Reports

Does Wealth Increase Parental Investment Biases in Child Education?

Evidence from Two African Populations on the Cusp of the Fertility Transition

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Why fertility declines is still a matter of intense debate. One theory proposes that fertility decline may be partly driven by shifts in parental investment strategies: couples reduce family size as demographic and economic changes cause investment in the quality of children to become more important than investment in the quantity of children. A key driver for this change is a shift from a subsistence-based to a skills-based economy, in which education enhances child quality. Evolutionary anthropologists have modified this theory to propose that parental investment will diverge during the demographic transition according to resource availability: couples with the greatest access to resources will invest more in quality than in quantity of children. Here we test the impact of resources on educational investment in two populations on the cusp of fertility decline: the patrilineal Arsi Oromo of Ethiopia and the matrilineal Chewa of Malawi. In both populations, increased wealth is associated with greater biases in the allocation of education between children. In richer families, early-born children are prioritized over later-born ones, although early-born sons are favored in the patrilineal population and early-born daughters in the matrilineal population. Poorer families invest less in their children's education but also discriminate less between children.

The dramatic decline in fertility associated with modernization and increasing availability of resources is still something of a conundrum (Bulatao and Casterline 2001; Caldwell et al. 2006). It seems to make little intuitive sense that as societies become healthier and wealthier, individuals should restrict the number of children born to a far greater extent than those in less healthy and poorer societies. This is a particular problem for evolutionary anthropologists, for whom reproductive decisions should maximize reproductive fitness (number of surviving offspring and grandoffspring; Borgerhoff Mulder 1998). One influential theory that has been proposed to explain this fertility transition is a shift in parental investment strategies (proposed by economists, e.g., Becker 1991, and subsequently modified by evolutionary anthropologists, e.g., Kaplan 1996; Kaplan et al. 2002). As mortality declines and as the economic costs and benefits of children change, investment in the quality of children provides a greater economic return than investment in the quantity of children. In high-mortality, subsistence economies, producing many children is necessary in order to ensure that at least some survive. Children are also able to offset some of the costs of raising them by contributing subsistence and domestic labor (Kramer 2005; Lee and Kramer 2002). Mortality decline, reducing the need for "insurance" births, tends to coincide with a shift to a skills-based market economy, where investment in the quality of children becomes important to ensure that children are more competitive (Kaplan 1996; Kaplan et al. 2002). Educational investment is critical in this new skills-based economy. This investment is costly, however, both intrinsically and because education takes children away from the household and reduces the ability of children to contribute to household labor. It has the potential to yield increasing payoffs to investment, but its costly nature requires parents to be more discriminative (Kaplan 1996; Kaplan et al. 2002). Couples therefore begin to limit births but invest more in each child. Such behavior may not maximize fitness at all, but it is driven by evolved tendencies to allocate parental investment in ways that produce the most-competitive offspring (Kaplan 1996; Mace 2007; but see Mace 1998 and McNamara and Houston 2006 for theoretical evidence that such behavior might ultimately enhance fitness in the long term).

This model predicts that wealthier families will begin to shift toward a child-quality strategy and away from a child-quantity strategy before poorer families (Kaplan 1996; Kaplan et al. 2002). Mortality will be lower in wealthier families, reducing the risks of concentrating investment in a small number of children, and such families will be able to bear the costs of educating children more easily than poorer families. Such families may also be able to "add value" to their children's education by being better able to capitalize on educational opportunities (e.g., traveling to job opportunities that may result from education). Evidence suggests that wealthy families were indeed the leaders of the fertility transition (e.g., Clark and Cummins 2009; Woods 1984). To fit this model, biased allocation of parental investment should therefore be more evident among the richer sections of the community, with less parental discrimination among the less wealthy (Gibson and Lawson, forthcoming; Lawson and Mace 2010).

Here we test this model by investigating parental investment in child education in two societies on the cusp of fertility decline: rural Ethiopia and rural Malawi. In both cases, fertility is still high and mortality relatively high (though declining).

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Educational levels are also still relatively low in both populations, though increasing. Both populations are still largely subsistence economies, although integration into a market-based economy is beginning. We test whether biased allocation of parental investment in education is seen in these populations and how it is affected by resource availability. Does wealth increase parental discrimination between offspring?

