Dynamic Effects of Sibling Death on Children's Outcomes[1]

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Abstract

This paper explores the effects of experiencing the death of a sibling on children's outcomes. Recent work has shown that experiencing a sibling death is common and the long-term effects are large. We extend our understanding by estimating the dynamic effects on cognitive, non-cognitive and home environmental measures as the surviving children age using the Longitudinal Survey of Youth 1979 (NLSY79). We first examine the family level predictors of experiencing the death of a child. Because families who experience a death may differ from other families, we compare the trajectories of children before and after experiencing a sibling death only among families who experience a death. We find large initial effects on cognitive and non-cognitive outcomes that decline over time and also provide evidence that the effects are larger if the surviving child is older, suggesting sensitive periods of exposure. Auxiliary results suggest that parental inputs decline following the death but also that, for some families, children's outcomes rebound following the death of a sibling who had significant disabilities.

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Introduction

In 2010, more than 45,000 children under the age of 20 died in the United States with the highest rates among infants and those 15-19 and with rates higher among boys than girls (Murphy et al. 2012). For parents and other family members, these deaths are likely to have profound effects. Indeed, such deaths have been found to have strong negative effects on parents, including elevated rates of marital disruption, depression and health problems persisting decades after the child's death (Rogers et al. 2008; Song et al. 2010). Other members of the family such as siblings are also likely to be influenced by a sibling's death, both directly through the loss of a sibling and indirectly through the parental response to the death. Contemporary US panel data sets suggest high rates of experiencing a sibling death before age 25 (nearly 8% in Add Health and the Wisconsin Longitudinal Survey (Fletcher et al forthcoming)). Such rates make it as common as other consequential childhood experiences, such as experiencing a maternal death (Jacobs and Bovasso 2009) or chronic health conditions (Perrin et al. 2007). The uniqueness and typical longevity associated with sibling ties suggests that this experience could substantially disrupt the life course trajectory for the surviving sibling.

In the case of siblings, there are a large set of shared experiences and interconnected developmental trajectories, so that the loss of a sibling during childhood might be expected to result in increased risk of poor outcomes for surviving siblings along a variety of dimensions. The risks could be tied to the experience of having a sibling with a significant disability that ultimately resulted in death or to the circumstances surrounding the death (e.g., long-term illness vs. sudden or violent death). Given the frequency of childhood deaths and the potential effects, there is surprisingly little study of these experiences.

In this paper, we extend the small literature on this topic in several ways. Although the long term, cumulative impacts of sibling death are beginning to be understood and suggest large reductions in years of schooling (Fletcher et al. forthcoming), we further investigate the dynamics involved in producing the long term effects. We do this by leveraging a longitudinal panel data set (NLSY79) that contains repeated outcome measures throughout childhood; this allows us to study siblings prior to the death, close to the death, and subsequent to the death. We also broaden the literature by examining the effects of sibling death on cognitive, non-cognitive, and home environment outcomes. Our results suggest an important dynamic process that works differently based on the outcome of interest. We find large initial impacts of sibling death on cognitive and non-cognitive outcomes that then decline over time. We also show that the effects are smaller if the surviving child is older, suggesting the existence of "highly sensitive periods" of exposure.

Background Literature

Numerous disciplines have outlined the critical components of successful human capital development. Many of these critical components occur during childhood and adolescence, including early health status (Almond 2006, Currie and Almond 2010, Fletcher 2011, in press a, in press b), family characteristics (e.g. Wolfe and Haveman 1995), favorable environments and policy (Hostinar et al 2012), and many other factors. One aspect of child development that has had limited focus in economics is within-family dynamics, especially related to sibling dynamics. While a large set of papers describe the potential resource implications of siblings (e.g. quantity-quality trade off in Becker and Lewis 1973 among others), fewer papers explicitly

consider the presence of a sibling as a potential input into the human capital of his co-sibling, through learning, modeling behavior, and other effects.[3] Indeed, either mechanism could affect the outcomes of children in families and thus be disrupted if a sibling dies during childhood.

There are several mechanisms from the economics literature that could link together sibling outcomes. The quantity-quality trade-off suggests that siblings would vie for parent's time, attention, and other resources, with the implication that a death of a sibling could enhance the total resources to the surviving child (net of any reduction in parental support from their own bereavement process). A slight alternative to this (Hanushek 1992) suggests assuming the amount of resources parents have is fixed (e.g. time), and if they have a greater number of children, each child will receive a smaller amount of resources. This has been called the resource dilution theory. This theory also can add a birth order effect as those born earliest will get more parental resources per child (time) than those born later (e.g. Price 2008). In the case of a child's death this would suggest an increase in resources to the remaining children. However, the death of a child may call into question the idea of "fixed resources" underlying the theory and emphasize that there is no adjustment for quality of time in this model.

