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Uncertainty and Fertility in a Generalized AIDS Epidemic

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Abstract

Sociologists widely acknowledge that uncertainty matters for decision making, but they rarely measure it directly. In this article, we demonstrate the importance of theorizing about, measuring, and analyzing uncertainty as experienced by individuals. We adapt a novel probabilistic solicitation technique to measure personal uncertainty about HIV status in a high HIV prevalence area of southern Malawi. Using data from 2,000 young adults (ages 15 to 25 years), we demonstrate that uncertainty about HIV status is widespread and that it expands as young adults assess their proximate and distant futures. In conceptualizing HIV status as something more than sero-status itself, we gain insight into how what individuals *know they don't know* influences their lives. Young people who are uncertain about their HIV status express desires to accelerate their childbearing relative to their counterparts who are certain they are uninfected. Our approach and findings show that personal uncertainty is a measurable and meaningful phenomenon that can illuminate much about individuals' aspirations and behaviors.

Keywords

Africa; fertility; HIV/AIDS; uncertainty

Uncertainty is a fundamental feature of the social world, and its consequences are vast (Halpern 2005; Keynes 1921; Knight [1921] 2002). Uncertainty shapes how people determine which goals are worth pursuing and decide on the strategies that will facilitate their accomplishment. Macro-level uncertainty brought about by economic crisis, rapid social change, or epidemics pushes people to respond to unpredictability by diversifying risks, opportunities, and relationships and forging new strategies of action (Johnson-Hanks 2004, 2006; Swidler 1986). But societal levels of uncertainty are not experienced uniformly across all members of a population. Heterogeneity of populations and experiences can produce inequalities—with some individuals remaining largely insulated from uncertainty and its consequences while others are vulnerable to it. This state of affairs raises a persistent question about human behavior: how does personal uncertainty—what people know they don't know about their present and their future—shape individuals' orientations and, ultimately, behavior?

In this article, we demonstrate the limitations of treating HIV status as a binary construct in the context of sub-Saharan Africa's generalized AIDS epidemic. In so doing, we introduce the element of personal uncertainty into an analysis of variation in decisions about the tempo of fertility. While clinically accurate, the practice of categorizing people based on what we

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know about their serostatus from biomarker data (i.e., HIV positive versus HIV negative) fails to capture the complexity of living in an environment shaped by AIDS. We argue that personal uncertainty about HIV status represents a fundamental type of uncertainty that differs from procedural uncertainty (see DiMaggio and Powell 1983) and from mere ambiguity (i.e., incomplete information [see Camerer and Weber 1992; Dosi and Egidi 1991]).

Debates about uncertainty generally focus on two issues. The first problem is the task of differentiating uncertainty from risk. Second is the question of whether uncertainty is measurable. Many scholars adopt Knight's ([1921] 2002) definition of uncertainty as the inability to assign probabilities to eventualities (e.g., Duncan 1972; Milliken 1987). From this view, risk is quantifiable; uncertainty is not. More recent work in sociology challenges the notion of a tight distinction between uncertainty and risk (Beck 1999; Giddens and Pierson 1998). But the resulting elaborations prioritize the development of sophisticated theories of risk while largely neglecting uncertainty as its own construct. We build on Dequech (1999, 2000, 2003), taking the position that uncertainties are *experienced by individuals* and that they are measurable and gradable. In other words, risk and uncertainty are related yet distinct phenomena, both of which can be quantified. Here, we focus on one specific type of personal uncertainty: what people know they don't know about their HIV status.

In the following sections, we discuss the nature of uncertainty in sub-Saharan Africa and examine how fertility scholars have treated uncertainty in the past. Then, using new data from young adults (ages 15 to 25 years) in southern Malawi, we examine personal uncertainty about HIV status, specifically its measurement, prevalence, and consequences. We structure our investigation of uncertainty's consequences around fertility because the desire to have children is quasi-universal among young people in the region, and because demographic and sociological research on fertility and uncertainty offers a strong foundation upon which to build. Analyses focus on the relevance of HIV status uncertainty for the tempo dimension of fertility preferences—that is, the timing and spacing of births—which is an important and sensitive indicator of demographic change. Beyond an interest in understanding how young Malawians construct their reproductive goals, we argue that personal uncertainty is a measurable analytic construct that holds promise for theorizing about decision making more generally.

Uncertainty, Africa, and AIDS

As in the past, uncertainty is widespread in modern societies: it is a poignant component of individual identities and larger social structures (Giddens 1991). This is, perhaps, nowhere more true than in sub-Saharan Africa (Ashforth 2005; Chabal 2009; Johnson-Hanks 2004). One need only dabble in the popular and scholarly portraits of sub-Saharan Africa to emerge convinced that social life on the subcontinent is made up of layer upon layer of uncertainty, ranging from political instability (e.g., civil war and corrupt states) to spiritual insecurity (e.g., witchcraft). AIDS represents one additional layer of uncertainty in an environment characterized by sudden (and often inexplicable) mortality, natural disasters, and the more mundane and universal hardships of daily life.

Populations experiencing generalized AIDS epidemics1 are characterized not only by high levels of HIV prevalence but also by wide-spread anxiety about infection. Most people in high prevalence countries know someone who has HIV or who has died of AIDS;2 indeed, in Malawi, over 95 percent of the adult population knew someone who died of AIDS as

[1]An AIDS epidemic is considered "generalized" when more than 1 percent of the general population is infected.

early as 2001 (Watkins 2004). While often patterned, infections can appear random to people living through an epidemic, as well as to researchers (Lopman et al. 2008). The supra-individual nature of HIV transmission—partner traits and community prevalence shape an individual's risk—and the long latent period between infection and the onset of symptoms make the uncertainty surrounding this disease particularly acute. Infection is simultaneously perceived to be within and beyond one's control. Uncertainty around HIV status is thus highly personalized and distinct from collective uncertainties like waiting for rain in an agriculture-based society.

Even in a generalized AIDS epidemic where HIV prevalence can reach as high as 25 percent, most adults—indeed 75 percent—are not infected. Because it is a cumulative measure, HIV prevalence is relatively low among young adults across sub-Saharan Africa (UNAIDS 2010). During this life stage, however, new infections are rapidly increasing, particularly among young women for whom incidence peaks before age 30 (White et al. 2007; Zaba et al. 2008). A woman's risk of infection increases sharply as she nears and enters marriage (Bongaarts 2007; Clark, Poulin, and Kohler 2009; Glynn et al. 2003). Although relatively few young adults have HIV right now, during the next few years many will become infected as they start having sex, search for marital partners, and begin to have children.

Most young adults living in an AIDS epidemic perceive the realities of this period of heightened risk. Findings from the growing literature on risk perceptions demonstrate that local understandings of HIV reflect accurate readings of epidemiological realities (Anglewicz and Kohler 2009; Bignami-van Assche et al. 2007; Kengeya-Kayondo et al. 1999; Watkins 2004). Thirty years into the epidemic, the relational nature of risk is widely understood. Women are most worried about being infected by their spouse, while men, who marry later, worry most about infection through non-marital partners (Smith and Watkins 2005).

Some individuals in this context are certain of their status—they are infected and they know it, while others are confident that they do not have the virus. The remaining individuals are uncertain about their status. Moreover, many who are certain they are negative today are uncertain about their future status, which may hinge on their own sexual behavior or, commonly, on something outside of their direct control, like a spouse's or partner's sexual behavior.

