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Walking and the Social Life of Solar Charging in Rural Africa

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ABSTRACT

We illustrate links between walking, sociality and using resources in a case-study of community-based, solar, cellphone charging in two villages in Eastern Cape, South Africa. Like 360 million rural Sub-saharan Africans, inhabitants are poor and, like 25% and 92%, of the world respectively, do not have domestic electricity or own motor vehicles. We show that the ways we move through the world affect the meanings we embody; that certain representations obscure continuities in the practices we seek to understand and influence; and, some of the motivations of the billions of people who are marginalized in discussing sustainable HCI. Locally, about 65% of inhabitants over 14 years old own cell-phones and, over a year, we recorded 500 names of people using the Charging Stations that, we deployed within several technology probing endeavours, many on a regular basis. The detail of our longitudinal study contributes considerably to sustainable design for ‘developing’ regions. Walking is a noticeable part of charging, and all other subsistence routines, and shapes inhabitants’ motivations when they use, re-purpose, store and share resources. Inhabitants are motivated by cost and comfort and, importantly, by performing collectivity in their tight-knit community; but, not by being green. Further, different ways of walking relate to social roles and other aspects of sociality and, we propose, shaped inhabitants’ and researchers’ perspectives on charging and using phones. We suggest this is significant for the methods and designs that we use to explore and support sustainable practices in rural Africa and, indeed, more generally.

ACM CATEGORIES AND SUBJECT DESCRIPTORS

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INTRODUCTION

HCI researchers and designers usually inhabit environments full of technologies that use electricity or fuel; in contrast with 25% of people globally without effortless access to electricity or the 92% who do not own motor vehicles. In this article we describe a case study in which people in rural Africa walk to charge cellphones at the solar Charging Stations we deployed. We aim to show, firstly, that the ways we move through the world effect the meanings we embody when we pursue sustainable HCI and, secondly, that our use of certain representations obscures continuities in the practices we seek to understand. And, thirdly, we explore some of the motivations of people who, with few exceptions (Dillahunt et al., 2009, Brynjarsdóttir and Sengers, 2009), are marginalized in discussion of sustainable HCI; such as the 50% of the world who live on less than \$2.5 a day and 70% of the developing world’s poor who live rurally (Worldbank, 2010).

Designers and researchers tend to live fairly affluently, often atomized in small, social units in cities and/or industrialized regions, unlike users of the solar powered, cellphone Charging Stations we deployed in South Africa’s Eastern Cape who, like 360 million rural Sub-saharan Africans, are poor (IFAD, 2011) and survive using practices oriented by communalism. We begin by proposing that walking fundamentally shapes culture and embodies the meanings we create about the world and others in it, but is obscured by the schema we use to gather data and make decisions about practice. Then, we trace our path in designing and deploying the Charging Stations. Along the way we describe practices through which users generated meanings about the Stations and the methods we used to learn about users’ practices. We do apologize that


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we ask you to absorb many details as we trek along together in this ‘exotic’ terrain; but, contend that it is these nuances that reveal how the schemas that we apply, in HCI, limit insights about sustainable practice.

Points are Not Practice

In HCI we are becoming aware of how our narratives about actions, interactions and settings are unavoidably embedded in the things we design and, concurrently, conceal the power we have to authorise certain perspectives (Dunne and Raby, 2001). Consider, for instance, how Gehl’s (1987) representations showed that car-clogged streets interrupted pedestrian movements in Danish cities and led to converting streets into pedestrian zones. We accept narratives about sustainable practice because they are meaningful not because they are provable. National campaigns and policy discourse produce narratives about being “green” (Shove, 2003) and, in turn, the representations we use to explore practice and design technologies (Strengers, 2011). For instance, in-home displays (IHDs) aim to encourage or restrain householders to minimize water and energy use by depicting what can be easily represented and saved but, at the same time, mask and legitimize consumption that users consider non-negotiable and normal (Strengers, 2011). So strategies for sustainability and tactics in consuming and conserving resources clash, conceal and collude. Dourish (2006) cites de Certeau (1984) in considering forms of discipline and resistance by referring to walking in cities, which is mutually “*a spatial acting-out of the place*” and “*a process of appropriation of the topographic system on the part of the pedestrian*” (1984: 97-98). But, practice is not merely located within systems of binary power relations, nor is walking only about domination from above, tactical defiance from below or complicity in between. Rather, we forge paths and produce meanings, individually and collectively, through everyday choices and actions (Lee and Ingold, 2006:76).

Suchman (1987) taught us to distinguish situated actions from the schema that we use to orient, reflect on and justify actions; but it is Tim Ingold’s emphasis on the work of walking in that situating that we apply in this article. Through our practice of habitation, he writes, humans and non-humans participate in the process of the world’s continual “*coming into being*” and the environment becomes part of us, as we are part of it. He illuminates several ideas that are relevant to methods to understand, and design for, environmentally sustainable practices. Firstly, our everyday “*going along*”, in the settings that constitute our lives, actually creates the environment: concretely, intangibly and ideologically. Our world is a “*world-in-formation*” and its inhabitants contribute to its “*weave and texture*” (Ingold and Lee, 2006:2). Secondly, we make our way in a movement that is “*open-ended, having neither a point of origin nor any final destination*”. Thirdly, we accrue meanings as we move, speak and gesture in and physically manipulate the world not just by integrating separate observations into a comprehensive mental representation. Such “*embodied knowing*” (Dourish, 2001, Klemmer et al, 2006) does not assemble data from multiple, discrete loci of observation yet methods in sustainable HCI use point-based representations to survey users’ activities in relation to resource consumption. For instance, we sample resource use by devices or in activities and summate these; such as in the IHDs that Strengers (2011) studies.

Organising information around temporal and/or spatial nts certainly assists strategies to manage bulk resources, such as electricity load shedding in South Africa, and to manage complexity in reporting research. But it does not necessarily help us to engage with the way users inhabit the world. We encounter significant problems when we try to advance from assembling data through a “*surveyor’s walk*”, if indeed, Ingold says, the surveyor “*does walk, rather than take a vehicle*” (Ingold, 2005:29). Clearly, we need to make visible relationships between users’ passages and the meanings that these embody; but it is not only a matter of moving with users as they go along each day. The meanings *we* make about *user’s* choices and actions inherently reflect our *own* going along and we observe practices with, as Ingold (2011:95) writes, “*bodies that have become accustomed, by the lives we lead, to certain kinds of movement*”.

Walking and Design

The research or design schema we apply in exploring or influencing resource consumption obscure the meanings, knowledge and infrastructures that people draw on in use. Practices embody social norms (Strengers, 2008); so, we begin by asserting that, throughout the world, walking contributes in some way to all meaning making; and that walking is “*not just what the body does; it is what a body is*” (Ingold and Lee, 2006:2). Adults walk at least some 6,000 steps daily, ranging from 3,766 steps per day for Americans older than 65 years to 18,425 for those living without technology such as Amish men (Bohannon, 2007). We may walk to transport, relax, educate or exercise ourselves but most of our walking is incidental and buried in the minutiae of life; from going to the bathroom in the morning to taking the trash out at night. Yet, while walking contributes to all our embodied knowing, specific research on walking shows that we rarely reflect

on it (Oksanen-Särelä and Timonen, 2004). Even ethnographers who carry out their work on foot do not typically reflect on their walking (Ingold and Lee, 2006). Walking is normalized, not by its frequency but by our lack of mindfulness in practice. We become aware of the intricacy of this bodily feat, and its physiology, only when watching an infant's faltering steps, the pained or unsteady gait of the old, arthritic, unwell or drunk or in learning to walk with special devices (Shove and Pantzar, 2005).

Through socialization we embody competence in the norms of posture and coordination that comprise walking (Shove and Pantzar, 2005). In considering "Ways of Walking" along different places Ingold and Lee remind us that, our movements are "*rhythmically resonant with the movement of others around us – whose journeys we share or whose paths we cross*" (2006:2). Walking differs between countries and Levine's (1997) time use studies show that some nations walk faster than others shaped by factors such as population size and expected pace of life. Camera-based surveillance research indicates that gait performs identity (Bashir et al, 2010) and in Namibia we noticed relations between gender, walking and women's long, multi-layered dresses, that restrict moving swiftly so they walk at a sedate pace (Bidwell and Winchiers-Theophilus, 2012). We linked the latter observation to how walking shapes interactions with others and habitats. Gait responds to the demands of, and resources offered by, the terrain and our agility adapts through the 200 million or more steps that we walk in our lives but this, again, pervades awareness only when we meet changes in terrain. Through each step our movement and settings respond to each other and this exchange connects our steps to those who walk with us, or trod a path before. Indeed, many cultures explicitly link sociality and walking in physical terrain. For instance, Traditional Owners in Australia gain their knowledge by combining oral histories with walking in their land (e.g. Truna et al., 2007; Bidwell and Browning, 2010; Dourish and Bell, 2011)

Some methods recognize that walking is inherently embedded in design. For instance, bi-annually scientists, villagers and students walk 11 miles a day to discover "barefoot inventors" amongst India's rural and economically poor (Honey bee Magazine); and 'bodystorming' integrates moving through settings into design in several ways (Oulasvirta et al., 2003). Despite appreciating the relevance of moving along HCI does not tend to "evert" (Verran, 2001; 2002) this banal practice in relation to locative media, mobile devices or situated displays or any kind of sustainable practice. Rather, efforts in labeling walking are limited to exercise by presenting it as calculations (e.g. distance, steps, speed, calories). When we speak of walking in daily life, though, we apply complex schemas to classify practices and patterns (e.g. "walking the dog") and distinguish between genres like a "purposeful" walk to a shop for groceries or going for a "proper" walk (Ryave and Schenkein, 1974). Yet, even Tamminen et al's (2003) influential article on mobile contexts uses the words 'walking' or 'walk' only five times.

