

A Timely Matter

Advancing Methods to Study Time Use in Low-Income Context
A Time Use Accelerometer Study in Malawi

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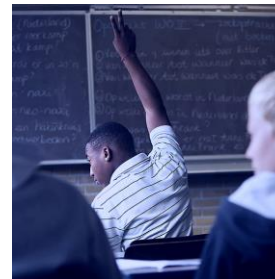
Centerdata

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Provide insights for science, society, and policy



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LSMS

World Bank's flagship household survey program focused on strengthening household survey systems and improving quality of microdata to better inform development policies



Time Use and Activity Recognition



Farming



Social activities



Fetching water



Hunting



Cooking

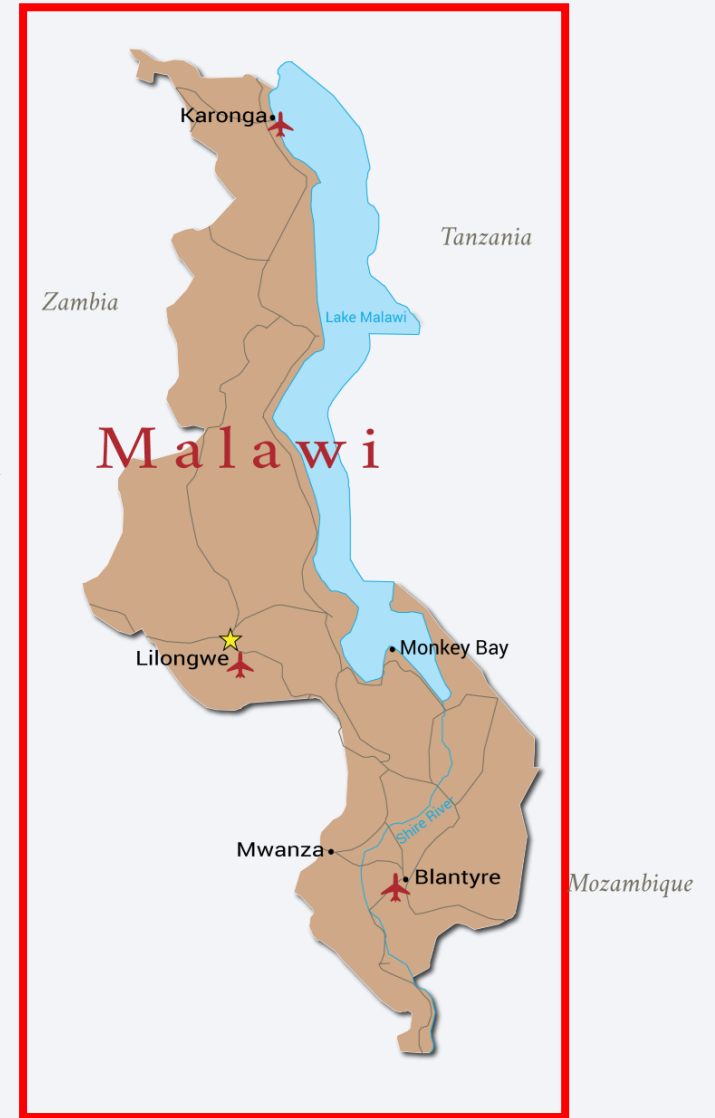


Working for wage





Time use in Malawi



Motivation

- Time use data
 - Important for understanding economic decision-making among men and women
 - Highlighting inequities within and across households
- Effective policy targeting and evaluation
 - Accurate understanding of differences in time use by gender and sub-populations
 - Examples: Childcare subsidies, transport and infrastructure projects
- Most surveys in low-income countries
 - Rely on recall- and interview-based diaries to measure time use
- Relying on recall
 - May affect time use data accuracy
 - Particularly in sub-populations with lower literacy and numeracy



Survey experiment in Malawi – Design

(Kilic et al., 2024)

- 720 HHs, 1,440 adults, evenly split by 72 regions and urban/rural
- HHs with at least one man and one woman (aged 15-64)
- Randomly assigned households to each of the two treatment arms:
 - T1: 24-hour recall time use diary
 - T2: Smartphone pic time use app
- All respondents also received
 - a 7-day recall module
 - a physical activity tracker



24-hour recall time use diary

Adapted from IFPRI WEAI Time Use Module

MODULE: TIME ALLOCATION

PLEASE RECORD A LOG OF THE ACTIVITIES FOR THE INDIVIDUAL IN THE LAST COMPLETE 24 HOURS (STARTING YESTERDAY MORNING AT 4 AM, FINISHING 3:59 AM OF THE CURRENT DAY). THE TIME INTERVALS ARE MARKED IN 15 MIN INTERVALS. MARK ONE PRIMARY ACTIVITY FOR EACH TIME PERIOD BY ENTERING THE CORRESPONDING ACTIVITY CODE IN THE BOX. A SECONDARY ACTIVITY (OPTIONAL) CAN BE ENTERED IN CASE OF SIMULTANEOUS ACTIVITIES.

THIS FORM MUST BE ADMINISTERED TO THE **RESPONDENT HIMSELF/HERSELF**.

Now I'd like to ask you about how you spent your time during the past 24 hours. We'll begin from yesterday morning, and continue through to this morning. This will be a detailed accounting. I'm interested in everything you did (i.e. resting, eating, personal care, work inside and outside the home, caring for children, cooking, shopping, socializing, etc.), even if it didn't take you much time. I'm also interested in how much time you spent caring for children, as well as other activities you were involved in while you did some other activity (e.g., collecting water while carrying a child or cooking while watching after a sleeping child).

	Night		Morning	Day																					
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00													
1a. Primary Activity (WRITE ACTIVITY CODE)																									
2a. Secondary Activity (WRITE ACTIVITY CODE)																									
	Day		Evening	Night																					
	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00													
3a. Primary Activity (WRITE ACTIVITY CODE)																									
4a. Secondary Activity (WRITE ACTIVITY CODE)																									

5. All things considered, how satisfied are you with your life as a whole these days? Using this card on which 1 means you are “completely dissatisfied” and 10 means you are “completely satisfied” where would you put your satisfaction with your life as a whole?