There could also be direct (i.e. not through parents) influences between siblings through "peer effects" of learning and norm construction. For example, Oettinger (2000) uses age-adjacent sibling pairs from the NLSY to examine whether the high school graduation status of siblings is interdependent. Using two-stage methods to correct for endogeneity, the evidence suggests that the graduation status of older siblings affects younger siblings but not vice-versa. Ouyang (2004) uses the NLSY-97 data to examine whether the risky behaviors of one sibling spills over on the choices of other siblings. The results suggest that older sibling's alcohol, tobacco, and drug use decisions impact the decisions of younger siblings. In related research, Widmer (1997) uses a smaller sample of matched siblings from Philadelphia to show that the age of first sexual intercourse of older brothers influences the age of first sexual intercourse for their younger siblings. Kuziemko (2011) provides evidence that older sisters influence the fertility outcomes of younger sisters. These papers suggest that an additional mechanism of sibling influence is through "peer effects".

In addition to the specific mechanisms that suggest how siblings can directly and indirectly influence each other, there is also a small but growing literature that shows how child and adult death spillover to affect other family members[4]. Adda et al. (2011) find that the loss of a parent during childhood on the earnings of males is modest (less than 7%) and slightly lower for girls in Sweden and finds that the loss of mothers is more important for cognitive skills of children. Case and Cally (2006) and Chen et al. (2009) focus attention on the impacts of completed schooling in developing countries. Chen et al. (2009) finds that maternal deaths are associated with negative consequences on college enrollment in Taiwan, but paternal death effects are not statistically significant. Case and Cally (2006) also find negative effects of maternal death on education outcomes in South Africa.

Only one paper has examined impacts of sibling death on the surviving sibling's outcomes. Using two large US datasets (Wisconsin Longitudinal Survey and Add Health), Fletcher et al. (forthcoming) find consistent educational consequences for children who experience a death of a sibling as well as some evidence of increases in co-residence with

[3] An exception is Fletcher, Hair and Wolfe (2013).

[4] See also the emerging literature on the spillover impacts of sibling disability on family outcomes. Gould (2004) finds that having a disabled child reduces maternal labor force attachment. Fletcher and Wolfe (2008) provides suggestive evidence that having a sibling with ADHD reduces the educational achievement of siblings.

parents. However, the authors did not examine the potential dynamic (i.e. short vs. long term) effects of sibling death and were limited to examining achievement effects on a single test score. We use this paper as a starting point to leverage an additional longitudinal dataset with high-frequency achievement measurements to investigate the dynamic impacts of sibling death on children's human capital outcomes as well as investigate potential mechanisms of the effects and potential heterogeneity in the impacts.

Data

We use the children of the female respondents of the NLSY79, a nationally representative sample of 12,686 individuals who were between 14 and 21 years old when they were first interviewed in 1979. Periodic resurveys have been conducted since then, collecting rich socio-economic information and diverse outcomes of every woman's biological child starting in 1986. The child survey (NLSYC) includes cognitive and non-cognitive assessments, quality of the home environment, as well as additional demographic and development information collected from either the mother or the child[5]. The availability of a thorough record of the mothers' family background along with extensive data on every child's outcomes and years of birth and death make the NLSY79 Children and Young Adults an ideal dataset to explore the relationship between sibling death and surviving sibling's outcomes across time.

We restrict the sample to mothers who had at least two children to allow comparison between children who experienced a siblings' death and those who could have potentially experienced it.[6] In terms of outcomes, we analyze changes in cognitive and non-cognitive assessments as well as measures of the quality of the home environment for families who experience the death of a child. Children's cognitive assessments measured in the CLNYS79 are the Peabody Individual Achievement Tests in Mathematics (PIAT-M)[7], Reading (PIAT-R and PIAT-C)[8] and the Peabody Picture Vocabulary Test (PPVT)[9]. All assessments have been used extensively in a myriad of studies assessing the cognitive development of young children.[10] Test scores are in age-standardized percentiles.

While cognitive assessments are important measures of children's early achievement,

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[5] Some children born before or in 1972 never belonged to the CNLSY79, because once they turn 15 they leave the sample and start the NSLY79 Young Adults survey (NLSY79YA), which resembles the NLSY79 questionnaire.

[6] Out of the 5,418 females of the NLSY interviewed at the start of the CNLSY79 survey, 3,363 have remained in the survey and become mothers of a total of 7,538 interviewed children by 2004. Our analysis excludes 653 single children. Out of the remaining 2,710 families, we exclude 72 disabled focal children and those for whom we have missing information on any of the background variables included in the analysis, which leaves with a final sample of 5,426 children alive born to 1,989 mothers.

[7] PIAT-M assesses knowledge and application of mathematical concepts and facts. PIAT-M tests are administered to children between 5 to 18 years old.

[8] The PIAT-R is a test designed to assess word recognition and pronunciation ability and is divided into two parts. Tests are administered to children between 5 to 18 years old. The PIAT-R: Reading Recognition assesses skills such as matching letters, naming names, and reading single words aloud. The second part, Reading Comprehension (PIAT-C) measures the child's ability to derive meaning from sentences that are read silently. PIAT-R completion rates are typically lower than PIAT-C and PIAT-M because it involves recording of responses by the interviewer who did not record all the responses.