Recently authors have drawn attention to the ways that using digital devices can disrupt interactions between bodies and environments as we walk. For instance, interacting with small, handheld devices competes for visual attention and conflicts with the oscillations walking produces (Heikkinen et al, 2009; Bergstrom-Lehtovirta, 2011) and some propose reducing the need to switch our gaze to displays (Fröhlich et al., 2011). Browning's analysis of video, gathered by people who wore cameras while walking, revealed that they spent 25% of the time viewing the ground and he speculates that this not only helps posture and direction but also couples with memories and felt-life (Bidwell and Browning, 2010). Still, we tend to neglect the consequences of disconnecting bodies from their paths or the paths of others, consider the devices on which we type and read as, neck bent, we dodge others along a street. Reid et al (2004) report that participants who walked and listened to sound-files about events that had ensued in a plaza said they felt "*empathy with the people involved in the riots and a sense of walking in their footsteps*". Others have shown how conversation shapes our experience of our bodies when we use a phone while moving (Light, 2009); that rhythms in walking help us to sense our own (Usoh et al, 1999) and others' presence in places (Vogiazou, 2007); and, that we synchronize our walking gait for long periods, without physical proximity or visual feedback by using audible cues about the gait of the person on the other end of a phone call (Murray-Smith et al., 2007). Nonetheless, while our footsteps impress passages, wear carpets thin and crush grass, overall, HCI's narratives obscure how walking connects bodies and settings, socially and physically, and how continuous movement along relates to environmental sustainability.

MANKOSI AND PRIOR RESEARCH

To show how walking shapes perspectives on sustainable practice we detail events in deploying Charging Stations in Mankosi, an impoverished rural area along the 'Wild Coast' of South Africa's Eastern Cape. Mankosi's population of 11,000 Xhosa people live in twelve villages that are geographically spread across 30km² of very hilly land (Figure 1). As in many rural economies, inhabitants are poor and families survive

on less than 1000Rands per month, mostly in the form of government pensions and child allowances and payments from family members working in cities (Bidwell, 2009). Daily life in Mankosi anchors to customary habitation, land-use and governance. Families of up to five adults and seven children live in informally distributed homesteads connected by foot-trodden paths across common grazing land. Homesteads comprise clusters of thatched, mud-brick rondavals with a kraal (animal corral) and a garden for subsistence crops. Inhabitants spend much of their life outdoors and, as many can trace their ancestry to the area's settlement eight generations ago, have extensive family networks between villages. Most inhabitants move by walking, as less than 1% own a car, few own bikes and there is only one bus, which departs at 5am, takes over an hour to move through Mankosi and does not reach all villages. Like 36% of the population of South Africa (SA), inhabitants are governed by a Tribal Authority, which is separate from other legislative and political institutions, inherited patrilineally and comprises a Headman and Sub-headmen, each of whose homesteads are sites for administration.

Our approach was primed by experience in neighboring areas in Nyadeni municipality where we started research when we (Author-4, A4) built a solar powered Wi-Fi network between a clinic in Lwandile and the nearest rural hospital in order to trial health information prototypes (Vuza and Tucker, 2004). We were assisted by a technically able volunteer with TransCape, a local Non-profit Organisation and the co-operation of Lwandile's Headman, in whose homestead we also sited part of the Wi-Fi network. We used different Action Research methods in these technology endeavours (e.g. Chetty et al., 2004; Tucker and Blake, 2008, Tucker and Blake, 2010) and ethnography when we (A1) lived in the homestead of Lwandile's Headman (Bidwell, 2009; Bidwell, 2010). Our (A1's) insights into communication practices, movements and technology use emerged through diverse experience. We conversed with and interviewed the Headman and family members, including a Chief of another area, in the homestead and while sharing daily domestic duties or walking in the village or beyond. We observed visitors to the homestead in connection with the Headman's duties and various meetings in villages, at a school's official opening, and at a workshop on Archives in Lwandile School. We always used local transport beyond the village, whether moving alone or with the Headman's son on trips to the Palace or Municipal Archives, so we gained insight into peoples' interactions with each other as they travelled between villages and en route to Mthatha (the nearest small city, some 3 hours away). We observed media use and talked about media preferences with Lwandile inhabitants, in an Internet cafe in Mthatha, in a hostel in a tourist area an hour away and in TransCape's Education Centre. We gained insight into local issues, opportunities for technologies to generate income and collected data on phone handset models. We also undertook various situated technology experiments and deliberate and impromptu digital storytelling activities, such as blogging and discussing media that the Headman's family collected on feature phones. Our insights motivated extending the Wi-Fi network, including solar, to remote villages along the coast and setting up email and Facebook accounts, which yielded more, locally and remotely accrued, data on interactions between inhabitants.

ETHNOGRAPHIC ACTION RESEARCH (EAR) IN MANKOSI

In this article we draw on gathered data in Mankosi for 18 months between 2010 and 2012 in a SA-based design study on media sharing (Reitmaier, et al. 2012) and a SA-UK research collaboration on digital storytelling and social media sharing (Bidwell et al, 2011). We generated data in Mankosi by Ethnographic Action Research (EAR) (Taachi et. al., 2003) within technology probing endeavours so our insights about using the Stations are grounded in various practices of communication. The breadth of our account is based on a view that ethnography does not just elicit requirements for software and hardware or help to devise and effect plans with local people but situates insights in the entire sites of our own and others' interactions during research and design. Our approach was informed by SA-based studies including those summarized above and in designing a digital storytelling application (Bidwell et al., 2010, Reitmaier et al., 2011).

Both studies that were "home-grown" in SA and those framed in the wide scope of the SA-UK collaboration were founded on a partnership between those of us in previous research in Nyadeni (A1, A4) and TransCape, which has premises in, and a focus on Mankosi. Our studies did not aim to address environmental sustainability directly but to tackle constraints on communication within Mankosi's isiXhosa-speaking community and improve the potential for local media production in rural development (Watkins and Tacchi, 2008). They were prompted when TransCape's Chair explained to SA-UK collaborators, at a meeting in Cape Town, that despite the increasing accessibility of cellphones in Africa (Ling and Donner, 2009) Mankosi's Community Association had difficulties in "*sharing information throughout Mankosi*". Thus, we sought to understand ways to enable users to record, store, and share information within and between villages that are compatible with social, technological and economic needs and constraints. To do so

we deployed two software prototypes (Prototype 1 and 2) which run on Tablet PCs in two villages in northern Mankosi: Ngcobo and Ngogo (Figure 1). Since inhabitants have no access to mains electricity, deploying prototypes also required installing Charging Stations (yellow stars) gathered a vast range of data, before and during trials of prototypes and Stations, on practices of consuming, sharing and storing digital and material resources. Here we overview each of the various methods between 2010 and 2012 since they continuously altered how our insights unfolded, although we have not yet formally analysed all data.



Figure 1: Sites of Charging Stations (yellow stars) and homes of A1 and operators amongst Mankosi's villages. North: orange arrow; 1KM: red arrow

Local Researchers

Between 2010 and 2012 A1 lived for a cumulative 16 months in Mankosi; however, as our author list shows, Local Researchers (LRs) from Mankosi are integral to our EAR. Our initial LR team started when a former TransCape employee, who had been involved in earlier projects (Tucker and Blake, 2008), recommended five young men based on their: spoken English; print literacy; availability and enthusiasm; and that they lived in four of Mankosi's twelve villages, including the Headman's. As the project progressed we recruited three young women. LRs have had varied education opportunities. Two women have university degrees, in media/linguistics and in psychology, three men matriculated high school, one of which has certificates from basic computer courses; but, the rest, like most locally, do not have "matric". Again like most people locally, LRs have had little paid employment before though some are involved in community initiatives. Author-2 (A2), who co-ordinates LRs, teaches teenagers after school and recently become TransCape's Education Centre Manager, one LR works on social welfare projects, two are part-time lifeguards and three referee and coordinate the popular local Tschani Soccer League (TSL). Most LRs approach local protocols conservatively, though this varies. One is an 18 year-old woman, who moved to Mankosi five years ago from the small city Eastern Cape city where she grew up, when her mother died, and has had a European boyfriend. This contrasts with, for example, a young man of the same age, whose his mother is a ward counselor and who has never been further than Mthatha. Though accounts sometimes conceals identities, LRs are fellow researchers who translate linguistically and culturally to mediate between local and non-local understandings and whose everyday practices, social networks, problems, interests and aspirations influence data gathering and deployments. By living in this tight-knit community, the actions of locally-based researchers (including A1) are intimately discussed and personal wellness depends on local accountability. We distributed tasks based on confidence in English and translation, personal disposition and interest and together LRs variously translated in all interactions with inhabitants and traditional governors, gathered, recorded and interpreted data and operated Charging Stations. LRs adapted and refined methods to fit the situation, negotiated meanings and refocused interpretations as our understandings, and those of others participating in studies, dialogue or planning evolve.

