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Changing Sibship Size and Educational Progress During Childhood: Evidence From the Philippines

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Abstract

This paper investigates the association between changes in coresident sibship size and children's educational progress in the Philippines. When conceptualized at the household level, sibship size is a dynamic aspect of the family context with potentially important implications for resources needed to support a child's education. Individual-level change models suggested that adding younger siblings in early childhood (from birth to age 9) and losing both younger and older siblings later in childhood (from age 9 to 19) were associated with less educational progress by the focal child between ages 9 and 19. These effects were additive and indicated the importance of assessing both type of change and timing in evaluating the relationship between coresident sibship size and educational progress during childhood.

Keywords

child school achievement; child siblings; coresidence; family

Education is an important indicator of life chances across settings, with major social and economic inequalities developing between those who do not obtain a high school degree and those who go on to pursue higher education (Brunello & Comi, 2004; Chung, 2003; Liu & Hummer, 2008; Siphambe, 2000). Family contexts are likely to contribute to the development of these educational inequalities, and large family size (or sibship size) has been one aspect of families thought to limit individuals' educational achievement across cultures (Blau & Duncan, 1967; Sewell & Hauser, 1975). Family size research to date, however, has been limited by its focus on one-time measures of sibship size (henceforth referred to as "sibsize") and cross-sectional analyses of the relationship between individuals' sibsize and educational attainment (Steelman, Powell, Werum, & Carter, 2002). Similar to other aspects of the family context, sibsize, when considered as a household measure, may be quite dynamic over time, as children are born into and leave the parental household. These changes in sibsize (characterized here as gains and losses in younger and older siblings) may have important implications for individuals' education if household resources also shift with these changes in household composition. No study to date has provided a consideration of sibling gains and losses and how these changes may impact individuals' educational attainment.

To address this gap in the literature, this paper takes a life course and household-based perspective of sibsize, exploring whether changes in coresident sibsize are associated with

individuals' educational progress (number of grades passed) from age 9 to 19 in Cebu, Philippines. In doing so, this study captures prospective changes in family size and distinguishes among gains and losses in younger and older siblings in both early childhood (birth to age 9) and later childhood (age 9 to 19). The use of individual-level change models provides a methodological contribution by reducing potential biases attributable to unobserved time-invariant differences among children and their families.

The Philippines, with high fertility, migration, and child labor rates, provides a setting where coresident sibsize is likely to change throughout a child's life course. Schooling delays and early drop out are also prevalent in this context, as household duties and work responsibilities often force children out of school prior to high school graduation. Coresident sibsize may play an important role in this work and school trade-off.

The findings from this paper indicate the complexity and significance of changes in coresident sibsize in this developing country context while also informing the broader literature on the role of coresident siblings in the development of social inequalities during childhood.

Background

Sibsize may be related to children's education in several ways. First, having more siblings may mean fewer household and family resources to support an individual child's education. This "resource dilution hypothesis" (Blake, 1985) maintains that larger sibsize produces a "quantity/quality" trade-off where more siblings means fewer of the children will have adequate support for their education (Becker, 1981). Having more siblings is theorized to result in poorer educational outcomes by reducing parental time, money, and other resources needed to support schooling (Blake; Kuo & Hauser, 1997; Mare & Chen, 1986) and by producing a lower quality intellectual environment at home (Zajonc, 1976; Zajonc & Markus, 1975).

A review of the large body of empirical literature on the effects of sibsize suggested support for the resource dilution hypothesis in developed countries, with some important exceptions (Steelman et al., 2002). Rigorous methodological tests have found that exogenous changes in family size (using twin births and sibling sex composition as instrumental variables) reduced the likelihood of attending private school in the United States (Cáceres-Delpiano, 2006; Conley & Glauber, 2006). Developing country research also has found negative sibsize effects on education (Bronte-Tinkew & DeJong, 2004; Connelly & Zheng, 2003; DeGraff, Bilsborrow, & Herrin, 1996; Jejeebhoy, 1993), although the magnitude of these effects may depend on the national fertility context (Lu & Treiman, 2008; Maralani, 2004; Razzaque, Streatfield, & Evans, 2007).

Other research, however, suggests that siblings may provide resources that enhance children's education through tutoring opportunities (Zajonc, 1976; Zajonc & Markus, 1975), socializing experiences (Downey & Condon, 2004), or household help or income (Chu, Xie, & Yu, 2007). Developing country contexts may be particularly useful for testing this theory because children are more likely to need to work (at home or for income) to support family welfare. In this context, having more siblings may mean less work and more time for

school for a given child. This is suggestive in a recent study that found that older girls' education was constrained by having more younger siblings in the household (Chu et al.). Put another way, the younger siblings may have benefited from having older siblings provide income or stay home to help. It is also possible that null or small sibsize effects have hidden contradictory effects of siblings, with some competing for resources while others provided resources that supported a child's schooling.

