

Report

Trade-Offs in Children's Time Allocation

Mixed Support for Embodied Capital Models of the Demographic Transition in Tanzania

Sophie Hedges, Rebecca Sear, Jim Todd, Mark Urassa, and David W. Lawson

Department of Population Health, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, United Kingdom (sophie.hedges@lshtm.ac.uk; Hedges, Sear, and Todd)/National Institute for Medical Research, Mwanza Intervention Trials Unit, Isamilo Street, PO Box 11936, Mwanza, Tanzania (Todd and Urassa)/Department of Anthropology, University of California, Santa Barbara, Santa Barbara, California 93106, USA (Lawson). This paper was submitted 24 VIII 17, accepted 22 I 18, and electronically published 12 IX 18.

Online enhancements: supplementary material

Embodied capital theory (ECT) argues that socioeconomic “modernization” leads to high-cost, high-return parental investments in education, in turn incentivizing demographic transitions to low fertility. However, few studies have directly investigated the proposed opportunity costs of schooling in contemporary developing populations undergoing socioeconomic change. We present a study of children's time use in two communities in Mwanza, Tanzania, representing either end of a local rural-urban gradient. Consistent with ECT, town residence compared with village residence was associated with increased schooling at the expense of time allocation to children's work. However, these patterns apply primarily to boys, for whom herding work is relatively incompatible with schooling. Girls more readily combine domestic chores with school attendance, a pattern that may account for unexpectedly high female school enrollment in this population. Furthermore, the strongest time allocation trade-offs were not between school and work but between school and leisure time, suggesting overall low opportunity costs to education. Mixed support for ECT may partially explain why fertility decline has stalled in many low-income countries despite education uptake. Finally, we advocate that international development programs consider the well-being implications of reduced leisure time accompanying education uptake, particularly for girls maintaining a “double shift” of school and domestic work.

Embodied capital is defined as the skills, knowledge, experience, physical growth, and strength acquired during childhood and adolescence that increase adult social and reproductive success. Embodied capital theory (ECT), developed by evolutionary anthropologists, predicts that children's time allocation favors activities that improve long-term social and reproductive success but that there may be trade-offs between activities with long-term returns, which are not immediately productive, and activities with short-term returns (Gurven and Kaplan 2006). Processes involved in economic modernization, including urbanization, declining mortality, and market integration, lead to greater payoffs to investment in embodied capital gained through formal education (Mattison and Sear 2016). Schooling enables children to gain practical and social skills that will be beneficial in the long term. But attending school is costly—both directly and indirectly through opportunity costs arising from time allocation away from productive activities. Children therefore become more costly, leading parents to invest more resources in fewer children. These “quantity-quality trade-offs” are hypothesized to have driven the global decline in fertility over the past two centuries (Kaplan 1996; Kaplan, Bock, and Hooper 2015).

Support for the importance of quantity-quality trade-offs in causing a fertility decline primarily focuses on data from historical European demographic trends and variation in fertility within modern affluent populations (Lee 2003). However, the primacy of Europe in influencing demographic transition theories is problematic because the process of modernization in contemporary developing populations may be distinct (Thornton 2001). Embodied capital models of the demographic transition posit that parents incur costs but that these are offset by increased payoffs for their children in adult life. Thus, education is presented as beneficial, but this may not always be the case in contemporary rural low-income settings. Poor education quality, a lack of employment prospects, and reliance on subsistence livelihoods make the payoffs to education uncertain (Nieuwenhuys 1993). There are also concerns that the widely assumed trade-off between children's work and school attendance (i.e., the opportunity costs of educating children) is exaggerated in both current theory and policy discourse, with few studies demonstrating a direct trade-off between time spent in work versus in education (Beegle et al. 2008; Pörtner 2016). Indeed, work and school may often be complementary; for example, children may earn money for school expenses through part-time work (Nieuwenhuys 1993).

ECT also anticipates that parents will invest according to the specific returns expected for different children, based on socioecological context household factors, and individual-level factors such as child gender (Bock 2002; Gurven and Kaplan 2006). In a patrilocal, patrilineal context such as we study here, sons remain nearby as adults, meaning that parents may anticipate greater returns to educating boys. Furthermore, when men earn higher wages than women and are more likely to have a job requiring formal education, parents are anticipated to favor edu-

cating sons. However, noneconomic outcomes—including maternal and child health, social status, and marriage opportunities—also are improved by education and may lead to greater payoffs to girls' education in some contexts (Bedasso 2008).

With long-term benefits to education uncertain, and potentially limited or absent altogether, differential opportunity costs of schooling may be pivotal for parental investment decisions in many rural low-income populations. Typically, girls do more domestic chores and childcare, while boys are more involved in work outside the household (Murdock and Provost 1973). Anthropologists have highlighted the importance of girls' childcare in underwriting the costs of high fertility in pretransition societies (Kramer 2002). Other studies emphasize the importance of boys' labor in contributing to household subsistence (Cain 1977). However, existing data on children's work and time allocation in contemporary low-income settings likely underestimate the amount of work done by children, and particularly girls, because of the focus on market-based work done for cash income (Assaad, Levison, and Zibani 2010; Esquivel et al. 2008). Household work is often overlooked, yet these duties may be both time- and energy-consuming, essential to household functioning, and disruptive to schooling (Ilahi 2000). Additionally, few studies have considered the effects of schooling and work on children's leisure time (Bacolod and Ranjan 2008).

We present a novel study of children's time allocation in two communities in northwestern Tanzania, representing either end of a local rural-urban gradient. Departing from much of the prior literature, we take a holistic perspective on children's time allocation throughout a complete day, including contributions to domestic and farm work and leisure time. Defining work more broadly and collecting data on leisure activities rather than focusing solely on school or market work, allows a more nuanced investigation of predictions derived from ECT. We outline five hypotheses regarding the effects of modernization and gender on (i) school enrollment, (ii) patterns of children's work, and (iii) the trade-offs between these activities.

Social Context and Hypotheses

Fieldwork was conducted in the Mwanza region of northwestern Tanzania, a context in which social, economic, and demographic transitions are occurring. Primary school enrollment in Tanzania increased dramatically following the universal education movement in the 1970s but declined in the 1980s (Beegle et al. 2008). Fewer than 60% of children progress to secondary school, and there are concerns about the low quality of schooling available (Hivos 2014). Many households are still involved in subsistence agropastoralism, with children also working on household farms (International Labour Office 2013; US Department of Labor 2013). In the Mwanza region, mortality in children under 5 years old has declined substantially over the past decade, but fertility remains high at 6.4 children per woman, on average (Demographic Health and Surveys Program 2016; Kishamawe et al. 2015). Within this context, we use residence in a neighboring village and town as a proxy for

degree of modernization in order to test hypotheses derived from ECT. While we acknowledge that modernization is a multifaceted process that cannot be fully captured by a two-way comparison (Kirk 1996), there are clear differences between the village and town in the anticipated payoffs to children's work and education.

