Happy Collecting Water?

Measuring Hedonic Well-Being among Water Carriers in Rural Kenya using the Experience Sampling Method

Joseph Cook, Jane Kabubo-Mariara, and Peter Kimuyu

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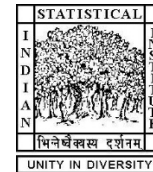
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Abstract

Despite work's importance in most people's overall sense of purpose in life, several studies measuring momentary well-being find that people are quite unhappy while at work. The study populations and the nature of work in these studies, however, are all similar: industrialized workers doing paid labor in the formal sector. What about the large fraction of humanity for whom "work" is primarily working on smallholder farms, tending cattle or collecting water or firewood? We use the Experience Sampling Method (ESM) on a sample of 220 water collectors in rural Meru County, Kenya, the first such application in this type of setting. We asked respondents to complete a short survey multiple times per day over eight weeks, asking about their primary activities and affect (happiness, sociability, energy and safety) at that moment. Results from a person-fixed-effects model of 12,939 ESM records show that respondents are indeed less happy "at work", whether that work is paid or unpaid casual labor (6 and 4 pts less happy on a 0-100 scale) or paid formal sector employment (10 pts less), or collecting water or firewood. Two results are somewhat tenuous but intriguing: the self-employed are actually happier while at work, and people are less happy when they report that their primary activity is "having nothing to do". We also find a statistically significant, though small, relationship between the intercepts in the model (individual-level average well-being) and the log of household income. The relationship is stronger with wages earned by the water collector herself.

Key Words: Experience Sampling Method, water, Kenya, happiness

JEL Codes: Q56

Contents

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1. Introduction

How happy are people while at work? The traditional economic view of the time allocation problem (Becker 1965) models people as trading off labor and leisure, where leisure is enjoyable but labor provides disutility – workers either need to be compensated with wages to buy market goods or the product of that labor must be a necessary non-market or subsistence good. No one works for fun. The subjective well-being literature, however, points to a seemingly contradictory conclusion: the unemployed report lower overall well-being, even in countries with public safety nets that partly offset the loss of income (Clark and Oswald 1994, Winkelmann and Winkelmann 1998, Theodossios 1998; see Diener et al. 1999 and Kahneman and Krueger 2006 for reviews). Part of the answer to the puzzle is that different disciplines have focused on distinct types of subjective well-being: *evaluative* well-being, where people are asked about 'satisfaction with their life as a whole', *eudemonic* well-being, which captures overall feelings of meaning and purpose in life, and *hedonic* well-being, in which people rate their

momentary feelings of happiness (Dolan and Metcalfe 2012). Kahneman and Krueger (2006) and Kahneman and Deaton (2010) refer to the first two measures as "life evaluation" and the hedonic measure as "emotional well-being" or "experienced utility".

As Bryson and MacKerron (2016) point out, the measurement of moment-by-moment happiness harkens back to the original conception of utility – both measurable and cardinal and thus amenable to inter-personal comparison, as in Francis Edgeworth's hedonimeter. Measuring it, however, is far harder than evaluative measures that can be asked with a handful of questions and compared using large cross-country surveys. One hedonic approach – the Experience Sampling Method (ESM) – asks respondents to answer a short survey that asks about the person's activity and feelings at a randomly selected time of day over many days or weeks, and typically during many points throughout the day (Larson and Csikszentmihalyi 1983, Csikszentmihalyi 2014). This allows a statistical reconstruction of time use that is not prone to recall bias, as well as hedonic measures of well-being during activities. It places a heavy demand on respondents, however, and the technology used during its conception in the 1970's (pagers, paper forms) limited the number of respondents who could be recruited. The Day Reconstruction Method of Kahneman et al. (2004) (DRM, a variant of which is the "Yesterday Interview") is similar but somewhat less resource-intensive since it asks respondents to "relive" the prior day and the affective states throughout. In a sample of 909 women in the US who had done paid work, they find that time spent at work was rated second to lowest in overall happiness, though working from home made respondents somewhat less unhappy.

The advent of networked, low-cost smartphones has dramatically lowered the cost of administering large numbers of ESM surveys, though the respondent burden remains high. Using data on over one million ESM records from 20,000 individuals in the UK who self-selected by downloading the "Mappiness" app, Bryson and MacKerron (2017) also find people are unhappy at work: paid work is ranked as the least enjoyable of 39 activities, with the exception of being sick in bed. Like Kahnemann et al. (2004), they find workers are less unhappy when they are working from home or working with others, and happiness varies across the day.

The main contribution of this paper is to test whether these results also apply to a quite different setting: rural Kenya. "Work" in these settings is less likely to be salaried formal-sector labor; much more common is manual labor on smallholder farm plots (either on one's own plot or working for barter or cash on another's), resource collection,

or tending to livestock. Although both Bryson and MacKerron (2017) and Kahnemann et al. (2004) include household chores as a category of time use, women's unpaid labor in rural areas of low-income countries is a larger fraction of overall time use than household work in industrialized settings[1].

Fetching water is one of the largest components of unpaid work in developing countries, and it is done largely by women (Sorenson et al. 2011, Graham et al. 2016). We focused our application of the ESM approach on the person in randomly-selected households who spends the most time collecting water, whom we refer to as the main water carrier. This allows us to focus attention generally on women's welfare in the household, and more specifically on a question: do women enjoy water collection? Many water professionals argue that water collection is physically taxing work and, if more women were relieved of this task, they would improve their quality of life by earning more income, attending school or spending time on more enjoyable activities. Others argue for a long-held but poorly-documented belief that women enjoy water collection because it allows them autonomy from their husbands and time away to socialize. Although few would argue that the activity of carrying 20 kilograms (44 pounds) of water on one's head or back for a kilometer or more is itself enjoyable, the positive utility from socializing and autonomy may outweigh this disutility. This belief is so ubiquitous that it has even made it to Hollywood[2].

We use the ESM approach on a sample of 220 water collectors in rural Meru County, the first such application of the technique in a low-income country that we are aware of. We asked respondents to complete a short, custom-designed survey on a low-cost smartphone four times per day, six days per week, over eight weeks during the dry season, in August – October 2016, when water collection burdens are the highest. The survey asked them to report primary and secondary/concurrent activities, who they were with, and a series of affect questions. We collected a total of 12,939 useable records. We find that, compared to work around the household (our base activity for comparison), water collectors are less happy when the ESM survey found them farming, collecting

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[1] Target 5.4 of the new Sustainable Development Goals (SDG) is to "recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate."

[2] In the movie "Whiskey Tango Foxtrot", Tina Fey plays a journalist in Afghanistan who embeds with an army unit that keeps returning to the same village over and over again to repair its water source. Each time the military (and the men in the village) believe the Taliban has destroyed the water point. Finally, a local woman furtively takes Fey's character aside to reveal a cabal of village women who have been plotting to destroy the well because water collection allows time away from their husbands.

water or firewood, or doing informal or formal sector work. Two results are tenuous but intriguing for the wider question of happiness and labor: the self-employed are actually happier while at work, and people are less happy when they reported their primary activity as "having nothing to do". We also find a statistically significant, though small, relationship between the intercepts in the model (individual-level average well-being) and the log of household income. The relationship is stronger with wages earned by the water collector herself.

2. Study Site and Respondents

We conducted baseline interviews with a total of 248 households in four villages ("sublocations" in the Kenyan local government scheme) in the Tigania West political constituency. The sublocations are rural areas with no paved roads and are clustered around the small market town of Kianjai. Kianjai is connected by 19 kilometers of paved road to the larger city of Meru, in the shadow of Mount Kenya in eastern-central Kenya. Meru County is a relatively fertile and important agricultural area, though our study site receives less rainfall than the agricultural areas around the city of Meru. Predominant crops in our Tigania West constituency are beans, peas, cassava and mangoes, and many households raise commercial livestock (Kenyan Bureau of Statistics 2015).

The study site was chosen purposefully in 2013 for a study of households' water source and collection decisions because of the diversity of existing water source options available. Sample households in 2015 were chosen randomly based on a transect approach, but, because of the overall research agenda,[3] we excluded households that had a well or piped water on premises or did not have at least one school-aged child at home. We provide more details on the sampling approach in the appendix. As described below, respondents reported that water collectors in their household spent nearly three hours in total the previous day collecting water. We believe this collection burden is broadly representative of many rural Kenyan households without piped water at home, though we cannot confirm this because a similar figure is not collected in nationally-representative

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[3]To test the impact of exogenously reducing water collection times on household time use and school outcomes, we randomly assigned half the households to receive water delivered to their doorstep for free for a period of six weeks.

surveys[4]. Nevertheless, our focus here is on measuring happiness and other affect measures "at work" rather than the time burden of water collection itself.