Finally, it may be that associations between larger sibsize and education reflect unmeasured parental preferences, where parents who prefer larger families have lower expectations for their children. In this "spurious causation" theory, parental preferences (or other unobserved characteristics), rather than the number of siblings, are seen as the root causes of the association between sibsize and education (Rogers, 2001; Rogers, Cleveland, van den Oord, & Rowe, 2000). Two important studies using methods to decrease unobserved biases found no relationship between sibsize and cognitive skills in the United States (Guo & VanWey, 1999) and educational attainment in Norway (Black, Devereux, & Salvanes, 2005). These studies suggest sibsize research should aim to reduce unobserved biases by using within-individual methods of analysis.

Evidence of sibsize effects on education in the Philippines is mixed. One study in the Bicol area suggested that having more younger and older siblings was related to school dropout among boys, whereas only older siblings increased the likelihood of dropping out for girls (DeGraff et al., 1996). An earlier study in the Philippines, on the other hand, found a positive effect of older siblings on school enrollment (Bauer, 1991). These studies suggest that, in the Philippines setting, although siblings may compete for schooling resources, differences exist by the position of the siblings (older or younger) and the gender of the focal child. These studies, however, like most sibsize research, utilized one-time measures of sibsize and did not control for unobserved differences among children and their families.

Building on the extensive body of sibsize literature, this study aims to improve our understanding of the importance of sibsize for children's education in several ways. First, sibsize is measured as the number of siblings living with the focal child. Most sibsize studies have utilized a one-time measure of sibsize, assessed by the number of siblings a person reports having or the number of births to a woman, neither of which takes into account the residency status of siblings. Coresident siblings may have the most influence over the index child's interactions with parents and may compete directly for parental and household resources. Coresident siblings also may provide resources to the household (time and help) that cannot be garnered if they live elsewhere. Thus, gaining or losing coresident siblings may increase or decrease resources available for the focal child's education, depending on the position of the siblings (younger or older than the focal child).

Second, when considered as a household-based measure, sibsize can be conceived of as a dynamic aspect of children's family context, as siblings are born into, move out of, and possibly move back into the household. Existing studies of changes in sibsize have focused on sibling births and cognitive outcomes of the focal child (Baydar, Greek, & Brooks-Gunn, 1997; Baydar, Hyle, & Brooks-Gunn, 1997; Guo & VanWey, 1999). The two studies by Baydar et al. found negative effects of the birth of a sibling for child development, whereas

the third (Guo & VanWey) found no effects once unobserved differences in families and the children were taken into account. No study to date has considered multiple types of sibsize change over an extended period of time or how changes in sibsize may be related to children's educational progress.

Although there is limited research on adding siblings to the household through births (noted above), we know even less about how sibling loss relates to children's educational attainment. Across cultures, siblings may leave the parental household early to work, to establish their own family (Goldscheider & Goldscheider, 1998), to attend college, or to mark the transition to adulthood (i.e., independence). In developing countries, and in the Philippines specifically, leaving the parental home (either early or late) is a practical decision related to work needs, marriage, and the availability of housing (Camacho, 1999; Ting & Chiu, 2002). Resource dilution theory might predict that losing a coresident sibling improves the remaining children's educational progress because household resources (parental time, attention, school materials, etc.) are being shared by fewer siblings. A positive association between sibling loss and educational progress may also occur if these nonresident siblings provide resources to the parental household through remittances that can be used to improve the remaining children's education (Yang, 2008). On the other hand, the loss of siblings from the household may reduce education for the remaining children if sibling migration means that children left at home must take on additional work and household duties, reducing their time spent in school. Empirical research is needed to determine which of these scenarios is likely occurring in the Philippines.

Another contribution of this study is to consider changes in coresident sibsize in early childhood (birth – age 9) and late childhood (ages 9 – 19). Alwin and Thornton (1984) provided the only test of sibsize associations with education over time. They found early (between birth and age 4) and late (between ages 15 and 18) sibsizes to be independently negatively related to children's GPA, curriculum placement, and years of schooling at age 19 in the United States. In conducting further, indirect analyses, they inferred that early sibsize was more important than late sibsize for an individual's education (Alwin & Thornton). This suggests that sibsize at different stages of childhood may have distinct effects on education. No sibsize research to date has considered both change and timing issues together, which is the goal of this study.

Finally, this study makes a methodological contribution by providing evidence of the association between coresident sibsize and education using within-family models. The focus on change (in both sibsize and education) allows for the use of individual-level fixed effects (or first difference) models that reduce biases related to unobserved differences among children and their families. The Guo and VanWey (1999) study found that change models provided more stringent tests of the associations between sibsize and children's outcomes, effectively eliminating a negative effect found through traditional ordinary least squares (OLS) estimation. Although other studies have used within-family models to control for family-level unobserved differences (Black et al., 2005; Conley & Glauber, 2006), no other study has considered within-individual models (which control for unobserved time-invariant differences among children as well as their families) in estimating the relationship between sibsize and educational progress.