Many scholars and policymakers assert that Africans can address their uncertainty biomedically, having suspicions confirmed or disconfirmed with an objective test (De Cock 2005; Granich et al. 2009). But this oversimplification ignores the complexities surrounding HIV and the deep-rooted uncertainty that characterizes life in the midst of an AIDS epidemic. Access to testing has expanded rapidly within the past five years, but it remains unclear whether test results can eliminate or even abate uncertainty (Trinitapoli and Yeatman 2010). Indeed, uncertainty is built into the World Health Organization's HIV testing protocol. Testing is paired with mandatory counseling by trained personnel, in which counselors end with an explanation of "the window period," a 12-week period where a recent infection might not yet translate into a positive test result. Thus, even individuals who test negative often leave testing centers concerned about having been infected in the preceding 12 weeks and about future infection.

[2]Deaton, Fortson, and Tortora (2009) use data from the World Gallup Poll; we confirmed their findings with data from recent Demographic and Health Surveys (http://measuredhs.com).

Uncertainty and Fertility

There is precedent in the demographic literature for acknowledging that uncertainty is relevant for understanding fertility. Morgan (1982) shows, for instance, that "don't know" is an analytically meaningful response to questions about fertility intentions. Additional studies have moved this line of thinking forward substantially (e.g., Riley, Hermalin, and Rosero-Bixby 1993, Sandberg 2005). Today, "don't know" is no longer automatically treated as missing data but as a valid outcome that merits exploration. Reluctance to give a clear answer about ideal family size may indicate a woman's inability to think concretely about abstract things or her failure to internalize biological understandings of conception and childbearing; it may also reflect reproductive ambivalence or neutrality (Schaeffer and Thomson 1992).

Beyond exploring uncertain fertility preferences as an outcome, demographic studies have also led to important insights into how uncertainty promotes distinctive reproductive strategies. Uncertainty may trigger re-evaluations of fertility preferences that manifest through either the *quantum* component of fertility—that is, the *number* of children people desire and subsequently have—or the *tempo* component of fertility—that is, the desired and actual *timing* of births.

Theorizing about fertility transitions, Caldwell (2004) argues that social upheaval can accelerate fertility declines by creating uncertainty about the future. Scholarship from the West emphasizes that, from a macrolevel perspective, economic uncertainty can lead to delays in childbearing. This was true during the Great Depression (Morgan 1991; Ryder 1980); it is also relevant to current globalization processes (Blossfeld, Buchholz, and Hofacker 2006; Blossfeld and Hofmeister 2007; Blossfeld et al. 2009; Oppenheimer 2003) and to the most recent economic crisis (Sobotka, Skirbekk, and Philipov 2011). However, these macro-level perspectives on uncertainty and fertility fail to recognize two important facts: first, childbearing can be a strategy for reducing uncertainty; second, uncertainties are not experienced uniformly across populations. Micro-level studies engaging these two facts point to some very different conclusions.

Friedman, Hechter, and Kanazawa (1994) posit that uncertainty reduction is a universal value and that parenthood is a powerful mechanism for reducing uncertainty, particularly for people with limited alternatives. Researchers studying low-income and minority women in the United States find that childbearing minimizes unknowns in these women's lives because it commits them to a specific path (Burton and Tucker 2009; Edin and Kefalas 2005). In South Asia, Cain (1978, 1983; Cain, Khanam, and Nahar 1979) observed that people use childbearing strategically to guard against future economic insecurity. Kohler and Kohler (2002) found that during Russia's economic crisis, women and couples most directly affected by labor market uncertainty accelerated their fertility. And evidence from several other European countries shows that while economic uncertainty leads to delays in childbearing for highly educated women, these same conditions lead to either stable or increased risk of first-birth for socio-economically disadvantaged women (Sobotka et al. 2011).

Focusing on a different type of uncertainty, Sandberg (2006) demonstrates that uncertainty about child survival is associated with acceleration of childbearing for Nepalese women. Women who observed high levels of infant mortality among their friends and neighbors bore their children faster than those who observed low infant mortality within their social network. Moreover, where infant mortality was low but highly variable, women were uncertain about their children's odds of survival and similarly accelerated their childbearing.

These theories and findings translate directly to our examination of how people living amid the AIDS pandemic of sub-Saharan Africa use childbearing as a strategy for addressing a different type of uncertainty—the uncertainty associated with HIV infection. As the AIDS epidemic shifts cultural ideologies, it also facilitates behavioral diversification (Swidler 1986). New "strategies of action" may include re-evaluation of fertility preferences in response to perceptions of one's own HIV status.

AIDS need not alter the fundamental motivations for childbearing in sub-Saharan Africa in order to affect preferences. It need only alter the relative importance of some components of the childbearing calculus. A handful of studies demonstrate that HIV positive women are more likely to express a desire to stop childbearing than are their HIV negative counterparts (Heys et al. 2009; Taulo et al. 2009; Yeatman 2009a). But the scope of this literature is limited. First, it almost entirely excludes men (for a notable exception, see Yeatman 2009a). Second, it conflates older adults who have already had many children with younger adults who are just beginning their reproductive careers, and for whom the relationship between fertility and HIV could be quite distinct (Cooper et al. 2007; Noël-Miller 2003; Smith and Mbakwem 2006; Yeatman 2009a). Third, these studies focus on the quantum component of fertility—specifically, the stopping of childbearing. Previous research on uncertainty and fertility, however, suggests that changes often manifest through the tempo component of childbearing—that is, delays and accelerations (Kohler and Kohler 2002; Ryder 1980; Sandberg 2006; Sobotka et al. 2011).

Fourth, and most important, the literature's key distinction is drawn along the line of HIV status, comparing HIV positive to negative individuals. But perceptions about HIV infection are highly relevant for childbearing (Yeatman 2009b). Building on ideas fostered in the sociological theorem that "if men define situations as real, they are real in their consequences" (Thomas and Thomas 1928:572), Yeatman finds that rural Malawians who erroneously believed they were HIV negative and learned they were positive experienced the greatest increase in their desire to stop childbearing. On the other hand, individuals who thought they were positive and learned they were negative had the steepest increases in their desired fertility. In other words, fertility strategies were fundamentally based on *perceptions* of HIV status and subject to change as new information modified those perceptions.

Drawing on this evidence, our analyses center on the measurement, prevalence, and consequences of AIDS-related uncertainty for young adults living in a generalized AIDS epidemic. Given that high levels of HIV prevalence are accompanied by high levels of anxiety about AIDS, we expect the following:

> *Hypothesis 1:* HIV status uncertainty in the Malawian context will be more prevalent than HIV itself and will expand along time horizons.

Our examination of the consequences of uncertainty centers on the following question: *How does uncertainty about HIV status, now and in the future, influence the tempo of childbearing preferences?* Under certain circumstances, uncertainty may prompt advantaged individuals to delay their childbearing, but strong evidence suggests that people with limited opportunities behave in the opposite way. In the impoverished and strongly pro-natalist context of Malawi, we expect to find the following:

> *Hypothesis 2:* HIV status uncertainty will be associated with a desire to accelerate child-bearing.

Before testing these hypotheses, we must first establish that personal uncertainty about HIV status is measurable. We begin with the task of operationalizing and validating a new measure of uncertainty before moving to our questions about uncertainty's prevalence and consequences for fertility.

STUDY CONTEXT

Among reproductive age individuals in Malawi, 12 percent are HIV positive, making the country's epidemic among the most severe in the world (NSO Malawi and ORC Macro 2005). As elsewhere in sub-Saharan Africa, HIV prevalence in Malawi rose throughout the 1980s and early 1990s before stabilizing in the late 1990s as a result of a decline in incidence (Bello, Chipeta, and Aberle-Grasse 2006; Bongaarts et al. 2008; White et al. 2007). Nonetheless, the number of HIV positive individuals continues to increase due to population growth and increased access to anti-retroviral therapy (ART).