The village and town are both within the Magu Health and Demographic Surveillance Site (HDSS), approximately 20 km east of the city of Mwanza (fig. 1). Most residents are part of the Sukuma ethnic group, the largest in Tanzania, representing about 17% of the nation (Malipula 2015). Traditionally, the Sukuma lived in large, dispersed homesteads and maintained large herds. Now cattle keeping is declining as land holdings decrease in size and consumer goods become a more important indicator of wealth (Wijsen and Tanner 2002). In the village, 83% of households are reliant on agropastoralism, with 45% of households selling surplus crops or animal products and 38% being subsistence farmers. In the town, more households rely on petty trading or laboring (20%) or small businesses and skilled work such as, for example, mechanics or tailors (53%). The opportunities for paid employment and entrepreneurship are much greater in the town, which has a central market and is linked by public transportation to large markets in the city of Mwanza and its surrounding suburbs. Near the town are large businesses, including a textile factory and Coca-Cola depot, that require a secondary school certificate for employment. In contrast, in the village, knowledge and skills associated with traditional livelihoods, particularly cattle herding, remain important and are best acquired through practical experience. The village generally retains a stronger Sukuma identity, with many families continuing to speak Sukuma and 42% practicing traditional religious beliefs. In the town, most speak Swahili, the national language in which primary school is taught, and the majority of households identify either as Christian (92%) or Muslim (5%).

While predictions are drawn from ECT, our analyses are somewhat exploratory given the unpredictability of returns to investment in a transitioning context. Our first two hypotheses concern parental decisions to enroll children in school. In the town, we anticipate higher returns of investment in skills acquired through school because of the greater potential for formal employment (Kaplan 1996; Mattison and Neill 2013). Our first hypothesis therefore is that (1) modernization (proxied here by town residence) will be associated with greater school enrollment. Given the patrilineal, patrilineal context and the typically higher earnings of men (Food and Agriculture Organization 2014), we expect boys to receive more education. Thus, we anticipate that (2) girls will be less likely to be enrolled in school than boys. We also take the opportunity to consider potential interactions between gender and village/town residence in predicting education outcomes.

Our third and fourth hypotheses concern children's work. Agricultural, and particularly pastoralist, livelihoods are associated with high labor demands that are traditionally met partly through children's labor (Kramer 2002; Sellen 2003). Modernization is associated with lowered reliance on agriculture and

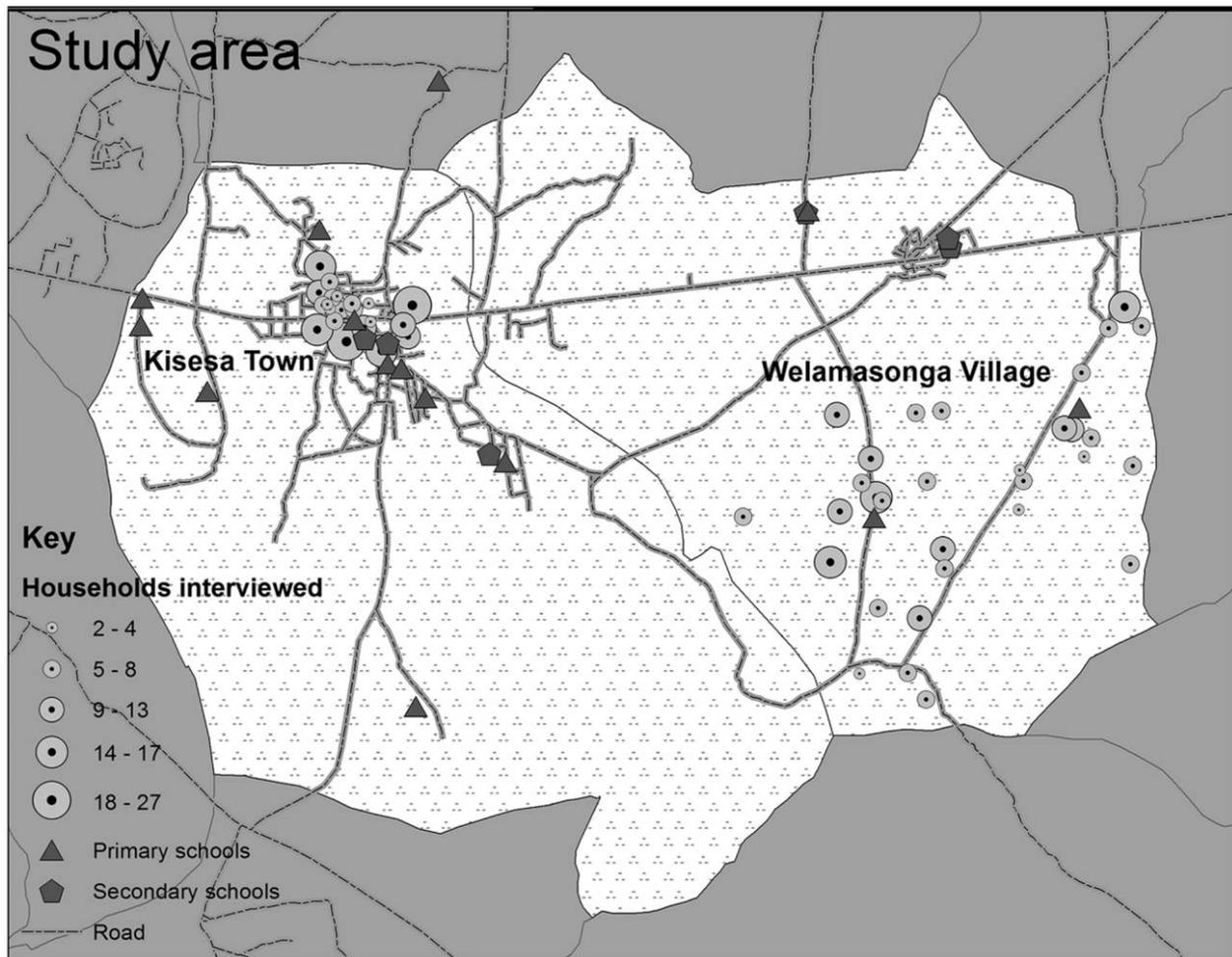


Figure 1. Map of the study area showing distribution of households interviewed as well as the main roads and schools attended by children.

reduced livestock ownership and so is expected to be associated with lower returns to children's agricultural work. Additionally, better access to water and smaller household size (i.e., fewer household members) in the town are expected to reduce the returns to children's household chores. This leads to our third hypothesis, which is that (3) modernization will be associated with less work overall for children and particularly less farm work. Gendered division of labor is observed across societies, and children are socialized to fulfill these gendered roles as adults. Among the Sukuma, farm work and cattle herding are boys' tasks, while household chores are girls' tasks (Varkevisser 1973). Our fourth hypothesis is, therefore, that (4) boys will do more farm work and girls will do more household chores.