We test for biased parental investment by determining whether sibling configuration—the composite of number of siblings, their sex, and birth order—affects the amount of education a child receives. Sibling configuration is more useful than overall number of siblings for exploring parental investment biases in such pretransitional populations, because differences in wealth between groups may be confounded with family size (Gibson and Lawson, forthcoming). Here we are measuring the outcome of investment—the amount of education received—rather than parental investment itself, but this is a common strategy in this literature, given that investment itself is hard to measure. Previous research has found that aspects of sibling configuration are frequently associated with differential parental investment, as measured by child outcomes. For example, among Western populations there is a negative relationship between a child's order of birth and height (Lawson and Mace 2008), education and IQ (Bjerkedal et al. 2007; Boomsma et al. 2008; Steelman et al. 2002), income generation (Black, Devereux, and Salvanes 2005), and survival (Modin 2002). Social scientists make the general assumption that more siblings simply dilute a child's allocation of parental resources: the "resource-dilution effect" (Blake 1989). Evolutionary explanations provide a more nuanced interpretation, suggesting that firstborns receive more investment because they have higher reproductive value: within a family, older children are more likely than younger children to survive to adulthood, having already survived the most risky period of early infancy. They are also closer in age to starting reproduction, thereby shortening generation time. Jeon (2008) provides a mathematical model of parents' allocation of resources among multiple dependent children that supports the hypothesis that older children will usually be favored over younger, although it is worth noting that this model concerns the allocation of parental resources at a given point in time rather than the sequential decisions likely to characterize parental investment in education for different-aged children.

However, results are not always consistent with the resource-dilution model, most notably among non-Western populations, where higher birth order is associated with improvements in child well-being, for example, intrauterine growth (Ghosh and Bandyopadhyay 2006), early child survival (Magadi, Madise, and Diamond 2001), and fertility (Draper and Hames 2000). A number of alternative explanatory models have explored the possibility that investment in children may not simply decline with increasing birth order. Some emphasize the cooperative breeding strategy of our species and the potential for older children to contribute to investment in their younger siblings through labor-force participation or helping with child care (e.g., Caldwell 1976; Sear et al. 2002; Eloundou-Enyegue and Williams 2006), while others underline the importance of increasing parental experience in determining child well-being (Hertwig, Davis, and Sulloway 2002). The "terminal-investment hypothesis" emphasizes the increasing value of each offspring relative to its parents' residual reproductive value with increasing parental age (Clutton-Brock 1984). It predicts that parents coming to the end of their own reproductive lives should increase investment in later-born offspring, because they represent the last opportunity to invest in direct offspring. Incorporating both terminal-investment and resource-dilution effects, some models predict a nonlinear relationship between birth order and parental investment outcomes. First- and last-born offspring benefit from periods of exclusive parental investment, with middle-born offspring being at a disadvantage (Faurie, Russell, and Lummaa 2009; Hertwig, Davis, and Sulloway 2002; Salmon and Daly 1998; Sulloway 1998).

Parents may also bias investment by sex of child, reflecting the relative costs and benefits of each sex. Some evidence indicates that sons, as the more expensive sex to rear, reduce investment in all later-born offspring, measured by reductions in birth weight (Nielsen et al. 2008), adult height (Rickard 2008), and reproductive success (Rickard, Russell, and Lummaa 2007; Sear, Mace, and McGregor 2003). Sons may receive more investment from parents because they can benefit more, in terms of reproductive success, from parental resources than daughters can. This may explain why the majority of human societies that hold inelastic heritable resources (e.g., limited land and cattle) practice patriliny, or male-biased wealth inheritance. Competition between brothers is particularly evident in such societies, where males with many brothers have been found to have higher risks of dying in childhood (Voland and Dunbar 1995) as well as lower education levels, less inheritance, fewer marriage opportunities (Beise and Voland 2008, Borgerhoff Mulder 1998), and lower reproductive success (Low 1991; Mace 1996).

Parental biases in investment between daughters, in general, appear to be less pronounced. A few studies have provided evidence for same-sex competition between sisters; for example, older sisters are associated with poorer growth among females in Ethiopia (Clegg and Pawson 1978) and lower educational attainment in the United States (Butcher and Case 1994). But in many pretransitional populations, older sisters may actually offset costs of large families by helping with child care (Quinlan and Flinn 2005; Sear et al. 2002) and, in bridewealth societies, by improving their brothers' marriage opportunities (Borgerhoff Mulder 1998). However, few studies have been undertaken under conditions of matriliny. Societies are matrilineal where daughters benefit more from inherited resources than sons, and in such societies girls are likely to be in greater competition with older sisters for resources, including inherited wealth (e.g., Holden, Sear, and Mace 2003; Sear 2008).