1	2	3	4	5
Completely dissatisfied				Completely satisfied

(Code one number from scale)

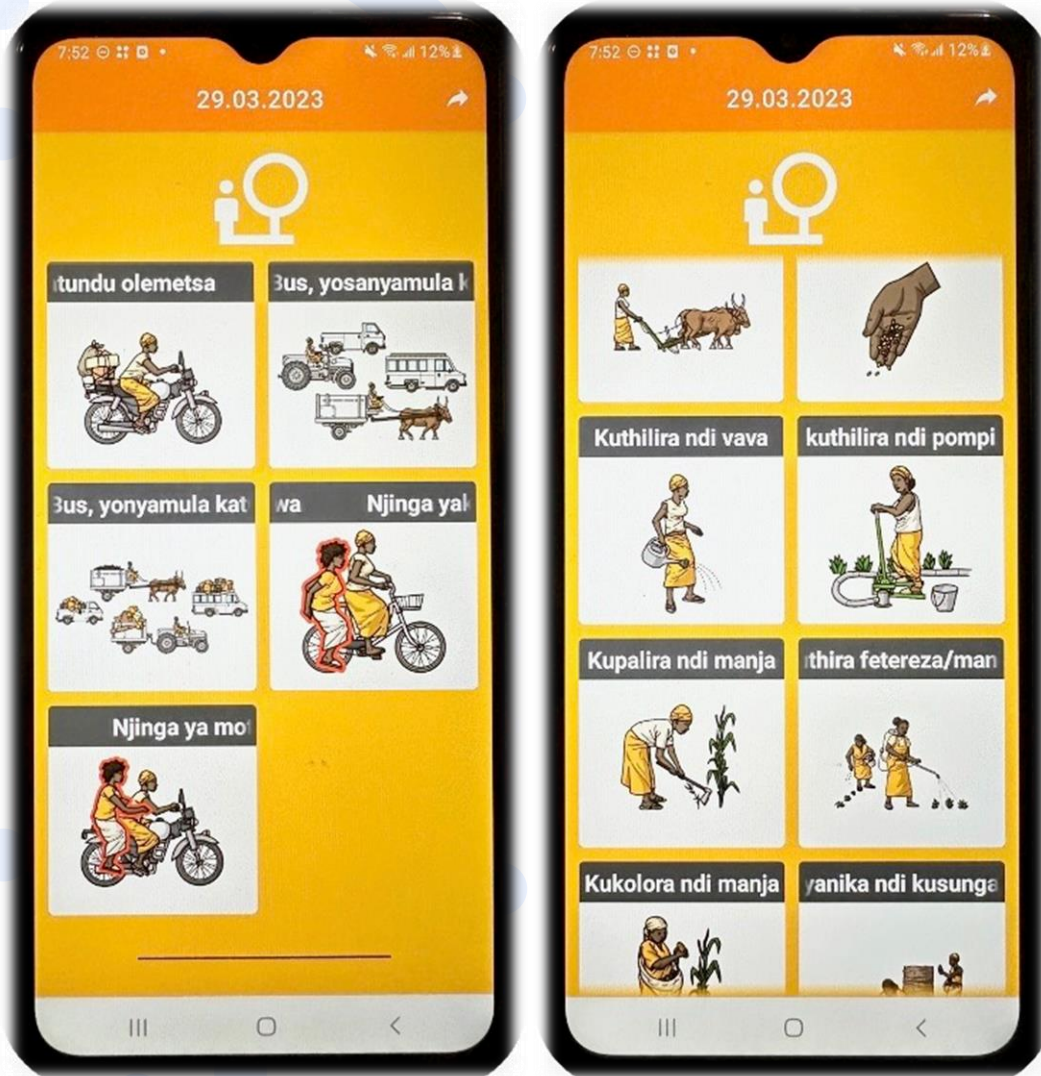
6. How have you felt about the activities you were engaged in the last day?

HAPPY.....1
 NEITHER HAPPY NOR UNHAPPY...2
 UNHAPPY.....3

Activity list

ACTIVITY CODES			
<p>A.....Sleeping</p> <p>B.....Eating/drinking</p> <p>C1.....Personal: bathing, dressing</p> <p>D1.....Sick/not active, at home</p> <p>D2.....Sick/not active, in healthcare center</p> <p>Schooling</p> <p>E1..... Studying outside of school</p> <p>E2.....At school</p>	<p>Agriculture</p> <p>F1.....Fishing or tending to livestock</p> <p>F2.....<u>Crops</u>: land clearing and preparation, manual</p> <p>F3.....<u>Crops</u>: clearing land, with animal</p> <p>F4..... <u>Crops</u>: planting, manual</p> <p>F5.....<u>Crops</u>: manual watering</p> <p>F6.....<u>Crops</u>: pumping water, using pump</p> <p>F7.....<u>Crops</u>: weeding, manual</p> <p>F8.....<u>Crops</u>: fertilizer/pesticide application, manual</p> <p>F9.....<u>Crops</u>: harvesting, manual</p> <p>F10.....<u>Crops</u>: drying and storage</p> <p>F11.....<u>Crops</u>: processing, manual</p> <p>F12.....<u>Crops</u>: processing, mechanical</p> <p>Other market activity for income</p> <p>G1.....Service or office-related occupations</p> <p>G2.....Manual or <u>ganyu</u> labor, or manufacturing</p> <p>G3.....Selling goods in the market</p> <p>G4.....Gathering foodstuffs, hunting</p>	<p>Unpaid work for one's own household</p> <p>H1.....Shopping</p> <p>H2.....Cooking, cleaning in house</p> <p>H3.....Collecting fuel/firewood</p> <p>H4.....Collecting water</p> <p>H5.....Stitching/knitting; weaving mats, baskets</p> <p>H6.....Building and repairs</p> <p>H7.....Maintenance of vehicles, electronics</p> <p>H8.....Household finances</p> <p>H9.....Care of elderly and sick adults</p> <p>H10.....Care of children</p> <p>H11.....Visit bank or office for services</p> <p>H12.....Discussion with survey team</p> <p>Transport</p> <p>I1.....Walking, not hauling heavy load</p> <p>I2.....Walking, hauling heavy load</p> <p>I3.....Running</p> <p>I4.....Bicycle, not hauling heavy load</p> <p>I5.....Bicycle, hauling heavy load</p> <p>I6.....Motorbike, not hauling heavy load</p> <p>I7.....Motorbike, hauling heavy load</p> <p>I8.....Truck/tractor/ox cart/bus, not hauling heavy load</p> <p>I9.....Truck/tractor/ox cart/bus, hauling heavy load</p> <p>I10.....Bicycle, as a passenger</p> <p>I11.....Motorcycle, as a passenger</p>	<p>Leisure</p> <p>J1.....Reading for leisure</p> <p>J2.....Using devices (mobile phone, computer, TV)</p> <p>J3.....Resting/doing nothing</p> <p>J4.....Chatting with others inside/outside household</p> <p>J5.....Celebrations</p> <p>J6.....Religious activities</p> <p>J7.....Exercise/playing games</p> <p>K1.....Public works projects</p> <p>K2.....Local community meetings</p> <p>L.....Other (specify)</p>