Beginning in the mid-1990s, media and public health campaigns disseminated information about the epidemiology of HIV, the major sources of transmission, and common opportunistic infections associated with AIDS and their symptoms. To prevent transmission, a deluge of public health interventions emphasized premarital abstinence, marital fidelity, and condom use. By the late 1990s, awareness of HIV was widespread, and rural Malawians regularly talked about the disease (Watkins 2004). HIV testing and counseling were not readily available outside of urban areas in Malawi until 2005, when services spread to all district hospitals and some rural health clinics (Malawi Ministry of Health 2006, 2007; UNAIDS and WHO 2006). District hospitals started providing free ART between 2005 and 2006, and access has been scaled up since then, although less than a third of people who need the drugs are currently receiving them (World Health Organization 2009).

At the same time, Malawi has experienced slow declines in fertility. The country's total fertility rate fell from 7.6 children per woman in 1984 to 6.0 children per woman in 2004 (NSO Malawi and ORC Macro 2005). The decline was relatively modest compared to fertility declines elsewhere in the world and is largely explained by reductions in fertility among women over age 30. Traditional methods of birth spacing have long been common in Malawi, and recent reductions in fertility were facilitated by a dramatic increase in the use of modern contraceptives during the past two decades—from about 13 percent of married women in 1992 to 33 percent in 2004 (NSO Malawi and ORC Macro 2005). Condoms, however, remain unpopular (Tavory and Swidler 2009), particularly in marriage. Approximately 1.5 percent of women use condoms with their spouse—a number that has remained stable despite extensive efforts to promote their use (NSO Malawi and ORC Macro 2005). On average, Malawian women become sexually active at age 17, marry at age 18, experience a first birth by age 19, and go on to have five more children, with approximately 34-month intervals between births. Malawian men, in contrast, become sexually active about a year later and marry around age 23 (NSO Malawi and ORC Macro 2005). Premarital sexual activity is common in Malawi, but the majority of childbearing still occurs within the context of marriage (Boileau et al. 2009; Clark et al. 2009; Poulin 2007).

DATA AND METHODS

Data for the study come from the first wave of Tsogolo la Thanzi (TLT), a new study designed to examine how young people navigate reproduction in an AIDS epidemic.[3] Tsogolo la Thanzi means "Healthy Futures" in Chichewa, Malawi's official and most widely spoken language. Data collection took place in the Balaka district of southern Malawi between May and August 2009. The TLT research team randomly selected 1,500 female and 600 male respondents from a sampling frame of 15- to 25-year-olds living in census

[3]Tsogolo la Thanzi is a research project designed by Jenny Trinitapoli and Sara Yeatman and funded by grant (R01-HD058366) from the National Institute of Child Health and Human Development. See http://projects.pop.psu.edu/tlt for more information about this dataset, to request data access, and for replication files.

enumeration areas within seven kilometers of the center of the district capital. The catchment area includes Balaka township and its surrounding rural communities.

One unique feature of TLT is the use of a centrally located research center for conducting interviews. Respondents were first contacted in their homes and asked to schedule an interview. On their assigned day (or, more accurately, close to it), respondents came to the TLT research center and were interviewed in a private room where their responses could not be overheard by family members or neighbors. Surveys took approximately one-and-a-half hours to complete. Refusal at the time of recruitment and passive refusal by not showing up at the research center were rare; TLT successfully interviewed 95 percent of recruited respondents. Respondents received an incentive of 500 Malawian kwacha (equivalent to 3.50 USD) for participating in the interview.

Tempo Fertility Preferences

We measure desired fertility timing with the following question: "How long would you like to wait before having your first/next child?" Response categories are ordered as follows: "as soon as possible" and "less than two years from now" are collapsed (1), "two or three years from now" (2), "three or four years from now" (3), "four to five years from now" (4), and "five or more years" (5).4 A relatively small proportion of respondents (5 percent, $n = 103$) report wanting no more children; we handle these respondents separately.

To document the relationship between uncertainty and the tempo component of childbearing preferences, we are limited to responses of the 95 percent of our sample who plan to have a child in the future. Because this means responses to questions of fertility timing are drawn from a non-random, restricted subsample, we must account for any selection bias introduced by individuals who do not want to have more children and for whom the tempo fertility dependent variable is not observed. Previous literature from Malawi and the region suggests that individuals who know themselves to be HIV positive are more likely than others to want to stop childbearing (Heys et al. 2009; Taulo et al. 2009; Yeatman 2009a). We account for the distinctiveness of this group by using a two-stage Heckman model (Heckman 1976, 1979; Winship and Mare 1992). First, we use a logistic regression model to predict "stopping" (i.e., expressing a desire for no more children) and generate the inverse of Mills' Ratio (IMR) from this model. In the second stage, we model desired timing of next birth for respondents who want to have another child using a right censored tobit model, which adjusts for the open-ended nature of the 5+ years category.5 Including the IMR as a regressor in the second-stage models controls for correlated errors between the selection equation and the tobit models.

Uncertainty

Our measures of uncertainty are based on an interactive, probabilistic measure of risk, that is, perceived likelihood of HIV infection. In this method, an interviewer places 10 beans on a table and asks the respondent to shift onto a plate the number of beans that represents the likelihood of a particular eventuality. The interviewer introduces the method with straightforward questions about the likelihood of a common occurrence (e.g., going to the

[4]We exclude respondents who stated "no preference" ($n = 26$) or "don't know" ($n = 4$) from our analyses. We acknowledge the irony of this decision in light of our overarching argument that uncertainty matters. However, because our focus here is on AIDS-related uncertainty and this group is too small to analyze as a separate outcome (as Morgan and others have done), we follow Von Hippel (2007) in our conclusion that multiple imputation is not appropriate for our analyses.

[5]We tested and explored numerous approaches to modeling this dependent variable, four in particular: (1) as a categorical variable using multinomial regression models; (2) a zero-inflated poisson model, which accounts for individuals who do not want to have more children but does not adjust for the non-linearity of the 5+ years category; (3) a hurdle model (Long and Freese 2006); and (4) a zero-inflated tobit model. Our preference for the Heckman model is motivated by its interpretive ease and familiarity to readers. Results from all other models are comparable in direction and magnitude for all variables and are available on request from the authors.

market) given a specified time frame and moves slowly to questions about more sensitive issues. Here, we examine respondents' answers to the prompt: "Pick the number of beans that reflects how likely it is that: a) you are infected with HIV right now, b) you will become infected with HIV during the next 12 months, c) you will become infected with HIV during your lifetime." We give respondents who indicated 10 beans at any point in this series of questions a value of 10 for the likelihood measure for the subsequent time horizons.

This method and its successful implementation have been described in detail elsewhere (Delavande and Kohler 2009),6 but its many merits deserve additional elaboration here. First, the beans method is an inexpensive and easily implemented tool that generates very little missing data.7 Second, and more important, our research team found this method to be a particularly humane way to ask what are, frankly speaking, invasive questions about people's innermost fears and underlying insecurities. Rather than being asked to verbally articulate their AIDS-related concerns or confess their HIV status, respondents need only move beans across the table in response to questions. According to our interviewers, most respondents did this in silence, often putting their heads down to avoid making eye-contact with the interviewer.