[9] The PPVT is a vocabulary test administered to children age 4 and 5 or 10 and 11 starting with the 1996 round and is widely recognized to be a good measure of cognitive ability, especially of verbal intelligence. It has been found to be highly correlated with scores on other intelligence tests and is viewed to be an important indicator of early and middle school outcomes (Baker, Keck, Mott and Quinlan 1993).

[10] Some examples are Heckman (2008) and Sacerdote (2002).

they may fail to capture critical differences in children's development (Heckman et al. 2006) that are key in determining later adult outcomes. Thus, we also focus on two non-cognitive assessments: the Behavior Problems Index (BPI)[11] and the Self-Perception Profile for Children (SPPC).[12]

Finally, we use the Home Observation Measurement of the Environment (HOME) measure to understand possible changes in the quality of the child's home environment and maternal traits and behavior. We focus on the total HOME score as well as on the two sub-scores focusing on cognitive stimulation (HOME-C) and emotional support (HOME-E). Depending on the age of the child, the HOME questionnaire asks about the number of books the child has at home, whether the mother reads to the child, availability of toys, interaction with parents, parental attentiveness, discipline patterns, and frequency of outings.[13]

We present summary statistics of background characteristics in Table 1. Columns (2) and (3) show characteristics of individuals whose sibling did and did not pass away, respectively. We observe that in general, differences between affected and non-affected families are statistically significant but not large. Nevertheless, it is important to note that mothers who experience the death of child score half a standard deviation less on average on the Armed Forces Qualification Test (AFQT), which is a generalized proxy for IQ and indicates that affected families are likely to come from a disadvantaged background (but these mothers also had children earlier on average so the longer window of being a mother may be partly responsible for this difference). Table 2 presents the means of our outcome variables for the full sample and for the sub-samples of families who did and did not lose a child during the NLSY79 sample window. There is also a column (Final) composed of those who experienced a sibling death and for whom we have observations both prior to and after the sibling death. These columns show large observable differences between families who did and did not experience a child's death, though some of the difference may be caused by the loss of a child.

We further explore whether background characteristics can explain whether a family experiences the death of a child (a sibling death) in Table 3, where we regress sibling's death on all background variables. As we can see in Table 3, there seems to be some mild evidence that mother's education and age at first pregnancy are negatively correlated with the likelihood of experiencing a children's death. The columns do not suggest important differences between all siblings who experienced a child's death and those for whom we have more comprehensive (pre and post) data. Thus, in order to control for unobservables that may differ between families who

[11] The BPI measures the incidence and the severity of behavior problems for children of 4 to 18 years of age. The index is based on 28 age-specific responses from mothers on conducts that her children have exhibited in the previous three months. The index is increasing in the presence of problematic behaviors.

[12] The SPPC assesses a child's sense of general self-worth and self-competence in their academic skills based on the child's self-reported answers to the interviewer's verbal questions. The SPPC is completed by children between 8 - 18 in years 1986 to 1994, and starting in 1996, the assessment is limited to children between 12 and 18 years old. The score is divided into two sub-scores: a scholastic competence score (SPPC-SC) and a global self-worth score (SPPC-GS). In the SPPC assessment, each child has to choose between the former or the latter part of a two-part statement that describes him or her the best and indicate the extent to which the description is true for them. For example, a statement on the SPPC part of the survey declares, "Some kids feel like they are just as smart as other kids their ages, but other kids aren't so sure and wonder if they are as smart."

[13] These responses to these questions are either answered by the mother or recorded from observations of an official home visitor, and the HOME scores are reported as simple summations of the scores from individual items in the questionnaire, with higher scores indicating a better home environment. HOME scores are assessed for every child less than 18 years of age. Starting in survey year 2006, only children 4 years and older were given the interviewer-administered assessments.

do and do not experience the death of a child (Tables 1 and 2), we focus our main analysis only on families who experience a death of a child. [14]

Empirical Specification

In order to examine the dynamic impacts of sibling death on children's outcomes we use multiple observations for each child in the data and compare outcomes that occur before and after the experience of a sibling death. Implicitly we are assuming that while the likelihood of exposure to a sibling death may differ across families based on observable and unobservable characteristics of the family[15], the timing of the sibling death is not related to these characteristics. Hence, we compare children's outcomes before and after experiencing a death of a sibling and across families where the death occurred at different ages in order to examine the dynamic effects of the process. To analyze the dynamic effects of experience a siblings' death, we restrict our analysis to children who suffer a sibling's death and for whom we have at least one assessment before and after the event.[16]