A team of ten trained enumerators asked households a number of detailed questions in Kimeru, the local language. We interviewed the household member "who is mostly responsible for water-related decisions, such as where to get water and how much to collect," but asked that the phone and ESM survey (described below) be deployed with the person in the household who spends the most time collecting water. Of these 248 households, 12 dropped out of the study and did not provide any meaningful number of ESM surveys. We dropped an additional 16 households because enumerators expressed multiple concerns that the person carrying the phone was not the main water collector or because more than 75% of the ESM surveys did not have the correct pictorial passcode, described in more detail in the next section.

Who were the water collectors who carried the phones and completed the ESM surveys? The typical (median) person was a 37 year-old woman with eight years of education who could read "with difficulty". Overall, only 7% (n=17) were men, who were slightly older on average (42 years old). The youngest person was 12 (there were only 3 respondents younger than age 18)[5] and the oldest was 72; 65% of phone carriers were age 40 or under (the full distribution is shown in the appendix). Approximately half could read "with difficulty", 23% could read "easily" and 28% could not read at all. In 90% of households, the person carrying the phone identified herself as both the "main water decision maker" and the person who spends the most time collecting water. Nearly all (98%) said that they work on the household's own farm, and 39% said they have worked for wages in the past two weeks. On average, they had worked for 4.7 days in the past 14, and earned an average daily wage of 250 Kenyan shillings (Ksh), about USD 2.45 (~102 Ksh/USD in August 2016). Among those who worked for wages, 29% said the wage work was casual labor, 40% performed wage labor on someone else's farm, and

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[4] The 2014 Demographic and Health Survey in Kenya found that the total roundtrip time to collect water from the house's main drinking water source is "less than 30 minutes" for 33% of rural households and "30 minutes or more" for 40% of rural households (Kenyan Bureau of Statistics 2014). To compare with our estimates, one would also need to know the number of trips taken per day by all collectors.

[5] This does not mean children were not collecting water in these households; they were. A typical household had one or more children collecting water, but this was to supplement water collected by the main water carrier, typically the mother, who is our focus here. These estimates are roughly in line with rural Kenya overall. The 2014 Kenyan DHS found that the person "who usually collects water" is a woman over age 15 in 77% of rural households, a man over 15 in 19% of households, and a child younger than 15 in 5% of households.

23% were self-employed entrepreneurs. Only four respondents were employed in the formal sector.

3. Methods

Each participating household was given a low-cost (USD 20) smartphone as well as a solar charger kit to make sure the phone would remain charged. Each also received a SIM card; each SIM card account was loaded daily with enough airtime credit to transmit any completed forms. Network coverage, however, sometimes prevented the user from submitting the form exactly as it was completed, but the forms were stored (and time-stamped) in the phone, to be sent in batch when the phone connected with the network.

Our survey was conducted on a custom Open Data Kit (ODK) app designed by the research team. The survey asked about what the respondent was doing when the phone buzzed, with 18 time use categories. The order in which the categories were shown to the respondents was randomised in ODK each time a respondent completed an ESM survey. Each category was represented by a picture, and accompanying text gave a description of the activities that respondents should include in that category. Descriptions were revised with input from focus groups and the enumerators, and back-translated into Kimeru (see appendix). They were also designed to map to the new UN Time Use standard categories (UN Statistics Division, 2016). The time use categories and descriptions were carefully explained to each participant during a baseline survey as part of the recall-based time use elicitation. Enumerators asked respondents to "reconstruct" the prior day, minimizing possible recall bias where contemporaneous diary approaches are infeasible due to low literacy rates (see Masuda et al. 2014 for a pictorial diary approach).

We made the ESM program flexible for users to interact in the way most comfortable to them. Because many educated Kenyans prefer to read in English, the category headings could be shown in either English or Kimeru with a menu option on the program. We also assigned a photo for each category to help illiterate users. Users could push a button to have the program play back a recording of each of the detailed descriptions for each activity, read in Kimeru. The ESM survey also asked: a) follow-up labor questions (for respondents who said they were farming, going to market, or working), which asked the type of work, whether they worked for wages, and whether they worked for themselves or others; b) how much they enjoyed the activity; c) whether it was important to them and others; d) whether they wished they had been doing something else; e) a secondary (concurrent) activity (if any); f) who they were with when

the phone buzzed; g) whether they were in any physical pain or discomfort; h) whether they felt safe; and i) affect on three dimensions (happy vs. sad, tired vs. energetic, lonely vs. sociable)[6]. Each of the affect measures was asked of respondents as a 7-point Likert scale. For the happiness measure, for example, the options were "very sad" (coded in the data as 1), "quite sad" (2), "a bit sad" (3), "neither happy nor sad" (4) "a bit happy" (5), "quite happy" (6) and "very happy" (7). We follow Bryson and MacKerron (2017) in assuming cardinality of the categories and transforming them onto a 0 to 100 scale for ease of interpretation, where 0 is "very sad", "quite sad" is assigned 16.7 (100/6 intervals), "a bit sad" is 33.3, etc. up to "very happy" (100). The question on safety was asked on a 4-point scale (very unsafe, somewhat unsafe, somewhat safe and very safe) and similarly transformed to a 0 to 100 scale. The options for the question on physical pain were "none", "slight pain" and "severe pain." Because these response options are less likely to be cardinal, we collapse this into a dummy variable that is equal to one if the respondent reported either slight or severe pain.

To generate a randomly-timed prompt to complete the survey, we adapted an existing Android app called Randomly Remind Me. The app generated a reminder at four randomly-chosen times of the day (during waking hours), six days a week. The reminder included a pop-up message that would open the ODK app automatically when clicked. The program should have logged when each reminder was issued, allowing us to check whether respondents clicked immediately after the reminder rather than after some delay. Unfortunately, this functionality did not work well in the field and we were unable to verify when respondents answered questions with the Randomly Remind Me app. We instead rely below on the timestamps of submissions in ODK, which did work properly, in arguing that respondents seem to have replied to reminders promptly.

The household member who spends the most time collecting water was supposed to be the person completing the ESM surveys. To guard against the phone being taken by another household member, we asked the main collector in the baseline survey to choose among a list of pictures of East African animals. That would be her "secret animal" that she should not share with others. The first question of the ODK survey asked for the "secret animal" as a sort of password, and we did identify several cases where the animal was inconsistent and the team learned that someone else had been using the phone. In

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[6] The underlying file needed to replicate the ODK survey are available at https://tinyurl.com/y8o33vcm , and a video showing how the app would have looked and sounded to respondents (on the actual phones) is at https://www.youtube.com/watch?v=L1MBUk4Idfk .

each case, a member of the team visited the household to emphasize that the main water carrier was the person who needed to carry the phone, and that their participation in the program could end (losing the smartphone and solar charger).

Phones were deployed to households beginning on August 19, 2016. Dropping records with an incorrect "secret animal" leaves 14,280 time use records from 220 respondents (from a total of 248 baseline interviews). Because surveys are time-stamped on the mobile phone, we can assess how likely it is that respondents filled out the surveys when prompted, as opposed to waiting until a convenient time to fill them out. In some cases, respondents completed more than four forms per day, which implies they were completing them at times not prompted by the Randomly Remind Me program. We drop 1,341 ESM records where this was the case, leaving 12,939 records. Many of these dropped records are duplicates where the respondent was not sure that the form was submitted correctly and re-took the survey immediately.

Among those remaining, Panel A of Figure 1 shows that the number of submitted surveys in total varied fairly little over the time period of the study, and Panel B shows a similar pattern of average submissions per person. Note that this average is less than four: as expected, respondents did not on average respond to all four prompts from the phone each day. Panel C shows that surveys were submitted throughout the day, and Panel D shows balance by day of the week (the program did not prompt ESM surveys on Sundays). Finally, Panel E shows that the time between when the ESM program was started by the respondent and when it was submitted as complete is mainly under 10 minutes. The average and median times were 4.2 minutes and 2.7 minutes; 95% were under 10 minutes.