Given our view that uncertainty about HIV infection is distinct from the risk of infection, we conceptualize uncertainty as existing between two poles of certainty: certain negative (zero beans) and certain positive (10 beans), where any value between one and nine represents some degree of uncertainty. To capture gradations of uncertainty between these poles, we treat the beans measure of likelihood of infection as a quadratic term (beans and beans-squared). This accommodates our theory that answers in the range of three to seven beans represent particularly high degrees of uncertainty, compared to answers of one or two or eight or nine beans, which are closer in proximity to the poles of certainty.

HIV Biomarker Data

We leverage HIV biomarker data collected as part of TLT to validate the beans measure using simple epidemiological models. Immediately following their interviews, TLT offered HIV testing to a random subsample of one-third of respondents using the protocol for HIV testing outlined by the World Health Organization and Malawi's Ministry of Health. Acceptance rates for HIV Testing and Counseling (HTC) were approximately 80 percent, with higher levels of acceptance from women than men, but no discernible patterns of uptake/refusal by perceived HIV status, age, socioeconomic status, prior testing experience, religion, or sexual behavior.8

Sociodemographic Factors and Controls

Our models include controls for key sociodemographic factors that previous literature has established are associated with fertility preferences: gender, age, marital status, education (completed years of schooling and current school enrollment), household goods (an index of nine common goods designed to approximate socioeconomic status), parity (number of

[6]Delavande and Kohler (2009) find that rural Malawians using the beans method demonstrated an understanding of the basic properties of probabilities and of differential risks associated with the probability of financial distress and HIV infection. For example, they found that individuals with lower income and less land felt more at risk of financial distress, and that perceived probabilities of HIV infection were well-calibrated with actual probabilities of infection observed in Malawi (i.e., women perceived themselves to be at higher risk of infection, as did people with more sexual partners and lower levels of education).

[7]Out of 2,041 respondents, two were unable or unwilling to answer questions about likelihood of infection asked using the beans method. For comparison, when the 2004 Malawi Diffusion and Ideational Change Project asked respondents to assess their likelihood of infection using Likert-type response categories, 12 percent of the sample reported "don't know" and 3 percent refused to answer.

[8]This compares well with other survey-based testing in the country. The 2004 Malawi Demographic and Health Survey had HIV test acceptance of 70 percent for women and 63 percent for men. Analyses of acceptance versus refusals are not shown here but are available upon request.

living children), sibship size, urbanicity measured as a function of distance to Balaka's main market (standardized to aid interpretation), and self-reported current pregnancy status (because pregnant women may report a longer intended waiting time to the next birth to accommodate their current pregnancy).

The analytic sample includes 1,472 women and 567 men (N = 2,039) with valid responses on all variables used here. We excluded two cases due to missing data on the beans measures. We weight all multivariate analyses to account for TLT's gender stratified sampling design.

RESULTS

Table 1 provides a descriptive overview of sample characteristics and highlights the study's setting. Average age of the TLT sample is around 19 years, and 40 percent of respondents have at least one living child. Educational attainment is low: respondents have, on average, less than eight years of education, and over 60 percent have not completed primary school, although nearly half are still enrolled. On average, households possess fewer than three of the items in the household index, the most common of which are radio (77 percent), cell phone (63 percent), and bicycle (57 percent).

Figure 1 offers a visual representation of the shifting distribution of perceived likelihood of HIV infection across three time horizons: now, in one year, and lifetime. Panel A shows that slightly over 60 percent of respondents told us there is no chance (0 beans) they are infected right now. Although most respondents perceived themselves to be at relatively low risk of infection, 36 percent of our sample was uncertain of their current HIV status, placing between one and nine beans on the plate, and a few individuals (n = 20) indicated certainty that they were already HIV positive (10 beans). The story changes in Panel B as the reference period for the question changes; the mean shifts slightly (by approximately one bean), but more important, the proportion of respondents who are certain they will remain negative in the next year falls by 20 percentage points, increasing the proportion of respondents falling within the uncertain range to approximately 60 percent. When questions progress to lifetime infection (Panel C), uncertainty dominates the picture: 77 percent of respondents indicated some degree of uncertainty, and the modal response is five beans, a perceived 50/50 chance of infection in one's lifetime.[9] In support of our first hypothesis, current uncertainty about HIV is a full three times higher than adult prevalence in Malawi and six times higher than prevalence in this age group (NSO Malawi and ORC Macro 2005). Furthermore, this widespread uncertainty expands as young adults project into the future. Along one-year and lifetime horizons, HIV status uncertainty characterizes the vast majority of the young adult population.

Our argument is premised on the principle that perceptions of personal uncertainty matter. Indeed, the accuracy of self-assessed likelihood of infection is irrelevant to the argument that perceptions are more important than actual HIV status for fertility decision-making. Still, the TLT study design allows us to validate this key measure by demonstrating (1) that perceptions, as measured by beans, are consistent with known epidemiological patterns and (2) that the beans measure is a good predictor of reality (HIV status)—or at least better than other subjective measures.

[9] In ancillary analyses (not shown here), we tested for patterns of uncertainty, comparing AIDS-related uncertainty to other areas of life about which we have comparable data (e.g., food insecurity, malaria, and labor market) and found no evidence of "generally uncertain" respondents. Pearson correlations range between .07 and .14.

TLT interviewers provided HIV testing and counseling to 564 respondents. Of the subsample of tested respondents, seven respondents indicated 10 beans during their interview (i.e., prior to testing), and all seven tested positive subsequently during HTC. Figure 2 shows that age and sex patterns of perceptions closely follow epidemiological patterns from our HIV-tested subsample.

We further validate the measure by comparing the predictive power of likelihood of current infection (measured with beans) to another commonly used subjective measure—worry about HIV (see Manglos and Trinitapoli 2011; Smith and Watkins 2005). Figure 3 demonstrates the superior predictive power of the beans method for actual HIV status. Significance tests comparing pseudo R-squared values from these models reveal strong support for the superiority of the beans measure for predicting HIV status, with and without controls for key sociodemographic factors (e.g., gender, age, urbanicity, education, and marital status).10

Table 2 shows results of the first stage of the two-stage Heckman model. We find a modest positive relationship between perceived likelihood of infection and the desire to stop childbearing (Model 1). When we model this outcome using a dummy variable for 10 beans (Model 2), however, it becomes evident that the desire to stop childbearing is unique to respondents who are certain they are positive.11 Even this relationship is far from deterministic, particularly at this early stage of one's reproductive career; more than half of respondents who indicated certainty that they are currently infected intend to have more children. Model 2 serves as the basis for the IMR employed in subsequent models to account for selection out of the subsample intending to bear (additional) children.

Table 3 tests consequences of uncertainty by examining its relationship to desired fertility timing using tobit regression models to account for right censoring at the "five or more years" category. Sociodemographic patterns are in line with the literature on fertility preferences and are stable across these models. Women and older adults want to accelerate their next birth (i.e., less waiting), whereas respondents who have never been married, already have children, and are of higher socioeconomic status and education want to delay.

We begin with the traditional binary approach to thinking about HIV status (Model 1 in Table 3), distinguishing respondents who currently know they are positive (10 beans) from all others. Modeled this way, perceived HIV positive status is not associated with preferred timing of next birth. In Models 2 through 4 in Table 3, we use a quadratic specification of the beans measure to allow for examination of uncertainty as distinct from risk. We do this across all three time horizons. Because of difficulties involved with interpreting interaction terms, we depict key relationships graphically in Figure 4.