Meetings with the Tribal Authority and Inhabitants

Between November 2010 and March 2012 we met with Mankosi's Headman 25 times to discuss issues related to designing, deploying, trialing and maintaining systems to assist information sharing within and between villages. Usually, we first met with the Headman, at his or our request by phone, and discussed intentions, ideas or problems with him, and any elder men accompanying him (e.g. Sub-Headmen and/or the Headman's administrator or Messengers). Then the Headman scheduled a community meeting. In all

discussions we (A1) spoke in English and LRs translated into isiXhosa and inhabitants spoke in isiXhosa and LRs translated into English. The frequency of meetings reflects our emphasis on local conceptual and operational ownership of the system. Mostly, inhabitants oriented discussion towards current operation but we (A1) always sought to relate issues that arose to what would happen after the trial.

Meetings commenced when we (A1, LRs) gained permission to experiment with new systems to support local communication that might benefit Mankosi inhabitants and “*communities like theirs around the world*”. We explained that we sought to deploy portable Charging Stations and Tablet PCs in key, but flexible, sites of information exchange. We described this system as best we were able, given that it was being developed in cities far away, and that we had sufficient budget for a year’s trial but that inhabitants must sustain it later without monetary support. We asked people to account for all of these factors in choosing where and how to situate the system. They raised many concerns and that, before making any decisions, the project needed a name; later suggesting ‘Mankosi Communications Mobile Phone Project: Unxibelelwano’.

We observed other meetings convened by the Headman, some of which we recorded. Between 20 and 60 inhabitants, around 60-70% of whom were male, attended meetings. Some meetings are convened when local counselors or municipal officers visit while others like regular Tuesday meetings address Mankosi’s internal issues, such as resolving conflicts that were not reconciled with a village Sub-Headmen, publicizing jobs in small short-term government projects and discussing where inhabitants can build homes. Conflicts vary from contesting “*paying damages*” to the family of a woman who is made pregnant if no private agreement was reached or issues about TSL. Work of meetings with Tribal Authority can occur in different locations; for instance, when a man seeks a site for a homestead the Sub-Headmen of his village takes the proposal to the Headman and then all interested parties walk to the proposed site. We attended meetings in the Headman’s homestead in Ngcobo: outside in the meeting area of his yard, in his office (Figure 3), a rondaval where his wife serves food, and the recently built “*Great Place*” rondaval. We also attended three meetings in the yard of the Sub-Headmen’s homestead in Ngogo (Figure 8), where inhabitants decided to site one of the Stations, and on a hill in Mathakazeni village, where A1 lives.

Locally Generated Video and Audio

Inhabitants recorded their own interviews and/or storytelling on various themes, which they translated into English afterwards. This started in November 2010 when LRs and others video recorded: 14 different conversations or interviews involving 18 people aged 14 to 80 years; a self recorded opinion piece; two sets of stories by old people; a group around a fire; and the presentations of young people in a tourism training workshop. The majority of this video was gathered in Mankosi’s southern villages where tourism brings income, exposure to higher-end phones and access to premises with mains electricity. But four videos were recorded in Ngcobo. The corpus covered many topics: local business, such as owning shebeens (informal unlicensed bars set-up within homesteads), fishing or cleaning for white homeowners; aspects of family history and reminiscences, such as migrant work; folk-stories and accounts of cultural protocol. The vast range expressed local values and concerns, from pride in identity to corruption, the state of roads and health care. In July 2011 three young people recorded material during the annual launch of TSL in which teams from Mankosi, and beyond, play on soccer fields in the south of Mankosi. First one LR video recorded 20 minutes of interviews with 9 players and supporters of the Ngogo team about how they communicate about the soccer then two supporters recorded the match between Ngogo and the team that three LRs play on. A young man also made audio commentaries of weekly TSL matches for 2 months. In January 2012 a LR devised and recorded ten-minute interviews with five women about buying and growing food and disposing waste and then recorded three short tours around sites that participants mentioned.

Workshops

We ran different training workshops, at the sites where the Charging Stations were stored: in the Headman’s office (Figure 3) and rondavals in the Sub-Headmen’s homestead (Figure 4). This started when we trained LRs and potential operators, who had been appointed by the Headman or introduced by LRs, to use Prototype 1 and Charging Stations. Between April and September 2011 we ran seven workshops of between 3 and 5 hours with LRs, Sub-headmen, Headman’s ‘Messengers’ and Community Association members in using Prototype 1. In February and March 2012 we ran seven workshops of 2 - 4 hours with the Headman, Sub-headmen, Messengers and groups of other males and females in using Prototype 2. In total 24 and 50 inhabitants participated in workshops for the Prototypes 1 and 2, respectively, which reflected local perceptions about the prototypes. LRs translated and facilitated, in a ratio of one LR to 2 - 8 participants in workshops.

Observations and Interviews

Our (A1) long immersion in situ enabled us to record, in notebooks and photos, many participant observations about daily life and communications. We also watched operation and use of the Stations and prototypes in visits to sites for meetings, workshops and monthly check-ups and focused observational visits. In the first five weeks of deploying the Stations we made weekly observational visits of 4 hours to each site on different days of the week and at different times of day. To begin with, our presence (A1, various LRs), even sitting away from operators, disrupted interaction, as we had to support their practices. Three months later we made daily observational visits of 5 hours across a week at each site. We noted who brought phones for charging, how long they stayed, what they did, the phones they bought, and how they interacted with the Tablet and/or Prototype 1. We recorded observations in handwritten notes and sometimes video recorded and/or took photos. We also conducted brief contextual interviews with 40 inhabitants dropping off or collecting phones when observing Station use and at the end of some meetings. In workshops we observed prototype and phone use and asked participants for their opinions of prototypes.

Across the trial we conducted over 90 hours of focused interviews with 160 people, mostly in their homes or yards but sometimes along paths or roads. We compensated participants with airtime vouchers (5Rands for every 30 minutes of participation). Before and since deploying Charging Stations, we undertook interviews and focus groups on communication practices and use and non-use of phones and specific phone services. This started five months prior to deployment when we (LRs) interviewed 141 inhabitants in eleven villages about phone ownership of which 66% live in villages near potential deployment sites (Bidwell et al, 2011). We interviewed in people's homes, shebeens, along roads and paths and at football matches, that many inhabitants attend, and between Saturday morning and Tuesday evening to include people who work outside their villages on weekdays. This revealed the prevalence of using free Callback services, which allows subscribers to send a free 10-character text appended to "Please Call ...". (Bidwell et al, 2011). Thus we conducted a small-scale interview study with 16 inhabitants in nearby Lwandile to explore the Callbacks that participants had sent, received and personalised in the past two days, details about senders' and recipients' age, gender and relationships. During January and February 2011, twenty people with whom we who undertook assisted diary studies, also participated in one of 9 individual or group interviews on use and non-use of phones and specific phone services including social networking services.

While we were introducing Prototype 1 and the Charging Stations, 28 inhabitants of Ngcobo and Ngogo who owned feature phones participated in one of 17 individual or group interviews. Participants were aged between 18 and 60, but the majority were women between 18 and 30. We (Author-6, A6) interviewed inside Ngogo's Sub-Headmen's home and a Headman's Messengers' home in Ngcobo and asked participants to talk about, and when possible show, media stored on their phones, their favourite images and other media, such as voice recordings and music, on media that they would 'never delete'.

Three months after deploying the Stations we started to conduct group interviews with people living near Ngogo Station. We interviewed six women, in Ngogo, aged 27 to 69 years, and four men, aged 22 to 38 years. Half always used Ngogo Station to charge their phones and half charged phones elsewhere. We asked six men in Ngogo's soccer team, aged 20 to 27 years, about their phone use related and unrelated to soccer and explored ways that Prototype 1 and phones might support the league by showing video and photos of TSL. At the end of workshops introducing Prototype 2 we also conducted four short group interviews with twenty-three people about practices of owning and sharing digital material and electricity.