Thus, we first estimate the pre/post effects of experiencing the death of a sibling as:

$$y_{ift} = \beta_0 + \beta_1 X_{ift} + \beta_2 Death_{jft} + \varepsilon_{ift} \quad (1)$$

where the outcome (y) of child *i* in family *f* at time *t* is determined by child and family characteristics (X), whether the death of sibling *j* has occurred ($Death$) and an idiosyncratic term (ε). X includes age at assessment of outcome in months, male, black, hispanic, age at which the mother got pregnant for the first time and whether she was married by then, mother's AFQT, whether there is any disabled child in the family, log of income and welfare in 1979, maximum parental education, mother religious in 1979, living in an urban area in 1979, and region the mother lived in in 1979 indicators. In order then to examine the dynamic effects, we enhance equation (1) as follows:

$$y_{ift} = \beta_0 + \beta_1 X_{ift} + \beta_2 Death_{jft} + \beta_3 Death_{jft} * YSD_{it} + \varepsilon_{ift} \quad (2)$$

which allows the effect of experiencing a sibling death to vary by "years since death"(YSD), which denotes the number of years that have passed since the death of the sibling . β_3 then examines whether the main effect fades out or increases as the surviving child gets older. In additional analysis we test for "sensitive periods" by examining whether the effects of experiencing a death of a sibling vary based on the age of the surviving child at the time of the sibling death:

$$y_{ift} = \beta_0 + \beta_1 X_{ift} + \beta_2 Death_{jft} + \beta_3 Death_{jft} * age_i + \varepsilon_{ift} \quad (3)$$

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[14] Results on the full sample of families with two or more children are in appendix A.1.

[15] If we assume that families who experience a death of a child were no different than families who do not have this experience, we could instead pursue a difference-in-difference type analysis.

[16] While we are able to use pre/post measures of each child, our sample and within-family/child heterogeneity is too small to use level fixed effects.

Equation (3) allows us to examine heterogeneity in the main effects of interest. In all models we cluster the error terms at the family level to allow for inter-siblings correlation.

Results

We begin our analysis by examining the main and dynamic impacts of experiencing a sibling death by estimating equations (1) and (2) on three sets of outcomes: cognitive scores, non-cognitive scores, and the home environment scales. Table 4 reports our results for cognitive outcomes; the first column in each panel shows the main effects and the next column examines duration since sibling death effects (results for the full sample are available in Appendix Table 1). For the main effects, there is limited evidence of detectable differences in math, word recognition, reading comprehension or the vocabulary test before versus after the death, but three of the four coefficients are negative. Part of the explanation of finding limited effects is the pooling of tests across various time periods from before and after the death. In order to address this issue, the second column shows strong support of a large fadeout effect of the impacts of experiencing the death of a sibling on each of the tested domains. For example, for math achievement, we find more than a 6 percentile point immediate impact that declines by 1 point each year following the death of a sibling, suggesting the effect fades out approximately 6 years after the death. Likewise, we also find a 7 point, 10 point, and 5 point reduction in word recognition, reading comprehension, and PPVT scores immediately following the death of a sibling that fade out over time, although this pattern is less clear for reading comprehension. The results for reading comprehension suggest both a larger absolute effect tied to the death and only suggestive evidence that the effect declines over time.

The next results in Table 5 examine non cognitive outcomes. As before, in Column 1 of each panel, we find increases (i.e. worsening) of the behavioral problems index and reductions in the self-perception profile scores (SPP) when we compare pre versus post periods across children, although none of the main effects are statistically significant. Then, in the results interacted with duration since a sib's death, we find strong immediate effects on the behavioral problems index and on the self worth component of the SPPC. The behavioral problems index pattern seems consistent with the cognitive test pattern and shows a decline over time such that by about 7 years after the sibling's death the effect fades away. The pattern for self worth suggests a longer detrimental effect of the loss of one's sibling. In contrast, the SPPC scholastic competence scores are unique in Tables 4 and 5 in not showing any effect of a experiencing a sibling's death.

Finally, we examine two aspects of the home environment that might respond to a child death in the family; this allows us to examine one of the many potential mechanisms (parental responses) linking sibling death to cognitive and non-cognitive outcomes. To do this, we examine the total HOME scale and also divide the scale into its two components—cognitive inputs and emotional inputs. The results in the first two columns of Table 6 show no detectable changes in the total HOME scale, although the signs are negative. However, when we divide the scale into the two sub-scales, we find evidence that the emotional resources in the home environment are substantially reduced following a sibling death, and that these effects do not seem to fade out over time. In contrast, we little evidence of changes in the cognitive environment in the household. These results are somewhat intuitive in that the cognitive measurements include books in the home and other material inputs while the emotional

measurements include the positive and negative ways the parent interacts with the surviving child, which could be influenced by bereavement effects on the parent.

Heterogeneity in the Effects

Next we examine whether the influence of a sibling's death differs by the age of the surviving sibling when they experience the death of their sibling. These findings are in table 7 for all three sets of outcomes.. For our measures of cognition, the results suggest that for all measures that the effect on a child is larger if the child is older when their sibling died. The results are strongest for the picture vocabulary tests. To give a sense of the difference, we estimated the effect at ages 6 and 12. For the picture vocabulary tests the results are -.8 at age 6 but -15.5 at age 12. For Piat math the results we calculate are -2.4 at age 6 and slightly more than -12 at age 12. Turning to non-cognitive outcomes, we find a mixed pattern, with lack of significance for the SPPC outcomes but a strong result suggesting that behavioral problems are likely to larger if the siblings was older at the death of their sibling. Thus at age 6 we calculate that the effect would be an increase of nearly 7 on the behavioral risk index but that at age 12 it would be nearly 22. This could be consistent with greater opportunity to act out among older children, with a stronger reaction among children who spent more years with their sibling or a sibling feeling guilty for their sibling's death. Finally for Home scores we find essentially no differential effect by the surviving child's age at the death of their sibling.