Here, we test for effects of sex, birth order, and sibling configuration in two culturally distinct populations, a patrilineal agropastoralist society in Ethiopia and a matrilineal horticulturalist society in Malawi. We test the following in each population: (1) Does sibling configuration (number of older or younger, same-sex or opposite-sex siblings) influence education outcomes? (2) Does investment vary according to household resource availability? We predict that the influence of sibling configuration may differ in the two populations (specifically, that sons are more likely to be favored in the patrilineal population and daughters in the matrilineal one) but that the influence of household resource availability on parental discrimination between children will be the same in both populations.

Study Sites

Ethiopia

The Arsi Oromo are agropastoralists, combining cattle rearing with maize, wheat, sorghum, and teff farming in the low-lying areas of the Arsi region, in southern Ethiopia. Once described as the "breadbasket of Ethiopia," the region has experienced irregular rainfall and poor agricultural productivity in recent years. High population growth and a shortage of land have resulted in increasing competition for resources both within and between households (Gibson 2008; Gibson and Mace 2006). Fertility and mortality are still high in this population, while childhood and adult undernutrition are prevalent (see table 1). Inheritance patterns are patrilineal, and postmarital residence is predominantly patrilocal. There is a strong cultural preference expressed for sons and other members of the patrilineage. Polygyny is present in just under 30% of households. Herd size is considered to be the best measure of wealth in this population. Demographic, socioeconomic, and education data used in this study were collected from 240 households during a household survey undertaken by M. A. Gibson in 2003–2004 in four villages.

Table 1. Description of the study populations

	Ethiopian agropastoralists (2003–2004)[a]		Malawian horticulturalists (1997)[b]	
	n	% Educated	n	Years of education (mean ± SD)
Overall	400	31.2	1,792	2.5 ± 2.5[c]
Girls	198	29.8	893	2.3 ± 2.3
Boys	202	32.7	899	2.7 ± 2.6
Rich	251	33.5	942	2.7 ± 2.6
Poor	149	27.5	850	2.3 ± 2.3
Birth order:				
1	76	33.3	426	2.8 ± 2.5
2–4	175	37.6	866	2.5 ± 2.5
5–7	114	24.5	391	2.2 ± 2.2
8+	35	17.6	109	2.5 ± 2.7
Mean age (yr)	10.96 ± 3.2		12.11 ± 3.9	

[a] Total fertility rate: 7.86; under-5 mortality: 23.2%; patrilocal residence, patrilineal inheritance.
[b] Total fertility rate: 5.89; under-5 mortality: 12%; matrilocal residence, matrilineal inheritance.
[c] Range: 0–14.

Malawi

The Chewa are largely horticulturalists, growing maize, although a small proportion are also involved in income-generating activities such as wage labor or trade (91% of this sample consider their main subsistence activity to be farming; about 30% in total engage in other activities). They occupy the central and southern regions of Malawi and are similarly experiencing high population growth and a shortage of land. Fertility and mortality are also still high in this population, though slightly lower than in Ethiopia (table 1). Inheritance patterns are predominantly matrilineal and postmarital residence predominantly matrilocal, although there is some evidence that inheritance patterns may be changing toward a relatively flexible strategy. Land ownership mainly resides with women and passes from mother to daughter, but in a small fraction of households in the data set used here (20%), men owned this household resource (Sear 2008). These households tended to be wealthier than those in which women owned land. Wealth is measured by a combination of garden size and whether the household is involved in any income-generating activities. Almost all marriages are monogamous. Data used here were collected during a household survey undertaken by R. Sear in 1997 in two villages in the southern region.

Methods

Table 1 shows descriptive statistics for education and background sociodemographic characteristics for the study populations. The outcome variable measuring level of education varied between models. In the Ethiopian sample, overall levels of education were low: only 31.2% had received any education, and less than 15% of school-aged children had spent more than a year in school. The outcome variable therefore became a simple dichotomous variable indicating any level of education (0 = no education, 1 = any education). Only children of school age (7–17 years old) were included in the analyses, to control for secular changes in education (n = 400). In polygynous households, only the first wife's offspring were included, to control for known effects of lower investment in junior wives' offspring (Gibson and Mace 2007). In the Malawian sample, 73% of children were in education, so the dependent variable measured was the total number of years in education (at the survey date). This sample included 1,792 Chewa children from 702 households; here school age is defined as 6–19 years of age. Logistic regression was used to determine the effects of siblings on educational attainment in Ethiopia; linear regression was used for the Malawian analyses described below.