Figure 1. ESM Survey Diagnostics
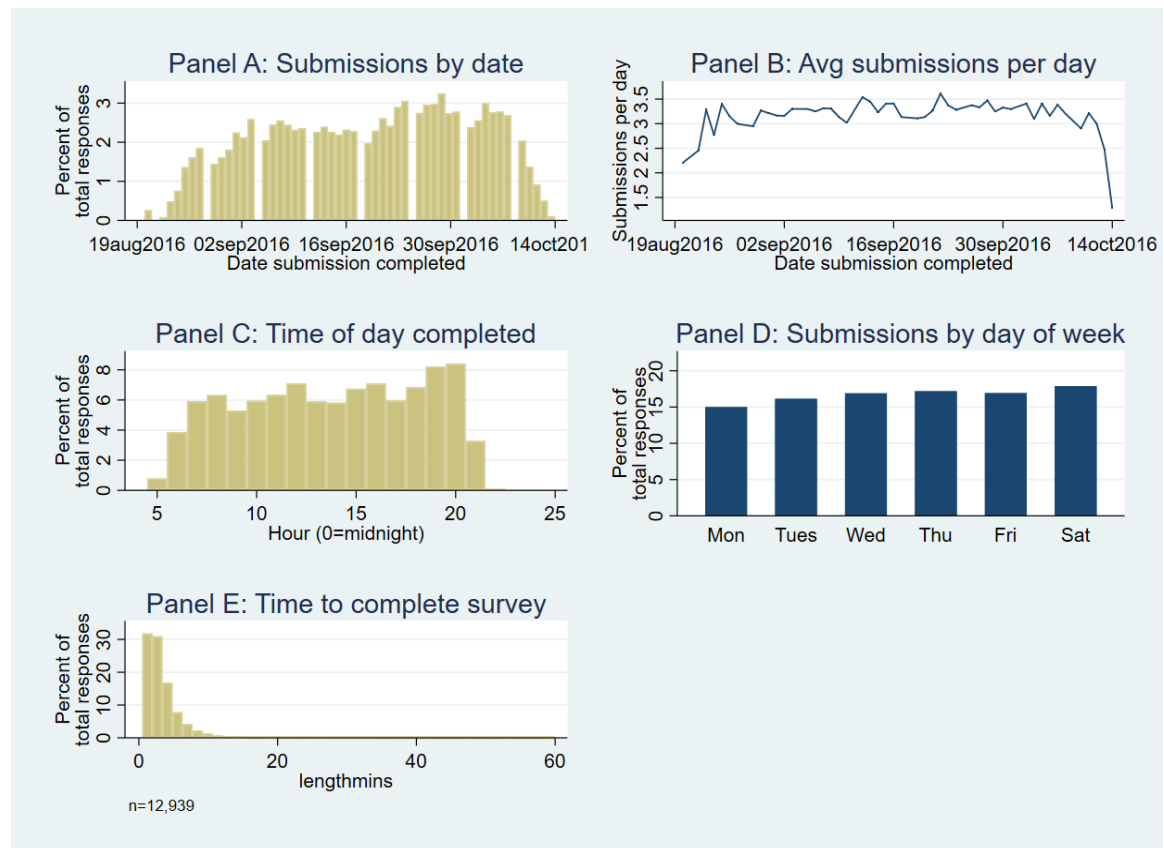
4. Results

4.1. Baseline Survey

Before turning to the ESM data, we begin by discussing survey questions added specifically to understand water collection behavior and attitudes towards water collection. Eighty-nine percent of collectors interviewed reported collecting water every day. Of those who do not, most collect at least every other day or more (average number of days = 3.7). Nearly all (95%) said that when they queue to get water, they have to queue with their storage container ("jerrican"); only 5% said they could leave their jerrican as a placeholder, go do other productive activities, and come back later. The median respondent said that they spent roughly two and a half hours (153 minutes, average 172 minutes) collecting water the previous day. This includes the time spent traveling there, waiting to fill their container, and returning, though we explicitly asked them to exclude any time spent doing other activities along the way. Of this time, the median respondent spent 40 minutes queuing. Three-quarters carried water on foot; the

remainder mainly used bicycles, though a small percentage used a wheelbarrow or animal-drawn cart.

Based on a few simple questions, we find no evidence in our sample to support the belief that women enjoy the activity of water collection. First, only 22% percent reported that they combine trips collecting water with other activities such as stopping to visit friends, going to the market, or doing other work. The vast majority of respondents collect water by themselves; only 11% regularly reported collecting water with another person. Second, we directly asked respondents how much they enjoy collecting water. Three-quarters said they "dislike it a lot", and 19% dislike it "a little". Only 6% said they enjoy it a "little" or "a lot".

Water collection is, however, an activity in which some households reported labor sharing. Half of respondents reported that they had collected water for "people who don't live in [their] compound, for example when they were sick" in the past month, and 66% said they had helped at least one time. They helped primarily friends and neighbors (rather than only relatives). Similarly, 45% said someone outside the household had helped them collect water in the past month (50% had ever received help); the majority of helpers were again friends and neighbors.

4.2. Affect: Happiness, Safety, Sociability and Energy

4.2.1. Raw Results

We begin with a description of the unprocessed affect data. Respondents generally report lower levels of happiness when the phone alarms while they are collecting water or firewood, are doing paid or unpaid casual labor, or describe themselves as being idle (see the appendix for 95% confidence interval graphs). Overall, though, respondents report being fairly content: the average value across all observations is 79 on a scale of 0 (very sad) to 100 (very happy), between "a bit happy" and "quite happy". Similarly, on average, respondents reported feeling somewhat sociable (mean=64), but feeling more sociable during meetings and, of course, when their main activity was socializing. Our measures on the tired versus energetic scale demonstrate the overall content validity of the exercise: respondents report feeling most tired when the ESM has captured them in tiring manual work: collecting water or wood, farming, casual labor, or going to market. Similarly, a higher fraction of respondents reported feeling moderate or severe physical pain in the past hour when their primary activity is resource collection, farming or casual labor. There is little apparent difference in perceptions of

safety by activities. Finally, our measure of agency (percent who said they were doing the activity because they "wanted to") is highest for entertainment (TV or radio), socializing, studying or sports/hobbies. Only 6% said they were doing the activity because they "had nothing else to do;" the majority (79%) said it was because they "had to." However, the small number of men in our sample were more likely than women to report doing an activity because they wanted to (24% of records for men vs. 14% for women, *t-statistic* for difference= 7.78).

Finally, we asked respondents who they were with when the phone buzzed. They were alone 43% of the time, with a friend in 32% of records, with a relative in 19% of records, and with a neighbor or stranger in 6%. Respondents were, of course, less likely to report being alone when the primary activity was attending meetings, socializing, or going to market (see appendix). Interestingly, we find more indications of the social nature of water collection in the ESM data than in our simple question above, where only 11% reported regularly collecting with someone else. Among the ESM records where the primary activity was collecting water, half (49%) reported being with someone else. In two-thirds of these cases, respondents said they were with a friend.

4.2.2. Panel (individual fixed-effects) Regressions

We next exploit the panel nature of the dataset to explore how different activities cause changes in momentary well-being. The dependent variable is the response to each of the affect questions, scaled from 0 to 100 as described above. By estimating a model with person- fixed-effects, we exploit variation within each person's reporting of her happiness, safety, etc. as it varied by the activity that the ESM found them doing. The key regressors are a set of dummy variables for each activity type. Because these are exhaustive categories, we exclude a dummy for "household work." We chose household work because a) it is the most commonly-reported activity and b) it is approximately equal to the overall mean level of happiness across activities. The average happiness during household work is 80.8 on our 0-100 scaled measure, compared to the overall average of 79.4 reported above (see Figure A2). This implies that coefficients should be interpreted as a change in the 0-100 scaled measure (e.g., happiness) relative to the average level reported in the sample when doing household work, or roughly the mean overall happiness level. Although it is not strictly speaking a percentage, we will refer to these coefficients as percentage changes, so that a positive coefficient of 6 points on the 0-100 scale is a 6% increase in happiness. The specific estimation model is:

$$(1)$$

$$h_{it} = \propto_i + \beta_{A_j} A_{j_{it}} + \gamma x_{it} + \epsilon_{it}$$

where *h* is the affect measure (0 to 100) of individual *i* at time *t* while doing one of *j* activities (A). Standard errors are clustered by respondent (implemented with *xtreg,fe vce(cluster)* in Stata 15)[7]. We estimate a panel logit (*xtlogit*) as our binary measure of pain (the percent who felt moderate or severe pain).