Smartphone time use diary: *TimeTracker App*



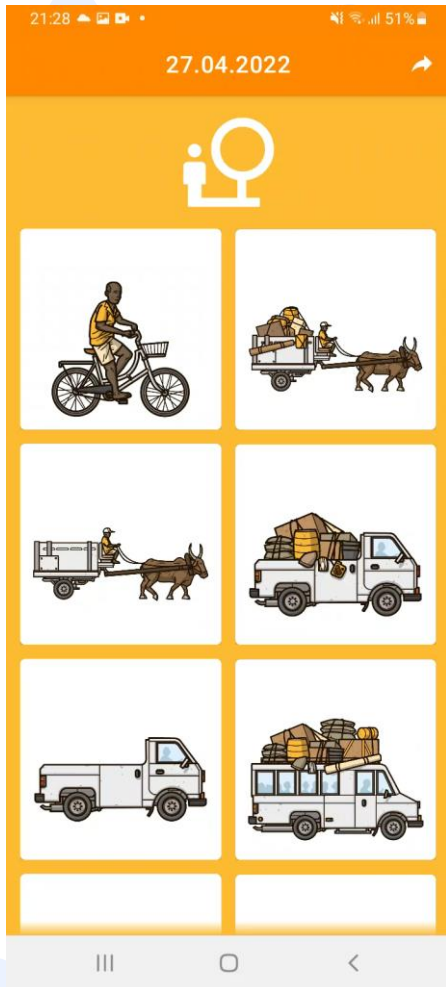
- Android pictorial app

Devs: university of Hohenheim and the Institute for Applied Science at the University of Media, Stuttgart (Daum et al., 2018) and enhanced for this study with LSMS support

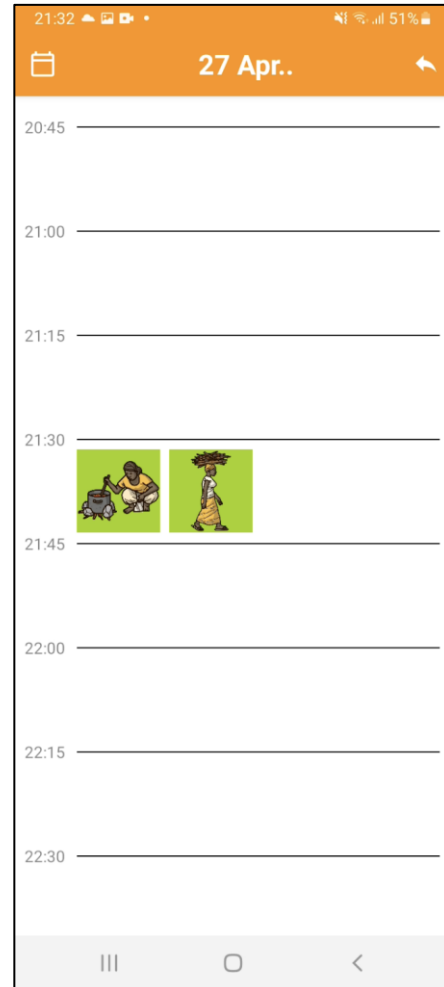
- Real-time recording of time use
- Allowing for simultaneous activities
 - 84 percent at least two activities conducted simultaneously
- Only app installed on smartphone
- One-to-one match activities recall treatment arm
- Separate sets of images for men and women