To test for sib effects in educational investment within households, we first determined the relationship between overall birth order and educational attainment for each pop-

Table 2. Model 1: effect of family size and birth order on measure of education

	All		Males		Females	
	n	Beta ± SE	*n*	Beta ± SE	*n*	Beta ± SE
Ethiopia	400					
Sex (female)		−.741 ± .312*	196		204	
Birth order		−.259 ± .132*		−.382 ± .231+		−.252 ± .169
Birth order squared		.008 ± .027		−.006 ± .046		.014 ± .038
Family size		.118 ± .111		.143 ± .187		.158 ± .143
Wealth (herd size)		.093 ± .054+		.232 ± .094*		−.050 ± .094
Rich (4+ cattle)	253		118		135	
Sex (female)		−.610 ± .386				
Birth order		−.386 ± .162*		−.528 ± .286*		−.376 ± .218+
Family size		.187 ± .133		.115 ± .227		.332 ± .178+
Poor (≤3 cattle)	147		78		69	
Sex (female)		−1.19 ± .596*				
Birth order		.034 ± .259		.076 ± .035		−.036 ± .333
Family size		−.045 ± .237		.226 ± .452		−.428 ± .351
Malawi	1,777					
Sex (female)		−.205 ± .096*	891		886	
Birth order		−.461 ± .078**		−.534 ± .111**		−.403 ± .109**
Birth order squared		.028 ± .007**		.033 ± .010**		.024 ± .010*
Family size		.091 ± .032**		.094 ± .046*		.091 ± .044*
Wealth (garden size)		−.004 ± .029		.014 ± .042		−.025 ± .040
Wealth (income)		1.281 ± .178**		1.278 ± .244**		1.290 ± .264**
Rich	933		482		451	
Sex (female)		−.205 ± .135				
Birth order		−.742 ± .104**		−.674 ± .142**		−.883 ± .158**
Birth order squared		.043 ± .009**		.039 ± .012**		.053 ± .014**
Family size		.170 ± .044**		.128 ± .060*		.225 ± .065**
Poor	844		409		435	
Sex (female)		−.193 ± .135				
Birth order		−.048 ± .121		−.286 ± .197		−.125 ± .147
Birth order squared		−.002 ± .012		.016 ± .020		−.016 ± .015
Family size		.019 ± .046		.043 ± .072		−.040 ± .059

Note. Age, age squared, and mother's age controlled for.
+ $P < .1$.
* $P < .05$.
** $P < .01$.

ulation, controlling for family size (total number of siblings). Model 1 analyzes the relationship between education and a quadratic function of birth order, in order to pick up any nonlinear effects of birth order. For each population, we first ran this model on all children, including covariates for sex and wealth. Then, to explore the effects of sex and wealth on the relationship between birth order and education, we divided the sample by sex and wealth and ran the model separately for boys and girls and for rich and poor households. In both cases, "poor" households included approximately the bottom half of the wealth distribution and "rich" households approximately the top half (in Ethiopia, "poor" equates to households with less than four cattle and "rich" to those four or more cattle; in Malawi, "poor" indicates households with two or fewer hectares of land and "rich" those with more than 2 ha or involved in income-generating activities). All models controlled for child's age and age squared, mother's age, and family size.

Overall birth order may be confounded by the sex of siblings, however. So we then investigated the effects of sibling configuration on educational investment. In model 2, we tested the effects of number of older brothers, number of younger brothers, number of older sisters, and number of younger sisters on our education outcomes. Again, we first ran the model on all children, including variables for sex and wealth, and then divided the sample by sex and wealth and ran the model separately for girls and boys and for rich and poor households. All models controlled for child's age (as a quadratic function) and mother's age.