Finally, we examine the trade-off between work and education as suggested by ECT. Because time is a limited resource, school attendance is expected to reduce the time spent in other activities. Furthermore, as the returns to children's work are expected to be lower and the returns to school attendance in

the town higher, the opportunity costs of school are expected to be lower. Thus, we hypothesize that (5) there will be a trade-off between work and education but that modernization will reduce the magnitude of this trade-off.

Methods

We conducted a study of children and young adults aged 7–19 years. The HDSS provided a sampling frame of all households with members aged 7–19, from which we randomly sampled 550 households. Surveys collected information about household membership, education, occupation, household assets, land and livestock ownership, business involvement, and food security, based on the Household Food Insecurity and Access Scale (Coates, Swindale, and Bilinsky 2007). Food security is used as a proxy for household wealth in our analyses. We believe this is an effective measure of household wealth in the context of a food-insecure population and that it avoids

comparability issues in alternative wealth measures (e.g., comparing land or cattle ownership) in the face of marked livelihood variation between town and village.

Children's time allocation on the previous school day was recorded through a time allocation interview (fig. 2). We followed up with 1,278 of 1,387 total eligible children (92.1%). Children were shown a diagram representing the day and were asked to remember everything they did on the previous week-day, from when they woke up until they went to sleep. A diagram was shaded to indicate the time and duration of the activities (time diagram example shown in supplementary materials; fig. S1; supplementary materials, including figs. S1, S2, are available online). The advantage of these data is that they provide a "child's-eye" view of children's contributions to their households. There are some limitations, however, including possible biases in self-report. For example, previous studies have suggested that children may overestimate their work hours (Janzen 2018); as a snapshot of a single day, these data cannot account for seasonal variation or all potential strategies that families may employ to ameliorate the trade-off between work and school, such as working on weekends or during school holidays. We also collected data only on the primary activity and did not ask about concurrent activities, which we acknowledge may underestimate time in activities potentially combined with others, such as childcare, for example.

We used logistic regression models to test hypotheses 1 and 2, regarding the effect of town residence (our proxy for modernization) and gender on schooling. We constructed three binary outcome variables relating to schooling: "schooled," where 1 indicates whether the child has ever been enrolled in school; "enrolled," where 1 indicates the child is currently enrolled in school; and "progressed," for those aged 14–19 only,

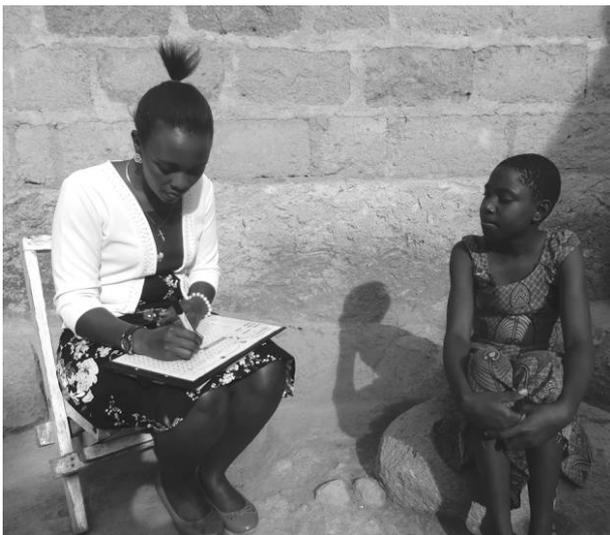


Figure 2. A fieldworker completes a time allocation diagram during an interview with a girl outside her home in the town. A color version of this figure is available online.

where 1 indicates the child has attended secondary school. The clustering of children (level 1, $N = 1,367$) within households (level 2, $N = 456$) was accounted for using mixed effects models, including a random effect for household in schooled and enrolled models. Progressed models did not include a random effect because the clusters are more sparsely populated, which may overestimate fixed and random effects (Clarke 2008). All models adjust for child age and food security as a proxy for household wealth. An interaction between gender and residence was included to investigate whether gender differences were reduced in the town.

Hypotheses 3 and 4, regarding children's time spent in work, were tested using linear regression models. Activities from the time allocation interview were coded into one of five categories: leisure/personal (hereafter, "leisure"), education, household chores, farm work or herding (hereafter, "farm work"), and market work (see full details in table S1; tables S1–S3 are available online). Total time spent in each activity category was calculated and divided by the number of hours covered by the interview (5 a.m.–10 p.m.; 17 hours) to give the proportion of time spent in each activity category. Separate regression models were run for each activity, as well as a new activity variable, productive work, which was calculated as the total number of hours spent in household chores, farm work, and market work. The outcome variable for each regression model was hours spent in that activity, with gender and place of residence being the key predictor variables. An interaction between residence and gender was included to investigate whether gender differences exist between the town and the village. Analyses were stratified by school attendance (attended on the previous school day or not) and age group (7–13 and 14–19), as work patterns change with age and differ between those who attended and did not attend school. Models were adjusted for age, household food security, and school enrollment for those who did not attend school.

Fractional multinomial logistic regression (Buis 2017) was used to investigate hypothesis 5: the trade-off between education and other activities. This method accounts for autocorrelation between time uses, as time spent in one activity automatically reduces time available for other activities. The outcome variables are the proportions of time spent in education, leisure activities, household chores, farm work, and market work, adding up to 1 for each child. The key predictor variables were gender, residence, and school attendance. These models were stratified by age group and adjusted for age, household food security, and school enrollment. Models give predicted proportions of time in the five categories, subsequently converted back into hours. All analyses were carried out in Stata, version 14.

Results

Descriptive Statistics

Town households are smaller, are more likely to have an educated household head, are less likely to own land or cattle or

grow crops, are more likely to have a formal business or salaried member, and have greater access to public services such as electricity and water (table 1). These data support our assumption that town residence is a proxy for modernization. Food insecurity is high and is similar across the village and the town, suggesting that despite livelihood variation, both locations face similar socioeconomic challenges in provisioning their families.

Only 5% of children had never attended school, primarily because they were still considered too young. In the village, 79% of girls and 71% of boys were currently enrolled, while in the town, 84% of girls and 87% of boys were enrolled. Of the 1,278 children interviewed, 80% were enrolled and 70% had attended school. There was no significant difference in missing school between the village and the town.