Logged Data and Diary-Studies

Before and after deploying the Prototype 1 we gathered daily data on using phones, social networking services, prototypes and charging stations and walking. We started in January 2011 with assisted "diary studies" with twelve older and/or print-illiterate inhabitants in Ngogo and Ngcobo. We sought to explore the ways people managed mixtures of face-to-face communication and phone services within their daily routines. We (A1, LRs) first interviewed, either individually or in a group and then over the following week we (LR) conducted sequences of short individual interviews about their phone-based communication since we last saw them. On average each participant reviewed their calls, buzzes (deliberate missed calls), SMS messages and Callbacks and told us: the time; what they were doing; their and the caller/sender/recipient's location; their relationship with the caller/sender/recipient; the age and gender of the caller/sender/recipient; whether they had seen the caller/sender/recipient in the previous day and the circumstances of this; whether they expected to see the caller/sender/recipient in the next day and the expected circumstances; the main aim of buzz/call/SMS/Callback; reasons for not responding to a call-

er/sender/recipient; and, finally, the exact text of an example SMS or Callback. At the end of dairying we (A1, an LR) interviewed participants individually or in groups to discuss themes emerging in diaries.

In March 2011 we undertook group interviews and remote assisted diary studies with 8 younger people about their use of phones in social networking. We (A1, LRs) first spoke to a group about their use of phones and low cost services, such as MXit, an IRC-like (Internet Relay Chat) text-based, chat service popular in SA (Kreutzer, 2009). Then we conducted a diary study with 6 inhabitants, aged 18 to 28 years, over MXit. Every evening for 7 days we asked participants, in isiXhosa or 'MXit English' (an idiomatic abbreviated English) about their calls, buzzes, SMSs and Callbacks and social network chat. For each type of interaction we collected data on: the time; what they were doing; their and the caller/sender/recipient's location; their relationship with the caller/sender/recipient; the caller/sender/recipient's age and gender; and, whether the buzz/call/SMS/Callback was part of a communication thread. We also collected data on participant's MXit sessions: time, length, location and relationships between chatters.

After deploying the Charging Stations and software prototypes we logged usage in two ways. Firstly, the operators of each Station kept daily notebooks recording. Secondly, we automatically logged use of the prototypes running on the Tablet. Between February and April 2012 we conducted a small study to log the steps and distance walked by six of A2's family members and three other residents who wore pedometers for a week and then discussed their daily routines.

Software

We deployed two software prototypes, running on Tablet PCs, to explore ways people could store and share media. Both prototypes distribute information asynchronously either at the Tablet or between the Tablet and users' own Bluetooth-enabled phones. They differ in their capacity to distribute information synchronously and support oral exchange and people who do not own phones.

In April 2011 we deployed Prototype 1 within the SA-UK collaboration. It mixes asynchronous and synchronous communication, using the MXit platform for real-time, text-based chat but sends and receives photos and other media later when users visit the Tablet. After initial uneasiness and practice in clicking on the screen workshop participants appreciated the Tablet's touch interface, that their stored material was accessible only by their phone's presence and the concept of sharing media. Positive perceptions about Prototype 1 often related to communicating asynchronously, which aligned with earlier insights on local phone use, such as using Callback services to send alerts asynchronously. (Bidwell et al, 2011). Low-end phones do not always show missed calls when phones are flat, switched off or beyond network coverage if owners are at meeting places occur and in pasture or forests. However, most aspects of the platform failed and very few people used it. The software was often incompatible with phones owned locally: mostly low-end models, less than half with Bluetooth and less than 15% have the data access that enables use of MXit (Bidwell et al, 2011). We (A1, LRs) encountered many difficulties in helping people to use the software due to complexity associated with the third-party platform and unstable network connections. Further, print literacy and technological familiarity is much lower in Mankosi than elsewhere in SA, especially for older people, and many people said that they were "*not educated to use the phone*" (e.g. Bidwell et al, 2011). We tried to increase using the repository within a Bluetooth-based mule system, since local phone use builds on a tradition of person-to-person messaging, and uploaded a corpus of locally generated content to the Tablets about TSL matches including audio commentaries, photos and videos. Our efforts failed to increase use.

Our workshops on and evaluations of Prototype 1 confirmed our insights about local preferences for making, sharing and listening to voice recordings (Bidwell et al, 2010; Bidwell et al, 2011). Tribal leaders and other inhabitants often said they could archive record meetings for access by those unable to attend and to hold people accountable to verbal commitments, or '*stop people lying*', and publicize notices a, such as building a new clinic or the availability of temporary work. Thus, for Prototype 2 we emphasised voice, not text, and sought to cater for the 35% of inhabitants who do not own a cellphone and/or require support in using phones. In February 2012 we introduced Prototype 2, which A1 and A3 designed and was developed in SA (Reitmeier et al, 2012). It enables users to create, store, delete, find and retrieve voice recordings and share recordings with other users or groups of users. Users create and listen to recordings in two ways, either directly on the Tablet or by recording/listening to files on their own low-end Bluetooth-capable cell-phones and sending/receiving the audio files to and from the Tablet via their accounts. Users can record on their own low-end Bluetooth enabled phones using inbuilt voice recording functionality but can distribute content using mule transport only. Prototype 2 was much more successful than Prototype 1.

Hardware

We deployed 7-inch Samsung Galaxy Android Tablets on which to run the prototypes at sites inhabitants' chose. Then, to support people's use of Prototype 1 we gave two 34 Bluetooth-able phones (25 Nokia 2330 classic, seven Nokia 2730 models) to the Headman and Sub-headman and/or their wives; Messengers; and, Mankosi Community Association members. We needed to develop a solution to power the Tablets as most homes in Mankosi do not have grid electricity, despite pylons along the main gravel road that serve visitors who own or rent cottages along the coast. A few homesteads do own a solar panel or generator they use on special occasions or for business at shebeens and spazas. But, most people, unable to afford to buy such equipment or grueling journeys to petrol stations, pay, on average R5.50 (\$0.72) to charge their phone at shebeens and spazas. In April 2011 we deployed two Charging Stations, which we (A3) constructed in Cape Town and (A6, A7) brought and reassembled in situ. In the ensuing months we (A1, A2) modified the Stations to respond to local practices.

We sought to ensure people could protect Stations from criminal intent and the elements. In our prior projects in neighbouring areas, the large solar panels, that we installed on the roof of a clinic, and batteries were stolen and the Headman's son also chased away a man trying to remove a panel on the roof of A1's room. In the latter case, we (A1) improvised by carrying the panel outside each day and passing the cables through a window to connect to the batteries inside the room. We (A1) are all too familiar with local weather conditions: strong, often incessant, wind and frequent overcast or rainy days, especially between October and March. A hybrid system of solar and micro-wind turbines would have optimised power. However, external designers (A3) considered such solutions too costly and that noise might be problematic, as we had found in our prior projects that, without careful damping, a panel on a roof can cause such distress that people cannot sleep in their home because they associate its sound in the wind with malevolent spirits.



Figure 2: Smaller Station V1 showing component storage box (a) and in situ in Ngogo (b) (c)

As we designed the first versions of the Charging Stations while Mankosi's inhabitants decided on deployment sites, we needed to ensure that our design was robust, easily movable and offered opportunity for local customization so the community could choose where and how to operate it. After several concept ideas we settled on designing a solar system based around a sack trolley. Sack trolleys are sufficiently narrow to fit through the 'person size' doorways of rondavals; can take heavy loads; and, can be fitted with pneumatic tyres to cushion the solar panels and deep-cycle batteries from shocks when moving. We constructed two versions of the Stations: one with larger panels and two batteries (Figures 3 and 5) and one with small panels and one battery (Figure 2). For both versions we mounted the battery(s) at the base of the trolley and affixed the solar panels either in parallel to the handles, for transportation, or perpendicular for stationary charging (Figure 1). We sought to enable safe local repair and re-design. To provide charging we used only standard components, rather than custom charging hardware or an inverter to provide mains power: a 12v cigarette lighter socket that accepts a USB and 3 standard car chargers. We did not lock batteries in boxes and left cables and connectors exposed and used screw-based cable connectors and bolts and nuts that were all the same thread and diameter so that components could be moved and did not require soldering.

Eversion, Interpretation and Analysis

At the time of writing we had only recently concluded research on the Stations and, while we have watched and listened to all video and audio recordings and read field notes at least once, the quantity of

data means we have only transcribed and/or annotated material in the first eight months. We used descriptive statistics to analyse responses to any closed questions, thematically coded the transcribed/annotated recordings to date and written descriptions, of varying ‘thickness’, which we sometimes shared between authors. We present quotations in English but consider these to be LR’s interpretations, since almost all dialogue with participants’ was in isiXhosa. Many inhabitants know some English but lack confidence in speaking and prefer their own rich and metaphoric language, which LR’s translated in vivo and post-interaction.