Results

Ethiopia

The results of the logistic regression analysis on the probability of school attendance shown in table 2 suggest that female children were disadvantaged, with girls being significantly less likely to receive education for their age than boys. For all children, there is a linear reduction in the likelihood of receiving education with increasing birth order that is more evident among male offspring. These birth-order effects appear to be driven by discriminative parental investment in the richest households, since birth-order effects are absent in poor households. Model 2 (presented in table 3 and illustrated in fig. 1) identifies more specifically that earlier-born sons are prioritized in educational investment at the expense of later-born sons in rich households. The number of older brothers is negatively associated with the probability that a male child receives education. This pattern of unequal investment among male siblings is not found among female siblings. There is some suggestion that younger brothers may be beneficial, since in rich households younger brothers have a positive impact on educational attainment, particularly for girls.

Malawi

The results of the linear regression analysis on the total number of years of education, shown in table 2, suggest that again female children were disadvantaged, with girls having significantly fewer years of education than boys. Birth order also affects the amount of education received, although here this relationship appears to be quadratic, suggesting early- and late-born advantages in education. As in Ethiopia, however, these effects appear to be driven by biased parental investment in rich households: they are seen for both sexes in rich households but for neither sex in poor households. When included in the same model as birth order, family size has a positive relationship with education, perhaps capturing an unmeasured effect of wealth (when included in preliminary models without birth order, family size has the predicted negative effect on education; results not shown). This effect also seems to be driven by rich households (a similar trend for a positive effect of family size is observed in the Ethiopian data set, but in that case only among females).

When sibling configuration is investigated in more detail, birth-order effects in Malawi seem to be largely driven by a biased investment in older daughters, in that having older sisters has a negative effect on the amount of education received (table 4). Again, however, these effects are more substantial in richer households. In poor households, boys suffer from the presence of older sisters, but no other kind of sibling has any affect on boys or girls. In rich households, children of both sexes suffer from the presence of older sisters, but boys also have lower educational attainment in the presence of older brothers (illustrated in fig. 2). As in Ethiopia, there appears to be a beneficial effect of younger brothers, this time for both sexes.

Wealth Effect

Finally, it is worth noting that there is overall a positive effect of wealth on education in both populations. For traditional forms of wealth, this effect is either rather weak (for herd size in Ethiopia) or nonexistent (for garden size in Malawi). In Malawi, however, a newer form of wealth appears to be more strongly associated with education: children in families that engage in income-generating activities are substantially better educated than children in families without income generation.

Discussion

In two rural African populations, we find clear evidence of biased parental investment in education according to child's

Table 3. Model 2: Ethiopian education (ever educated) and sibling configuration by wealth group

	All		Males		Females	
	n	Beta ± SE	*n*	Beta ± SE	*n*	Beta ± SE
Total	400					
Sex (female)		−.716 ± .315*	196		204	
Older brothers		−.326 ± .140*		−.598 ± .238*		−.160 ± .183
Younger brothers		.262 ± .146⁺		.352 ± .229		.197 ± .203
Older sisters		−.018 ± .137		−.074 ± .213		−.050 ± .189
Younger sisters		.030 ± .837		−.054 ± .250		.114 ± .184
Rich (4+ cattle)	253		118		135	
Sex (female)		−.632 ± .395				
Older brothers		−.435 ± .188*		−.827 ± .328*		−.192 ± .232
Younger brothers		.460 ± .196*		.466 ± .307		.523 ± .274⁺
Older sisters		.004 ± .171		−.197 ± .273		.140 ± .236
Younger sisters		.090 ± .176		−.026 ± .314		.220 ± .220
Poor (≤3 cattle)	147		78		69	
Sex (female)		−.989 ± .580⁺				
Older brothers		−.155 ± .228		−.155 ± .313		−.307 ± .399
Younger brothers		.065 ± .259		.348 ± .445		−.477 ± .418
Older sisters		.064 ± .260		.416 ± .334		−.633 ± .430
Younger sisters		−.060 ± .291		.121 ± .521		−.250 ± .399

Note. Logistic regression; age, age squared, mother's age, and wealth (herd size) controlled for.
⁺ $P < .1$.
* $P < .05$.