We also include a set of covariates x_{it} for other characteristics of that moment that may explain momentary well-being: whether the person reported being alone, and time of day (morning (5am-noon), afternoon (noon-5pm) or evening (5pm – 11pm), with morning as the excluded category). The appendix reports regression results with and without these controls; our key results are unchanged without these controls. Unlike Bryson and MacKerron (2017), we see no effects of being alone or time of day on average happiness. Respondents are more likely to report feeling tired but more sociable as the day wears on. All models reported hereafter include these controls. Results without them are available on request. We also ran gender-disaggregated models, also available on request. The comparison of differential effects is underpowered, however, given the small number of men in our sample who are the primary water collector.

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[7] We also explored random-effects models to increase efficiency and reduce standard errors. Hausman tests of fixed-effects vs. random-effects models for each of the four measures indicated that random-effects models would be consistent for the sociability, energy, and safety measures (the tests fail to reject null of no systematic difference in coefficients at p=0.61, p=0.364, and p=0.27). For happiness, however, the test statistics imply that random effects models are inconsistent (rejecting the null at p=0.039). To avoid confusion, we report fixed-effects results for all four measures throughout.

Figure 2. Coefficients from Fixed-Effects Panel Regression Model of Happiness, Energy, Sociability, and Safety
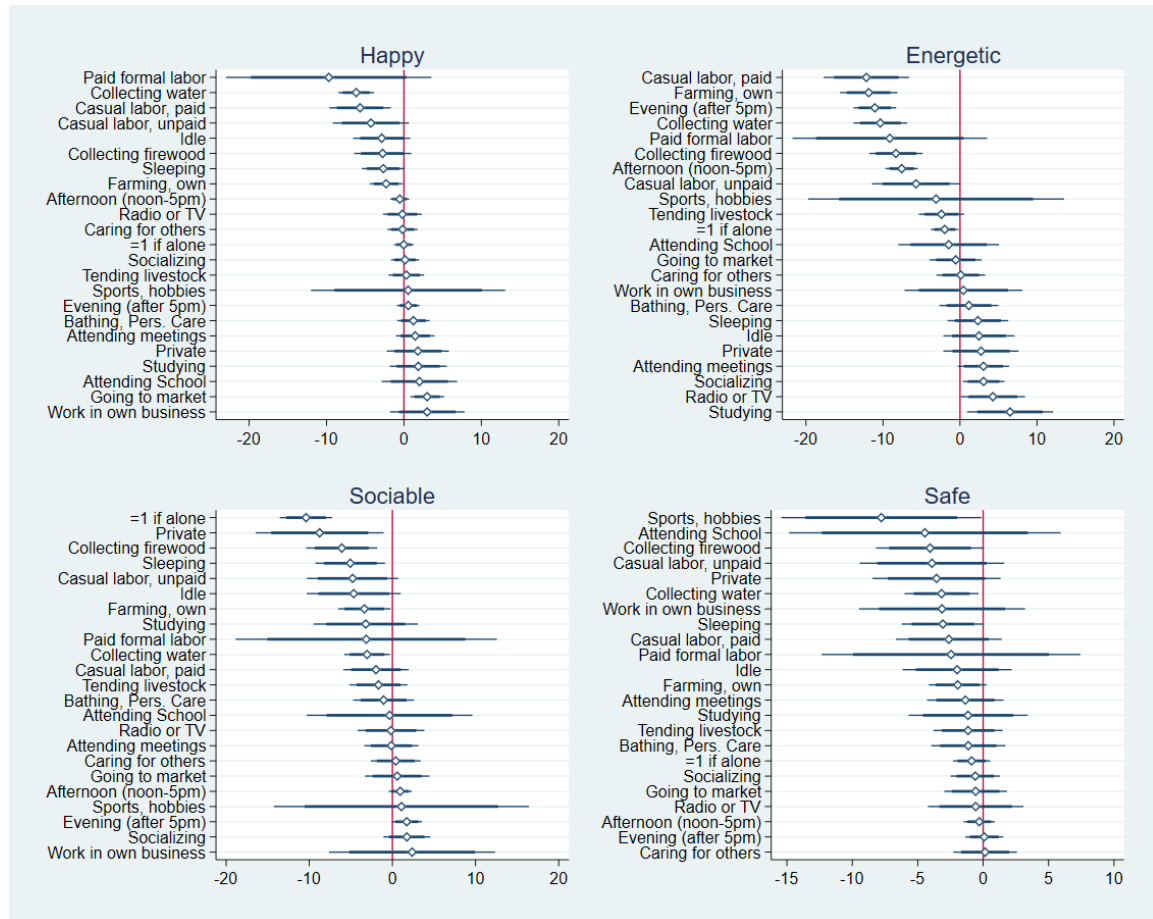
Notes: Coefficients plotted from panel regression model (xtreg). Standard errors clustered at the person level. Thicker line represents 95% confidence interval; thinner line 99%. Regression on happy-sad based on 12,732 records from n=220 individuals, energetic (n= 12,701), sociable (n= 12,685), safe (n= 12,744). All four measures were recoded (as cardinal) from original 4 or 6 answer codes to a 0-100 (cardinal scale).

Compared to household work, respondents report feeling 6% less happy, 10% less energetic, and 2% less energetic when they are collecting water (Figure 2 plots regression coefficients; full regression results are reported in the appendix). Note that because these models control for whether the respondent was alone or socializing, we can also rule out the possibility that the utility of socializing outweighs the disutility of water collection. We also estimated a model with an interaction term on being alone and collecting water to capture anything special about being with others while collecting water. The coefficients on water collection and being alone barely change, and the interaction term is

not statistically different from zero. Respondents also feel 3% less safe when they are collecting water, providing support for a claim that has often been discussed in the rural water supply literature but is not well documented: women and girls in rural areas may be more likely to be attacked when they are collecting water or looking for places to defecate in the open[8].

Because the data collection was done as part of a larger study, where it was obvious to respondents that we cared most about water, it is possible that the study focused their attention on that activity unnaturally, or that participants were exaggerating how much they disliked the activity. Other physically-demanding activities, however, show a similar pattern. Firewood collection, farming on the household's own farm, and paid or unpaid casual labor are associated with statistically significant drops in happiness, energy, sociability and safety, compared to household work. Firewood collection is associated with being 3% less happy, 6% less sociable, 8% less energetic and 4% less safe. Farming on the household's own farm is associated with being 2.3% less happy, 3.4 % less sociable, 12% less energetic and 2% less safe.

Casual labor is associated with a 4.3% drop in happiness when the work is unpaid, and, interestingly, a somewhat larger drop (5.6%) when work is paid, although the coefficients are not statistically different. Being "at work" when the job is in the formal sector is even worse: these respondents are 10% less happy when at work, though this result is based on a very small number of respondents and is statistically significant only at the 90% level. These results are all consistent with Bryson and MacKerron's central findings: people dislike being at work. We do find one weak but intriguing, contradictory result: those who are self-employed may be *happier* at work. The point estimate on "work in own private business" implies entrepreneurs are 3% happier while at work compared to household work. This result is significant at the 90% level in regressions without controls for whether the respondent is alone, but not in our preferred models with that control (*t*-statistic = 1.62).

"Leisure" activities such as reading, TV/radio, sports, bathing and personal care, and socializing are generally not statistically different from household work, though point estimates are typically positive. One exception is "going to market": people are 3%

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[8] Respondents were also more likely to report feeling unsafe when doing sports or hobbies, which is likely capturing a likelihood of sports-related injuries. Feeling more unsafe when sleeping is somewhat puzzling. Recall, though, that the respondent has just been awakened during the day by the ESM survey, so it may be that respondents felt vulnerable or disoriented on waking, particularly if they were napping away from the home.

happier on days when they travel into town (typically once or twice per week) to shop, sell, and socialize. This result will probably surprise no one with experience in rural African settings. Interestingly, unlike Kahneman et al. (2004), we see no statistically significant decrease in happiness when the respondent is "caring for others," which is predominantly childcare. We also find that people were also 4% less happy when their main activity was being idle ("doing not much of anything").