In sum, the research question investigated here is whether changes in the number of coresident siblings (younger or older) that occur early (birth – age 9) and later (ages 9 – 19) in childhood are associated with educational progress of the focal child between ages 9 and 19. I further explore whether specific changes (gains and losses) have distinct associations with educational progress and whether these associations differ by characteristics of the focal child. I now turn to a description of the study setting.

Study Setting

The Philippines is a developing country where almost 40% of the population lives below the national poverty line and 15% lives on less than \$1 per day (World Bank, 2004). Despite the high rates of poverty, the literacy rates reflect gender equality in access to basic education, averaging 97% for men and 96% for women (United Nations, 2000). There is a strong tendency toward married-couple, nuclear families (United Nations, 2000), and the Philippine household tends to be quite egalitarian in the gender distribution of resources and goods (Haddad, Peña, Nishida, Quisumbing, & Slack, 1996). Women in the Philippines have high levels of economic decision-making power compared with other Asian women (Mason, 1996), although dowry is still practiced in some regions of the Philippines.

Regarding childhood education, 95% of school-aged children completed primary school in the Philippines in 2002 (World Bank, 2004). There is, however, evidence of educational delays: Currently, students take, on average, almost 7.5 years to complete 6 years of elementary school and more than 5.5 years to complete 4 years of secondary school. The elementary school dropout rate averages 7%, and another 12% of children drop out of secondary school. Boys take more than a year longer than girls to get through high school (Department of Education, 2007).

These delays and early dropouts tend to be related to the need for children to work to support their families (Guerro, 1993), particularly for boys (DeGraff & Bilsborrow, 2003; DeGraff et al., 1996). In a country of approximately 29 million children under the age of 18, UNICEF and the International Labour Organization (ILO) estimate 5 to 5.7 million children work (Guerro, 1993). The need for children to participate in earning income provides a setting where children's ties to the education system are tenuous and change as they age and where siblings may move out of the household to find work. This work may be domestic or may require overseas travel: roughly 10% of the total population is estimated to be working overseas (temporary or permanent migrants), and remittances from overseas migrants are common (Asis, 2008). Qualitative studies suggest youth are among the migrants who leave their parental home in search of work to support their families (Camacho, 1999). The loss of siblings in this setting may mean either additional resources to support schooling if remittances are sent home or more non-school-related work for the focal child if migrating siblings are not contributing to the parental home or are pursuing their own schooling (Lu, 2007).

Competition for schooling resources among coresident siblings also may be a reality in this setting because of the relatively large family size in the Philippines: The total fertility rate (TFR) averaged 4.6 between 1985 and 1990 (United Nations, 2004). Although there have been recent declines, the TFR stayed at about 3.5 in the early 2000s (National Statistics

Office Region 5, 2005), reflecting the widely held belief that growing up with no siblings is unhealthy (Costello & Casterline, 2002). On the basis of the limited evidence to date, the influence of sibsize on education in the Philippines may be complicated and depend on the family position (younger or older than the focal child), as well as residency status, of the siblings.

The specific geographic context for this study, Metropolitan Cebu, is made up of rural and urban communities and includes the second largest city in the country (Cebu City). Metro Cebu resembles the socioeconomic and household patterns of the Philippines (Flieger, 1994), and the most recent TFR for the Cebu region (3.6) is very similar to the national TFR (3.5; National Statistics Office Region 5, 2005). Metro Cebu offers both public and private schools from kindergarten to the university level. Although this study setting is limited to a specific area of the Philippines, Metro Cebu provides a setting where married-couple households and their children are likely facing conditions similar to those in the Philippines as a whole.

Method

Sample

The data used here are from the Cebu Longitudinal Health and Nutrition Survey (CLHNS), a survey conducted by the researchers at the University of North Carolina at Chapel Hill and the University of San Carlos, Cebu, Philippines. In 1982 – 1983, the CLHNS team identified and invited all pregnant women in 33 randomly selected communities (17 urban and 16 rural) in Metropolitan Cebu to participate in a longitudinal study of infant and child health and nutrition (Adair & Popkin, 2001). Women who accepted (few refused) were interviewed in person (and in their native language) during their 3rd trimester and were included in the study if they had a live birth in the coming year (1983 – 1984). Household, parental, and individual child information was gathered in follow-up interviews with the mothers at the birth of the focal child (1983 – 1984), and when the child was average age 2 (1986), 9, 12 (1994), 16 (1998), and 19 (2001).

Of the 3,080 original children (live births), 1,927 focal children had valid education data at ages 9 and 19. Those without education data, who were deleted from the sample, were not statistically different from those with education data in terms of maternal education, child sex, or household assets at birth. The missing children had slightly larger family size at age 2 (2.5 compared with 2.4 siblings) and were slightly less likely to have their fathers working at age 2 than those with valid education values. The 1,927 sample size was further reduced to 1,836 by focusing on those who were living in their mothers' household (the basis for measuring coresidential siblings) and had valid sibsize data at birth, age 9, and age 19. Those missing from the analysis because of these restrictions had slightly lower change in education between ages 9 and 19 compared with those in the sample (mean change was 7.6 for the missing cases compared with 8.7 for the nonmissing cases), mainly because of mean differences in education by residency status of the child. Including the children who lived elsewhere at some point before age 19 in the models did not alter the results, however. To utilize change models, the sample was also restricted to those who experienced change in sibsize at some point from birth to age 19. This reduced the sample by 139 children (who

had, on average, 0.8 years of schooling more than those who experienced some sibsize change), yielding a final sample size of 1,697 children.