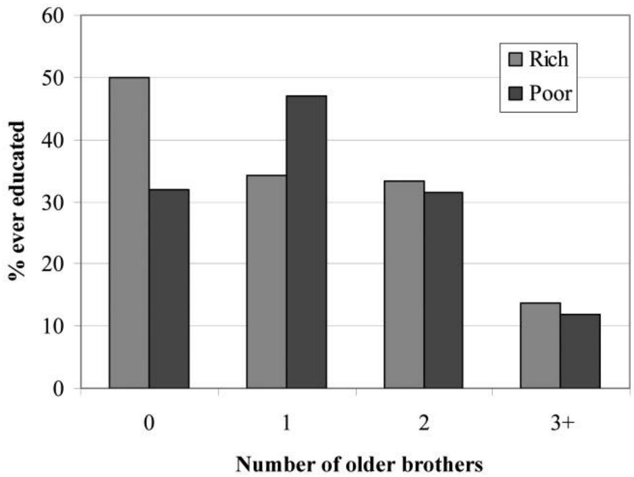

Figure 1. Percentage of Ethiopian male children receiving education by number of same-sex older siblings; data for rich and poor households. A color version of this figure is available in the online edition.

birth order. In both populations, early-born children are favored in terms of parental investment in education, at the expense of later-born children. In line with Kaplan's model of the demographic transition (Kaplan 1996; Kaplan et al. 2002), where the shift from child quantity to child quality occurs first among the wealthy, we find biased allocation of education investment to be more evident in wealthier households. By investing heavily in a few older offspring, wealthy parents seem to be attempting to provide them with a competitive advantage in the acquisition of both resources and mates. Poorer parents opt for a more opportunistic strategy of educational investment that does not discriminate between offspring. A similar "bet-hedging" strategy in terms of education has been observed in a poor South African community, where parents divide educational investment equally across all their offspring (Liddell, Barrett, and Henzi 2003). The authors argue that parents living under uncertain conditions with high environmental risks cannot predict which child will be successful and so educate all equally. Under conditions of improved resource availability and reduced environmental

Table 4. Model 2: Malawian education (years completed) and sibling configuration by wealth group

	All		Males		Females	
	n	Beta ± SE	*n*	Beta ± SE	*n*	Beta ± SE
Total	1,777					
Sex (female)		−.207 ± .096*	891		886	
Older brothers		−.051 ± .048		−.082 ± .074		−.014 ± .063
Younger brothers		.129 ± .049**		.172 ± .072*		.101 ± .066
Older sisters		−.187 ± .045**		−.248 ± .066**		−.126 ± .063*
Younger sisters		.066 ± .049		.029 ± .070		.097 ± .068
Rich (>2 ha, income)	933		482		451	
Sex (female)		−.258 ± .139*				
Older brothers		−.112 ± .065*		−.188 ± .097*		−.060 ± .090
Younger brothers		.257 ± .069**		.269 ± .094**		.234 ± .102*
Older sisters		−.231 ± .062**		−.190 ± .089*		−.268 ± .087**
Younger sisters		.055 ± .069		.035 ± .095		.091 ± .102
Poor (≤2 ha)	844		409		435	
Sex (female)		−.199 ± .136				
Older brothers		.045 ± .074		.115 ± .115		−.001 ± .093
Younger brothers		−.016 ± .072		.151 ± .119		−.078 ± .087
Older sisters		−.157 ± .070*		−.377 ± .101**		.058 ± .094
Younger sisters		.050 ± .072		.040 ± .109		.074 ± .093

Note. Linear regression; age, age squared, mother's age, and wealth (garden size and income-generating activities) controlled for.
* $P < .05$.
** $P < .01$.