Manual labor like water or firewood collection, farming or casual labor are all associated with a higher probability that the respondent reported being in "some" or "severe" pain (Figure 3). Respondents are also more likely to report pain in the afternoon or the evening, compared to the morning.

Figure 3. Coefficients from Panel Regression Model of Whether Respondent Felt Some or Severe Pain in Hour before ESM Survey
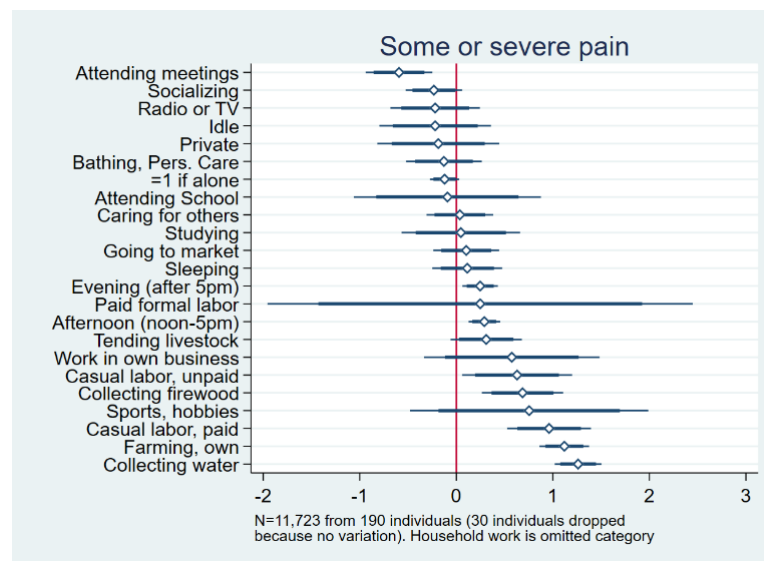
Notes: Coefficients plotted from panel regression model (xtlogit). Standard errors clustered at the person level. Thicker line represents 95% confidence interval; thinner line 99%. Regression on happy-sad based on 11,723 records from n=190 individuals; 30 individuals dropped because no variation in responses.

4.2.3. Explaining Individual Intercepts

The intercepts from these panel regressions ($\propto_i$) are also of interest: they represent each respondent's estimated average level of happiness, pain, sociability, etc. We report here only the intercepts for the "happiness" measure; other results are available on request. Panel A of Figure 4 displays their distribution with the population-level intercept added to maintain a scale of 0-100. This represents the distribution of average

momentary happiness in our study population of 220 individuals, the first such estimate of which we are aware in a setting like ours in rural Africa.

We employed a simple quadratic fit to explore the relationship between the intercept and age and found neither coefficient was statistically different from zero. Kahneman et al. (2004) similarly found a low correlation with DRM data. Following Kahneman and Deaton (2010), we use the log of three different income measures rather than its absolute amount because respondents are more likely to perceive changes or differences in percentages rather than in absolute amounts. One notable difference between their study and ours, however, is that 40% of our households reported no earned income in the past two weeks, consistent with poor agricultural households interviewed during the dry, post-harvest season. The log operator converts these zeros to missing values, so our regressions should be interpreted as the effect of income on well-being *conditional* on earning some income.   We also briefly discuss regressions using absolute values that do include these zero-wage households. The models also exclude one wage record of 60,000 Ksh (a monthly income of USD 1,200), which is an order of magnitude higher than all other respondents. It is likely this income is misreported.

We find no statistically significant relationship between the intercepts and the log of the midpoint of self-reported total monthly household income, asked in ranges (i.e., 5,000 – 10,000 Ksh, 10,000 – 15,000 Ksh). We also find no statistically significant relationship with the log of a wealth index score created using information from assets and housing characteristics with a Principal Components Analysis (PCA) approach (Filmer and Pritchett 2001).

We do find a statistically significant relationship with total household wages over the past 14 days, asked individually of each household member who worked for wages, and summed over all household members (Panel B, Figure 4). It is, however, very small in magnitude ($\beta=2.30$, $t=1.74$); our results imply that increasing household income by 10% increases the happiness index by only 0.22 units (2.30*log(1.1)) on the 0-100 scale. This relationship was also not statistically significant in a quadratic fit with the absolute level rather than its log.

**Figure 4. Predicted Intercepts from Happy-Sad Panel Regression (Panel A),
Plotted against Household's Reported Wages (Panel B) and the Phone Carrier's
Reported Wages in the Past 2 Weeks (Panel C).**
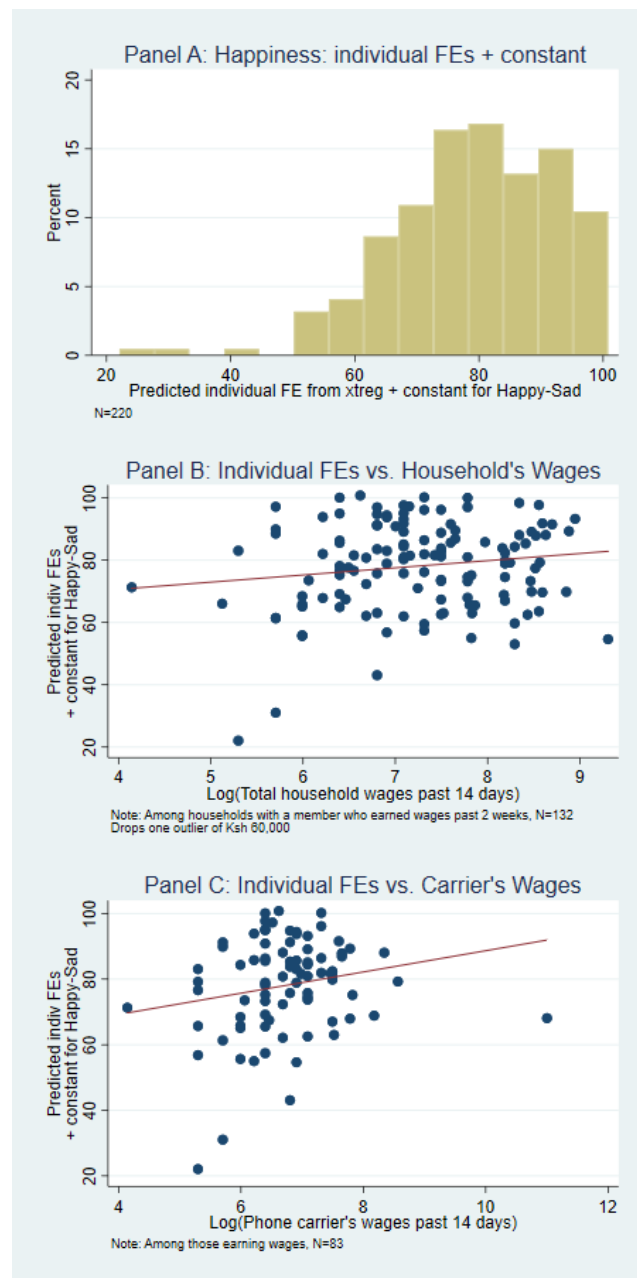
We find a larger, though still modest, relationship between average momentary well-being and the total labor income earned over the past two weeks by the water carrier ONLY (Panel C of Figure 4, β=5.34, t=2.60). Increasing wages by 10% increases average well-being by 0.51 units, twice the size of the effect of household wages[9]. We do not have information on each household member's perceived bargaining power, but it seems logical that one's own earned wages contribute more to experienced well-being than wages earned by other household members if resources are not pooled completely. It could also be the case that even water carriers who pool their resources with the household feel a greater sense of contribution to family wealth as wages increase.

5. Conclusions

In summary, we find little evidence to support the idea that women enjoy water collection. Based on a simple question, nearly all told us they dislike it and our ESM results suggest that, controlling for person fixed effects *and* controlling for whether the respondent was alone or socializing at the time, respondents are less happy, less sociable, more tired, and more likely to be in pain when the ESM survey has captured them collecting water. They also feel less safe, compared to household work, when they are presumably away from home collecting water. It is possible, of course, that this result is unique to our study setting in rural Kenya. We did not specifically explore household bargaining power or women's roles in the household, and it may well be the case that in other settings where women's autonomy is very low, water collection may be both sociable and an escape for women. Women experiencing domestic violence at home may be more likely to appreciate the opportunity to collect water; Fajardo-Gonzalez (2017) finds that the incidence of domestic violence increased the labor supply of women in Colombia.   The effect of socializing versus being alone on overall happiness is also likely to vary culturally; in other sites, the utility of being with others may outweigh the physical discomfort of water collection. However, without careful empirical study – directly asking women themselves – development professionals should be especially careful not to *assume* that women enjoy water collection, or that infrequent use of an improved water source is attributable to this type of preference. It is also possible for development policies to support other types of activities that provide women autonomy

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[9] We also find a statistically significant relationship using the absolute level of carrier's wages, but only among the carriers who earned some wages (n=83). The relationship disappears when including the zero-wage-earning carriers.

and time socializing without the physically demanding drudgery of water or fuelwood collection.