Smartphone time use diary: *TimeTracker* App

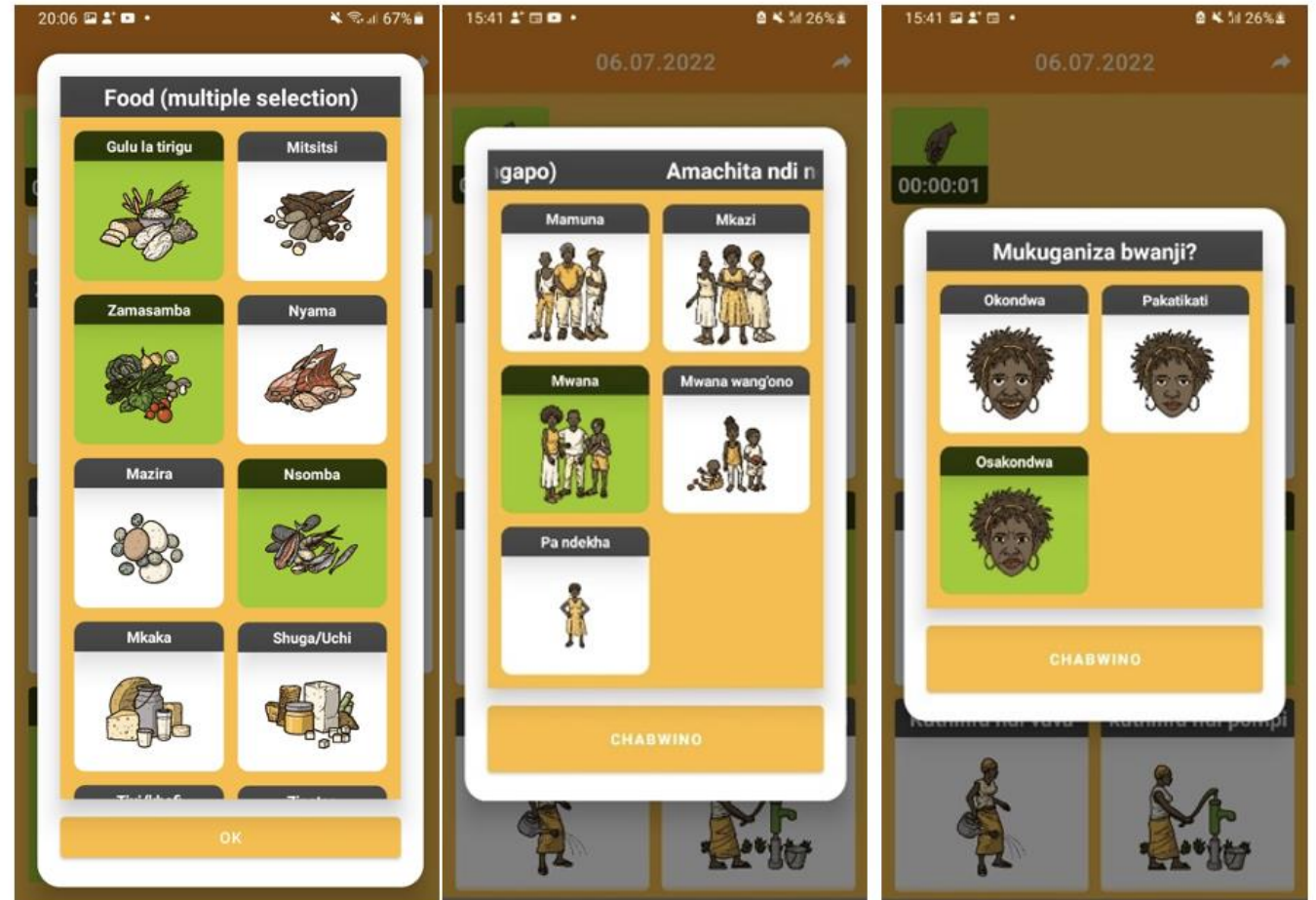
Main screen



Calendar view



Pop-ups



Both recall and app treatment arms

ActiGraph wGT3X-BT, 60Hz



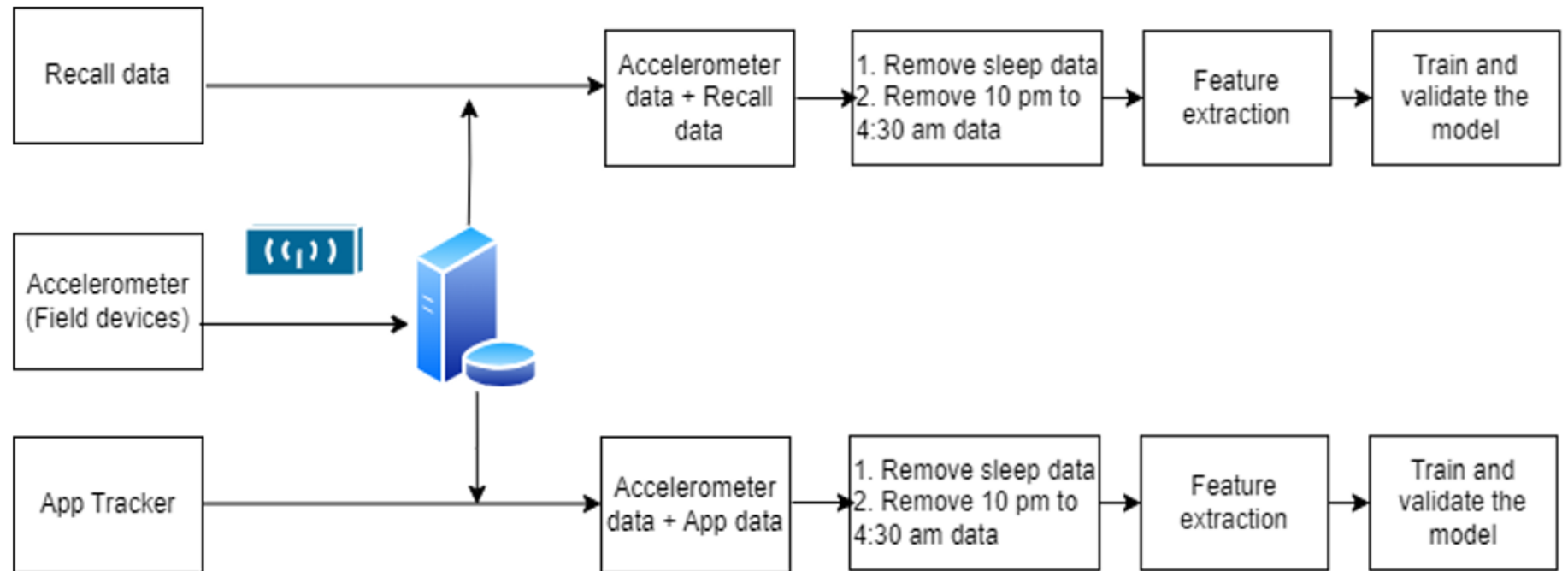
7-day recall stylized questions

		Did you conduct this activity over the last 7 days?	ENUMERATOR - AFTER ASKING Q2 FOR ALL ACTIVITIES, ASK THE FOLLOWING FOR THOSE WHERE Q2=1: During the last 7 days, that is from [DAY] up to yesterday, how many hours did you work on these activities?
CODE	ACTIVITY	YES 1 NO 2 >> NEXT CODE	
101	Livestock or fishing activities		
102	Crop-related agriculture on a household farm		
103	Run or do any kind of non-agricultural or non-fishing household business, big or small		
104	Help in any of the household's non-agricultural or non-fishing household businesses		
105	Casual or ganyu labor		
106	Work for a wage, salary, commission, or any payment in kind, excluding ganyu		
107	Engage in an unpaid apprenticeship for anyone that is not a member of the household		
301	Cleaning the house, washing clothes, cooking or shopping for the household		
302	Paying household bills, or visiting the bank for financial services		
303	Repairs or maintenance work him/her-self (e.g. fixing broken appliances or fixtures, painting walls, repairing vehicles), or any time doing construction work him/her-self to renovate, extend or build the household's dwelling		
304	Fetching water from natural or public sources for use by the household		
305	Collecting firewood or other natural products for use as fuel by the household		
306	Providing care, help or assistance to household members aged 18 years or older because of a disability, illness, or problems related to old age ENUMERATOR: READ: For example: Administering medication, feeding, helping them with bathing and personal hygiene, etc.		
307	Looking after children aged 17 years or younger living in this household ENUMERATOR: READ: For example: Bathing playing with children, taking children to school, sports or other activities, instructing, tutoring or helping children with homework, advising or talking with teens about their problems, etc		
401	Participating in local public works projects (involved in construction of local public infrastructure, for example), or participating in local community or government meetings		
402	Studying or in school/classes for his/her own education		
403	Reading, watching TV or mobile devices for one's own entertainment, socializing, participating in religious occasions, exercise/playing sports		