Table 1 presents descriptive statistics for the sample children. The sample was 52% male, with 20% first born and 15% last born children. Reflecting the developing country setting, this sample was relatively disadvantaged: Mean maternal education was 7 years, mean number of household assets was 2.5 (of a possible 12), 30% of the children were living with unemployed fathers at age 19, and 27% of the sample children lived in a rural area at average age 9 (when education was first measured). The vast majority of mothers remained married to the same spouse during this time (14% changed spouses), which is consistent with the relatively low divorce rate in the Philippines (Table 1).

Measures

The outcome of interest here is change in education (number of grades completed) between 1991 and 2001, when the focal children were 9 and 19 years old (on average), respectively. Mothers were asked to report on their child's number of grades passed in the 1991 survey, and the children answered the education question in 2001 (mothers were also asked, which provided a check on the reliability of the children's answers). I use change in number of grades passed between ages 9 and 19 (what I refer to as educational progress) to be able to use change models in the statistical analysis (discussed below). Average educational progress during this time was 8.6 grades (median change in grades is 9), which represents less than a grade per year on average (Table 2). There was divergence from this average, with a 2.3 grade *SD* in educational progress in the sample.

The coresident sibsize change variables are based on household rosters of the focal child's maternal household at the child's birth and ages 9 and 19. I calculated early childhood changes in coresident sibsize as change in the number of siblings living in the household at age 9 minus the number living in the household at birth, and late change in sibsize as the number living in the household at age 19 minus the number living there at age 9. One drawback to these measures is that I did not capture changes in sibsize that happen between waves. Incorporating changes from the other waves of data (ages 2, 12, and 16) did not alter the results, however, suggesting that the sibsize changes in this setting may be relatively long term and best characterized by early and late changes.

I used the index child and siblings' birth dates to calculate whether each sibling is older or younger than the focal child. I also assessed sibsize change differentiated by sibling gender, but the results are not presented here because there were no statistical differences in sibsize change effects by siblings' gender. The sibsize measures include half-siblings because no distinction was made in the survey between full and half siblings. In this setting, however, there are few stepfamilies; thus, most siblings identified here are full siblings.

Table 2 provides the descriptive statistics for the sibsize change variables. During early childhood (birth – age 9), the main change occurring was an increase in the number of younger siblings, with a mean of 1.56 siblings added to the household. In late childhood (ages 9 – 19), the change in number of younger siblings was down to 0.55, on average. This was likely due, in part, to fewer siblings being born and to the loss of younger siblings from

the household (negative change bringing down the average), which can be seen in the minimum change value of -4 (Table 2). Change in older siblings was negative, on average, for both early and late childhood, with means of -0.28 and -0.84 , respectively. These changes illustrate that change in older siblings is concentrated in the later childhood period, most likely when older siblings are coming of age and moving out to work, start their own family, or pursue higher education. The descriptive statistics for the change variables in Table 2 illustrate that the early and late periods are characterized, on average, by change in sib-size in opposite directions, with siblings being added to the household in early childhood and lost in later childhood.

For my second and third set of analyses I further disaggregated sibsize change into gains and losses. The gains variables represent the number of younger or older siblings added to the household in each childhood period (early and late), and the loss variables represent the number of siblings (younger or older) lost from the household during these periods. I capped all sibsize gains and losses at 4 to reduce the influence of outliers ($<5\%$ of the cases). Table 2 shows the statistics for the number of siblings gained and lost, illustrating that gains in younger siblings (especially in early childhood) and losses in older siblings (especially in later childhood) are the most common changes occurring in these focal children's lives.

Figure 1 provides a view of the percent of the sample children who experienced each type of sibsize change at least once during childhood. The most common type of sibsize change was adding a younger sibling, with 79% of the sample children experiencing this change. The loss of an older sibling, a less studied aspect of sibsize change, however, was also quite relevant, with 58% of the sample children experiencing this change. Losing a younger sibling was much less common (occurring in 18% of the sample children). Surprisingly, over a quarter of the sample experienced the return migration of an older sibling who was not in the household in the previous survey wave. The changes in sibsize studied here, then, are relevant for significant portions of the sample children and may have important implications for the focal children's household and work duties during their key schooling years.