Model 2 in Table 3 establishes that the relationship between perceived likelihood of current infection and desired time to next birth is curvilinear. The visual depiction of the relationship in Figure 4 provides further support for our assertion that uncertainty shapes fertility preferences differently than does risk, revealing three important patterns. First, for current uncertainty, acceleration begins with one bean, the minimal expression of any uncertainty. Second, acceleration flattens out (slope not different from zero) around peak uncertainty (theorized as between four and six beans). Third, we observe a slight uptick among respondents who perceive a very high likelihood of infection or indicate certainty of their HIV positive status by placing 10 beans on the plate.12

10Analyses not shown; available upon request.
11All other relationships are consistent with key findings from previous literature on the topic (e.g., Taulo et al. 2009; Yeatman 2009b).

The exact functional form of the relationship between uncertainty and fertility is less clear when assessed along the proximate time horizon (Model 3 in Table 3). Individuals who perceive any likelihood of infection within the next year express a preference to accelerate their childbearing relative to respondents who are confident they will remain uninfected. While the magnitude of the main effect is similar to that for current uncertainty and the squared term is not statistically significant at the .05 level, the squared term would be statistically significant at the .10 level ($p = .076$). Ancillary analyses confirm that the slope of this acceleration is steepest at the low end of the beans spectrum.

By contrast, perceptions of HIV status over the course of a lifetime (Model 4 in Table 3) follow a linear pattern. Here, the perceived likelihood of lifetime infection is associated with a monotonic decrease in desired time to next birth. Throughout these models, the large negative coefficient on the IMR speaks to the role of selectivity in the tempo of fertility: people who "should" be stopping according to the prediction equation in Table 2, but do, in fact, want to have more children accelerate dramatically.13

To summarize, the vast majority of young adults in Malawi intend to have more children. Among this group, we find that fertility timing preferences of individuals who are certain they are HIV positive are not unique when the reference group is the rest of the population. By shifting from a binary notion of HIV status to a graded view that emphasizes uncertainty, we capture heterogeneity in how young Malawians experience their status and show that this type of uncertainty has consequences. In support of our second hypothesis, we find that uncertain individuals express a desire to accelerate childbearing relative to those who express confidence they are, and will remain, negative. The same is also true for individuals who see future HIV infection as inevitable.

DISCUSSION

Uncertainty features prominently in theories of human behavior. But previous research relies heavily on the use of macro-level indicators (e.g., labor markets or political unrest) to proxy individuals' experiences (e.g., their perceived economic insecurity or sense of safety). Empirical work on how uncertainty is experienced and how it shapes *individuals'* aspirations and behaviors is remarkably scarce.

AIDS-related uncertainty in a generalized epidemic characterizes an entire society, but it is also experienced by individuals. Among young adults in Malawi, this manifestation of uncertainty is pervasive and expands across time horizons. It is also marked by stochastic elements and distributed unevenly. For behavioral scientists, equating "HIV" with sero-status ignores the reality for between 35 and 75 percent of the population: these individuals are uncertain about their current and future HIV status, and they make important decisions about their lives through this lens of uncertainty.

We approached uncertainty as distinct from but related to risk and existing in degrees. Using a simple technique—beans—to elicit responses about how people experience and anticipate the likelihood of HIV infection, we inferred personal uncertainty from this direct assessment of perceived risk. Successful measurement of uncertainty in its various forms must be

[12]In ancillary analyses (not shown), we test for gender differences using a three-way interaction between gender, beans, and beans-squared. We also stratified our models by gender. We found no evidence that associations operate differently for women and for men. Gender differences we observed are adequately summarized by the stable ≈ −.80 coefficient for women (who bear children at slightly earlier ages) across all of our models.

[13]We ran all models with and without the IMR. Coefficients for the IMR are large, suggesting non-negligible selection bias, which is consistent with previous research on the relationship between actual and perceived HIV status and a preference to stop childbearing. However, the relationships of interest are similar with and without the IMR in the models, which lends confidence that the selection present is neither driving the observed relationship nor obscuring other patterns.

culturally informed, but it can also be straightforward. The beans method we implemented in southern Malawi might not be as well-received in U.S. high schools, for example. As scholars seek to understand how uncertainty—present and future—shapes the lives of research subjects, they will do well to be creative and thoughtful in their efforts to measure it at the individual level, rather than presuming to approximate it from macro-level indicators.

In addition to showing that HIV status uncertainty is measurable and widespread, we demonstrate that it is consequential for childbearing decisions. Young people who think they might have, or believe they are likely to get, HIV do not automatically cease to want children. On the contrary, they approach childbearing with a sense of urgency. This process may be conscious and expressed explicitly—perhaps in conversations with friends or older relatives. Alternatively, it may be subconscious, driven by strong biological and cultural urges to reproduce successfully (Vaisey 2009). Subconscious or conscious, the tendency for uncertain individuals to accelerate childbearing represents the primacy of personal reproductive goals over public health recommendations: there are no campaigns advising young men and women to "hurry up and have children while you can."

HIV's relationship to the body and to sex makes it especially salient for reproductive matters during the period of life in which two key prevention strategies—abstinence and condoms—are off the table for people who want to have (more) children. Combined with insights from other contexts (e.g., Cain 1983; Friedman et al. 1994; Sandberg 2006), our findings lead us to believe that young Malawians who are unsure about their HIV status use childbearing as a social device to reduce uncertainty.[14] We can think of three reasons why uncertain individuals would accelerate their childbearing. First, in pronatalist contexts such as Malawi, marriage and childbearing are universally ascribed goals. For men and women, these rites of passage are critical steps along the path to adulthood and are crucial for solidifying one's social position in the community (Lloyd 2005; Rutenberg, Biddlecom, and Kaona 2000; Smith and Mbakwem 2010). People who are uncertain of their HIV status may hurry to achieve these goals precisely to allay the uncertainty marking their lives.

Second, uncertain individuals may have their next child faster to capitalize on what they perceive to be a limited period of sufficiently good health for having a healthy baby. Evidence from Malawi (Yeatman 2011) and elsewhere in the region (Grieser et al. 2001; Ruttenberg et al. 2000) documents the widespread belief that childbearing can exacerbate an HIV infection, particularly when someone is already suffering from symptoms. People who want to have children but are uncertain of their HIV status may accelerate their childbearing plans because "I'm healthy now but might not always be."

Third, men and women concerned about their status may have a child precisely to demonstrate their good health. In Zimbabwe, Grieser and colleagues (2001) found that a healthy and growing child was a public indicator of parents' good health (i.e., HIV negative status). Biomedically, this is a flawed strategy: mother-to-child transmission occurs in approximately one-quarter of births to HIV positive women without medication (Bobat et al. 1996; Petra Study Team 2002). Nonetheless, visibly healthy children dampen fears of infection and "prove" good health to family and community members. Weber ([1930] 2001) noted that the Calvinist system of good works and asceticism did not serve to purchase salvation but to assuage fears of damnation. Likewise, for young Malawians, healthy childbearing may provide relief from the anxiety associated with an uncertain future.

[14]According to Beckert (1996:819–20), the term "'social devices' encompasses all forms of rules, social norms, conventions, institutions, social structures, and power-relations that limit the choice set of actors and make actions at the same time predictable."

Because our analyses are cross-sectional, it is possible that identified relationships between uncertainty and fertility preferences are working in the opposite direction. After all, both conception and infection result from sex. But there are two reasons we think it is unlikely that fertility preferences are driving perceptions of infection. First, scripted patterns of childbearing and child spacing in Malawi suggest that deviation from these norms—delays and accelerations—are more likely consequences than causes. Second, as in the rest of sub-Saharan Africa, condom use in Balaka is low, inconsistent, and extremely uncommon within stable unions, where most childbearing occurs (Garenne and Zwang 2008; Madise, Zulu, and Ciera 2007; Shapiro and Kapiga 2002; Tavory and Swidler 2009). In other words, young people in Balaka are not abandoning the use of condoms in order to conceive.