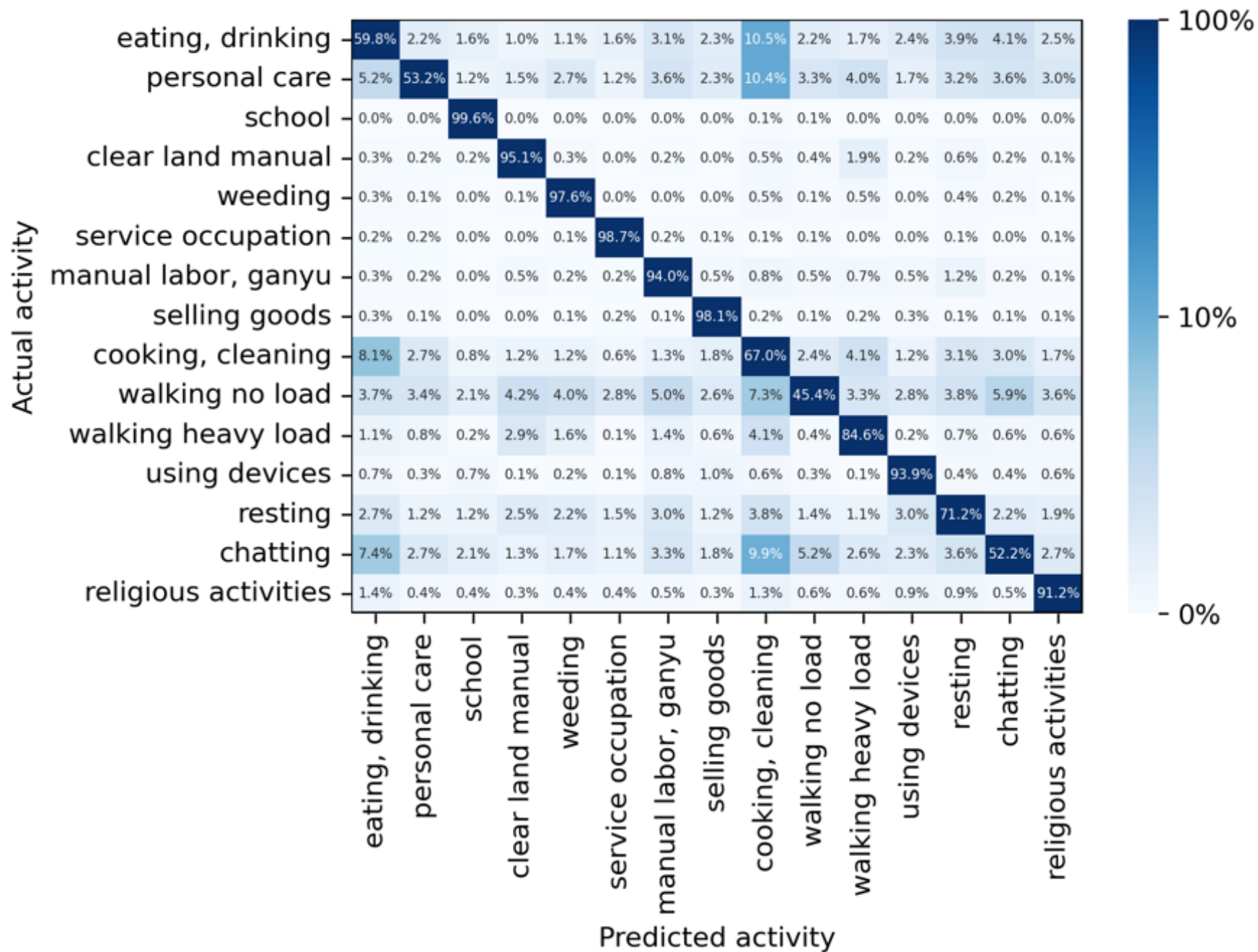
Machine Learning

Trained machine learning models (T1 & T2) to predict time use activities from the accelerometer data



Confusion matrix

(Based on Recall)



Predicting Combination of activities (Top-20)

24h Recall arm time use data

Activity without Chatting (Recall)	f1-score	support
cooking or cleaning + care of children	0,73	8006
walking + care of children	0,71	5184
resting + using devices	0,90	2869
cooking or cleaning + using devices	0,87	2716
service occupation + using devices	0,96	2091
eating and drinking + care of children	0,63	1876
selling goods in market + using devices	0,97	1770
eating and drinking + using devices	0,78	1716
resting + care of children	0,81	1473
clearing land manually + care of children	0,83	992
shopping + care of children	0,58	942
selling goods in market + walking	0,97	906
collecting stuff + care of children	0,69	869
cooking or cleaning + selling goods	0,95	780
religious activities + care of children	0,81	727
walking + using devices	0,84	716
weeding + care of children	0,80	666
manual labor or ganyu + using devices	0,93	660
manual labor or ganyu + motorbike	1,00	582
service occupation + care of children	0,83	522
macro avg	0,83	36063
weighted avg	0,80	36063

Prediction	24h Recall (F1-score)	Smartphone (F1-score)
With chatting	81%	81%
No chatting	83%	77%

Notes 24 hour Recall diary arm

- Chatting is most often (over)reported as secondary activity in Recall arm.
- Second most frequent is using devices for men and taking care of children for women.

Notes Smartphone diary arm

- Less chatting as secondary activity, much more diverse set of secondary activities.
- Some odd combination of activities.

Smartphone arm time use data

Activity without Chatting (App)	f1-score	support
resting + using devices	0,79	14065
care of children + cooking, cleaning	0,81	13834
cooking, cleaning + using devices	0,79	5767
studying + using devices	0,73	4753
cooking, cleaning + walking no load	0,82	3359
cooking, cleaning + selling goods	0,90	3354
care of children + walking no load	0,75	3297
using devices + walking no load	0,78	3285
resting + studying	0,82	3150
care of children + resting	0,70	3008
selling goods + using devices	0,91	2950
cooking, cleaning + resting	0,82	2468
manual labor, ganyu + using devices	0,89	2410
collecting water + cooking, cleaning	0,80	2293
selling goods + walking no load	0,89	2147
walking heavy load + walking no load	0,84	2121
cooking, cleaning + studying	0,79	2120
care of children + studying	0,65	1832
cooking, cleaning + personal care	0,83	1661
resting + walking no load	0,81	1386
macro avg	0,81	79260
weighted avg	0,80	79260

Key takeaways

- New, experimental findings on the relative performance of real-time data collection against recall approaches (24-hour and 7-day recall)
- Participation in smartphone arm greater across several categories of employment, unpaid work → time, on the other hand, higher in 24-hour diary (minimum 15-minute structure)
- Gender gaps in unpaid work remain large in smartphone sample, but narrower somewhat in household resource collection and care
- Smartphone arm captures more time in evening hours, and multitasking, esp. for women
- 7-day recall overreports relative to both 24-hour recall and smartphone – implications for interpreting standard stylized instrument commonly used in labor force modules
- *Paper from Kilic et al. 2024 → Recording the Time Divide: A Comparative Study of Smartphone- and Recall-Based Approaches to Time Use Measurement*

Machine Learning →

Both 24 hour-recall time use diary and smartphone time use diary app can be used to train time use prediction models.