Statistical Analysis

To answer my research questions, I utilized the above measures in multivariate regression models. In my initial set of analyses, I estimated the following model with OLS regression:

$$\begin{aligned} \Delta y_{it} = & \Delta Y \text{ sibs early}_{it} \beta_1 + \Delta O \text{ sibs early}_{it} \beta_2 \\ & + \Delta Y \text{ sibs late}_{it} \beta_3 + \Delta O \text{ sibs late}_{it} \beta_4 \quad (1) \\ & + \Delta Z \delta_{it} + \Delta u_{it} \end{aligned}$$

where $y_{it} = y_{it} - y_{i,t-1}$, i = individual focal child, Y = younger, O = older, Z = control variables, and u_{it} = time-varying unobserved differences among individuals (α_i , the time-invariant unobserved differences between individuals, is dropped when estimating this model). Change () was measured from age 9 ($t - 1$) to 19 (t) in the dependent variable and late sibsize change variables and from birth ($t - 1$) to 9 (t) for the early change variables. The early sibsize change variables were lagged measures of change, and the late sibsize change variables measured the changes concurrent with change in the dependent variable.

Because I used both change in education and change in sibsize, the OLS models are first-difference models, which are equivalent to two-time-period fixed effects models. First-difference models reduce biases attributable to unobserved time-invariant family or individual differences (Wooldridge, 2000). One disadvantage, however, is that the estimation is less efficient (reducing statistical significance), exacerbates measurement error, and limits the sample to only those who experience change. The benefits of the method outweigh the costs when the aim is to reduce biases in the association between sibsize and education.

In a second set of analyses, I specified the change in number of younger and older siblings as gains or losses (variables described above) in the first difference regression analysis. In a final set of analyses I tested for differences in these gain and loss coefficients by key characteristics of the children and their household: focal child's gender (male vs. female), maternal education (10+ years vs. less than 10 years), household assets at birth (3+ vs. fewer than 3 assets), number of siblings at age 2 (3+ vs. fewer than 3 siblings), and birth order (first born vs. other birth order and last born vs. other birth order). I tested these possible differences by creating interaction terms for each gain or loss variable multiplied by the above mentioned dummy variables and entering the interaction terms into the first difference model. Although these dummy variables do not change over time, the interaction terms do change and can be assessed in the change models.

In all models I controlled for time-variant variables (Z in Equation 1): whether the mother changes spouses, household assets, father's work status, the number of resident adults, the number of resident nonsibling children, and the urbanicity of the community, a score obtained by averaging variables related to urban development (Dahly & Adair, 2007). Standard errors were adjusted for heteroskedasticity and for clustering at the community level, and statistical significance for all variables was assessed at the $p < .05$ level or below.

Results

Table 3 provides the regression results from the first difference models, where the first model distinguishes changes by stage of childhood and the second model further disaggregates change by the position of the sibling (younger or older than the focal child). Results from Model 1 indicated that change in sibsize during early childhood (birth to age 9) was negative and statistically significant. This association was small, however, with an additional sibling during early childhood being associated with a 0.2-year decrease in education between ages 9 and 19. Sibsize changes occurring during later childhood (ages 9 – 19) seemed to work the opposite way, resulting in a positive association with changes in education (Model 1, Table 3).

Model 2 further distinguishes between changes in the number of older and younger siblings in addition to timing effects. These results revealed larger associations once younger and older siblings were differentiated (differentiating by siblings' gender did not matter). Further, Model 2 results suggested that sibsize change effects during early childhood were mainly attributable to changes in the number of younger siblings in the household and that the positive association found for the late childhood period in Model 1 was due mainly to

changes in older sib-size during this time. All of these sibsize effects were statistically different at $p < .05$. The R^2 s illustrated that Model 2 was a better fit, suggesting the importance of distinguishing both timing and younger from older sibling effects (Table 3).

To further understand these distinct associations (negative for younger sibsize change and positive for older sibsize change), Table 4 disaggregates change into gains and losses in coresident siblings. The results of this regression model illustrated that the negative association between changes in number of younger siblings and education from Table 3 was driven by the addition of younger siblings into the household during early childhood. Further, these results, and those from Table 3, showed the effects of gaining younger siblings were additive over time. According to the results in Table 4, adding one younger sibling in early childhood and one in late childhood was associated with a half a year loss of schooling ($-0.3 - 0.2 = -0.5$).

Gaining an older sibling, on the other hand, had a positive association, especially when it occurred later in childhood—educational progress increased by almost a half year with each older sibling added to the household during late childhood (Table 4). During this same period, having a younger or older sibling move out of the household was associated with a loss of 0.3 years of education. In sum, analyses of sibsize gains and losses revealed that older siblings contributed resources to a child's education (i.e., additional older siblings were associated with more progress in school), whereas losing older siblings was associated with reduced years of education.

A further research question addressed here was whether changes in sibsize matter for educational progress equally across all children. Several interaction effects were tested. Table 5 summarizes the significant differences in sibsize gains and losses by key groups (full results can be obtained by contacting the author). Of the interaction effects tested, only being born last (compared with other birth orders) had no significant differences in the sibsize gain or loss coefficients.

As Table 5 shows, differences in sibsize effects occurred mainly for younger sibling gains in early childhood and older sibling losses in later childhood. This might be because these are the most common sibling change events, providing the necessary variation needed to assess significant interaction effects.

