]					[0.022]
Second Child		-0.073**	-0.083**	-0.031	-0.141	
		[0.032]	[0.042]	[0.057]	[0.100]	
Third Child		-0.089**		-0.098	-0.042	
		[0.045]		[0.061]	[0.098]	
Fourth Child		-0.103			-0.082	
		[0.076]			[0.104]	
Observations	6629	6629	2893	2487	1249	6629

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. a This specification includes family size indicators. In Linear Probability Models. Categorical Dependent Variable with increasing categories of monitoring intensity.

Table 9: Intensity of Homework Monitoring and Birth Order. (OLS and Family Fixed Effects)

	OLS					Family Fixed Effects				
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	0.016*					0.037*				
	[0.008]					[0.022]				
Second Child		-0.032**	-0.034*	-0.021	-0.058		-0.063**	-0.028	-0.071*	-0.125**
		[0.014]	[0.018]	[0.025]	[0.044]		[0.025]	[0.047]	[0.037]	[0.059]
Third Child		-0.032		-0.028	-0.045		-0.076*		-0.109*	-0.1
		[0.019]		[0.026]	[0.044]		[0.046]		[0.065]	[0.085]
Fourth Child		-0.031			-0.04		-0.091			-0.116
		[0.034]			[0.047]		[0.070]			[0.116]
Observations	6629	6629	2893	2487	1249	6629	6629	2893	2487	1249
Number of Families						2138	2138	1082	735	321

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year.Specifications for all families include family size indicators. In Linear Probability Models. Dependent Variable =1 if parents check homework everyday, =0 otherwise.

Tables 10 and 11 show strong birth order effects on the likelihood that parent would increase supervision in the event of low school performance. The question is asked to the mother and is a scenario question, not a self report about behavior. In this sense, it provides an interesting complement to more standard data on observed behavior because it essentially recovers the parental "reaction function" directly, even in cases in which the child does well in school and never triggers the eventual punishment. Again, Table 10 shows estimates from an ordered probit model that exploit the variation in the categorical dependent variable.[6] In Table 11 we work with a dichotomous version of the dependent variable which equals one if mother would be very likely to keep a closer eye on the child in the event of low school performance and zero, otherwise. This allows us to easily control for family fixed effects.

Table 10: Likelihood of Increased Supervision in the Event of Low Grades and Birth Order (Ordered Probit)

	How Likely to Supervise more Closely if Low Grades ?					
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families (Family Random effects)
# of Younger Sibs	0.060***					0.093***
	[0.019]					[0.026]
Second Child		-0.049	-0.078*	-0.036	0.015	
		[0.032]	[0.046]	[0.053]	[0.077]	
Third Child		-0.121***		-0.159***	-0.003	
		[0.046]		[0.062]	[0.086]	
Fourth Child		-0.192**			-0.13	
		[0.080]			[0.099]	
Observations	10468	10468	4346	4031	2091	10468

Robust standard errors in brackets.* significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications for all families include family size indicators. Categorical Dependent Variable denoting increasing likelihood of parents closer supervision in the event of low school performance.

[6] The specific question we exploit in this context is the following : "*If (Child) brought home a report card with grades lower than expected, how likely would you (the mother) be to keep a closer eye on [his/her] activities?*" Allowed answers were: Not At All Likely, Somewhat Unlikely, Not Sure How Likely, Somewhat Likely, Very Likely.

Table 11: Likelihood of Increased Supervision in case of Low Grades and Birth Order (OLS and Family Fixed Effects)

	OLS					Family Fixed Effects				
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	0.017***					0.021*				
	[0.006]					[0.011]				
Second Child		-0.012	-0.021*	-0.006	0.007		-0.007	-0.021	-0.008	0.019
		[0.009]	[0.012]	[0.015]	[0.026]		[0.012]	[0.021]	[0.019]	[0.028]
Third Child		-0.036***		-0.046**	0.000		-0.039*		-0.068**	0.022
		[0.014]		[0.018]	[0.028]		[0.022]		[0.031]	[0.044]
Fourth Child		-0.053**			-0.035		-0.077**			-0.006
		[0.026]			[0.032]		[0.037]			[0.058]
Observations	10468	10468	4346	4031	2091	10468	10468	4346	4031	2091
Number of Families						2646	2646	1365	900	381

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

All regressions include indicators for child's age and year. Specification for all families include family size indicators. In Linear Probability Models. Dependent Variable =1 if parents are very likely to supervise more closely in the event of low grades, =0 otherwise.