This broad pattern, however, extends to other types of tiring manual labor like firewood collection, farming and casual labor. In all cases, respondents reported being less happy, less energetic, and less sociable when the ESM survey found them doing these activities. Since these activities are the majority of our respondents' "work," our results are in line with Bryson and MacKerron (2017). The exception is a new but tenuous result suggesting that entrepreneurs may actually be happier while at work. This result may help to bridge the evaluative/life satisfaction and hedonic well-being literatures if people are generally happier in the moment when they engage in work that they believe empowers them to live more productive lives with agency. While resource collection, wage labor or agricultural labor are all critical types of work for the family's economic wellbeing, entrepreneurs may consider their work both personally fulfilling and productive for their family's future.

Another novel result is that respondents' hedonic well-being is lower when they report "doing not much of anything." Such a category is not standard in most time use surveys, and is not included in the UN's new draft time use classification standard (UN Statistics Division 2016[10]). As such, one should interpret it cautiously and be aware of the possibility of different translations of the concept, possibly including ideas of "resting" or "relaxing" (our Kimeru translation is provided in the appendix). We added it because prior experience in the study site suggested that many people seemed to have little productive work to do during the dry season; young men, in particular, were frequently seen idle. Our enumerators, in fact, tried to dissuade us from including it as a category on the grounds that it would be perceived as socially unacceptable and lazy to admit having nothing to do. Given that our sample respondents were largely busy women doing work in and outside the home, these results might well be stronger had we included a broader sample of the population, including more men. Although economists are perfectly comfortable with the idea that the marginal utility of leisure is declining, our results suggest that at some point additional "leisure" time may provide disutility, perhaps from feelings of boredom or worthlessness. This again connects with the evaluative well-being literature, since seasonal idleness in agricultural regions is a close analog to "unemployment" in formal labor markets in industrialized countries.

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[10] The most relevant categories would be "Personal Care and Maintenance Activities" or "Hobbies, Games and Other Pastime Activities."

Goldsmith et al. (1996) find that current and past experiences of unemployment or inactivity reduce current self-esteem in the US. Clark et al. (2001) find "scarring" in the UK: higher spells of unemployment in the past are associated with lower evaluative well-being, even among those currently employed. Theodossiou (1998), using German data, find that the unemployed are 2.9 times more likely to think of themselves as a "worthless person".

References

Becker G. (1965). A theory of allocation of time. *Economic Journal* 75:493–517.

Bryson, A. and Mackerron, G. (2016). Are you happy while you work? *Economic Journal*, *127*(202647), 106–125.

Clark, A. E. and Oswald, A. J. (1994). Unhappiness and unemployment. *Economic Journal, 104*(424), 648–59.

Clark, A., Georgellis, Y., and Sanfey, P. (2001). Scarring: The psychological impact of past unemployment. *Economica*, 68(270), 221–41. Retrieved from http://doi.wiley.com/10.1111/1468-0335.00243

Csikszentmihalyi, M. (2014). *Flow and the foundations of positive psychology: the collected works of Mihaly Csikszentmihalyi*. Springer Netherlands. 298 pp.

Diener, E., Suh, E. M., Lucas, R. E., and Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin 25*, 276–302. Retrieved from http://doi.apa.org/getdoi.cfm?doi=10.1037/0033-2909.125.2.276

Dolan, P. and Metcalfe, R. (2012). Measuring subjective wellbeing: Recommendations on measures for use by national governments. *Journal of Social Policy, 41*(2), 409-427.

Fajardo-Gonzalez, J. (2017). Domestic violence, decision-making power and female employment in Colombia. Working paper presented at the 2018 ASSA meetings, Philadephia. Retrieved from https://www.aeaweb.org/conference/2018/preliminary/1822

Filmer, D., and Prichett, L. (2001). Estimating wealth effects without expenditure data — or tears: An application to educational enrollments in states of India. *Demography*, *38*(1), 115–32.

Goldsmith, A. H., Veum, J. R., and Darity, W. (1996). The impact of labor force history on self-esteem and its component parts, anxiety, alienation and depression. *Journal of Economic Psychology, 17*(2), 183–220.

Graham, J. P., Hirai, M., and Kim, S.-S. (2016). An analysis of water collection labor among women and children in 24 sub-Saharan African countries. *PLOS ONE, 11*(6), e0155981.

Kahneman, D., Krueger, A. B., Schkade, D., Schwarz, N., and Stone, A. A. (2004). A survey method for characterizing daily life experience : The day reconstruction

method. *Science, 306*(October). Retrieve from
http://doi.org/10.1126/science.11035721

Kahneman D, Krueger AB. Developments in the measurement of subjective well-being.
(2010). *Journal of Economic Perspectives*. 20(1):3–24.

Kahneman, D., and Deaton, A. (2010). High income improves evaluation of life but not
emotional well-being. *Proceedings of the National Academy of Science*, *107*(38),
16489–93. Retrieved from http://www.pnas.org/cgi/doi/10.1073/pnas.1011492107

Kenyan Bureau of Statistics. (2014). *Kenya Demographic and Health Survey 2014*.
Retrieved from https://dhsprogram.com/pubs/pdf/fr308/fr308.pdf

Kenyan Bureau of Statistics. (2015). County statistical abstract: Meru County. Retrieved
from https://www.knbs.or.ke/publications

Larson, R., and Csikszentmihalyi, M. (1983). The Experience Sampling Method. H. T.
Reis (Ed.). New directions for methodology of social and behavioral science, *15*.
San Francisco, CA: Jossey-Bass.

Masuda, Y. J., Fortmann, L, Gugerty, M. K., Smith-Nilson, M., and Cook, J. (2014).
Pictorial approaches for measuring time use in rural Ethiopia. *Social Indiccators
Research*, *115*(1), 467–82.

Sorenson, S. B., Morssink, C., and Campos, P. A. (2011). Safe access to safe water in
low income countries: Water fetching in current times. *Social Science &
Medicine*, *72*(9), 1522–1526. Retrieved from
http://www.sciencedirect.com/science/article/pii/S0277953611001572

Theodossiou, I. (1998). The effects of low-pay and unemployment on psychological well-
being: A logistic regression approach. *Journal of Health Economics, 17*(1), 85–
104.

United Nations Statistics Division. (2016). International Classification of Activities for
Time-Use Statistics, Trial 2016. Retrieved from
https://unstats.un.org/UNSD/cr/registry/regcst.asp?Cl=231&Lg=1

Winkelmann, L. and Winkelmann, R. (1998). Why are the unemployed so unhappy?
Evidence from Panel Data. *Economica*, *65*(257), 1–15. Retrieved from
http://doi.wiley.com/10.1111/1468-0335.00111
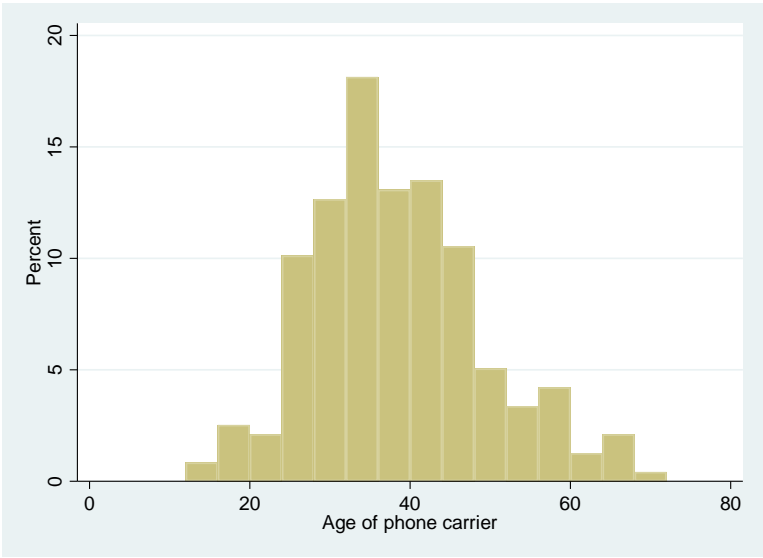
Appendix