More specifically, the first row in Table 5 illustrates that adding younger siblings in early childhood was negatively associated with educational progress mainly for boys, children in low socioeconomic positions (with low-educated mothers and living in households with few assets), and for non-first-born children. It is interesting to note that gaining younger siblings early in childhood was not associated with educational progress for girls or for those living in households with higher than average assets (Models 1 and 3, Table 5). Gaining younger siblings had a similar effect on educational progress across family size categories (less than three and more than two siblings), as indicated by the lack of a significant interaction between family size and gaining younger siblings in early childhood.

Table 5 also indicates that boys were the most disadvantaged by losing siblings during late childhood. Model 1 shows that for boys, the loss of each sibling (younger or older) during

late childhood was associated with almost a half year decrease in their educational progress (although the younger sibling coefficient was not statistically different from zero at $p < .052$). Low SES children were also most disadvantaged by sibling losses, namely, older siblings in late childhood (last row, Models 2 and 3, Table 5).

Interaction effects for sibsize at age 2 suggested that gaining older siblings was the only significant difference in coefficients by early family size (Model 4, Table 5). For children with two or fewer siblings living at home at age 2, gaining an older sibling in early childhood was associated with over a half year of additional schooling (0.6), and adding an older sibling in later childhood was associated with almost a full year of additional schooling (0.92). This indicates that adding older siblings may be beneficial for one's education only when family size is sufficiently small. Model 4 also illustrates (by the lack of other significant interactions) that the rest of the associations found for gains and losses in sibsize from Table 4 are generalizable across family sizes.

Discussion

The importance of sibsize as an aspect of the family context that creates social inequalities is a topic extensively studied by stratification and family researchers. Past theories and empirical papers, however, have largely relied on static concepts and one-time measures of sib-size, neglecting the significance of movement of coresidential siblings into and out of the household during childhood. This paper aimed to fill this gap by assessing how changing coresident sibsize during childhood was associated with children's educational progress (grades passed) between ages 9 and 19 in Cebu, Philippines. The relatively high migration, child labor, and fertility rates in the Philippines suggest an environment where changes in coresident sibsize may be complex and potentially meaningful for children's educational progress.

The descriptive statistics illustrated that change in coresident sibsize during childhood is a common and complex phenomenon, with siblings being added to and lost from the household in both early and late childhood. The regression models indicated that changes in residential sibsize matter for changes in individuals' education during childhood, with important differences by position of the sibling (younger or older) and age of the focal child when the change occurred (early or late in childhood). The statistically significant negative effects of adding younger siblings support the quality/quantity-trade-off and resource-dilution theories. A positive relationship between number of older siblings and educational progress, however, does not fit into these existing frameworks for understanding sibsize effects. The gain and loss models suggested that the positive association is due, in part, to the loss of older siblings from the household being associated with less educational progress. The loss of younger siblings also contributed to lower educational progress, although the effect was smaller than that for older siblings. Gaining older siblings back into the household, although a less common event, was associated with improved education progress.

These results suggested that siblings not only compete for resources, as the resource-dilution hypothesis suggests, but that older coresident siblings may provide important education-

enhancing resources for children (consistent with a “resource addition” hypothesis). Although we do not know where siblings go when they leave, the loss of older siblings may take resources away from the household if the older child is pursuing an education or needs economic support to start a new household. Sibling loss may also increase the workload of the child left behind. That adding older siblings has a positive association with the focal child’s educational progress suggests that siblings returning home may bring back resources or provide extra help around the house, freeing the younger focal child to pursue his or her education.

The different effects by stage of childhood indicate the importance of timing, with the strongest effects of adding younger siblings occurring in early in childhood (between birth and age 9), and the strongest effects of losing older siblings occurring later (between ages 9 and 19). It may be that siblings born early in childhood reduce the cognitive environment or that more closely spaced younger siblings provide more competition for household resources, with lasting effects into the schooling years (ages 9 – 19). Losing older siblings, however, is most associated with educational progress when the change is later in childhood (ages 9 – 19). This later stage is a time when older siblings are likely to be moving out to work, marry, or pursue more advanced education. It is important to note that the timing effects also suggest that changes in sibsize effects are additive, so that children experiencing multiple changes (like a younger sibling added in early childhood and an older sibling lost in later childhood) may be particularly disadvantaged.

The interacted models provide further evidence of the complex relationship between sib-size and education, with differences by focal child gender, maternal education, household assets, family size, and birth order. Boys are particularly disadvantaged by both adding younger siblings and losing siblings. Surprisingly, girls’ educational progress did not seem to be affected by changes in sibsize. The gender difference may be due, in part, to boys’ responsibility for earning an income, which may be more incompatible with formal schooling than home duties for which girls may be responsible. Changes in coresidential sibsize may be contributing to the gender gap in school progress (boys delaying and dropping out more than girls) reported in national statistics (Department of Education, 2007).