Figure 3 shows children's time allocation by age, stratified by gender and location. Children spend about half their time in leisure activities. Leisure time decreases with age, while time spent in education and work increases with age—except among the oldest children, who spend little time in education and more in either work (village) or leisure (town). Farm work is predominantly done by village boys and older village girls. Girls do more household chores than boys in both the town and the village.

Education

Table 2 shows results from our logistic regression of the three education outcomes. These results support hypothesis 1: town residence is associated with higher odds of enrollment and

progression to secondary school. Contrary to hypothesis 2, girls have higher odds of enrollment than boys, though there is no gender difference in progression to secondary school. There are interactions between residence and gender, with gender differences being reduced in the town (though this is only marginally significant for ever-enrolled children). In the village, therefore, boys are less likely to be in school than girls; in the town, the overall level of educational investment increases, and the gap between boys and girls is reduced. The educational “disadvantage” to village boys is surprising, given historical trends in this area indicating higher male enrollment rates (fig. S2).

Work

Figure 4 shows results from the linear regression models, predicting hours spent in household chores, farm work, leisure, and overall productive work (household chores + farm work + market work; full regression results shown in table S2). Results for market work are not shown, given the negligible amount of time spent in this activity. We first discuss work patterns for children who did not attend school before considering children who did attend school.

Among children who did not attend school, figure 4A shows that village/town differences are clear and in line with hypothesis 3: that modernization would be associated with less productive work. Hypothesis 4 stated that boys would do more farm work and girls more household chores. Our results show that gender differences in the type of work done are substantial and in the expected direction. Differences in the amount of work

Table 1. Sample size and description of child education outcomes and household characteristics

| | Village | Town | Total |
|---|------------|------------|--------------|
| Sample: | | | |
| Number of households | 234 | 222 | 456 |
| Number of children aged 7–19 | 768 | 619 | 1,387 |
| Number of children interviewed | 740 | 538 | 1,278 |
| Mean household size (SD) | 8.0 (2.9) | 7.1 (3.2) | 7.6 (3.1) |
| Mean number of children aged 7–19 per household (SD) | 3.3 (1.7) | 2.7 (1.8) | 3.0 (1.7) |
| Education outcomes: | | | |
| Ever enrolled (%) | 702 (91.4) | 608 (98.2) | 1,310 (94.5) |
| Currently enrolled (%) | 574 (74.7) | 528 (85.3) | 1,102 (79.5) |
| Progressed (%; 14–19-year-olds) | 80 (30.9) | 196 (72.3) | 276 (52.1) |
| Attended on previous day (%; currently enrolled and followed up only) | 490 (87.2) | 417 (88.7) | 907 (87.9) |
| Mean years of education (SD; previously enrolled) | 5.9 (2.5) | 8.1 (2.8) | 6.6 (2.8) |
| Percentage of households: | | | |
| With salaried member | 1.7 | 12.6 | 7.0 |
| With skilled member | 3.0 | 20.3 | 11.4 |
| With business or shop | 10.3 | 32.9 | 21.3 |
| Farming and selling agricultural produce | 45.3 | 4.1 | 25.2 |
| Subsistence farming | 38.0 | 9.9 | 24.3 |
| Owning land | 95.3 | 72.5 | 84.2 |
| Growing crops | 96.2 | 47.3 | 72.4 |
| Owning cattle | 43.6 | 7.2 | 25.9 |
| With electricity | 2.1 | 50.5 | 25.7 |
| With water source on own land | 3.4 | 36.0 | 19.3 |
| Classed as severely food insecure | 50.4 | 48.4 | 49.5 |