Given our analytic focus it is important to relate insights to the ways we accessed electricity and moved in Mankosi. Locally-based researchers, including A1, always walked at least 0.75Km to use mains electricity unlike visiting researchers who stayed at TransCape’s premises, which usually has electricity. We drove A1’s 4WD car only for distances of over 3Km, due to the quality of roads, bogging in mud in the wet season and inaccessibility of petrol and replacement parts, but external researchers (A6, A7) drove hired cars throughout visits. When we drove we, and external researchers, gave lifts to those who we passed on the main gravel road, and to research participants. Operators (A5, A8, A9) usually walked to Stations and rarely obtained lifts. One LR, who worked with us for the first 6 months, used the project’s mountain-style bike to cycle to Ngogo to conduct interviews; but his quirky approach to tuning the breaks and the steep potholed roads meant other LRs were uneasy in using it. The LR co-ordinator (A2) also inherited A1’s ‘quad-bike’, which enabled easier access to the Stations and carrying others of us, to the amusement of those we passed.

SITING AND OPERATING THE CHARGING STATIONS

We asked Mankosi’s Tribal Authority and others to take accessibility into account in choosing initial locations and operators for the Stations. Members of the Community Association who, ostensibly, communicate into local governance and across Mankosi, gave advice about potential sites for deployment. Informed by local knowledge and our data on phones and existing charging facilities (Bidwell et al, 2011) inhabitants chose two sites from the five suggested by the Community Association. Six weeks prior to deployment, the Headman confirmed the sites and we arranged official launch dates with celebratory lunches. The sites are about 25-minutes walk (2.5KM as the crow flies) from each other in Ngcobo, the Headman’s village, and Ngogo amongst the poorest three villages of Mankosi and identified locally as “Ridge”. Both are accessible on foot and are on the highest hills in each village: in the homesteads of the Headman and one of the twelve Sub-headmen. We paid honorariums of 50R (\$6.00) per month to recompense families living in the homesteads where the Stations are stored, and people charged phones for free in the trial.

Operators, Caretakers and Differences Between the Sites

The Headman indicated that his administrator, at Ngcobo, and Ngogo’s Sub-headman would oversee the Stations; based on their standing in the community and proximity to the sites chosen. We (A1, LRs) agreed, as we did not know what the system entailed until it arrived; but, as deployment approached we became uneasy about how these men would cope with Prototype 1 as both are over 50 years, unfamiliar with phones and Ngogo’s Sub-headman does not speak English and is print-illiterate. Thus we (A1, LRs) considered strategies that would reconcile with the Headman’s decisions but also facilitate use of Prototype 1. Two LRs living in Ngcobo and south Mankosi and could assist Headman’s chosen operator and in Ngogo we recruited, through a LR’s social network, a young woman who owned a feature phone. In the first month of deployment we realised that the complexity of Prototype 1 and local demand for charging required us to do much more than assist the Headman’s delegated operators. Thus, the Headman agreed that we pay for the LR’s assistance for 30 hours per week with the intention that others would assume responsibility for longer periods each day once they had become familiar. Over the next four months both users and operators engaged the Headman’s son and wife in Ngcobo and the Sub-Headmen’s daughter-in-law in Ngogo collection and pick-up of phones. However, as we return to several times, this caused or revealed tensions, especially in Ridge. We discussed moving the Station from Ngogo to another site but the Headman and Sub-Headmen decided that it remain; so we started remunerating the Headman’s son and the Sub-Headmen’s daughter for their work in overseeing phones, hoping to promote wider use of Prototype 1, extend Station operating hours and prepare for the longer term sustainability of the systems.

The facilities at, and roles of, the Headman and Sub-Headmen’s homesteads differ in ways that effected operators’ use of, and inhabitants’ access to, the Stations and Tablet. The Headman’s homestead, in Ngcobo, is Mankosi’s main tribal administration and, in deference to this authority, people treat it with formality, especially younger people. Operators distributed work between the Station outside and inside a two-

room building comprising the Headman's bedroom and office, which is occasionally used for short meetings. Operators usually sat on chairs and used a table to store phones and record entries in logbooks (Figure 3). In contrast, operators in Ngogo worked outside, where they sat on the ground and people socialized for longer at the site (Figure 2a). The visibility of the Stations from beyond the two homesteads also differs. There is a tall fence around the Ngogo headman's site and the Station is obscured, behind his office, from view outside the homestead. In contrast, the Station in Ngogo is visible from nearly 180° at 0.5Km away. The Ngogo site is more accessible, since it does not carry the same authority as the Headman's site, but the area's reputation for more "tostsies" (petty but sometimes armed criminals) introduced different access issues. Throughout the project the Ngogo operator kept the Tablet in a soft pencil-case inside a bag (Figure 2c), which she did not leave at the site when not there. The situation is different in Ngcobo where operators left the Tablet overnight in the Headman's office. Finally, there are gender and age differences that, as we discuss in detail later, affected interactions between inhabitants and the operators' daily routines. In Ngcobo the operators were unmarried male LRs, aged 19 and 24, who live with their families 0.5Km and 6Km from the site; and, more recently, the Headman's son aged 17 and his wife, aged late 30's who live in the Homestead. In Ngogo the operators were married females: one aged 24 who lives 1.75Km from the site, Ngogo Sub-Headmen's daughter-in-law, aged 23 and his wife, aged early 40s, both of whom live on site.

Operation and Rules

In the first month of deployment we ran six sessions to familiarize and gain feedback from the first paid operators on using the Charging Station and Prototype 1 and logging data in notebooks. Operators learnt to read and record the voltage of the battery, using handheld voltmeters, and not to charge phones if the battery reading fell below 12V. We devised a daily record to log the time operators set up and put away the Stations and voltage at each time; the weather; the names of people bringing phones charging at the Station and/or using the Tablet; and, times people delivered phones. The Headman and inhabitants encouraged us to create rules, for operation and place notices about these at each Station, in isiXhosa and English: thus we agreed that phones should be dropped-off and picked-up only by their owners at specified times. To begin with we also wrapped coloured bands around damaged phones, so that batteries would not fall out, and secured with sticky labels with phone-owner's names.

Now we turn to observable and/or reported operation of the Ngogo Station during the trial. Just before 8am, the operator walked 1.5Km from home to the Sub-Headmen's homestead, usually taking phones of those living in her homestead and, sometimes, nearby. Arriving at the Station at 8.30am she found between 3 and 6 phones left with the Sub-Headmen's wife or daughter-in-law since she departed the previous day. She brought the Station from the rondaval and set up, hanging up the bag in which she brought the Tablet and recorded the battery's voltage. The Sub-headman's daughter sometimes helped move the Station, but was uncertain about setting it up or taking voltage readings and did not have the key to the padlock on the storage box. If the battery was fine the operator connected phones for charging in the order they were delivered, including any delivered while she set up. She recorded the names of those who dropped off or own phones in the logbook, including those for phones delivered to the Sub-Headmen's wife who cannot write. Within the first few months the operator became familiar with who owned phones and brought others' phones. To avoid accusations of airtime theft, even if phones have PIN codes, she ensured all phones were turned off. Between 10am and 11am she locked the storage boxes, took the bag with the Tablet in it and walked home to undertake her domestic tasks. She became familiar with how long it took to charge individual phones, between 3 to 5 hours, often relating to the age of the phone battery. She usually returned to the Station at midday, depending upon how many and which phones were charging. When there were many phones to charge she returned earlier to replace fully charged phones with uncharged phones. While she waited for phones to charge, or was visited by other researchers, the operator sat chatting to the Sub-Headmen's daughter-in-law as she did chores (e.g. cooking, washing, feeding children) and sometimes other women. The operator disassembled the Station around 2:00pm, read and recorded the voltage and waited until 2:30pm for people to pick up phones. Many sent children arriving home from school, but she rarely worried that phones would not be returned to their owners when she sent them with someone else. For the first few months she locked charged and uncharged phones in the storage box when she left, so that owners who did not arrive to pick up phones before she left had to collect phones the next day. She locked only uncharged phones in the box, when we paid the Sub-Headmen's daughter-in-law, but continued to set up and store the Station as she remained concerned about damage. This restricted the panel's direct exposure to sun to 5 hours per day, provided she noticed when the solar panels became shaded by a rondaval.