Children living in households with low education and assets are also likely to have reduced educational progress when younger siblings are added and older siblings are lost to the household. This may reflect the stretching of already tight resources with these changes, resulting in the need for the focal child to help out more, with less time and attention being given to his or her schooling.

Finally, the family size interactions suggest that gaining older siblings back into the household may be beneficial to children who have relatively few siblings. These older siblings may add resources or provide key learning opportunities for children who do not have as many other siblings to fulfill these roles. Once a child is part of a larger family, however, adding an older sibling does not seem to matter for his or her educational progress. All other sibsize change effects appear to be similar across family sizes.

It should be noted that the coefficient sizes are, overall, quite small, in part because change models are used, and thus the full effect of sibsize is not considered. Further, measurement error, exacerbated in change models, may be attenuating the coefficients toward zero. The benefit, however, is that, unlike most sibsize studies, the results presented here illustrate significant associations between sibsize and education controlling for unobserved time-invariant and observed time-varying differences among children. Further, the standardized coefficients (not shown here) suggest that changes in the number of younger siblings in early childhood and the number of older siblings in late childhood have effect sizes as large as that of household assets (the largest of the control variable coefficients). The additive effects of sibling changes at two time points and the control variables (household assets, paternal work status, and number of other children in the household) suggest that children with more traditional disadvantages that experience relatively common changes in family size may have serious schooling setbacks in this setting. The interactions further indicate that boys may be particularly disadvantaged by these changes.

Another limitation of this study is the reduction, and possible biases, in the sample attributable to attrition (those who left the study or moved out of the maternal household) and the use of change models. It is possible that this sample is selective on education, although it is not clear in which direction. Those who attrited after age 9 had lower education than the remaining children (although including those still in the study who had moved out at some point did not affect the results). Those with no change in sibsize (dropped from the change models) had higher educational progress than those analyzed in the models. It is not clear, then, whether the findings presented here are biased in a particular direction by sample selection.

These results are also limited by the historical context, household social status, and geographic location of this sample of children. The historical context is one of high but generally declining fertility rates and relatively poor socioeconomic conditions. It may be that the results would be different in settings with stable high or stable low fertility rates. Conducting this study with a cohort born in Cebu, Philippines, also means that the findings cannot be generalized beyond Cebu. Because Cebu includes both rural and urban households with characteristics similar to the rest of the Philippines, however, the findings may be reasonably generalized to married couple households in the Philippines. Although limited in its generalization to the United States and other developed country populations, the Philippines setting provided the context of larger distributions and fluctuations in coresident sib-size needed to answer these important research questions.

Finally, the sibsize measures used here are limited by the inability to capture all changes in coresident sibsize that occur during childhood and to distinguish different types of sibling loss (death, migration for education, or migration for marriage). Infant deaths and other relatively short-term gains and losses in siblings may not be accounted for in these data if they occurred between waves. Thus, these findings may underestimate the potential association between sibsize changes and educational progress.

These limitations notwithstanding, this study informs both sibsize and the broader family structure literature in key ways. First, the findings emphasize that sibling structure cannot be

viewed statically, not only because coresident sibsize changes, but also because these changes are meaningful. The movement of siblings into and out of the household may have important consequences for child well-being and social status of adults.

Second, key demographic processes of sibling migration and residential mobility need to be considered in the study of children's family contexts. Although the Philippines may have a particular high rate of youth migration, across most cultures older children move out of the parental household at some point to pursue their education, get married, or to find work. Thus, considering sibsize change, including migration of siblings, is relevant for understanding family dynamics across settings.

Finally, sibsize effects cannot be viewed accurately without taking into account when they occur in a child's life course, and when the changes occur in the life course of other members of the family. In this case, older and younger siblings have different effects on individuals' education, not only because of the age of the focal child, but also because of the differences in the life course stage of the siblings when the change occurred. Taken together, these findings illustrate the need for more nuanced theories of sib-size and educational attainment, including a consideration of how household resources needed to support children's education may be affected by gains and losses in coresident siblings.

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Figure 1.
Percent of Sample Experiencing Each Type of Sibship Size Change

Table 1Sample Descriptive Statistics ($N=1,697$)

Variables	<i>M</i>	<i>SD</i>	Min	Max
Male	0.52	0.50	0	1
First born	0.20	0.40	0	1
Last born	0.15	0.35	0	1
No. sibs at birth	2.13	2.05	0	12
No. sibs at age 9	3.42	1.80	0	11
No. sibs at age 19	3.12	2.13	0	12
Maternal age at birth	26.10	6.00	15	46
Maternal education at birth	7.00	3.26	0	17
Mother changed spouses (birth – 19)	0.14	0.34	0	1
Father working at age 9 ^a	0.87	0.33	0	1
Father working at age 19	0.70	0.46	0	1
No. household assets at birth	2.51	1.88	0	10
No. household assets at age 19	5.21	2.05	0	11
No. adults in household at birth	3.16	2.12	1	16
No. adults in household at age 19	2.28	1.00	0	8
No. nonsib children in household at age 19	0.60	1.14	0	9
Living in rural area at age 9	0.27	0.44	0	1

^aFather's work status at birth has more missing, so father's work status at age 9 was used in calculating the change control variable.