Finally, Table 12 presents estimates for the outcome of whether privileges have been limited because of poor grades. The question here is asked of each different child and since the actual question is more related to observed limitations in privileges we expect only the kids who actually are perceived to be doing not so well in school to be the ones reporting loss of privileges. We then estimate the following model

$$\text{Limit Privileges}_i = \beta_0 + \beta_1 B_i + \beta_2 NYG_i + \beta_3 B_i \times NYG_i + \delta X_i + \varepsilon_i \qquad (4)$$

where $B_i = 1$ if the child is perceived to be doing bad in school (below the middle of the class) and NYG_i is our measure of birth order indicating the number of younger siblings. In this context, we expect the coefficient β_3 on the interaction term $B_i \times NYG_i$ to be positive and to capture the prediction of the reputation model: earlier-born siblings should be more likely to report a loss of privileges relative to later-born siblings, *only when they do bad in school.*[7]

As can be seen in the last column of Table 12, the family fixed effects estimates of β_3 are positive with a point estimate of 0.124 that is significant at 5%.

[7] Note that the results in columns 6 and 12 of Table 7 should be interpreted with caution as they do not control for the endogeneity of B.

Table 12: Observed Limits to Priviliges because of Low Grades and Birth Order (OLS and Family Fixed Effects)

	OLS						Family Fixed Effects					
	All Families	All Families	2-Child Families	3-Child Families	4-Child Families	All Families	All Families	All Families	2-Child Families	3-Child Families	4-Child Families	All Families
# of Younger Sibs	-0.028***					-0.029***	-0.056***					-0.058***
	[0.008]					[0.008]	[0.019]					[0.020]
Second Child		0.037***	0.026	0.056**	0.041			0.050**	0.079*	0.062*	0.019	
		[0.014]	[0.018]	[0.024]	[0.044]			[0.023]	[0.041]	[0.034]	[0.053]	
Third Child		0.062***		0.084***	0.029			0.114***		0.138**	0.009	
		[0.019]		[0.025]	[0.043]			[0.041]		[0.059]	[0.078]	
Fourth Child		0.061*			0.042			0.171***			0.035	
		[0.033]			[0.046]			[0.062]			[0.107]	
Bad Grades						-0.067						-0.160**
						[0.062]						[0.081]
Bad Grades x # of Younger Sibs						0.051						0.124**
						[0.053]						[0.062]
Observations	6579	6579	2855	2492	1232	6579	6579	6579	2855	2492	1232	6579
Number of Families							2134	2134	1077	738	319	2134

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications for all families include family size indicators. In Linear Probability Models. Dependent Variable =1 if child reports that parents limited priviliges when low grades, =0 otherwise

While many of the previous results are consistent with predictions from the reputation model, we can also test for other mechanisms that may generate birth order effects in performance. For example, we can provide a test of the dilution theory by looking at whether the frequency of parental help with homework varies with birth order. Dilution theory predicts that at any given age of the child, parents will help earlier born siblings more frequently. In Table 13, we show that there appear to be no birth order effects on the frequency of parental help with homework. Earlier-born siblings seem to benefit from the same level of parental input in this regard.

Table 13: How Often Parents Help with Homework and Birth Order. Ordered Probit

	How Often Parents Help with homework?					
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families (Family Random Effects)
# of Younger Sibs	-0.028					-0.022
	[0.018]					[0.022]
Second Child		0.009	-0.02	0.07	-0.023	
		[0.030]	[0.039]	[0.053]	[0.096]	
Third Child		0.062		0.139**	-0.019	
		[0.042]		[0.056]	[0.094]	
Fourth Child		0.09			0.054	
		[0.074]			[0.100]	
Observations	6640	6640	2897	2488	1255	6640

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications for all families include family size indicators. Child'sselfreported categorical Dependent Variable with categories denoting increasing frequency of parental help with homework.

In the first five columns of Table 14 we show OLS estimates for the same model and, if anything, the children who benefit the most from parental help with homework seem to be later-born siblings. The more robust fixed effects estimates in last five columns, however, show no relation between birth order and frequency of parental help with homework as reported by the children.