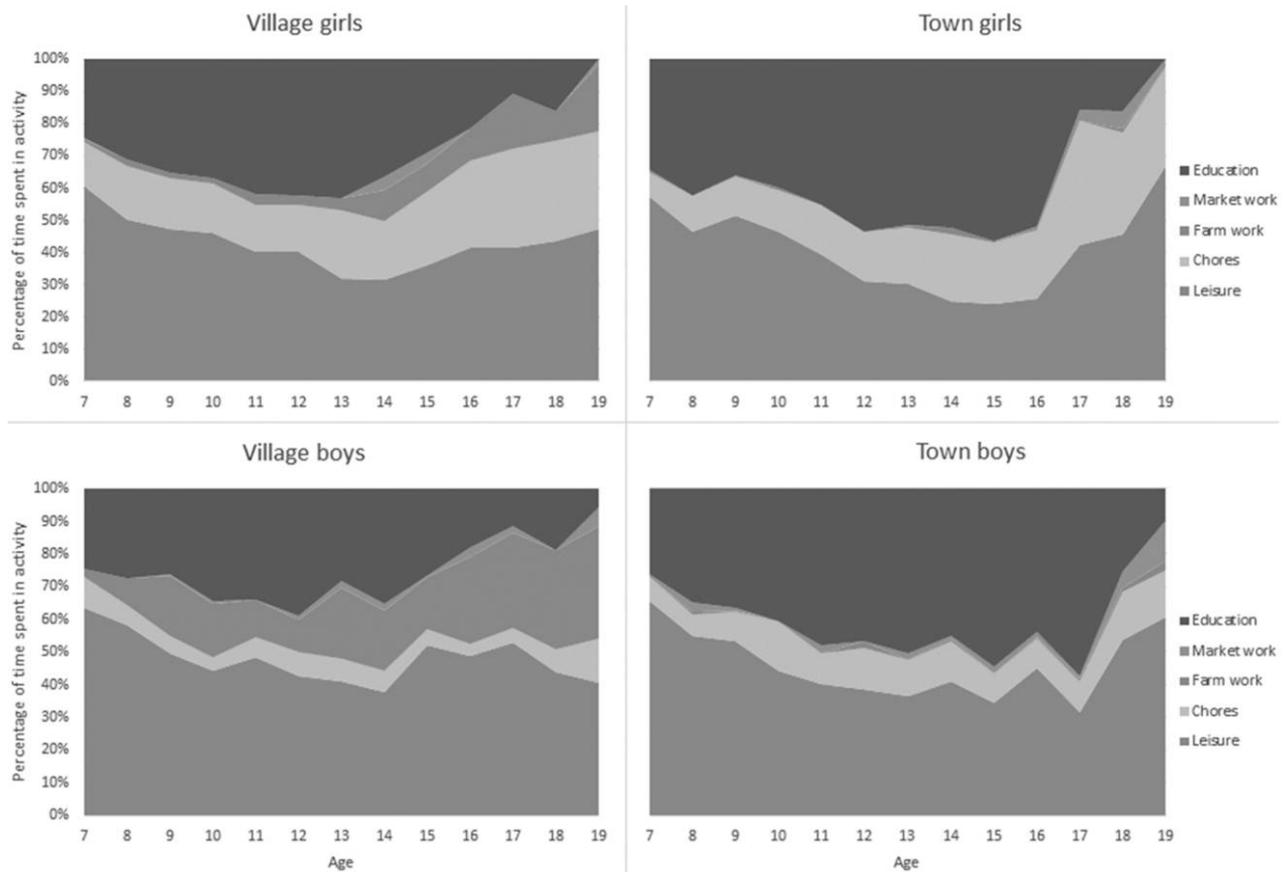


Figure 3. Mean percentages of time spent in education, market work, farm work, household chores, and leisure between 5 a.m. and 10 p.m. on the previous school day, by age. Data are displayed by gender and urban/rural residence. Time spent in leisure decreases with age, while time spent in education and work increases with age. Farm work is predominantly done by village boys and older village girls. Girls do more household chores than boys in both the town and the village. Only a small amount of time is spent by any children doing market work. A color version of this figure is available online.

done are more complicated. Among 7–13-year-olds, there are no significant gender differences in work and leisure in the town, but village boys do marginally more work and have marginally less leisure time than village girls. Among 14–19-year-olds, however, gender differences are exacerbated with modernization. Girls do approximately 4 hours more chores than boys in both locations. In the town, boys therefore do much less productive work than girls and have more leisure time, while in the village there is no significant gender difference in the amount of work done among 14–19-year-olds.

Among children who attended school, gender and village/town differences are much smaller (fig. 4B). Consistent with hypothesis 3, those in the town do slightly less productive work, a difference that is significant among 14–19-year-olds. Those in the town also have significantly less leisure time than those in the village because they spend more time in education. In line with hypothesis 4, some gender differences are statistically significant in that girls do more household chores than boys, and this difference is reduced in the town. In the village, boys do more farm work than girls, while neither boys nor girls do

much farm work in the town. This leads to town girls doing more productive work and having less leisure time overall, particularly among 14–19-year-olds.

These results suggest that the lower enrollment rates seen for boys in the village may be due to their time spent farming. They also suggest there may not be a straightforward trade-off between work and school because girls do similar amounts of productive work, if not more work, than boys, and yet are not less likely to be enrolled. In the next section, we estimate the trade-offs in time allocation among work, leisure, and school.

Trade-Offs between Work and School

Figure 5 shows results from the fractional multinomial logistic regression model, showing the predicted difference in time allocation, in hours, between school attenders and nonattenders (full model output in table S3). This gives us an indication of the opportunity costs of schooling, as it shows which activities are reduced to allocate time to education. In figure 5, activities for which we cannot be statistically confident of a

Table 2. Results from logistic regression models of educational outcomes; ever enrolled in school, currently enrolled in school (whole sample), and progressed to secondary school (for 14–19-year-olds only)

| | Ever enrolled | Currently enrolled | Progressed (14-to-19-year-olds) |
|--------------------------------|--------------------------|---------------------------------|---------------------------------|
| Town (reference = village) | 12.22** [3.67, 40.72] | 7.00** [3.83, 12.82] | 5.86** [3.40, 10.10] |
| Female (reference = male) | 1.98* [1.06, 3.72] | 1.82* [1.14, 2.88] | 1.27 [.74, 2.18] |
| Residence-gender interaction | .27+ [.06, 1.20] | .41* [.20, .87] | 1.22 [.56, 2.64] |
| Household food security score | 1.05+ [.99, 1.10] | 1.04* [1.01, 1.08] | 1.06** [1.02, 1.09] |
| Age (years) | 1.74** [1.50, 2.02] | .58** [.54, .63] | 1.25** [1.12, 1.41] |
| Constant | .01** [.00, .07] | 2,099.90** [578.02, 7628.80] | .00** [.00, .03] |
| Random intercept for household | .96 [.48, 1.90] | .83 [.52, 1.34] | |
| N | 1,367 | 1,367 | 523 |

Note. Exponentiated coefficients presented; 95% confidence intervals in brackets.

+ $P < .10$.

* $P < .05$.

** $P < .01$.

difference between school attenders and nonattenders have confidence intervals that cross 0. For example, school attendance has negligible effects on market work for both genders. As expected, school attendance substantially increases time in education, particularly among older children, who allocate 9–11 hours per day to education. Which activities are reduced to make space for schooling depend on gender and location.

Among 7–13-year-olds, school attendance primarily reduces leisure time, by up to 7 hours a day. Village boys are the exceptions here; school leads to a relatively small reduction in leisure time but a larger reduction in farm work of around 4 hours per day. Village girls also have a small reduction in both chores and farm work with school attendance, while for both girls and boys in the town only chores are reduced. These results imply that the opportunity costs of schooling are highest for village boys, while there are relatively small trade-offs between work and education for girls or town boys.

Among 14–19-year-olds, the effect of school attendance on reducing work is greater for girls. School attendance reduces time spent in household chores by approximately 5 hours for girls in the town. For village girls, school attendance reduces household chore time by around 3 hours and farm work by around 2 hours. As in the younger group, village boys trade off education and farm work, with school attendance decreasing farm work by around 5 hours. Town boys, in this case, are the exception, as they only show small trade-offs between work and education, with school attendance instead reducing leisure time by nearly 8 hours. Thus, the opportunity costs of school attendance are elevated at older ages for both town and village girls to a level similar to that of village boys but are negligible for boys living in town.

In summary, hypothesis 5, which is that work would trade off against education but that this trade-off would decrease with

modernization, is partially supported. We do find trade-offs between work and education, particularly for older children, but a substantial amount of the time that children spend in education is traded off with leisure time rather than work. Further, there are gender differences in this trade-off. Modernization affects boys' time allocation to a greater degree than girls' time allocation. In the village, boys' work is valuable, and this appears to affect their enrollment. In the town, boys do much less work, lowering the opportunity costs of schooling. Girls' work patterns, in contrast, show much smaller differences with modernization, with the opportunity costs of older girls' time being quite high in both the town and village.

Discussion

Consistent with ECT, we report evidence that modernization increases investment in education, reduces farm work, and is associated with lower opportunity costs to schooling. However, contrary to our expectations, the strongest trade-offs in time allocation are not between school and work but, rather, are between school and leisure time. Furthermore, we find that the classic narrative of ECT applies primarily to boys; male-dominated farm work is relatively incompatible with schooling, while female-dominated household chores are more readily combined with school. These findings have important theoretical and applied implications for our understanding of socioeconomic modernization and its effects on childhood experience.