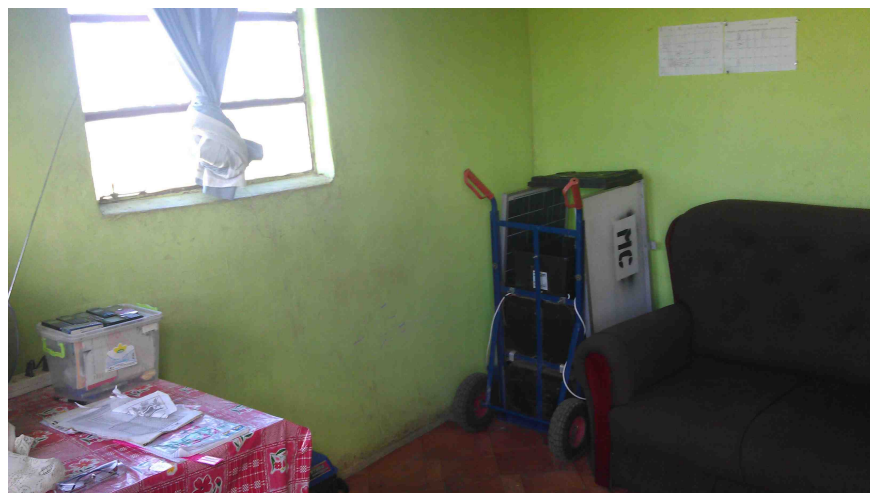


Figure 3: Final version of the larger station stored in the Headman's office in Ngcobo. The operator left phones for collection on the table (on top of an old storage box)

For most of the trial deployment we distributed work at Ngcobo between two LR's: one who undertook duties on Monday to Wednesday and the other Thursday and Friday. One took an hour to walk to the Station from home, and the other 10 minutes. From early in the trial both operators asked the Headman's son to distribute phones to people if they arrived after they left each day and thanked him with beer when they were paid. As time went on people also left phones with the Headman's wife, so for the last six months the project remunerated them both. On their respective workdays, operators arrived at 9am and brought the Station out of the office, trying to avoid bumping it over the edge of the doorframe (Figure 5). They recorded the battery's voltage, inspected any phones left on the table and asked the Headman's wife or son who owned or delivered any phone they did not recognize. Sometimes people were waiting to charge phones, or arrived shortly after 9am. They recorded the number of phones charged in the logbook and remained at the Stations until 2pm, checking on phones charging, accepting other phones, returning charged phones to those who came to collect them and meanwhile used the Tablet or MXit and other text-based chat portals on their phones. They aimed to return phones fully charged so anyone who arrived before their phones had charged had to return later. At around 1:45pm they checked the battery voltage reading, disassembled and brought the Station into the office. For the first six months operators wrote the names of phone owners on labels or small strips of papers and attached these to charged phones on the table (Figure 3), which the Headman's wife or son returned to owners later. Provided the battery reading was high they also left 2 or 3 phones charging in the office.

On rainy days routines for both Stations took a different form. If it was raining in the morning operators did not go to work but if rain started after they arrived they brought Stations inside and took them outside again when the rain stopped; however, they could not always predict if the break in the rain would be long enough to merit the work required in this.

CHARGING STATIONS USE AND SUSTAINABILITY

The Stations operated at Ngcobo for 207 days and Ngogo for 187 days during the trial. Average voltage readings at the end of operating on sunny days were 12.63V (st dev 0.31) at Ngcobo and 12.45V (st dev 0.23) at Ngogo. Readings were lower at 12.3V and 12.4V for the 42 and 31 cloudy days recorded at Ngcobo and Ngogo, respectively. Operation mostly reflected weather conditions as rain in the morning for about 50 days meant operators did not go to the Stations. Logbooks recorded rain for 11 days at Ngcobo and 16 at Ngogo when average voltage recordings at the end of the day were 12.21V and 12.17V, respectively. For 25 days, spread across two periods, Ngogo Station did not operate when we were unable to replace a blown fuse. In six weeks since we ceased supporting operation the Stations have operated for approximately 12 days at Ngcobo and 5 days at Ngogo as both incurred types of damage that did not happen during the trial.

Recorded Station Use

During the trial, operators' logs and our observation and inspection of batteries suggested that inhabitants' used the Stations exclusively to charge phones and the Tablet. Indeed, inhabitants own few other elec-



trical devices (Bidwell et al, 2011). In 10 logbooks for each Station, there were 500 different names, many regularly repeating. Operators at Ngcobo station charged between 3 to 24 phones per day (average: 12 phones; st dev: 4), and at Ngogo recorded on average eight names of people (st dev 3) delivering one or more phones. Of inhabitants who regularly charged at the Stations approximately 30% did so every 1 to 3 days and the remainder every 5 to 7 days. This often reflected the age of the phone and/or its battery. Phone batteries were always completely flat when inhabitants brought them to Stations. More people charged at either Station on, or the day after, monthly Pension day, when they buy airtime, make calls and flatten batteries. They also charged more on Mondays, because they made more calls on weekends when costs are lower, especially at Ngcobo because we did not operate the Station on Saturday. At Ngcobo, people charged more on Tuesday, when attending the Headman's meeting. Operators did not always charge all phones but the reasons differed between Stations. At Ngcobo it reflected high demand, such as on Pension day, but at Ngogo it reflected operator practices and the speed at which phones charged. Often people did not collect phones for 2 days at Ngogo and missed calls during this time, though they rarely complained because, perhaps, they are so familiar with switching off their phones (Bidwell et al, 2011). Indeed, expectations about phone use altered only subtly; for instance, most people said that they did not use their phones for music anymore than before.

Throughout the trial inhabitants repeatedly emphasized the importance of a person taking responsibility for phones and charging, yet we were not always able to impose the rules agreed. People often ignored the signs we installed, in English and isiXhosa, and removed the first sign at Ngcobo. While, the Tribal Authority insisted that only phone owners should drop-off phones; many often brought several phones, owned by different people, and/or sent children to do so and frequently the person who dropped-off and picked-up a phone differed. This caused occasional problems. One phone-owner came to pick up his phone, that he a child had dropped off at Ngogo, but the phone was blocked, suggesting repeated entry of an incorrect PIN code and once operators at Ngcobo were accused of stealing airtime when they returned a phone to its owner via another person. At Ngcobo, operators found it impossible to tell older people to keep to certain times because they said we were impolite. It was easier to enforce rules with younger people. On average 40% of people dropped off phones according to the drop off times indicated at Ngcobo and of those arriving later 74% arrived between after 10am when signs. People tended to drop phones off phones later in the first and last few months of the trial, possibly due to weather and seasonal work. We observed that 60% of inhabitants arrived at Ngcobo Station to collect phones before operators left for the day. The Headman was eager to enforce rules and did not use Ngcobo Station differently from other inhabitants, but on a few occasions fuses had blown, wires pulled from units and video uploaded to Tablet when operators were not there which led us to speculate about his family members' use outside of hours. Working practices in Ngogo made it easier to enforce rules about drop-off and pickup times as the operator was not at the Station across the day but this also led to complaints. Early in the trial older people came late at night to pick-up phones and later male inhabitants complained about access.

Some 65% of inhabitants, over 14 years old, own cellphones in Mankosi but not everyone who sought to charge phones at the Stations could do so and some continued to charge at places used before deployment, often paying 5R to a spaza, shebeen or neighbour. Sometimes this reflected our ability to obtain or replace appropriate charger models; for instance, we could not buy car-chargers for some Samsung models nor supply sufficient chargers for Nokia models, which were most often used and are very fragile. It also reflected our ability to replace and fit broken components, for instance early in deployment a fuse blew in Ngogo, while A1 was away, and LRs could not diagnose the problem.

People dropping off or picking up phones walked between 0.25 and 4.0Km to do so. Inhabitants' interpreted the Stations' affordance for mobility in a very limited way and while they moved the Tablet around each site and between homesteads they never moved the Stations far from where they were stored even around the flatter ground of the Headman's homestead.

Modification and Re-Design

Back-trolleys required us to modify the sites that inhabitants chose for the Stations and had maintenance issues. For the Ngogo site we (A1, an LR) constructed a wooden bridge between the narrow door and a flat area 8M away, as the rondaval where the Station stored is encircled by a deep trench and the homestead is on very steep, uneven ground (Figure 4a). The homestead in Ngcobo is on flatter ground, atop a steep hill, but the doorway to the Headman's office, where we stored the Station, has a high lower frame so we positioned a short plank of wood as a ramp over which to ease the bulky trolley over the entry (Figure

4b). A wheel on one sack-trolley was on the wrong way around when it was delivered which caused a puncture and meant we needed to remove it to inflate and wait a fortnight for a new inner tube.



Figure 4: Wooden bridge at Ngogo

Inhabitants' choice of sites and practices emerging in operation required different modifications to our (A3's) original designs for each Station. Ngcobo's operators stored phones waiting to be charged or collected inside the office, however the only flat surfaces on the trolleys are on the battery box and inside the storage box. The storage box became cluttered and to swap phones and chargers the operators moved phones and components inside the box and often hung phones by charger cables, which weakened and caught the cables (Figure 6). We mounted the regulator and sockets to the internal wall of the box and then, after 3 months, replaced the box with a larger one to afford room to lay phones (version 2.0). To begin with we failed to account for sufficient headroom when chargers were inserted into the socket so the lid was mostly left off and soon dust entered the box and female connectors, which meant operators 'jiggled' chargers to make electrical contact. We re-positioned the lighter socket and car chargers to enable replacing the lid which reduced dust but, since the only suitable box we had was matt black, in summer it became extremely hot, which might potentially damage components, phones and the Tablet charging (Figure 5).