Table 14: How Often Parents Help with Homework and Birth Order. (OLS and Family Fixed Effects)

	OLS					Family Fixed Effects				
	All Families	All Families	2-Child Family	3-Child Family	4-Child Family	All Families	All Families	2-Child Family	3-Child Family	4-Child Family
# of Younger Sibs	-0.012*					0.024				
	[0.007]					[0.017]				
Second Child		0.015	0.01	0.023	0.01		-0.026	0.011	-0.034	-0.053
		[0.011]	[0.015]	[0.018]	[0.034]		[0.019]	[0.037]	[0.028]	[0.042]
Third Child		0.025*		0.048**	-0.017		-0.055		-0.086*	-0.087
		[0.015]		[0.020]	[0.033]		[0.035]		[0.049]	[0.061]
Fourth Child		0.029			0.016		-0.056			-0.088
		[0.026]			[0.035]		[0.055]			[0.086]
Observations	6640	6640	2897	2488	1255	6640	6640	2897	2488	1255
Number of Families						2140	2140	1083	736	321

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
All regressions include indicators for child's age and year. Specifications for all families include family size indicators. Linear Probability Models. Dependent Variable =1 if parents often help with homework, =0 otherwise.

8 Directions for Future Research

In future work, we plan to examine the consistency of our data with other theories of birth order (i.e. dilution) that might complement the effects arising from differential birth order discipline. In particular, some of the predictions of the reputation model, such as the more intense homework monitoring of earlier born siblings, cannot be distinguished from the predictions of a time dilution model. In that sense, we plan to test whether birth order effects reflect a parental reputation mechanism or merely reflect changes in the relative costs of implementing, enforcing and monitoring a given disciplinary scheme over an increasing number of children of different ages at the same point in time.

Also, while family fixed effects account for time invariant characteristics of the family, they do not capture dynamic processes within the family that vary over time and are correlated with birth order and may affect school outcomes. In particular, later born siblings are more likely to be affected by family breakedown. The NLSY sample provides ample opportunities to control for family structure as a potential determinant of birth order effects.

The available data also allows us to estimate a structural version of the full reputation game. To proceed in that direction, we will have to specify the structure of the dynamic game. In particular, functional forms for payoffs, prior beliefs and the updating rule must be parameterized while allowing for rich forms of observed and unobserved heterogeneity. The solution to the dynamic reputation game can then be embedded in a estimation algorithm that should match the predictions of the game to the observed behavior in the NLSY families. Note that since we are able to observe the parental policy function over the last child we, as econometricians, are in a privileged position of knowing parental type. That is, we can readily identify severe parents when they report to be willing to punish the last born sibling in the event of low school performance. The estimated model can then be used to answer a number of interesting questions. The key counterfactual question of interest would be about school performance when kids are fully informed about parental type. In particular, we expect school performance to be lower as kids take advantage of altruistic-forgiving parents and don't put effort in school given that punishment threat by parents is no longer credible. This counterfactual provides a quantitative measure of the effects of "responsible" parenting in school performance. We also can explore whether birth order effects persist in this "complete information" scenario. We also can use the estimated game to endow children in high-risk groups with different priors, enough to induce their parents to build and maintain severe reputations. We can then ask whether the achievement gap across groups declines.

9 Conclusions

We contribute to the literature on birth order effects in human capital accumulation by showing that those born earlier are perceived to perform better in school. A validation of perceptions using actual transcript data shows that these findings do no reflect Lake Wobegon effects or, more importantly, any differential performance misperception by birth order. Our results are robust to controls for family size and, more generally, to the inclusion of family fixed effects.

We provide evidence consistent with parental reputation incentives generating birth order effects in school performance. In particular, earlier born siblings are more likely

- to be subject to rules about TV watching
- to face more intense parental monitoring regarding homework
- to suffer loss of privileges because of low grades.

Moreover, mothers themselves report being more likely to increase supervision in the event of low school achievement when the child in question was born earlier.

While further research is needed to rule out alternative explanations associated with changing cost and technologies of alternative parenting strategies as sibships grow we believe that results indicate that parental reputation dynamics may explain part of the observed birth order effects in school performance.

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