Effects of Sibling Death for Families with a Disabled Child

In this subsection of results, we present the results of our investigation of an alternative source of potential heterogeneity of the effects of sibling death—"rebound" effects. That is, for some families, we might predict that surviving siblings have higher measured outcomes following the death of a sibling in the instances where the death concludes a long illness or disability. In some cases, the surviving sibling may be able to devote more resources and time to school achievement and other measures when no longer taking care of an ill or disabled sibling. Of course, to be detected in our analysis, any rebound effect would need to be net of the bereavement effects for both siblings and parents of losing a family member. In appendix Table 2, we compare surviving children before and after the death of a sibling for those families with a disabled child[17]. The coefficients provide evidence of net rebound effects in the HOME environment in terms of both cognitive and emotional support (and total score) suggesting an improvement in the home for surviving siblings following the death of a disabled sibling. With the exception of a large, negative and significant coefficient on math, the results for cognitive and non-cognitive assessments suggest no effect on surviving siblings. Thus, we tentatively conclude that in a small subset of families with a disabled child, we find very little detectable evidence of negative impacts of the death of a child on the achievement of the surviving sibling and indeed find some evidence of rebound effects in the home environment which suggest the possibility of long term improvements for the surviving children.

Cumulative Effects of Sibling Death

Finally, we provide some evidence of cumulative effects of experiencing a sibling death on the surviving sibling's outcomes by young adulthood. This exercise is similar to those reported in Fletcher et al. (forthcoming) using the Wisconsin Longitudinal Study and National

[17] We define a child as disable if in any point in time he has any serious health limitation that requires medical equipment, drugs, or limits her ability to attend school, play, or do homework.

Longitudinal Study of Adolescent Health datasets. We use the full sample of children in the NLSY and examine differences in years of schooling, the likelihood of having a teenage pregnancy (females), participation in criminal activities, and problem drinking behaviors. We control for the observable differences in families who do or do not have a child death in the sample, following Table 2, and also include additional control variables to limit the effect of omitted variables bias. The descriptive results are reported in Table 8 and the regression analysis results in Table 9.

The descriptive results suggest a difference between young adult outcomes by whether or not the young adult experienced the death of a sibling. Average years of schooling are one year less for those who experienced the death of a sibling compared to those that did not. (The sample are all those who have 1 or more siblings and reach age 23 wtihin the time period we observe them.) The results for high school graduation for the sample members who reach age 19 also show a difference in the probability of finishing high school on time. College attendance is also lower for those who both completed high school and reached age 21 in the sample. Among females in the sample who are 12 or older, we also observe a difference by whether or not they experienced the death of a sibling in terms of the probability of a teen pregnancy with an estimated effect of nearly a three fold increase. And while ever been drunk does not really differ by the experience of a sibling dying; the probability of committing a crime is higher for those who had a sibling die by about .1 or 10 percent.

Turning to the regressions reported in Table 9, and consistent with Fletcher et al. (forthcoming), we find approximately a ½ year reduction in completed schooling for children who experience a sibling death as well as reductions in the likelihood of completing high school (4 percentage points,) and in the likelihood of attending college (10 percentage points). We also find a 16 percentage point increase in the likelihood of becoming pregnant as a teenager, a 2 percentage point increase in the likelihood of reporting ever being drunk, and a 10 percentage point increase in reports of criminal activity, though the latter two are not statistically significant. Altogether, these findings both mirror the Fletcher et al. findings from two complementary datasets and expand the outcomes to include criminal and alcohol problems. These findings suggest important cumulative impacts of experiencing the death of a sibling, even as the immediate impacts on cognitive and noncognitive tests fade out over time.

Conclusion

This paper contributes to the broad literature that seeks to understand the critical determinants and processes relevant for childhood human capital production. Although siblings are one of the most important and long lasting relationships over the life course, very little is known about the effects of siblings on each other's development and outcomes. We build on new findings that suggest that the experience of a sibling death is both quite common during childhood (5-8%, Fletcher et al. forthcoming) and has large and profound effects on human capital outcomes as a young adult by seeking to further our understanding of the dynamic processes underlying these results.

We use the children of the NLSY-79 cohort to examine the paths of achievement on cognitive and non-cognitive tests before, during, and after the experience of the death of a sibling. We find large initial impacts on most measures and that these childhood impacts largely fade over time, though this process often take years to complete. We find some evidence that a potential mechanism of these impacts is the reductions in emotional support provided by parents

following the death of a child—and these changes are longer lasting. We also sought to begin an analysis of potential heterogeneity in the effects of experiencing a sibling death. We find that older children appear far more sensitive in terms of cognitive outcomes, especially as captured by the Peabody Picture Vocabulary test; we also find older children to be much more sensitive as captured by the index of behavioral problems.