Questions?



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Machine Learning

Model building pipeline

Preprocessing

- Coupling accelerometer data with time-use data
- Enhancing with available background information

Data Cleaning

- Removal of non-wear time
- Excluding 2nd activities
- Time limit (4 am-10 pm)
- Discard correlated vars

Feature Engineering

- **39** features, i.e.,
4 base features (X, Y, Z, Step),
31 derived features,
4 background (age, gender)

Model Building

- Activity selection
- Data balancing
- Normalizing
- Classification algorithms

Model Evaluation

- 75%/25% train/test split
- Accuracy, F_1 -score, AUC
- Division: Young vs Old, Male vs Female

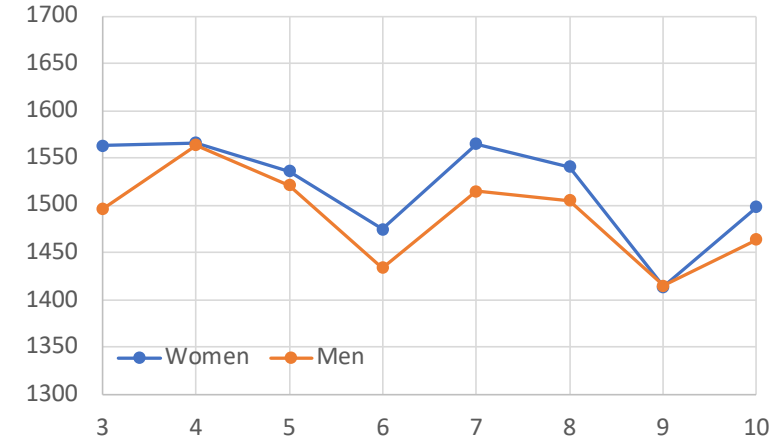
Extra slides for discussion

- From Kilic et al. (2024) presentation, World Bank

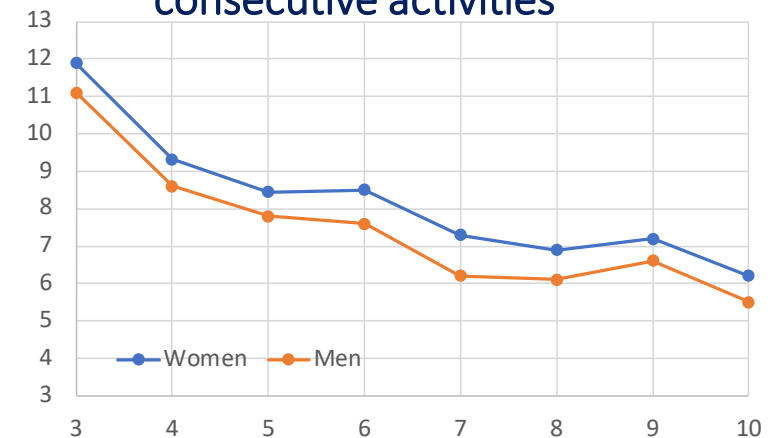
Field experience

- About 160,000 recorded activities across smartphone respondents, between deployment (Day 2) and pick up (Day 11)
- Only 2% or less entries in each activity category and day had reported time 3 SDs above the daily mean → no variation in this measure over the reporting period
- No major drop in reporting over the week; respondents also made fewer errors (fewer discontinuities, entries that needed editing)
- Considerable share of smartphone
- respondents forgetting or not registering sleep as an activity
 - About 7% entries overall needed editing by interviewers, mostly to correct sleep entries

Average total daily time reported (mins)



Number of “jumps” or discontinuities between consecutive activities



Treatment effects, and implications for understanding gender inequalities in time use

Empirical approach

- OLS regressions, pooling Day 5, 8 and 10 samples (individual-day sample)
- **(1) Smartphone vs. Recall** (outcomes y_{ijk} include **daily participation, daily minutes** in different activity categories; X_{ijk} individual and HH characteristics; fixed effects for enumeration area A_k and day of reporting D_{ijk}):
$$y_{ijk} = \alpha + \beta \text{Recall} + \gamma X_{ij} + \delta_1 A_k + \delta_2 D_{ijk} + \varepsilon_{ijk}$$
- **(2) Smartphone vs. 7-day, Recall vs. 7-day:** similar specification, comparing **average daily minutes** across overlapping activity categories

Smartphone vs. recall: Activity categories

Detailed set of 56 activity categories covered across both treatment arms, aggregated for treatment effects analysis

Unpaid work:												
Agri- culture	Nonfarm employ- ment	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly	TOTAL UNPAID WORK	Transport	School/ studying	Leisure	Comm. activities	Personal care	Sleep	Eating/ drinking
(1)	(2)	(3a)	(3b)	(3c)	(3d)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Smartphone vs. recall: Daily participation

Smartphone arm: greater participation in employment, unpaid resource collection, and care work, schooling, comm. activities

Recall: leisure, personal care

Men's unpaid work also underestimated in recall, along with care work (men and women)