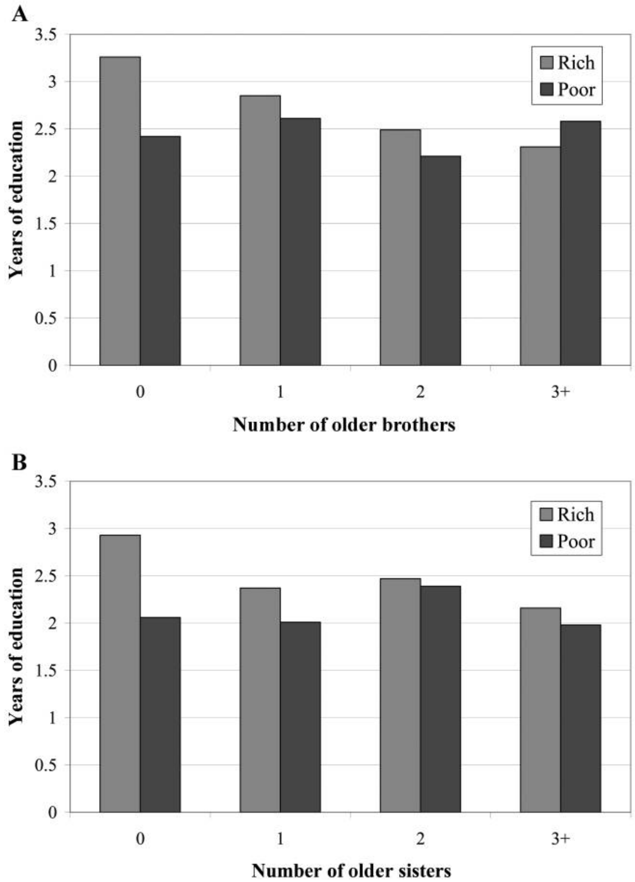

Figure 2. A, Mean years of education for Malawian male children by number of same-sex older siblings; data for rich and poor households. *B*, Mean years of education for Malawian female children by number of same-sex older siblings; data for rich and poor households. A color version of this figure is available in the online edition.

risk, parents may become more discriminative. This may also explain why a negative effect of family size on schooling has become more pronounced in recent decades in Cameroon (Eloundou-Enyegue and Williams 2006) and why, in a neighboring Ethiopian Arsi Oromo community, where a new development initiative has improved access to a clean water supply (and reduced extrinsic mortality risks), there has been an overall increase in investment in child education but also greater inequality between siblings within the household (Gibson and Lawson, forthcoming).

Among both Arsi Oromo and Chewa, investment tradeoffs in rich families are largely resolved in favor of early-born offspring. Sex also matters, however. Among the patrilineal Arsi Oromo, parents express the strongest overall preference for educating sons, who also inherit lineage titles, land, and cattle. Sibling competition is also greatest among brothers, with later-born sons losing out to their older brothers for educational opportunities. Incremental reductions in land size and bridewealth payments with son order are also found among the Arsi Oromo (M. A. Gibson, unpublished manuscript). Daughters, who leave the patrilineage (and village) upon marriage, represent a drain on the patrilineage, are less likely to receive any education, and represent little competition for their siblings.

A different pattern emerges among the largely matrilocal/matrilineal Chewa, as daughters remain within the lineage at marriage and benefit from inheritable resources (Sear 2008). In this case, although daughters receive slightly less education than sons overall, older daughters are prioritized for education. However, among the richest Chewa households, older boys also gain privileged access to education. This mirrors the shift toward investment in sons in terms of inherited resources (land) in the wealthiest households and is consistent with research in other populations suggesting that accumulation in wealth results in a shift to patriliny (Holden and Mace 2003). These biases toward educating males may also occur because males are better able to capitalize on employment opportunities arising from an emerging skills-based economy in the towns and cities in both countries (particularly the construction and tourism industries).

An overall early-born advantage is something of a simplification for both societies. There is some evidence for a "middle-born disadvantage," as there is a curvilinear relationship between birth order and education attainment in Malawi that may result from terminal investment in later-born offspring; again, however, this effect is seen only in wealthy households. The analysis of sibling configuration suggests that this effect may be driven by a beneficial effect of younger brothers, since having younger brothers is correlated with increased educational attainment. In Ethiopia, there is a similar trend indicating a positive effect of younger brothers in wealthy households. The mechanisms that bring this about are not clear, although it might simply reflect an unmeasured effect of wealth, as wealthier families may experience lower mortality among sons and/or produce more energetically expensive sons than poorer families. In support of this argument, previous research in this Ethiopian population has shown that mothers in better body condition produce a higher proportion of sons (Gibson and Mace 2003).

Conclusion

We tested the impact of resources on parental investment decisions by measuring sibling-configuration effects on education in two African populations. We find that wealthier parents have more-educated offspring but that greater wealth also results in greater educational inequalities between children within the same family. This suggests that the spread of education and integration into a market- and skills-based economy are beginning to change the cost and benefit calculations of parents. In line with Kaplan's model of the demographic transition (Kaplan 1996; Kaplan et al. 2002), it appears to be the wealthier parents who are beginning to manipulate the educational attainment of their children most. There is also suggestive evidence from Malawi that parents who are most integrated into the new market economy are capitalizing most on educational opportunities for their children. These are both populations in which fertility is not yet being controlled substantially, and in both there remains a positive relationship between wealth and reproductive success, typical of pretransition societies (Gibson and Mace 2007; Holden, Sear, and Mace 2003). In the near future, these changing cost-benefit calculations of parents may lead to a reduction in family size so that parents can invest more intensively in fewer children.

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