Figure A1. Age Distribution of Phone Carriers

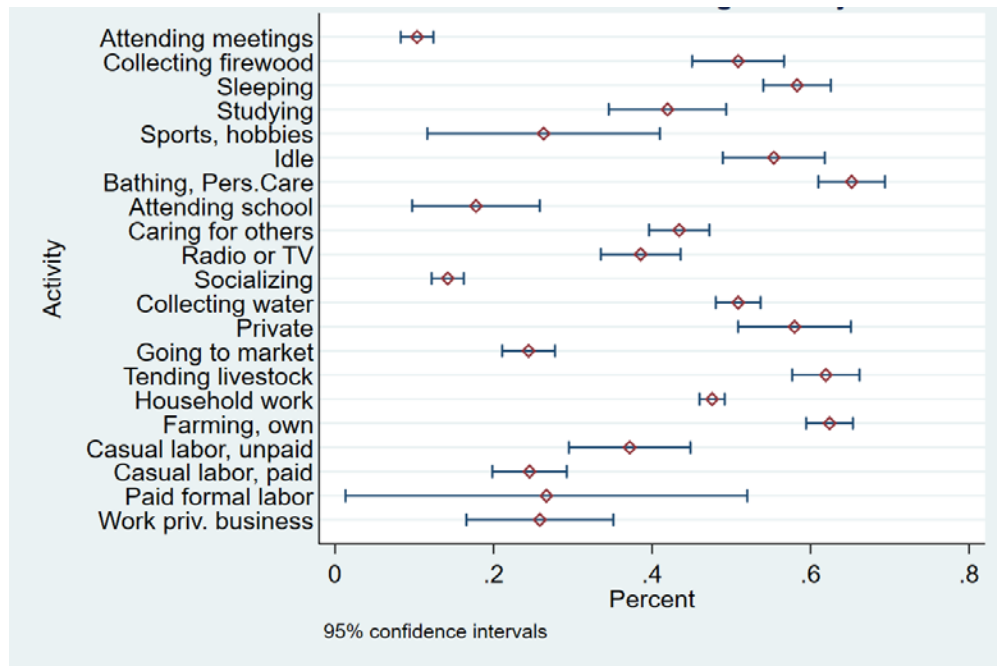## Figure A2. Raw Data on Affect Responses (95% Confidence Intervals)

Figure A3. Fraction Doing Activity Alone (95% Confidence Intervals)

95% confidence intervals

Table A1. Panel (Person Fixed-Effect) Regressions on Happy-Sad (0-100) with and without Controls for Time of Day and whether the Respondent was Alone

	(1)	(2)	(3)	(4)
Attending meetings	1.14	1.17	1.39	1.45
	(1.19)	(1.24)	(1.44)	(1.51)
Collecting firewood	-3.04**	-3.07**	-2.70*	-2.74*
	(-2.19)	(-2.22)	(-1.90)	(-1.93)
Sleeping	-2.59**	-2.61**	-2.65**	-2.67**
	(-2.45)	(-2.46)	(-2.50)	(-2.51)
Studying	2.01	1.94	1.91	1.85
	(1.45)	(1.38)	(1.37)	(1.30)
Sports, hobbies	0.32	0.29	0.56	0.55
	(0.07)	(0.06)	(0.12)	(0.11)
Idle	-2.98**	-3.02**	-2.82**	-2.86**
	(-2.06)	(-2.10)	(-1.97)	(-2.02)
Bathing, Pers. Care	1.09	1.04	1.28	1.23
	(1.34)	(1.30)	(1.58)	(1.53)
Attending School	1.80	1.76	2.03	2.01
	(0.96)	(0.94)	(1.08)	(1.07)
Caring for others	-0.23	-0.28	-0.13	-0.18
	(-0.32)	(-0.38)	(-0.18)	(-0.24)
Radio or TV	-0.059	-0.095	-0.17	-0.20
	(-0.06)	(-0.10)	(-0.17)	(-0.21)
Socializing	0.013	-0.085	0.22	0.15
	(0.02)	(-0.12)	(0.33)	(0.21)
Collecting water	-6.39***	-6.40***	-6.16***	-6.17***
	(-7.53)	(-7.54)	(-6.99)	(-6.99)
Private	1.41	1.61	1.62	1.81
	(0.90)	(1.04)	(1.03)	(1.17)
Going to market	2.70***	2.69***	3.00***	3.00***
	(3.30)	(3.29)	(3.61)	(3.60)
Tending livestock	-0.069	0.068	0.18	0.31
	(-0.08)	(0.08)	(0.20)	(0.35)
Farming, own	-2.66***	-2.62***	-2.34***	-2.30***
	(-3.37)	(-3.31)	(-2.87)	(-2.82)
Casual labor, unpaid	-4.62**	-4.66**	-4.24**	-4.27**
	(-2.48)	(-2.49)	(-2.25)	(-2.26)
Casual labor, paid	-5.89***	-6.01***	-5.56***	-5.67***
	(-3.90)	(-4.00)	(-3.62)	(-3.71)
Paid formal labor	-9.96*	-9.97*	-9.71*	-9.71*
	(-1.95)	(-1.96)	(-1.90)	(-1.90)
Work in own business	3.18*	2.79	3.38*	3.01
	(1.71)	(1.51)	(1.81)	(1.62)
=1 if alone		-0.083		-0.021
		(-0.17)		(-0.04)
Afternoon (noon-5pm)			-0.56	-0.53
			(-1.21)	(-1.14)
Evening (after 5pm)			0.54	0.56
			(0.98)	(1.00)
Constant	80.3***	80.4***	80.2***	80.2***
	(299.09)	(226.11)	(195.78)	(155.65)
Observations	12776	12732	12776	12732

Notes: t-statistics in parentheses, * significant at 90%, **95%, ***99%

Table A2. Fixed-Effect Panel Regressions of Happiness, Sociability, Energy, and Safety

	(1) Happy	(2) Sociable	(3) Energetic	(4) Safe
Attending meetings	1.45	-0.13	3.05**	-1.36
	(1.51)	(-0.11)	(2.38)	(-1.21)
Collecting firewood	-2.74*	-6.09***	-8.32***	-4.06**
	(-1.93)	(-3.71)	(-6.24)	(-2.56)
Sleeping	-2.67**	-5.06***	2.32	-3.08**
	(-2.51)	(-3.14)	(1.53)	(-2.55)
Studying	1.85	-3.21	6.51***	-1.15
	(1.30)	(-1.33)	(3.02)	(-0.66)
Sports, hobbies	0.55	1.08	-3.11	-7.78***
	(0.11)	(0.18)	(-0.49)	(-2.65)
Idle	-2.86**	-4.65**	2.46	-1.99
	(-2.02)	(-2.14)	(1.39)	(-1.24)
Bathing, Pers. Care	1.23	-1.07	1.16	-1.13
	(1.53)	(-0.76)	(0.78)	(-1.04)
Attending School	2.01	-0.36	-1.47	-4.45
	(1.07)	(-0.09)	(-0.59)	(-1.11)
Caring for others	-0.18	0.40	0.11	0.15
	(-0.24)	(0.35)	(0.09)	(0.16)
Radio or TV	-0.20	-0.17	4.27***	-0.56
	(-0.21)	(-0.11)	(2.66)	(-0.40)
Socializing	0.15	1.73	3.07***	-0.60
	(0.21)	(1.61)	(2.96)	(-0.83)
Collecting water	-6.17***	-3.04***	-10.3***	-3.18***
	(-6.99)	(-2.89)	(-7.69)	(-2.93)
Private	1.81	-8.75***	2.74	-3.56*
	(1.17)	(-2.96)	(1.45)	(-1.89)
Going to market	3.00***	0.57	-0.55	-0.57
	(3.60)	(0.38)	(-0.43)	(-0.62)
Tending livestock	0.31	-1.67	-2.41**	-1.15
	(0.35)	(-1.25)	(-2.14)	(-1.13)
Farming, own	-2.30***	-3.37***	-11.9***	-1.94**
	(-2.82)	(-2.79)	(-8.27)	(-2.28)
Casual labor, unpaid	-4.27**	-4.79**	-5.70**	-3.92*
	(-2.26)	(-2.27)	(-2.59)	(-1.84)
Casual labor, paid	-5.67***	-1.98	-12.2***	-2.62*
	(-3.71)	(-1.31)	(-5.71)	(-1.69)
Paid formal labor	-9.71*	-3.15	-9.12*	-2.45
	(-1.90)	(-0.52)	(-1.88)	(-0.64)
Work in own business	3.01	2.36	0.44	-3.15
	(1.62)	(0.62)	(0.15)	(-1.29)
=1 if alone	-0.021	-10.4***	-1.99***	-0.88
	(-0.04)	(-8.58)	(-2.89)	(-1.61)
Afternoon (noon-5pm)	-0.53	0.94*	-7.57***	-0.29
	(-1.14)	(1.77)	(-9.36)	(-0.64)
Evening (after 5pm)	0.56	1.73**	-11.1***	0.085
	(1.00)	(2.48)	(-10.38)	(0.15)
Constant	80.2***	68.8***	45.9***	74.5***
	(155.65)	(89.69)	(54.79)	(138.97)
Observations	12732	12685	12701	12744