In this context, the opportunity costs of educating children appear modest. This, in turn, implies that the returns to education need not be particularly high to justify parental investment in child schooling. Education uptake may therefore be driven not just by increasing economic benefits but also by

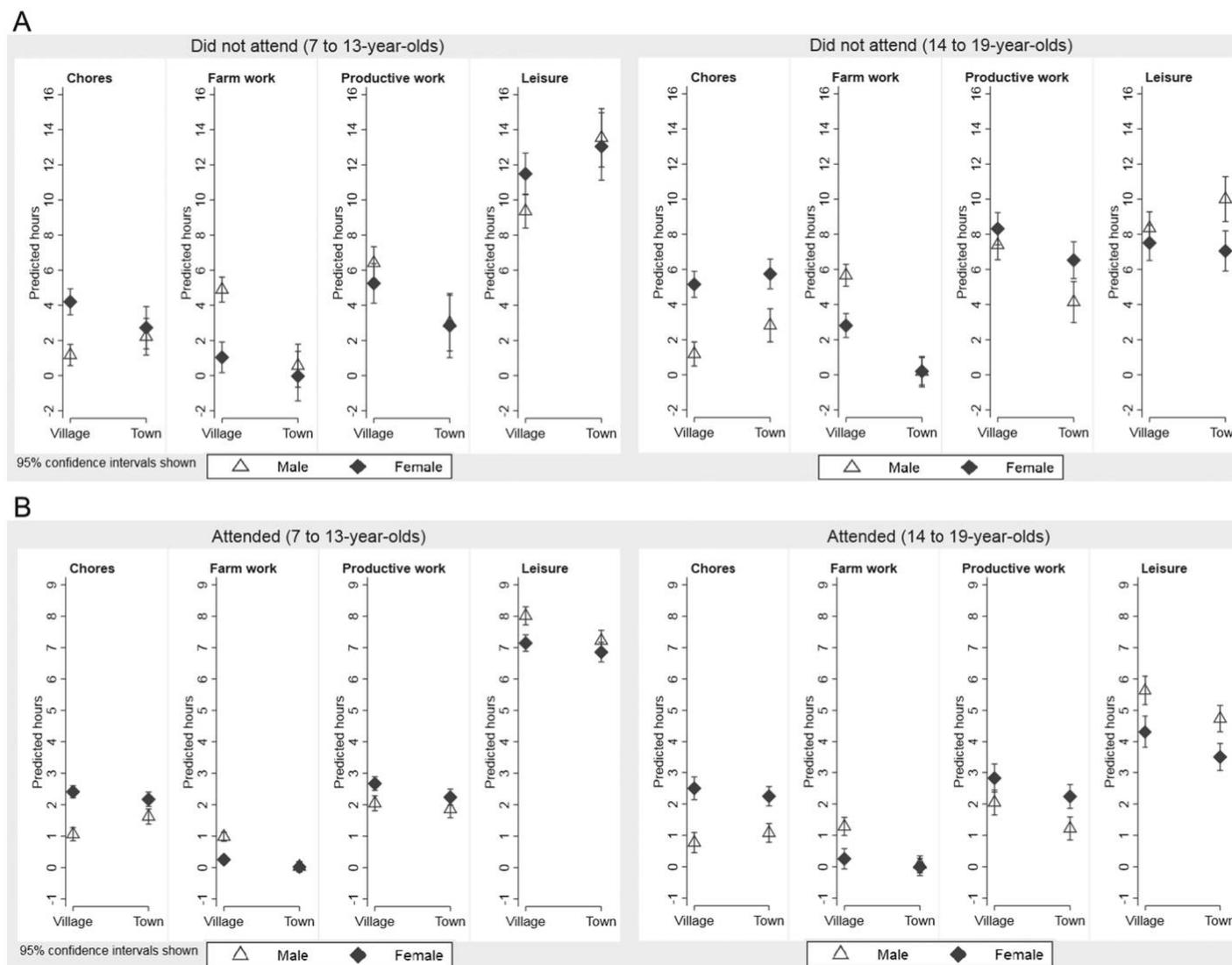


Figure 4. *A*, Predicted hours spent in household chores, farm work, leisure, and productive work from linear regression models for those who did not attend school the previous day. Results are shown by village and town and for boys (open triangles) and girls (filled diamonds). Error bars represent 95% confidence intervals. *B*, Predicted hours spent in household chores, farm work, leisure, and productive work from linear regression models for those who did attend school the previous day. Results are shown by village and town and for boys (open triangles) and girls (filled diamonds). Error bars represent 95% confidence intervals.