Finally, we show that although many of the immediate measurable impacts of experiencing a sibling death are acute and fade over time, there also appears to be considerable evidence of cumulative reductions to adult outcomes, such as completed years of schooling and the probability (among females) of giving birth as a teenager. Together, these findings both increase our understanding of the importance of siblings (and families) in the production of children's human capital as well as suggest spillover impacts on family members from policies that reduce the incidence of childhood mortality.

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Tables

Table 1: Descriptive Statistics by Sibling Status

	All	Alive Sibling	Dead Sibling	Difference
Child characteristics				
Male	0.51	0.51	0.48	0.03
	(0.5)	(0.5)	(0.5)	
Black	0.17	0.16	0.28	-0.12
	(0.37)	(0.37)	(0.44)	
Hispanic	0.08	0.08	0.06	0.02
	(0.27)	(0.27)	(0.24)	
Has a disabled sibling	0.01	0.01	0.001	0.01
	(0.09)	(0.1)	(0.03)	
Mother characteristics				
AFQT	0.16	0.19	-0.32	0.51
	(1)	(1)	(0.86)	
Education				
High School	0.43	0.42	0.54	-0.12
	(0.5)	(0.5)	(0.5)	
College or more	0.5	0.5	0.31	0.19
	(0.5)	(0.5)	(0.46)	
Age at first pregnancy	21	21.5	18.7	2.80
	(5.1)	(5.1)	(3.8)	
Married at first pregnancy	0.7	0.7	0.62	0.08
	(0.46)	(0.46)	(0.49)	
Religious in 1979	0.92	0.92	0.86	0.06
	(0.27)	(0.26)	(0.35)	
Parents' maximum years of education	12	12.3	11.1	1.20
	(3.1)	(3.2)	(2.4)	
Lived in an urban area in 1979	0.75	0.76	0.71	0.05
	(0.43)	(0.43)	(0.45)	
Real family income in 1978	11,534	11,718	8,786	2,932
	(8,069)	(8,142)	(6,248)	
Total real welfare received in 1978	78	74	139	-65.00
	(409)	(406)	(441)	
N	5,397	5,094	303	

Descriptive statistics are weighted to account for oversampling of minorities. Standard errors in parentheses.
Income and welfare are in 1983 dollars. AFQT stands for Armed Forces Qualification Test.
AFQT standardized to have a mean of 0 and a standard deviation of 1.

Table 2: Outcomes by Sibling' Status

	All	Siblings Alive	Sibling Dead	Final sample
A. Cognitive Assessments	(1)	(2)	(3)	(4)
PIAT-Math	58	58	49	51
	(27)	(27)	(28)	(29)
N (Wave*Child)	23,824	22,606	1,218	571
PIAT-Reading	63	63	53	55
	(27)	(27)	(29)	(30)
N (Wave*Child)	23,750	22,534	1,216	569
PIAT-Reading Comprehension	58	58	49	55
	(27)	(26)	(28)	(30)
N (Wave*Child)	20,366	19,329	1,037	475
Peabody Picture Vocabulary Test	45	45	35	39
	(30)	(30)	(30)	(32)
	13,712	12,993	719	340
B. Non-Cognitive Assessments				
Behavioral Problem Index	57	57	63	61
	(28)	(28)	(28)	(28)
N (Wave*Child)	26,381	25,073	1,308	623
SPPC-Scholastic competence	177	177	171	198
	(41)	(41)	(43)	(41)
N (Wave*Child)	10,711	10,099	612	265
SPPC-Self-worth	206	206	199	198
	(33)	(33)	(40)	(41)
N (Wave*Child)	10,709	10,098	611	266
C. Home Environment				
HOME Total	53	53	43	44
	(28)	(28)	(29)	(28)
N (Wave*Child)	34,051	32,413	1,638	797
HOME Cognitive support	53	54	44	44
	(28)	(28)	(29)	(28)
N (Wave*Child)	32,248	30,696	1,552	754
HOME Emotional support	52	53	46	47
	(29)	(29)	(29)	(47)
N (Wave*Child)	30,242	28,798	1,444	689

Descriptive statistics are weighted to account for oversampling of minorities.

Standard errors in parentheses.

The HOME subscores are imputed when only one item is missing (NLSY79 Userguide)

All scores are in age-standardized percentiles except from SPPC, which range from 0 to 250.

Missing values income and welfare imputed with average values.

Column (4) is restricted to children for whom we have at least one observations before and after death

Table 3: Determinants of Sibling's Death

Y=1 if Sibling Death	
Male	-0.005
	(0.009)
Black	0.014
	(0.018)
Hispanic	-0.030
	(0.021)
Has a disabled sibling	-0.054
	(0.024)
AFQT	-0.013
	(0.007)
High School	-0.018*
	(0.007)
College or more	-0.023
	(0.018)
Mother's age at first pregnancy	-0.003**
	(0.001)
Mother married at first pregnancy	0.015
	(0.012)
Mother religious in 1979	-0.035
	(0.015)
Grandparents' maximum years of education	-0.001
	(0.002)
Mother lived in an urban area in 1979	-0.011
	(0.014)
Log (Real family income in 1978)	-0.005
	(0.004)
Log (Total real welfare received in 1978)	0.004
	(0.003)
Constant	0.235**
	(0.043)
Observations	5,397
Adjusted R-squared	0.025

Models weighted to account for oversampling of minorities.