Notes: t-statistics in parentheses, * significant at 90%, **95%, ***99%

Table A3. Time Use Categories and Descriptions

Label (English)	Label (Kimeru)	Description (English)	Description (Kimeru)
Meetings	micemanio	Time spent attending community meetings, going to church, or attending funerals	Igiita riria utumaira gwita micemanione ya ntura, gwita kanicene kana gwita mathikone
Collecting firewood	Kuuna nku	Time spent collecting firewood; this includes the time spent walking from the house to the area where you collect and back.	Igiita riria utumaira kuuna nku, ugitaranagia, kagita karia utumaira kuuma njaa gweta naaria uunaa nku na gucoka njaa
Sleeping	Kumama	Time spent sleeping	Kagiita karia utumaira kumama
Other work outside the home	Ngugi ingi ome ya njaa	Time spent on other kinds of work or business outside the home, besides farming or caring for livestock.	Igiita riria utumaira kurita ngugi ingi kana biachara ome ya njaa iti kurima kana kumenyera nyomoo cia njaa
Reading and studying	kuthoma	Time spent reading books, newspapers, magazines or, for children, doing homework	Igiita riria utumaira kuthoma, mauku, gazeti, kana aana kubwithia ngugi iria baei cia cukuru
Games and hobbies	Michetho an matu yaria wendete	Time spent on games and fun activities or hobbies	igiita riria utumaira guchetha michetho na mantu yaria wendete/ yaria yakugwiragia.
Not much of anything	guti uu kuthithagia	Time spent doing not much of anything	Igiita riria utumaira utiu ukuthithia
Bathing	Kuthamba	Time spent bathing and washing your own body. If you wash a source away from the household, include the time spent walking there and back.	Igiita riria utumaria kuthamba, akethirwa uthambaira kuraja na njaa, utaranie kagita karia utumaira gwita na gucoka
School	Cukuru	For children, time spent at school	Kagiita karia aana batumaira cukuru
Caring for children and others	Kumenyera aana na bangi	Time spent caring for children, including breastfeeding, bathing children, dressing children, and helping them with their homework; and time spent caring for elders, the sick and the physically challenged who need your support	Igiita riria utumaira kumenyera twana, ugitaranagia gwonkia kubathambia, kubekira nguo, na kubatetheria kurita gungi cia cukuru, na igiita riria utumagira kumenyera antu bakuuru, aajie, baria bataukiri ni icunci bia mwiri, akiri, na ibakwenda, utenthio bwaku

Radio or TV	Kameme na TV	Time spent watching television or listening to the radio	Kagiita karia utumagira kwona TV kana kuthiukira kameme
Socializing	Kurianira na antu bangi	Time spent socializing and talking with friends and relatives, and time spent eating meals, including breakfast, lunch, and dinner. Do not include time spent preparing food.	Igiita riria utumaira, kurianiria na kwaranina na acore na antu benu, na kagita karia utumaria kuria biakuria, witaranagia biakuria bia rukiiri thaa mugwanja na biogoro, utigutarania kagita karia utumirite kuthuranira biakuria biu
Collecting water	Gutaa ruuji	Time spent collecting water, including the time spent walking from the house to the water source, the time spent waiting to fill the container, and the time spent walking home	Igiita riria utumagira gutaa ruuji, ugitaranagia kagita karia utumagira kuuma njaa gwita naaria utaaga ruuji, na kagita karia wetagira kujuria kiria ugutaa nakio na kagita karia utumagira gucoka njaa.
Private	Mantu ya witho	This category is for time you spend doing something else that is private for you and you do not want to tell us about. That is OK.	Kagiita karia utumaira kubuithia mantu ya witho kana mantu jaria utikwenda kwariria
Market	Thoko	Time spent traveling to the market and back, as well as time spent at the market	Igiita riria utumaira gwita thoko na gucoka, amwa na igiita riria utumaira thokone.
Livestock	Nyomoo cia njaa	Time spent taking animals to graze or drink	Igiita riria utumaira kurithia nyomoo cia njaa kana kunyuithia ruuji
Farming	Urimi	Time spent for farming work including plowing, sowing, weeding, harvesting, or hoeing. This include working on your own farm, or working on someone else's farm, either paid or unpaid.	Igiita riria utumaira urimine, ugitaranagia, gucimba, kuanda, kurimira, kana guketha. Ugitaranagia kurita ngugi muundene jwaku, kurita ngugi muundene jwa munti ungi ukiriawa kana utikuriwa
Household chores	Gwita ngugi cia njaa	Time spent on household chores, like preparing meals or tea, pounding grain or shelling beans, sweeping, washing dishes and utensils, washing clothes and tidying.	Igiita riria utumaira kurita ngugi cia njaa, ta kuthuranira biakuria na kuruga, gutira into ja mpempe, kana kuura mungau, kwegera, kuthambia into, kuura nguo na kutheria

Appendix on Sampling

We targeted a total sample of 250 households in the four sub-locations. We began by targeting households that had participated in the 2013 survey (chosen by a random transect approach in 2013) and met the following criteria:

The main source of water for the household was not a source in the compound (i.e., private well) nor primarily vended water.

Households should have school-aged children (6-18 years) who do not attend a boarding school (i.e., they go home every day after school) and must be within the area of study.

Of the 387 households interviewed in 2013, 180 household met these criteria. All of these households were visited. If a household was not at home during the first visit, the enumerators asked around about the household and tried a second time to contact the household. In total, 85 were recruited in the study from the 2013 sample frame, or 47% of the total 180.

This prompted recruitment of new households to reach the target sample size. The replacement was to be done within the same four sub-locations with the same recruitment criteria above. We constructed a census by asking the area sub-chiefs and village elders to list all of the households within their sub-locations that met the criteria and were not among the households interviewed in 2013. This census included 218 households in the Nairiri location, 78 in the Machako location, 194 in Mutionjuri, and 20 in Kianjai.

A systematic sampling was applied to the listed households where every second household in the list was recruited. Households would sometimes fall within the same compound (i.e., a shared common gate). In these cases, we randomly chose one of the households to be interviewed through choosing straws.

In total, we contacted 264 households who had not been interviewed in 2013. Of these, 187 households (71%) were recruited, roughly in proportion to the census lists drawn up by the local leaders (see Table 1). Of the 77 households who were contacted, but not recruited:

Eleven respondents (4% of the total 264) were dropped because the main water collector was physically challenged (i.e., hearing or sight problems) in a way that would have made it impossible to complete the time use surveys; had insurmountable difficulties using a smart phone; had substance abuse problems; or did not, in fact, have school-aged children at home.

48 households (18%) refused to be interviewed, because the head of the household would not allow the spouse or main water collector to participate, the parents of the main water

collector refused to allow the child to be involved in the study, or because of other reasons. A substantial fraction of refusals was due to rumors that the researchers were members of the Illuminati or were devil-worshipers.

15 households (6%) could not be contacted, though after only one attempt.

Sample frame

Sublocation	No. of households listed	No. of households recruited
Nairiri	218	95 (44%)
Machako	78	25 (32%)
Mutionjuri	194	46 (24%)
Kianjai	20	7 (35%)
Total	510	173