We focused exclusively on how uncertainty about HIV status is relevant to the reproductive realm. But we know that other types of personal uncertainty shape childbearing preferences and behaviors, and we believe that AIDS-related uncertainty must be relevant to other outcomes as well. Beyond AIDS and across contexts, a wide variety of uncertainties influences decision making in domains of sociological import. Personal uncertainty about the labor market, for example, may lead individuals to pursue distinctive educational strategies. Similarly, people may respond to all kinds of uncertainty by seeking comfort in religion or adapting their beliefs about the spiritual world. The study of uncertainty in all of these manifestations has the potential to reveal crucial insights into how knowledge is held and prioritized and how decisions are made.

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Biographies

Jenny Trinitapoli is an Assistant Professor of sociology, demography, and religious studies at The Pennsylvania State University, as well as an affiliate of the Population Research Institute. Her work examines the interplay between religion and demographic processes in

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Sara Yeatman is a sociologist and demographer and an Assistant Professor of Health and Behavioral Sciences at the University of Colorado Denver. Her research examines the social consequences and responses to HIV in sub-Saharan Africa, and the formation of fertility preferences. She helped design and continues to help oversee Tsogolo la Thanzi, and is currently fielding a mixed methods study of the implications of antiretroviral medicine for the meaning of HIV in Malawi.

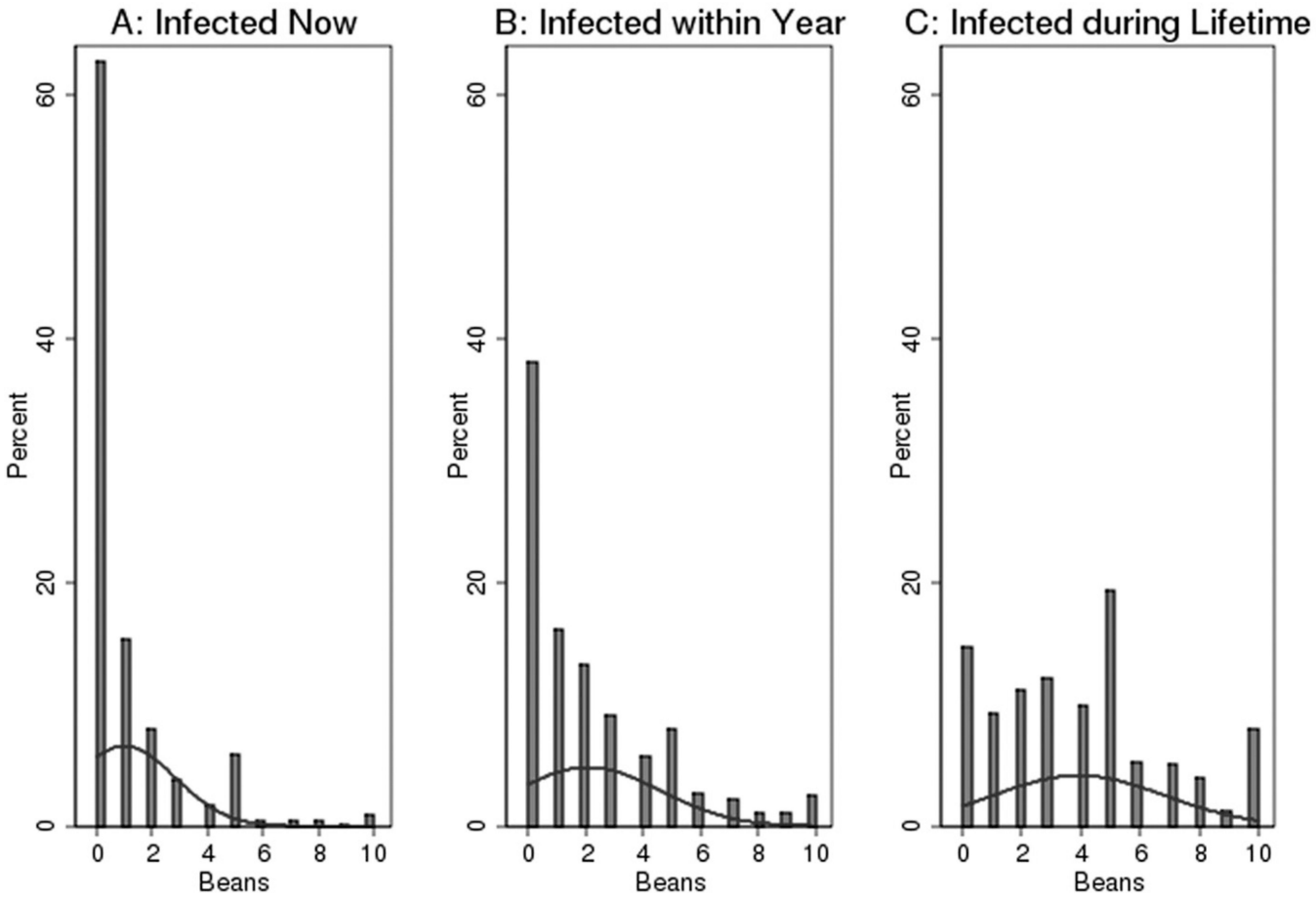

Figure 1.
Probabilistic Reports of HIV Infection among Young Adults (Age 15 to 25) in Malawi