Standard errors clustered at the regional level in parentheses.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Regressions include dummies for region in 1979.

AFQT stands for Armed Forces Qualification Test.

AFQT standardized to have a mean of 0 and a standard deviation of 1.

Table 4: Dynamic Effect of Sibling's Death on Cognitive Outcomes

	(1)	(2)
PIAT-Math		
Sibling Death (SD)	-0.351	-6.240*
	(3.780)	(3.453)
SDxYears since death		1.044**
		(0.421)
N	571	571
PIAT-Reading		
Sibling Death (SD)	-0.760	-7.217*
	(4.173)	(4.118)
SDxYears since death		1.142**
		(0.461)
N	569	569
PIAT-Reading Comprehension		
Sibling Death (SD)	-5.658	-10.388**
	(3.423)	(4.282)
SDxYears since death		0.775
		(0.491)
N	475	475
Peabody Picture Vocabulary Test		
Sibling Death (SD)	3.910	-5.201
	(4.348)	(4.958)
SDxYears since death		1.787***
		(0.524)
N	340	340

Models weighted to account for oversampling of minorities.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.
Regressions include dummies for region in 1979 and all background variables listed in Table 1.

Missing values income and welfare imputed with average values.

Table 5: Dynamic Effect of Sibling's Death on Non-cognitive Outcomes

	(1)	(2)
Behavioral Problem Index		
Sibling Death (SD)	3.137	13.084***
	(4.759)	(4.577)
SDxYears since death		-1.783***
		(0.398)
N	621	621
SPPC-Scholastic competence		
Sibling Death (SD)	-1.770	1.683
	(6.760)	(7.551)
SDxYears since death		-0.647
		(1.604)
N	265	265
SPPC-Self-worth		
Sibling Death (SD)	-11.243	-16.661*
	(7.939)	(9.320)
SDxYears since death		1.019
		(1.229)
N	266	266

Models weighted to account for oversampling of minorities.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.

Regressions include dummies for region in 1979 and all background variables listed in Table 1.

Missing values income and welfare imputed with average values.

Table 6: Dynamic Effect of Sibling's Death on HOME scores

	(1)	(2)
HOME Total		
Sibling Death (SD)	-6.365	-4.375
	(3.985)	(4.271)
SDxYears since death		-0.381
		(0.481)
N	794	794
HOME Cognitive support		
Sibling Death (SD)	0.988	2.643
	(4.002)	(3.745)
SDxYears since death		-0.323
		(0.423)
N	751	751
SPPC-Self-worth		
HOME Emotional support	-10.529**	-11.115**
	(4.087)	(4.775)
SDxYears since death		0.116
		(0.526)
N	686	686

Models weighted to account for oversampling of minorities.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.
Regressions include dummies for region in 1979 and all background variables listed in Table 1.

Missing values income and welfare imputed with average values.

Table 7: Effect of Age of Surviving Child on Outcomes

PIAT-Math	
Sibling Death (SD)	7.199
	(5.210)
SDxSurviving Sibling's Age at Death	-1.605***
	(0.563)
N	571
PIAT-Reading	
Sibling Death (SD)	7.505
	(5.275)
SDxSurviving Sibling's Age at Death	-1.754***
	(0.527)
N	569
PIAT-Reading Comprehension	
Sibling Death (SD)	-0.099
	(4.506)
SDxSurviving Sibling's Age at Death	-1.133**
	(0.547)
N	475
Peabody Picture Vocabulary Test	
Sibling Death (SD)	13.867***
	(4.752)
SDxSurviving Sibling's Age at Death	-2.447***
	(0.620)
N	340
Behavioral Problem Index	
Sibling Death (SD)	-8.257
	(5.395)
SDxSurviving Sibling's Age at Death	2.505***
	(0.528)
N	621
SPPC-Scholastic competence	
Sibling Death (SD)	-6.269
	(17.275)
SDxSurviving Sibling's Age at Death	0.677
	(1.919)
N	265
SPPC-Self-worth	
Sibling Death (SD)	-1.373
	(13.926)
SDxSurviving Sibling's Age at Death	-1.481
	(1.432)

N	266
HOME Total	
Sibling Death (SD)	-9.368*
	(5.197)
SDxSurviving Sibling's Age at Death	0.800
	(0.658)
N	794
HOME Cognitive support	
Sibling Death (SD)	-2.459
	(5.271)
SDxSurviving Sibling's Age at Death	0.930
	(0.620)
N	751
SPPC-Self-worth	
HOME Emotional support	-11.639**
	(4.880)
SDxSurviving Sibling's Age at Death	0.299
	(0.690)
N	686

Models weighted to account for oversampling of minorities.