Table 2Dependent and Key Independent Variable Descriptive Statistics ($N = 1,697$)

Variable	Focal Child's Age	Mean	SD	Min	Max
Dependent variable					
Change in number of grades	Age 9 – 19	8.61	2.33	1	13
Key independent variables					
Change in number of younger siblings	Birth – Age 9	1.56	1.20	0	6
	Age 9 – 19	0.55	1.22	-4	7
Change in number of older siblings	Birth – Age 9	-0.28	1.03	-7	6
	Age 9 – 19	-0.84	1.20	-7	2
Number of younger siblings gained	Birth – Age 9	1.56	1.18	0	4
	Age 9 – 19	0.65	1.01	0	4
Number of older siblings gained	Birth – Age 9	0.07	0.40	0	4
	Age 9 – 19	0.02	0.16	0	2
Number of younger siblings lost	Birth – Age 9	0.01	0.13	0	2
	Age 9 – 19	0.12	0.48	0	4
Number of older siblings lost	Birth – Age 9	0.33	0.80	0	4
	Age 9 – 19	0.84	1.12	0	4

Table 3

First-Difference Estimates of Educational Progress Regressed on Changes in Coresident Siblings for Sample Children Ages 9 to 19 in Cebu, Philippines ($N = 1,697$)

Variable	Model 1		Model 2	
	<i>B</i>	<i>SE B</i>	<i>B</i>	<i>SE B</i>
Change in sibship size				
Early (birth – age 9)	–0.16**	0.037		
Late (age 9 – 19)	0.076*	0.031		
Change by younger/older sibs				
Younger sibs (early)			–0.37**	0.047
Older sibs (early)			0.12*	0.053
Younger sibs (late)			–0.088	0.057
Older sibs (late)			0.30**	0.055
Controls (change birth – age 19)				
Mother's spouse	–0.30	0.19	–0.36	0.18
Household assets	0.20**	0.026	0.18**	0.024
Father work status	0.38**	0.14	0.34*	0.13
No. children < 18 in household	–0.16**	0.047	–0.12**	0.044
No. of adults in household	–0.032	0.029	–0.047	0.027
Urbanicity of the community	–0.0070	0.0073	–0.0062	0.0063
R^2	0.07		0.12	

*
 $p < .05$.

**
 $p < .01$.

Table 4

First-Difference Estimates of Educational Progress Regressed on Gains and Losses in Coresident Siblings for Sample Children Ages 9 to 19 in Cebu, Philippines ($N=1,697$)

Variables	Model 1	
	B	SE B
Gains in siblings		
Younger sibs (early)	−0.31**	0.043
Older sibs (early)	0.14	0.13
Younger sibs (late)	−0.21**	0.069
Older sibs (late)	0.49*	0.20
Losses of siblings		
Younger sibs (early)	−0.020	0.29
Older sibs (early)	−0.18	0.095
Younger sibs (late)	−0.34	0.17
Older sibs (late)	−0.30**	0.057
Controls (change birth – age 19)		
Mother's spouse	−0.35	0.18
Household assets	0.18**	0.024
Father work status	0.31*	0.13
No. children < 18 in household	−0.13**	0.044
No. of adults in household	−0.054	0.028
Urbanicity of community	−0.0058	0.0065
R^2	0.122	

*
 $p < .05$.

**
 $p < .01$.

Table 5
Summary of Significant Interaction Effects When Added to First-Difference Model Reported in Table 4

Unstandardized Coefficients for Significant Interactions ($p < .05$), differences by									
Model 1		Model 2		Model 3		Model 4		Model 5	
Child Gender		Maternal Educ.		HH Assets		Sibship Size Age 2		Birth Order	
Boys	Girls	< 10 Years	10 + years	Low (2)	High (> 2)	3 sibs	< 3 sibs	First Born	Other
Gains in siblings									
Younger sibs (early)	-.51**	-0.07	-0.37**	0.17*	-0.41**	0.03	—	-0.18*	-0.34**
Older sibs (early)	—	—	—	—	—	-0.02	0.64**	NA	—
Younger sibs (late)	—	—	—	—	—	—	—	—	—
Older sibs (late)	—	—	—	—	—	0.17	0.92**	NA	—
Losses of siblings									
Younger sibs (early)	—	—	—	—	—	—	—	—	—
Older sibs (early)	—	—	—	—	—	—	—	NA	—
Younger sibs (late)	-.41+	0.07	—	—	—	—	—	—	—
Older sibs (late)	-0.41**	-0.12	-0.30**	0.05	-0.41**	0.15	—	NA	—

No significant interaction terms for being the last born child (compared with all other birth orders).

NA = not applicable.

+ $p < .052$.

* $p < .05$.

** $p < .01$ = significantly different from 0.