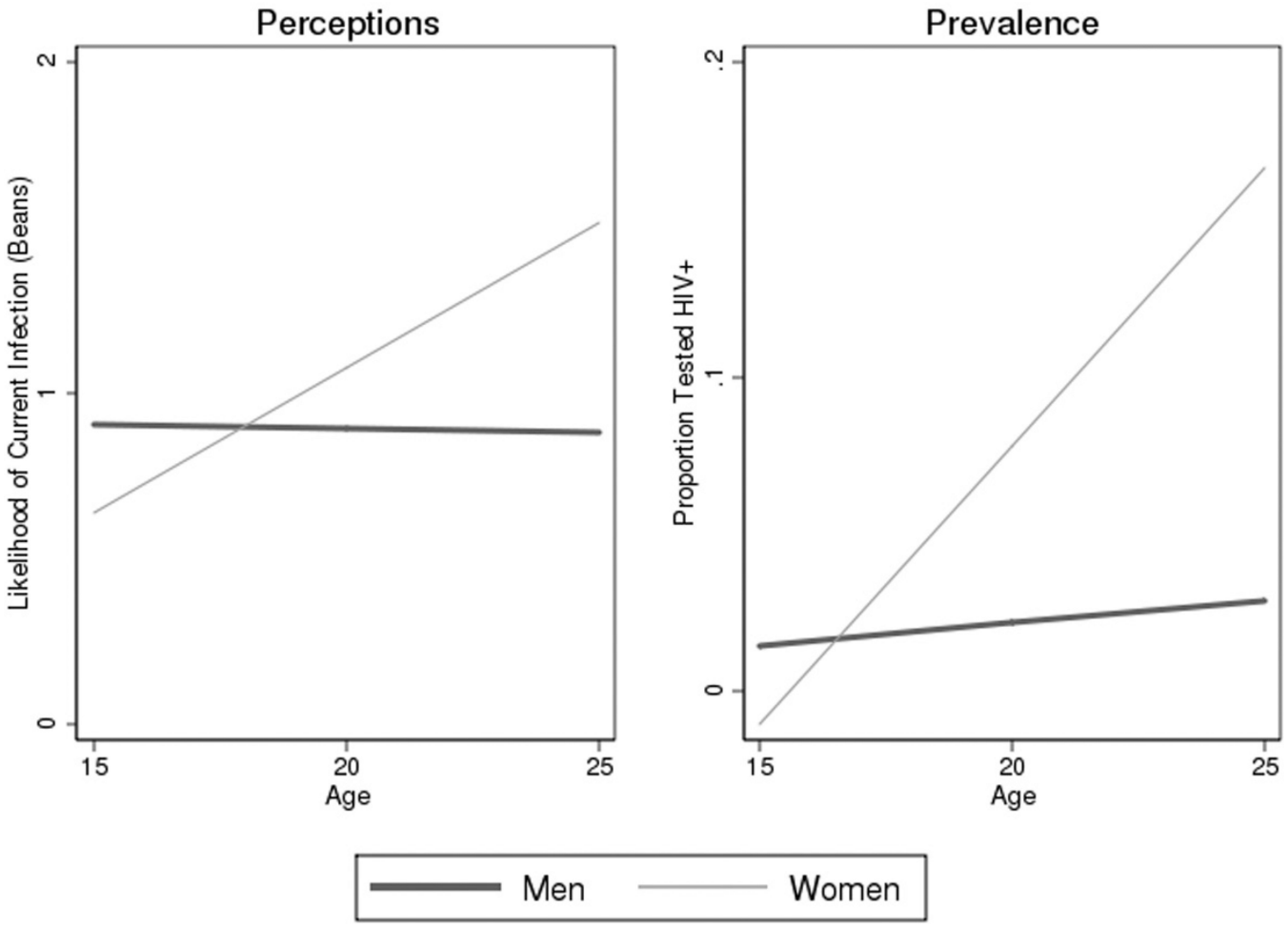

Figure 2.
Age and Sex Patterns of HIV Perceptions and Prevalence among Young Adults in Malawi

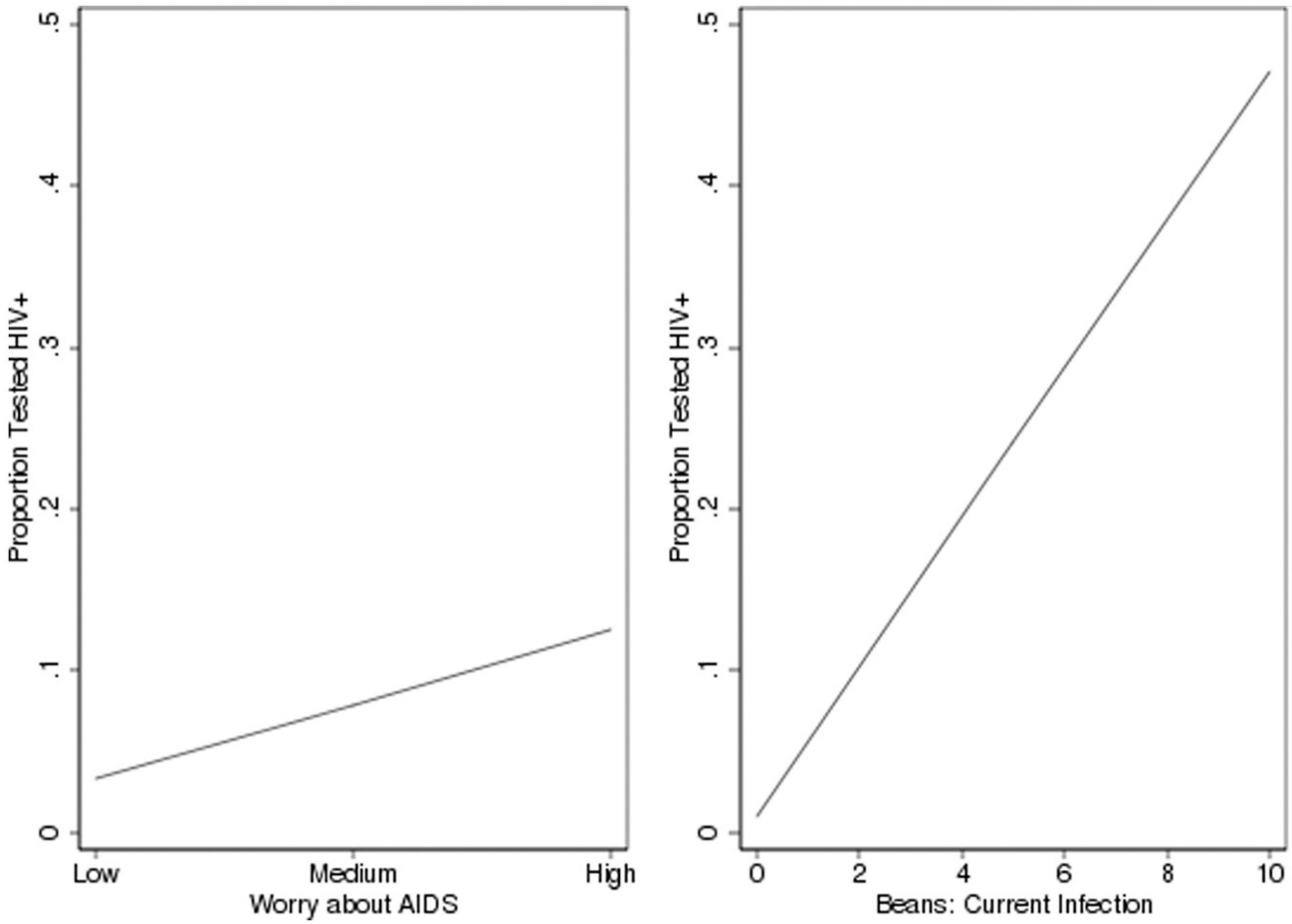

Figure 3.
Associations between Subjective Assessments of HIV and Biomarker Data from Young Adults in Malawi