Regressions are restricted to children for whom we have at least one observations before and after death

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.

Regressions include dummies for region in 1979 and all background variables listed in Table 1.

Missing values income and welfare imputed with average values.

Table 8: Adult Outcomes

Years of Education by age 23	All	Sibling Alive	S
Sibling Death	13.3	13.4	
	(2.2)	(2.2)	
N	2,768	2,607	
High School Graduation by age 19			
Sibling Death	0.93	0.93	
	(0.25)	(0.24)	
N	3,740	3,544	
College Attendance by age 21			
Sibling Death	0.8	0.81	
	(0.40)	(0.39)	
N	2,532	2,395	
Teenage Pregnancy (Women over 12 only)			
Sibling Death	0.12	0.11	
	(0.32)	(0.31)	
N	2,528	2,429	
Crime			
Sibling Death	0.33	0.32	
	(0.47)	(0.47)	
N	1,553	1,449	
Ever been drunk			
Sibling Death	0.34	0.34	
	(0.48)	(0.48)	
N	5,297	4,999	

Descriptive statistics weighted to account for oversampling of minorities.

Standard errors in parentheses.

Missing values income and welfare imputed with average values.

Survey questions on crime available only in years 1994-98.

Ever been drunk restricted to children over 12 years of age.

Crime is equal to one if the individual has ever injured someone, broken into a house, shoplifted, or held stolen goods

Table 9: Effect of Sibling's Death on Adult Outcomes

Years of Education by age 23	
Sibling Death	-0.518*
	(0.166)
N	2,768
High School Graduation by age 19	
Sibling Death	-0.042*
	(0.015)
N	3,740
College Attendance by age 21	2,532
Sibling Death	-0.099*
	(0.032)
N	2,532
Teenage Pregnancy (Women over 12 only)	
Sibling Death	0.162**
	(0.043)
N	2,528
Crime	
Sibling Death	0.098
	(0.072)
N	1,553
Ever been drunk	
Sibling Death	0.020
	(0.024)
N	5,297

Models weighted to account for oversampling of minorities.

Standard errors clustered at the regional level in parentheses.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Missing values income and welfare imputed with average values.

Regressions include dummies for region in 1979, cohort dummies and all background variables listed in Table 1.

Survey questions on crime available only in years 1994-98.

Ever been drunk restricted to children over 12 years of age.

Crime is equal to one if the individual has ever injured someone, broken into a house, shoplifted, or held stolen goods

Appendix Tables

A1: Effects of Sibling's Death (Full Sample)

A. Cognitive Assessments	
PIAT-Math	-1.522
	(1.674)
N	23,824
PIAT-Reading	-3.194
	(2.285)
N	23,750
PIAT-Reading Comprehension	-3.317*
	(2.014)
N	20,366
Peabody Picture Vocabulary Test	-1.058
	(2.822)
N	13,712
B. Non-Cognitive Assessments	
Behavioural Problem Index	2.293
	(2.582)
N	26,176
SPPC-Scholastic competence	-6.053**
	(2.977)
N	10,709
SPPC-Self-worth	-1.570
	(3.455)
N	10,711
C. Home Environment	
HOME Total	-3.442
	(2.148)
N	33,992
HOME Cognitive support	-3.091
	(2.217)
N	32,191
HOME Emotional support	-1.979
	(2.071)
N	30,183

Models weighted to account for oversampling of minorities.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.

Regressions include dummies for region in 1979 and all background variables listed in Table 1.

Missing values income and welfare imputed with average values.

A.2: Effects on Children with Deceased Disabled Siblings

A. Cognitive Assessments	
PIAT-Math	-21.564*
	(10.897)
N	134
PIAT-Reading	6.712
	(5.572)
N	137
PIAT-Reading Comprehension	-1.162
	(6.192)
N	113
Peabody Picture Vocabulary Test	-15.801
	(15.441)
	77
B. Non-Cognitive Assessments	
Behavioral Problem Index	0.508
	(3.678)
N	149
SPPC-Scholastic competence	13.064
	(26.688)
N	62
SPPC-Self-worth	-6.100
	(24.038)
N	63
C. Home Environment	
HOME Total	17.874***
	(4.095)
N	194
HOME Cognitive support	18.941***
	(3.611)
N	185
HOME Emotional support	18.094*
	(10.271)
N	169

Robust standard errors in parentheses.

Models weighted to account for oversampling of minorities.

*** significant at 0.01, **significant at 0 .05, *significant at 0.1

Standard errors in parentheses clustered at the family level.

All regressions include dummies for region in 1979 and all background variables listed in Table 1.

All include age at assessment in months.

Missing values income and welfare imputed with average values.

A.3. Ages at Assessment

PIAT	5-18
Peabody Picture Vocabulary Test	4-5 and 10-11
Behavioral Problem Index	4-18
SPPC-Scholastic competence	8-18
HOME	0-18

Source: NLS79 Child and young data users guide.

Starting in 1994, children aged 15 or older are no longer assesed.

Starting 1996, the SPPC Is only administered to children aged 12-15.