	Agri- culture	Nonfarm employ- ment	Unpaid work:			TOTAL UNPAID WORK	Transport	School/ studying	Leisure	Comm. activities	Personal care	Sleep	Eating/ drinking
	(1)	(2)	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly	(3d)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PARTICIPATION (Y=1 N=0)													
All areas													
Total (obs=4,108)	-0.06***	-0.01	-0.08***	-0.03*	-0.04**	-0.02	0.01	-0.03***	0.02***	-0.07***	0.05***	0.04***	0.04***
Women (obs=2,049)	-0.06***	-0.03	0.00	0.03***	-0.04*	0.06***	0.01	-0.03***	0.02***	-0.05***	0.06***	0.02***	0.03***
Men (obs=2,059)	-0.06***	0.00	-0.16***	-0.09***	-0.04**	-0.11***	0.01	-0.02	0.02***	-0.09***	0.05***	0.06***	0.05***
Rural													
Total (obs=2,081)	-0.04	-0.03	-0.13***	-0.08***	-0.07***	-0.06***	0.00	-0.03**	0.01*	-0.09***	0.05***	0.04***	0.04***
Women (obs=1,042)	-0.04	-0.00	-0.06*	0.03*	-0.09**	0.05***	0.01	-0.04***	0.01	-0.06***	0.08***	0.03***	0.03***
Men (obs=1,039)	-0.03	-0.06**	-0.21***	-0.19***	-0.04**	-0.17***	-0.01	-0.02	0.01	-0.11***	0.03	0.05***	0.04***
Urban													
Total (obs=2,027)	-0.08***	-0.00	-0.03	0.04*	-0.02	0.01	0.01	-0.03*	0.03***	-0.05***	0.06***	0.04***	0.05***
Women (obs=1,007)	-0.07***	-0.07**	0.06*	0.03**	-0.01	0.07***	0.01	-0.03	0.03***	-0.04**	0.04**	0.02***	0.04***
Men (obs=1,020)	-0.10***	0.05	-0.12***	0.01	-0.04*	-0.06*	0.01	-0.02	0.03**	-0.06***	0.07***	0.06***	0.06***

Smartphone vs. Recall: Daily minutes

24-hour diary: minimum 15-minute interval structure, leading to higher reporting times (except mainly in transport)

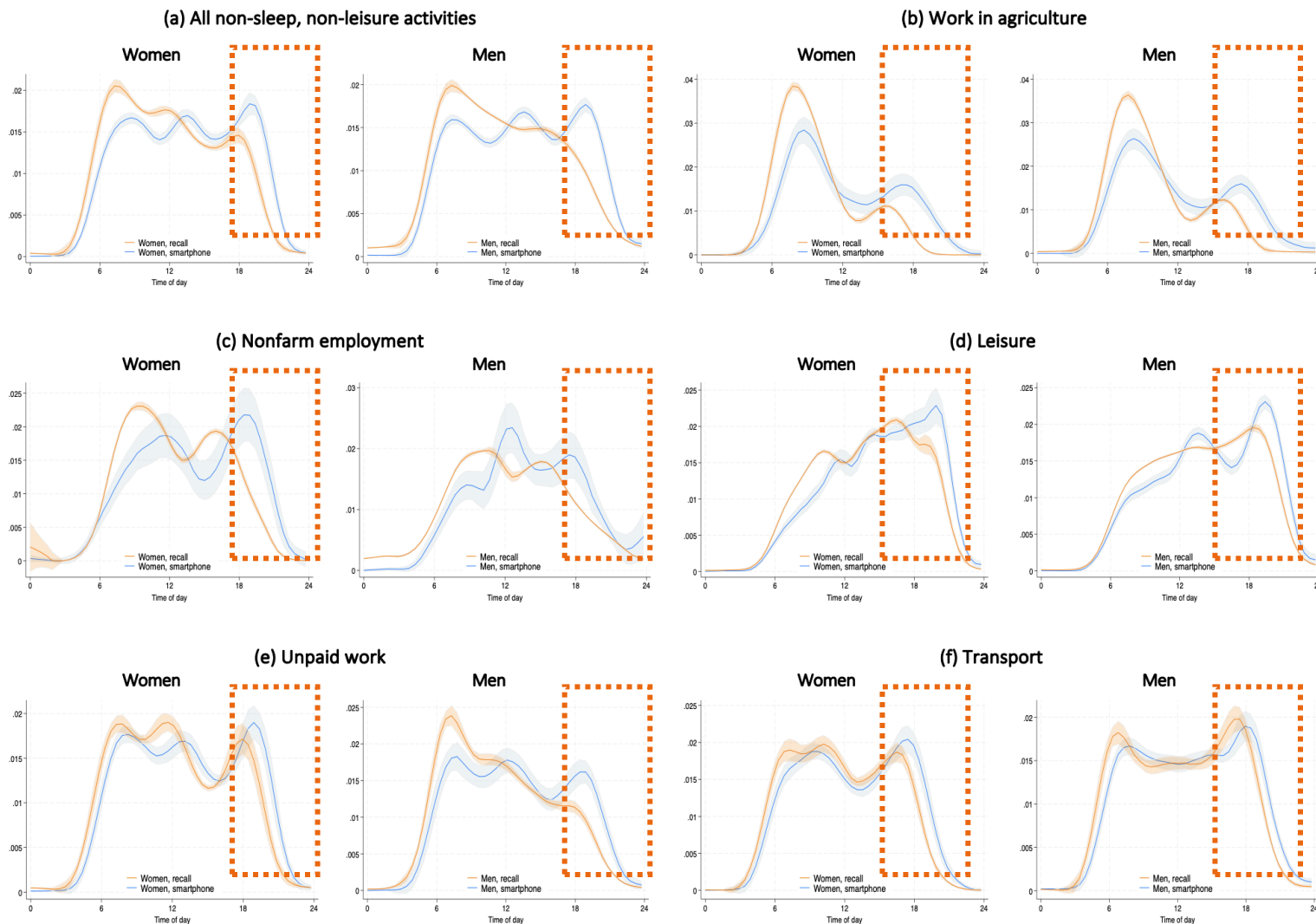
	Agri- culture (1)	Nonfarm employ- ment (2)	Unpaid work:			TOTAL UNPAID WORK (3d)	Transport (4)	School/ studying (5)	Leisure (6)	Comm. activities (7)	Personal care (8)	Sleep (9)	Eating/ drinking (10)
			Obtaining resources for HH (3a)	Cooking, cleaning in house (3b)	Care of children, elderly (3c)								
DAILY TIME, UNCONDITIONAL (MINS)													
All areas													
Total (obs=4,108)	26.2***	28.8***	0.1	-5.3	18.4***	23.8***	-30.8***	6.1**	141.2***	-2.3*	-2.6	11.3**	6.6***
Women (obs=2,049)	18.7***	8.8	6.3**	-0.1	32.1***	53.5***	-11.4**	3.8	108.2***	-0.3	-3.0	10.8*	3.4*
Men (obs=2,059)	34.8***	49.4***	-5.6	-13.1***	4.5*	-9.6	-50.9***	8.9*	170.1***	-3.9*	-2.7	14.0*	10.1***

Smartphone respondents: 1/3 of activities reported last < 15 mins, esp. in non-farm employment, unpaid domestic and care work, and self-care

Implications for understanding gender gaps

- Recall bias differs by women/men and activity
- Gender gaps in unpaid work in the smartphone sample, while remaining large, are narrowed somewhat when compared to the recall arm
- Smartphone arm reveals nuances on time allocation (less missing intraday reporting in time allocation; more data on multitasked activities) that are policy-relevant
- Findings are generally consistent over different reporting days, and treatment effects are robust to controlling for a range of individual, household and community characteristics.