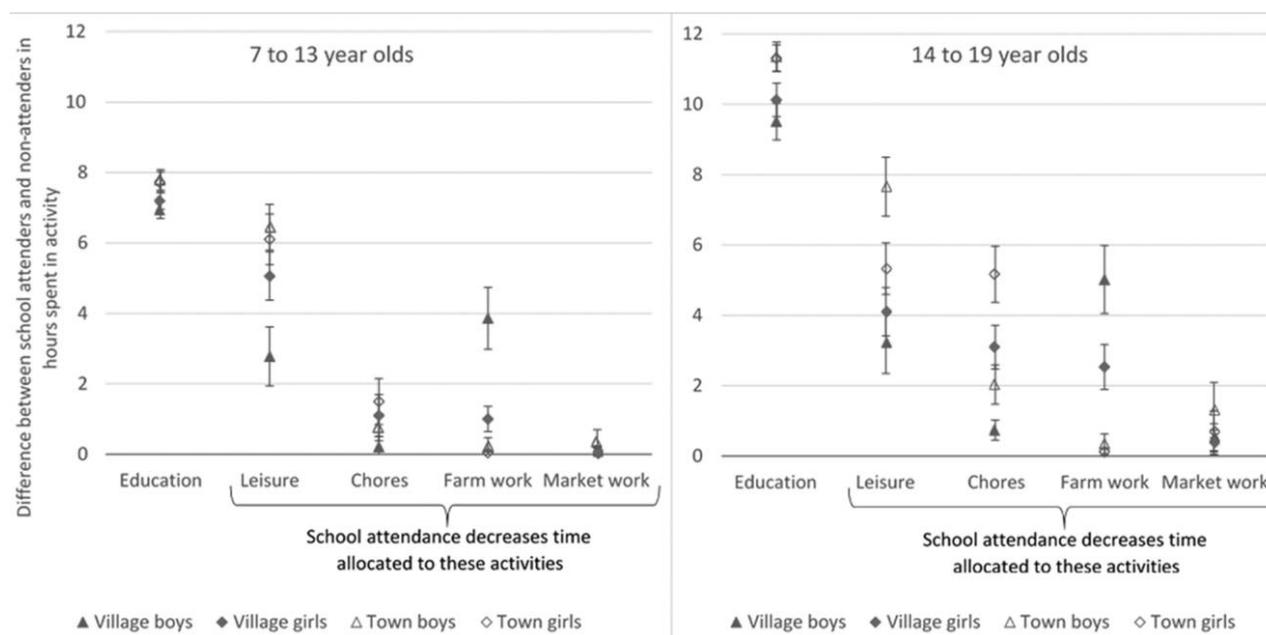


Figure 5. Predicted hours from fractional multinomial logistic regression models showing the absolute difference between school attenders and nonattenders in time spent in education, leisure, household chores, farm work, and market work by gender and residence. Models were run separately according to age group and are adjusted for gender, age, household food security, and enrollment status. The baseline, 0, represents time allocation for nonattenders. School attendance increases time spent in education and decreases time spent in other activities. Ninety-five percent confidence intervals that cross the baseline indicate a nonsignificant difference between attenders and nonattenders. Village markers are filled; town markers are open. Boys' markers are triangles and girls' markers are diamonds. A color version of this figure is available online.

decreasing opportunity and direct costs. Throughout Tanzania, household labor requirements have shrunk in recent years following villagization policies (*ujamaa*) and shifts toward less labor-intensive crops (Varkevisser 1973; Wijzen and Tanner 2002). Direct costs have also declined with the abolition of primary school fees, although families do bear the costs of school supplies—uniforms and stationery, for example.

Low opportunity costs to schooling in this setting—and perhaps more broadly across low-income, high-fertility African populations—may not be characteristic of past European transitions. However, historical analyses of education uptake in industrial England similarly contradict the view that schooling uptake was driven primarily by anticipated economic returns. It has been argued that the promotion of compulsory education was a way of controlling young people's time rather than because school would be useful to children (Cunningham 1990; Horrell and Humphries 1995). Thus, schooling may be better considered as a form of cooperative childcare that frees parental time for other productive activities by reducing the burden of child supervision and direct care. A fruitful area for future study would be to consider the impact of schooling on parental productivity.

If education is not very costly, as in this context where both opportunity costs and direct costs of schooling (at least at the primary level) appear modest, school enrollment can be high even in the absence of high returns. This has consequences

for fertility decline, implying that schooling does not necessarily, or even necessarily incentivize, a switch to a quality-over-quantity-focused parental investment strategy. Indeed, despite near-universal primary school enrollment and growing secondary school attendance in this population, fertility rates remain high, suggesting that many families perceive education and high fertility as compatible strategies. In rural South Africa, high investment in education was also observed despite limited payoffs, with parents argued to invest in education in the hope that at least one child might benefit but continuing to have many children to provide old-age security and household labor (Liddell, Barrett, and Henzi 2003).

The opportunity costs of boys' work appear much higher than those for girls, particularly at younger ages, and this is reflected in boys' lower school enrollment rates in the village. Lower enrollment of boys is an unexpected pattern, given the typically assumed greater economic payoffs to male wage labor and the international focus on out-of-school girls (United Nations 2015). Yet other studies have also recently documented a "male disadvantage" in education in pastoralist settings in both Kenya and northeastern Tanzania (Hedges et al. 2016; Mburu 2016). We suggest that this trend is driven by the relative compatibility of girls' household chores with school attendance. Sending boys to school and forgoing their work may be a more significant decision, involving the expense of employing someone else to herd the cattle, resulting in lost opportunities to pass

on knowledge and skills to the next generation and potentially forgoing income from cattle keeping altogether (Siele, Swift, and Kratli 2013).

While often overlooked by both theoretical and policy-grounded research on childhood, leisure and social time is an important component of childhood experience and may have important implications for child health, well-being, and achievement (Bock and Johnson 2004). Our results indicate that schoolgirls sacrifice leisure time and combine education with household work. This situation, where gender equality in the public sphere (school) has been achieved, at least superficially, but gender differences remain in the private sphere (household), echoes the double shift seen in many modern economies, in which women combine full-time work with responsibility for unpaid household work and childcare (Hochschild and Machung 1989; McDaniel 2012).

Conclusions

Embodied capital theory dominates contemporary research into the effects of modernization on parental investment and reproductive strategies, particularly in evolutionary anthropology and demography (Lawson and Borgerhoff Mulder 2016). Yet available data on patterns of educational investment and children's work, presented here and elsewhere, provide mixed support for assumptions about the costs and benefits of education and the consequent motivations for limiting fertility. Indeed, many contemporary low-income populations have both high enrollment in school and high fertility, supporting the view that low opportunity costs of schooling are an important explanatory factor behind stalled fertility declines. This conclusion echoes wider concerns that historical processes need not necessarily be reflected in current and future patterns of change (Thornton 2001).

Our analyses also make clear that the effects of modernization on childhood cannot be understood without considering gender. Parents in this population and elsewhere are increasingly educating daughters, often more than their sons, a pattern that may be driven by relatively low opportunity costs and emerging employment opportunities for young women. We caution that for girls school attendance involves sacrificing leisure time to combine school with household chores, with unknown consequences for their well-being. More holistic studies of the costs and benefits of children's time allocation that fully explore children's time beyond the most obviously "functional" behaviors of work and schooling will provide better understanding of how best to promote positive outcomes across all dimensions of children's lives.

Acknowledgments

We thank the National Institute of Medical Research, Mwanza; our fieldwork team, especially Holo Dick, Pascazia Simon, and Vicky Sawalla; all our participants; and the head teachers who allowed us to conduct interviews in their schools. This study

was funded by the UK Economic and Social Research Council, the Wenner-Gren Anthropological Foundation, the International Society for Human Ethology, the Parkes Foundation, and the European Human Behaviour and Evolution Association.