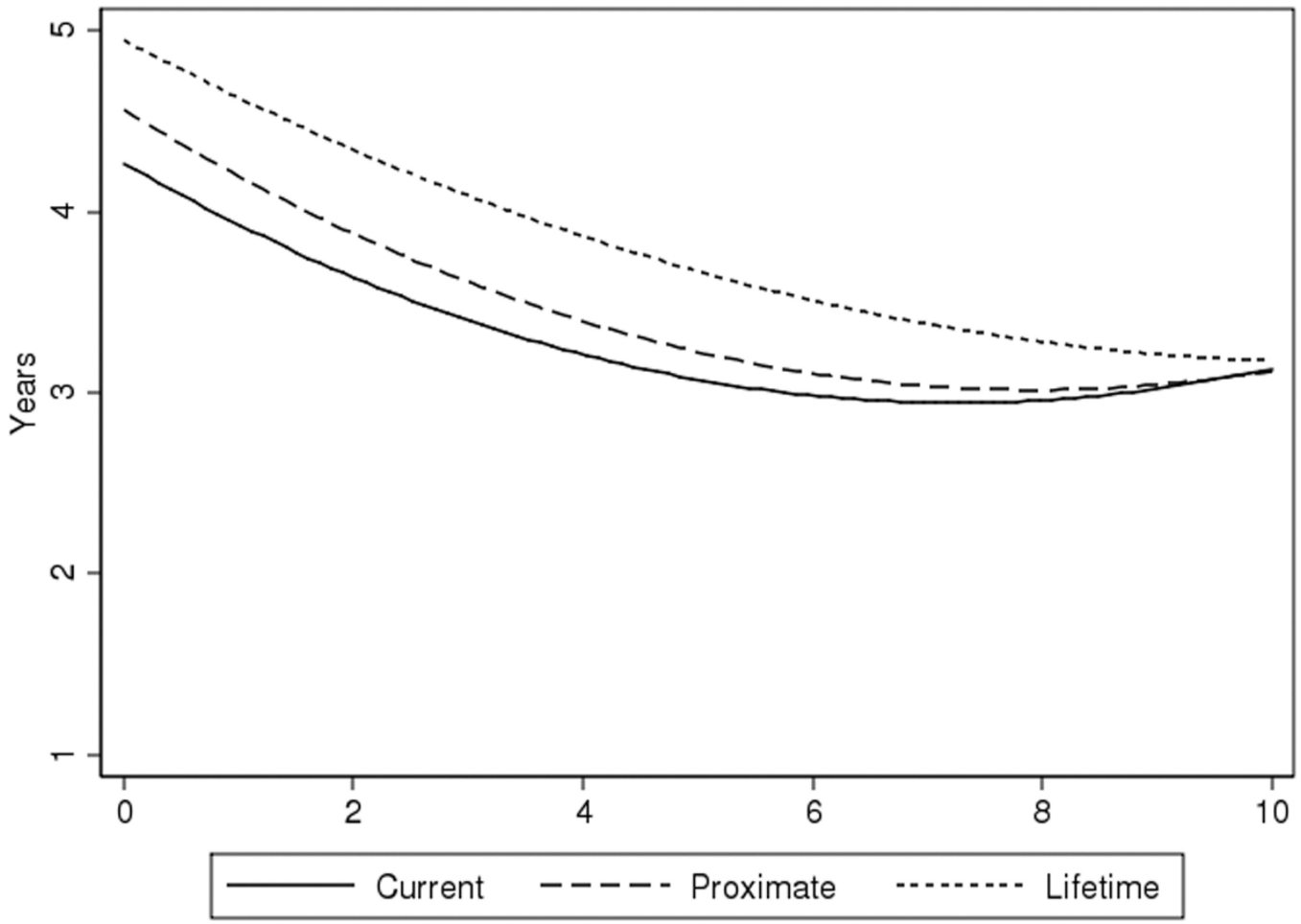

Figure 4.
Predicted Desired Time to Next Birth by Likelihood of Infection among Young Adults in Southern Malawi

Table 1

Sample Characteristics, Tsogolo la Thanzi, Wave 1

	Mean	SD
Sociodemographic Background		
Female	.72	
Age (15 to 25 years)	19.43	3.20
Marital Status		
Married	.35	
Divorced/Widowed	.06	
Never Married	.60	
Parity (0 to 13)	.62	.90
At Least One Child	.40	
Currently Pregnant	.08	
Sibship Size (0 to 23)	5.27	2.55
Years of Education (0 to 15)	7.80	2.82
Currently Enrolled in School	.46	
Household Goods Index (0 to 9)	2.70	1.69
Distance from Town (standardized)	.00	1.00
Fertility Preferences		
Wants No More Children	.05	
Time to Next Birth (1 to 5) *	3.47	1.46
Beans Measures		
Current Likelihood of Infection (0 to 10)	1.00	1.84
Likelihood of Infection Within One Year (0 to 10)	2.08	2.50
Lifetime Likelihood of Infection (0 to 10)	3.93	2.90

Note: $N = 2{,}039$;

* $N = 1{,}936$.

Table 2

Logistic Regression Model Predicting Preference to Stop Having Children among Young Adults in Southern Malawi

	Model 1		Model 2	
	β	SE	β	SE
Perceived HIV Status				
Beans (current, 0 to 10)	.0971	.0520		
Knows Positive (10 beans)			2.0925	.6352***
Controls				
Female	1.0226	.5425	1.0099	.5485
Age	.1755	.0632**	.1658	.0640**
Marital Status (vs. married)				
Divorced/Widowed	1.0763	.3361***	.9906	.3495**
Never Married	−.3213	.6138	−.3261	.6101
Parity	1.1195	.1697***	1.1568	.1645***
Current Pregnancy	1.7444	.3170***	1.7819	.3186***
Sibship Size	−.0495	.0500	−.0445	.0500
Years of Education	.0749	.0524	.0722	.0520
Currently Enrolled in School	−.1460	.6891	−.0955	.6946
Household Goods	−.0635	.0965	−.0584	.0972
Distance from Town	−.1552	.1391	−.1415	.1413
Constant	−9.6542	1.4434***	−9.4466	1.4789***
Log Likelihood (null)	−337.71		−337.71	
Log Likelihood	−212.07		−208.96	
AIC	450.14		443.91	
BIC	523.20		516.98	
Df	13		13	
N	2,039		2,039	

Source: Tsogolo la Thanzi, Wave 1, 2009.

Note: Analyses are weighted to account for gender stratification in the sampling design.

* $p < .05$;

** $p < .01$;

*** $p < .001$ (two-tailed tests).

Table 3

Tobit Regression Models Predicting Desired Waiting Time to Next Birth (in Years) among Young Adults in Southern Malawi

	Model 1. Certainty Only		Model 2. Current Uncertainty		Model 3. Proximate Uncertainty		Model 4. Lifetime Uncertainty	
	β	SE	β	SE	β	SE	β	SE
Perceived HIV Status								
Certain HIV Positive	−.4887	.3852						
Beans			−.2538	.0550***	−.1977	.0451***	−.1608	.0454***
Beans Squared			.0218	.0076**	.0098	.0055	.0053	.0045
Controls								
Female	−.7367	.1053***	−.7389	.1050***	−.7551	.1043***	−.7043	.1042***
Age	−.2743	.0203***	−.2738	.0203***	−.2723	.0203***	−.2681	.0201***
Marital Status (vs. married)								
Divorced/Widowed	.0323	.1738	.0922	.1833	.0243	.1820	.0161	.1815
Never Married	.7890	.1361***	.7754	.1341***	.7442	.1326***	.7995	.1333***
Parity	.4950	.0963***	.5067	.0942***	.4818	.0887***	.4789	.0885***
Currently Pregnant	.4609	.1718**	.4335	.1664*	.4230	.1621**	.4388	.1632**
Sibship Size	−.0236	.0172	−.0192	.0169	−.0214	.0168	−.0228	.0168
Years of Education	.0479	.0181**	.0445	.0182	.0404	.0183	.0380	.0185
Currently In School	1.5745	.1416***	1.5612	.1409***	1.5483	.1397***	1.5331	.1393***
Household Goods	.0287	.0308	.0333	.0304	.0290	.0302	.0250	.0302
Distance from Town	−.1723	.0468***	−.1645	.0464**	−.1641	.0452***	−.1650	.0464***
Constant	11.8907	1.3845***	11.8329	1.3157***	12.7716	1.2534***	12.7247	1.2309***
IMR	−5.0966	1.4376***	−4.8340	1.3648***	−5.7527	1.2806***	−5.5732	1.2628***
Log Likelihood (null)	−3243.23		−3243.23		−3243.23		−3243.23	
Log Likelihood (model)	−2631.84		−2613.07		−2600.32		−2598.52	
AIC	5293.69		5258.14		5232.65		5229.05	
BIC	5377.21		5347.23		5321.74		5318.14	
df	15		16		16		16	
N	1,936		1,936		1,936		1,936	

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Source: Tsogolo la Thanzi, Wave 1, 2009.

Note: Analyses are weighted to account for gender stratification in the sampling design.

[*] $p < .05$;

[**] $p < .01$;

[***] $p < .001$ (two-tailed tests).