Figure 5: Plank over the door frame of the office at Ngcobo to guide Station (V2)

In response to concerns about theft of phones, because the main operator for Ngogo Station did not live in the Sub-Headmen's homestead, we drilled into the storage box and inserted two padlocks: one to act as a hinge and the other as a lock (version 1.1). Again a lack of flat surfaces on the trolley resulted in cluttering in the storage box and the operator hung phones from chargers while swapping phones or chargers. Thus, again, we (A1, A2) mounted the regulator and lighter socket on the walls of the box (version 1.2). This reduced clutter but operators continued to hang phones by cables. So, after 6 months we re-designed storage to separate the lighter socket and car chargers from phones being, or waiting to be, charged, to reduce weight on the cables and prevent tugging (version 2.0). We arranged two storage boxes vertically, fitted both with the padlock-hinge system and drilled holes in the lids of boxes through which we fed charger cables (Figure 7a).

The affordance of our design for re-configuration enabled us to circumvent some issues but introduced others. Strong local winds on the panels severely destabilize the sack-trolley, indeed Ngcobo operators started to record the frequency of windy days and over a year the frame around a panel in Ngogo weakened considerably. However, the Stations also allowed laying panels on the ground or against a wall in extreme winds and in the summer for better solar efficiency (Figures 5 and 8). The protruding bolts on frames worried us when children played nearby.



Figure 7: Lock-hinge to lower storage box (a) of Ngogo Station V3.0 with connectors fed into lids (b)

Leaving connectors exposed also bought disadvantages and advantages. We (A1) easily fixed problems, such as replacing fuses, in Ngogo ten times and in Ngcobo three times; but access to components meant operators, or others, customized the Stations in ways that compromised longevity and safety. People who are not exposed to electricity regularly and do not have materials (e.g. insulating tape) can create circuits that are unsafe and/or draw more current exceeding fuse resistance. For instance, lying in the trench outside the Headman's office are exposed wires used to connect his TV to a generator that he runs once a week; and, early on in the trial one LR was concerned that charging the battery to exceed 12V was dangerous. Within two weeks of deploying in Ngogo the Nokia-compliant part of a multi-charger was cut when, allegedly, it was trapped between the arm of the solar panel and the operator tried to repair it (Figure 6a). In Ngcobo a charger broke and someone attempted to re-assemble it, which blew the inaccessible fuse in the molded car-socket. More recently, someone in Ngcobo spliced other chargers onto the wires from the car-socket, which means that if all chargers are connected they draw excessive current compromising the battery's longevity. During the trial we replaced four chargers and two car-battery sockets and added more

chargers suited to local phone models. The small pins of new Nokia chargers are especially fragile and malleable and unsuited to the constant use resulting from 80% of phones locally use these (Bidwell et al, 2011). Leaving components exposed did not thwart operation in the trial but has done so since. Within ten days of our (A1) departure wires were detached from the regulator and the fuse holder, between the regulator and the car socket, destroyed at Ngogo Station. We (A2) could not source the same fuse holder in Mthatha but managed to buy one with the same power specifications and TransCape is assisting in repair.



Figure 6: Broken components in situ in Ngogo (a) broken components during trial (b)

Local Perspectives on Access

Throughout the trial we (A1, LRs) always tried to contextualise any issues raised in what would happen when we ceased monetarily support of Stations in March 2012. But, while inhabitants answered questions regarding long-term use, most discussions focused on current operation, until a month prior to the trial's end. Even 5 months into the trial Headman said it was very hard to think about long-term maintenance.

In planning and launching the trial people raised concerns about theft of equipment, phones and phone batteries and frequently inhabitants said they expected us (A1) to edict rules about access and use. We introduced the idea of the Station and Prototype 1 as a system to improve communication within Mankosi. Thus, in meetings the Tribal Authority and more vocal participants tended to orient discussion towards the use of phones and prototypes by elders, who they consider important to Mankosi's governance and cohesion, and sites that are safe, accessible to the community and which host meetings and administration (e.g. stamping and signing inhabitants' proof of address documentation). They also proposed paying a fee of 2Rands to charge phones, perhaps because they were concerned that the Stations would undermine local business or to encourage charging phones only for certain practices since they said, younger people, used their phones to play. We (A1 and external researchers) were uncomfortable with the effect this might have on using Prototype 1 but did not intervene and the community did not impose a fee during the trial.

We had many meetings to address issues about Station use during the trial. In the first month after deployment we had five meetings with the Headman to generate strategies, such as recompensing operators. A month later a few elder men started to tell us (A1, A2) that they were not receiving service, particularly in Ngogo; and two months after that we conducted interviews about Station use with five women aged 20 to 70 years, recruited by Ngogo's operator. If the women's phones were compatible with the chargers we provided they charged approximately once a week and usually brought several phones each. Shortly after these discussions the Headman explained that the Ngogo Sub-Headmen requested a higher honorarium because his family members were returning phones to owners. When we all met to resolve the issue the Sub-Headmen's wife said that the Station damaged the floor of the rondaval in which it was stored, and where she sleeps, threatened her security from tostsies and that people dropping off or collecting phones outside of operating hours disturbed her. We (A1, A2) explained that we could not raise the caretaking honorarium, noted this would be unsustainable after we ceased support and suggested relocating the Station. The Sub-Headmen said he preferred the Station remain where it was and, with clear discontent, the Sub-Headmen's wife said she could not override her husband's decision. The men paid no attention to the wife's concerns about crime risks, and A2 advised A1 against supplying a phone to the Sub-Headmen's wife to improve her sense of security. We decided to remunerate those who returned phones and insist existing operators train them in using the Station and Prototype 1. We (A1) thought this might improve operation during the impending wet season and operators said that this would improve access and that the households storing the Stations who could generate income afterward.



Figure 7: Final Version of Ngogo Station during a meeting about sustainability, a panel is not attached to the sack trolley as its frame was weakened by the wind

Our discussions in planning for sustainability after the trial's end also made the contested nature of access visible. In February 2012 we met with the Headman and four elders about rumors that Ngogo Station was not "*helping the community*" and that operators and/or Sub-Headmen's family prioritized their friends. Further, one Messenger had his memory card stolen from his phone left there to charge two months before. The group speculated that the Sub-Headmen's family might be doing this "*as a way of complaining*" and there was "*carelessness in the house*". They sought to avoid friction in Ridge that would implicate other Subheadmen and Messengers or imply favouritism by relocating the Station.

We planned to explore perspectives on Station use in Ridge at the end of workshops for Prototype 2 and so, independently, the Ngogo operator and the Headman recruited participants. But, when we arrived for the first workshop the Headman, elders, 20 other men and 20 women were waiting, so we framed discussion in Station sustainability. The Headman asked the women to move away so they could not hear the men speaking. As in earlier meetings some men demanded we (A1) provide rules for use and, again, we said that the community should do this as we had now trained different people. The men did not want to move the Station, mind paying or waiting for two days for phones to charge but sought to ensure equal access and compliance with rules about one person per phone. A man, who had complained in the first few months, initiated discussion and then 65% of the men who lived in Ridge said they been unable to charge at the Station. One said he always charged at his workplace on the other side of Mankosi and several younger men reiterated there was insufficient or no chargers for their phone models. But, 50% of men who sought, but were unable, to charge said the operators prevented them because they "*bring their friends phones*", and a Messenger said: "*whenever I come they say its full and because I don't have time I have to go to another place*". However, none of the 20 women gathered said that they had been sent away. Two women did not have phones and the others who were unable to charge (19%) could not because they had phones for which there was no charger. Most women bought up to 4 phones of others in their family and left phones for two days to be charged. The Sub-Headmen's wife raised concerns but the other women challenged her. The following week in workshops six young men reiterated the importance of rules which the women sometimes abided to, but also lied. When we reported our interpretations of Ridge perspectives to the Headman, he said he intended the Station to remain in Ngogo despite the Sub-Headmen's wife's objections.

When we formally ended the trial we found a sign, outside the Headman's homestead, indicating a charging fee and 74 people waiting (53% male, 46% female, and 60% older than 30 years). The 11 Tribal Authority members present explained to us, privately in the office, that since people realized the impending end of the trial fewer had brought phones, thus they would charge R3 per phone at both Stations and employ someone to charge only if the number of phones for charging increased. The Ngogo Sub-Headmen

also raised concerns that his family would be accused if the Station broke. The Tribal Authority then explained to those gathered that they sought to ensure maintained service of the Stations and were concerned about damage. The women, many from Ridge, remained silent until a Sub-Headmen raised issues about responsibility for security and charging phones to batteries are full. “*We don’t have any record of stolen phones so why will it be a problem now?*” replied one woman and another asked why the men dictated the price. The Sub-Headmen’s wife said she did not object to pricing but to regulating use and managing dissent and stressed, repeatedly, that she would bring such issues to the Headman when they arose. In a workshop the next week women asserted that that access depended on someone taking responsibility and that an alternative idea of self-service charging at a secure place, such as a coin operated machine installed at a clinic, would bring access, security and vandalism problems.