Marked differences in intraday reporting across arms



Respondent fatigue in recall arm is a possibility (earlier sleep times reported, particularly for women)

Potential policy implications:
role of household energy infrastructure on time use

Smartphone arm: electricity access significantly associated with women's time allocation in nonfarm employment, and leisure in the evening/nighttime

Recall arm: no effect

Notes: (1) Local polynomial smooth plots, with 95% confidence intervals. Pooling Days 5, 8, 10 for both treatment arms

Addressing multitasked activities

Average share of respondents conducting distinct employed, unpaid and transport activities together within a day (pairwise)

Women, smartphone

	Agri- culture	Nonfarm employ- ment	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly
	(1)	(2)	(3)	(4)	(5)
Agriculture	(1) 0.03				
Nonfarm employment	(2) 0.01	0.01			
Obtaining resources for HH	(3) 0.01	0.03	0.04		
Cooking, cleaning in house	(4) 0.04	0.05	0.14	0.02	
Care of children, elderly	(5) 0.03	0.03	0.07	0.17	0.01
Transport	(6) 0.05	0.05	0.17	0.11	0.11

Men, smartphone

	Agri- culture	Nonfarm employ- ment	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly
	(1)	(2)	(3)	(4)	(5)
Agriculture	(1) 0.03				
Nonfarm employment	(2) 0.01	0.01			
Obtaining resources for HH	(3) 0.02	0.04	0.02		
Cooking, cleaning in house	(4) 0.02	0.01	0.02	0.00	
Care of children, elderly	(5) 0.00	0.00	0.01	0.01	0.00
Transport	(6) 0.06	0.10	0.13	0.04	0.02

Women, recall

	Agri- culture	Nonfarm employ- ment	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly
	(1)	(2)	(3)	(4)	(5)
Agriculture	(1) 0.00				
Nonfarm employment	(2) 0.00	0.00			
Obtaining resources for HH	(3) 0.00	0.00	0.00		
Cooking, cleaning in house	(4) 0.01	0.02	0.02	0.00	
Care of children, elderly	(5) 0.03	0.04	0.08	0.21	0.00
Transport	(6) 0.00	0.00	0.00	0.00	0.17

Men, recall

	Agri- culture	Nonfarm employ- ment	Obtaining resources for HH	Cooking, cleaning in house	Care of children, elderly
	(1)	(2)	(3)	(4)	(5)
Agriculture	(1) 0.00				
Nonfarm employment	(2) 0.00	0.00			
Obtaining resources for HH	(3) 0.00	0.01	0.00		
Cooking, cleaning in house	(4) 0.00	0.00	0.00	0.00	
Care of children, elderly	(5) 0.00	0.00	0.00	0.00	0.00
Transport	(6) 0.01	0.03	0.02	0.00	0.01

→ Greater incidence and range of multitasked activities in smartphone sample, particularly for women: 74% of women in smartphone arm conducted non-leisure activities together, compared to 37% in recall

Comparison with 7-day recall, and implications

Effect of smartphone and recall arms on average daily minutes spent in:

	Empl (agr.) (1)	Empl. (non-agr.) (2)	Unpaid work: obtaining resources for HH (3)	Unpaid work: cooking and cleaning (4)	Unpaid work: care (5)	Community activities (6)	Schooling/ studying (7)	Leisure (8)
Total								
Smartphone arm (using all days)	-17.6***	-78.2***	-3.7	-23.6***	-50.5***	0.6	-3.8***	248.3***
24-hour recall arm (days 5, 8, 10)	6.1	-49.1***	-3.4	-13.8***	-30.1***	-0.1	-2.0	404.4***
Women								
Smartphone arm (using all days)	-7.3*	-54.4***	-23.1**	-37.7***	-71.5***	-0.6	-2.7*	192.7***
24-hour recall arm (days 5, 8, 10)	11.8**	-40.8***	-19.4***	-16.4**	-32.7***	-0.8	-1.3	331.5***
Men								
Smartphone arm (using all days)	-27.6***	-100.8***	14.7***	-10.8**	-30.1***	1.8	-4.8**	302.4***
24-hour recall arm (days 5, 8, 10)	0.3	-57.8***	12.6***	-11.6***	-27.4***	0.5	-2.3	477.7***

→ 7 day recall overreports both 24-hour recall, and smartphone arm: implications for using even recall periods considered to be short

Key takeaways

- New, experimental findings on the relative performance of real-time data collection against recall approaches (24-hour and 7-day recall)
- Participation in smartphone arm greater across several categories of employment, unpaid work → time, on the other hand, higher in 24-hour diary (minimum 15-minute structure)
- Gender gaps in unpaid work remain large in smartphone sample, but narrower somewhat in household resource collection and care
- Smartphone arm captures more time in evening hours, and multitasking, esp. for women
- 7-day recall overreports relative to both 24-hour recall and smartphone – implications for interpreting standard stylized instrument commonly used in labor force modules

Looking forward

On pipeline research:

- Using **ML and physical activity tracking data to predict time use** - with Centerdata at Tilburg University, building on an upcoming publication based on an earlier (2017) survey also from Malawi
- **Time use agency** and flexibility over time use - with IFPRI and MAGNET

Looking forward

On scaling up smartphone-based time use data collection:

- Existing app and training materials can be deployed in different contexts (app to be made publicly available by June 2024)
- The app illustrations and translations can be updated with ease
- Costs associated with smartphone procurement are marginal: 60 low-cost smartphones were cycled throughout the sample over 9 months

Still, we need to:

- Provide guidance on whether duration of smartphone data collection can be reduced + on whether we can limit smartphone data collection only to a sub-sample and rely on within-survey imputation of time use measures to better manage costs
- Implement the study in different contexts - but with expanded recall alternatives – to assess cross-country validity of our findings

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