References Cited

- Assaad, R., D. Levison, and N. Zibani. 2010. The effects of domestic work on girls' schooling: evidence from Egypt. *Feminist Economics* 16(1):79–128.
- Bacolod, M. P., and P. Ranjan. 2008. Why children work, attend school, or stay idle: theory and evidence. *Economic Development and Cultural Change* 56(4):791–828.
- Bedasso, B. E. 2008. *Investing in education as a means and as an end: exploring the microfoundations of the MDGs*. Addis Ababa: UN Economic Commission for Africa.
- Beegle, K., R. H. Dehejia, R. Gatti, and S. Krutikova. 2008. *The consequences of child labor: evidence from longitudinal data in rural Tanzania*. Washington, DC: World Bank.
- Bock, J. 2002. Learning, life history, and productivity: children's lives in the Okavango Delta, Botswana. *Human Nature* 13(2):161–197.
- Bock, J., and S. E. Johnson. 2004. Subsistence ecology and play among the Okavango Delta peoples of Botswana. *Human Nature* 15(1):63–81.
- Buis, M. L. 2017. FMLOGIT: Stata module fitting a fractional multinomial logit model by quasi maximum likelihood. Stata Software Component. Retrieved from <https://ideas.repec.org/c/boc/bocode/s456976.html>.
- Cain, M. T. 1977. The economic activities of children in a village in Bangladesh. *Population and Development Review* 3(3):201–227.
- Clarke, P. 2008. When can group-level clustering be ignored? multi-level versus single-level models with sparse data. *Journal of Epidemiology and Community Health* 62:752–758.
- Coates, J., A. Swindale, and P. Bilinsky. 2007. *Household Food Insecurity Access Scale (HFIAS) for measurement of household food access: indicator guide*. Washington, DC: Food and Nutrition Technical Assistance Project.
- Cunningham, H. 1990. The employment and unemployment of children in England, 1680–1851. *Past and Present* 126:115–150.
- Demographic Health and Surveys Program. 2016. Tanzania: Demographic and Health Survey and Malaria Indicator Survey, 2015–16. Retrieved from <https://dhsprogram.com/pubs/pdf/FR321/FR321.pdf>.
- Esquivel, V., D. Budlender, N. Folbre, and I. Hirway. 2008. Explorations: time-use surveys in the South. *Feminist Economics* 14(3):107–152.
- Food and Agriculture Organization. 2014. *Gender inequalities in rural employment in Tanzania mainland: an overview*. Rome: Food and Agriculture Organization.
- Gurven, M., and H. Kaplan. 2006. Determinants of time allocation across the lifespan: a theoretical model and an application to the Machiguenga and Piro of Peru. *Human Nature* 17(1):1–49.
- Hedges, S., M. Borgerhoff Mulder, S. James, and D. W. Lawson. 2016. Sending children to school: rural livelihoods and parental investment in education in northern Tanzania. *Evolution and Human Behavior* 37(2):142–151.
- Hivos. 2014. *Are our children learning? literacy and numeracy across East Africa*. Nairobi: Twaweza.
- Hochschild, A. R., and A. Machung. 1989. *The second shift: working families and the revolution at home*. London: Piatkus.
- Horrell, S., and J. Humphries. 1995. "The exploitation of little children": child labor and the family economy in the Industrial Revolution. *Explorations in Economic History* 32(4):485–516.
- Ilahi, N. 2000. *The intra-household allocation of time and tasks: what have we learnt from the empirical literature?* Washington, DC: World Bank.
- International Labour Office. 2013. *Marking progress against child labor*. Geneva: International Labour Office.
- Janzen, S. A. 2018. Child labour measurement: whom should we ask? *International Labour Review* 157(2):169–191.
- Kaplan, H. 1996. Theory of fertility and parental investment. *Yearbook of Physical Anthropology* 39:91–135.
- Kaplan, H., J. Bock, and P. L. Hooper. 2015. Fertility theory: embodied-capital theory of life history evolution. In *International Encyclopedia of the Social and Behavioral Sciences*. Pp. 28–34. Amsterdam: Elsevier.
- Kirk, D. 1996. Demographic transition theory. *Population Studies* 50:361–387.
- Kishamawe, C., R. Isingo, B. Mtenga, B. Zaba, J. Todd, B. Clark, J. Changalucha, and M. Urassa. 2015. Health and demographic surveillance system profile: the Magu Health and Demographic Surveillance system (Magu HDSS). *International Journal of Epidemiology* 44(6):1851–1861.

- Kramer, K. L. 2002. Variation in juvenile dependence: helping behavior among Maya children. *Human Nature* 13(2):299–325.
- Lawson, D. W., and M. Borgerhoff Mulder. 2016. The offspring quantity-quality trade-off and human fertility variation. *Philosophical Transactions of the Royal Society B* 371(1692):20150145, doi:10.1098/rstb.2015.0145.
- Lee, R. 2003. The demographic transition: three centuries of fundamental change. *Journal of Economic Perspectives* 17(4):167–190.
- Liddell, C., L. Barrett, and P. Henzi. 2003. Parental investment in schooling: evidence from a subsistence farming community in South Africa. *International Journal of Psychology* 38(1):54–63.
- Malipula, M. 2015. Depoliticised ethnicity in Tanzania: a structural and historical narrative. *Afrika Focus* 27(2):49–70.
- Mattison, S. M., and D. B. Neill. 2013. The effects of residential ecology on patterns of child work and mother's reproductive success among Indo-Fijians. *Evolution and Human Behavior* 34(3):207–215.
- Mattison, S. M., and R. Sear. 2016. Modernizing evolutionary anthropology: introduction to the special issue. *Human Nature* 27(4):335–350.
- Mburu, S. 2016. Effects of livestock herd migration on child schooling in Marsabit District, Kenya. *Compare: A Journal of Comparative and International Education*. <https://doi.org/10.1080/03057925.2016.1257352>.
- McDaniel, A. 2012. Women's advantage in higher education: towards understanding a global phenomenon. *Sociology Compass* 6(7):581–595.
- Murdock, G. P., and C. Provost. 1973. Factors in the division of labor by sex: a cross-cultural analysis. *Ethnology* 12(2):203–225.
- Nieuwenhuys, O. 1993. To read and not to eat: South Indian children between secondary school and work. *Childhood* 1:100–109.
- Pörtner, C. C. 2016. Effects of parental absence on child labor and school attendance in the Philippines. *Review of Economics of the Household* 14(1):103–130.
- Sellen, D. W. 2003. Nutritional consequences of wealth differentials in East African pastoralists: the case of the Datoga of northern Tanzania. *Human Ecology* 31(4):529–570.
- Siele, D., J. Swift, and S. Kratli. 2013. Reaching pastoralists with formal education: a distance-learning strategy for Kenya. In *Pastoralism and development in Africa: dynamic change at the margins*. A. Catley, J. Lind, and I. Scoones, eds. Pp. 206–214. Abingdon: Routledge.
- Thornton, A. 2001. Developmental paradigm, reading history sideways, and family change. *Demography* 38(4):449–465.
- United Nations. 2015. Sustainable development goals thematic clusters: youth, education and culture. <https://sustainabledevelopment.un.org/majorgroups/post2015/thematicclusters>.
- US Department of Labor. 2013. *Findings on the worst forms of child labour: Tanzania*. Washington, DC: US Department of Labor.
- Varkevisser, C. M. 1973. *Socialization in a changing society: Sukuma childhood in rural and urban Mwanza, Tanzania*. The Hague: Centre for the Study of Education in Changing Societies.
- Wijzen, F., and R. Tanner. 2002. "I am just a Sukuma": globalization and identity construction in northwest Tanzania. Amsterdam: Rodopi.