In the six weeks since the community has assumed responsibility for the Stations there have been breakages and further issues related to access. The Ngcobo Station broke when the Headman was away for a day to attend the Chief’s meeting and his son oversaw the station. Both LRs who had previously operated the station were not available to assist and he had to wait ten days until A2 visited the site and fixed a charger. Meanwhile, the Headman was only able to charge one phone at time and not the Tablet, which affected the Tribal Authority’s use of Prototype 2 to record meetings. At Ngogo, the Subheadman’s daughter-in-law took responsibility for a seriously broken component, as she is the only one with access, however, when we (A2) asked to remove the Station to fix it the family objected. They referred to gossip that the Tribal Authority planned to site the Station elsewhere and did not want it to remain in Ngogo since the Subheadman has been unwell and not worked consistently for the Tribal Authority. They referred to inhabitants’ discussions a month before and that, while the Station was owned by Mankosi community, it specifically serviced Ridge and thus would block moving it without full discussion with the Headman.

SUSTAINING PRACTICES IN MANKOSI

Our case-study shows tensions between inhabitants’ strategies and tactics in sustaining community-based solar cellphone charging. To make sense of their practices and perspectives we now seek to contextualise interactions with Stations within the movements through which local people use and share resources. We derive themes from data gathered across studies because, as we hope to show, understanding sustainability in the periphery of technological culture involves becoming aware of the mundane ways people embody meaning in practice and relaxing our grip on narratives and point-based schema that we often apply in relating electricity-use to sustainability.

Paths in Inhabiting Mankosi

Operators’ visibility and routine, in walking to and within the Stations, enabled some, but not others, to integrate their use of the Stations into their routines. Inhabitants do not wear watches so if their phones are uncharged or charging they lack direct personal access to the absolute time represented on signs. Instead, inhabitants often walked to Stations to drop-off or collect phones when they saw operators walking to Stations or if they knew, or could see that they had setup the Station. Indeed, when we, A1 walked with an operator to a Ngcobo Station one morning we passed eight people along the main gravel road, eight visible on hills nearby, and three collecting water at the tap at the foot of the hill on which the Station is based. Similarly, at Ngogo people saw the operator walk up a path and along a track from home and across a ridge to the Station. The Ngogo’s operator did not remain at the Station all day and some women became familiar with, and predicted, her coming and going contextualized in their own routines; for instance, many said they saw her walk up the hill while cooking, so paused cooking or sent a child to collect phones. All inhabitants walk to move around Mankosi, though a few men own bikes or ride horses or donkeys occasionally. To deepen insights into how walking facilitates familiarity and co-ordination and produces meanings in using and sharing resources we describe aspects of the way that people inhabit Mankosi.

In Mankosi, hedges or fences around homesteads do not bound domestic routine and to run their homes women can take at least three times as many steps as most in the West (Bohannon, 2007). Mama NS, aged 52 years, for instance, walks on average 19,058 steps a day, to care for a household of between 10 and 13 people, depending on whether children are away at school. Like some 25% of households her family catches drinking water in a barrel from a zinc roof of a “flat” (square building). But to collect water for washing and cooking she walks three times per day to a communal tap, 2Km from home: just after dawn, before lunch and then again at dusk. Mama NS collects firewood from one of two forests, 1 and 3Km away from home, once or twice a week, and always on Friday when she took 20,449 steps. She hand washes much laundry on Saturday and Sunday, as the children own 2 - 3 school uniform shirts but just one trouser, skirt

and jumper, which requires extra water and incurs 20,500 to 20,800 steps. Within her homestead Mama NS walks to cook on fires outdoors and to the gardens. Her walking is shaped by protocols and taboos, such as prescribing that she, being married, does not cross in front of a kraal where patrilineal ancestors sleep in the day. It is also shaped by seasons that effect what is grown in each vegetable patch. Mama NS took fewer steps on Thursday, when from 1pm to 4pm she always attends the ladies service at church 2Km from home.

There is greater variability in the number of steps men take than women. Some move cattle between kraals and common grazing land, lead donkeys hauling wooden sleighs (Figure 9) or carrying packs of sand from the beach for building. For instance, Mama NS's husband, aged 63, awakes at 4:30am to inspect his kraal and two gardens behind his home for animal or human theft of maize. Then he takes his 32 cows, and sometimes his 47 goats, to pasture and walks back up the hill to tend to a larger garden, a slash-and-burnt patch in a forest 5Km from his home. He returns home for lunch and rests for 30-minutes, between 2pm and 3pm, before walking back down the hill to take cattle to kraals or to a warm area on the beach. He accumulates an average of 19,632 steps daily and once a week he, and his eldest son, drive cattle to dip so he walks 24,601 steps. Less than 40% of men in Mankosi own cows and most have only 3 to 7 cows. For instance, Tata MM, aged 51, has only chickens and pigs in his kraals but still walks 20,224 steps a day to tend his spinach, cabbage and carrots in plots in his garden and in the forest and to the soccer pitch to watch or join his team training in the afternoon. Men spend longer in meetings, answering for their family's conduct or discussing politics in the shade of a hedge at the Headman's home. Indeed, when Mama NS's husband was at a meeting he took half as many steps as usual (10,062) as he expects his sons to tend cattle. Men, more than women, sit drinking in shebeens and chatting on hills between homes. Tata NN, aged 47, for instance undertakes "*ilima*" (making Xhosa beer) which he drinks with others at shebeens, so he can take as few as 1,033 steps a day. Actually, he averaged 8,320 steps a day but this was raised by the day he went fishing and walked to sell crayfish to white homeowners, when he walked 19,758 steps.

Households tend to be fluid and children may move between parents, siblings, grandparents, aunts and cousins. So, for instance, Tata MM (above) walks to help his mother, who cares for his younger brothers and her grandchildren in his former home, in the morning and again after lunch and Mama NX, aged 43 years, walks on average 16,987 steps per day to care for eight family members who live 2Km from where she sleeps. Teens and children also walk a long way to do chores and attend school. Mama NS's youngest daughter (age 15 years) and elder granddaughter (age 11 years) walked 13,729 steps to Junior school, to TransCape's afterschool classes, and in between to fetch water and wood to wash their shirts. They can walk 1,117 steps, just within the homestead cooking and cleaning at the weekend. Another of mama NS's daughters, aged 22, is in grade 12 and her trip to school leaves less time for chores beyond the homestead. The bus leaves early and returns late but saves some 13,300 steps to High School and back. Despite all this walking the girls and young women also participate in netball, volleyball or athletics at school. Even Mama NS's granddaughter who is just 3 ½ years old walked 14,145 steps to TransCape's pre-school, to the store and to fetch water with her mother one day. Through walking the little girl assumes her social role so when it rained she walked 7,992 steps playing indoors and helping her grandmother to cook and clean.

Walking links inhabitants to each other, their setting and entwines with a mundane orality. People devote significant time to talking face-to-face and we often hear women singing or calling to each other or children for errands, as isiXhosa carries well. Often girls and young women collect their water together to chat en route and while buckets fill. Women living close to a stream or dam launder there and chat to others who fill buckets they take home. Women carry infants swaddled in blankets on their backs thus, from 5 months old, inhabitants experience life and an air full of the sounds of wind, livestock, and voices and start to embody local rhythms and pace and the conventions of mandatory oral exchanges. Women rarely carry anything in their hands but rather on their heads, which they hold high and faintly tilted, able to greet those they pass and chat with those walking with them. Perhaps the way walking shapes sociality contributes to inhabitants' ease with bodily, platonic proximity and, especially for women, harmonizing voices in song, in meetings and along paths. Such sociality may contribute to tolerance in sitting cramped with over 15 people in canopied Coupe Utility taxis and to huddle amiably around radios or when interacting with Prototype 2. "Where are you going?" - "Ou api?" - is one of the first phrases a foreigner learns, denoting our visibility. People develop a pace that endures the demands of long distances in difficult terrain and, in turn patience, as no meeting starts 'on time'. We (A1) were charmed by a friend who aptly caricatures the idiosyncrasies of others' gait, and humbled when others tease us about our (A1) hurried, Western march when we feel we are 'running late'. Many walk shoeless, even in winter, and their bodies remember information about their land while they preserve shoes for church or school. So too walking routines tune those of animals who wandering languidly along tracks, and often into homes. When people collect other households' cows,

along with their own, each set leaves the main gravel track at the path to their respective kraal and within two days goats learn when people will return them to the kraal.

Familiarity and Co-ordination

Inhabitants' visibility and sociality embodied through walking enabled them to coordinate to charge phones and shapes their phone use in many ways (Bidwell et al, 2011). Many sent a child when they saw an operator walk to the Station, some always sent the same child, others the child that was closest and sometimes children walked together. Whichever way though, operators always recognized children and knew their relationships with phone owners. Children often act as messengers for their elders and, under some kind of supervision, may assist textually and/or technologically illiterate inhabitants in using their phones. For instance, a mother in her late 20s, who recognizes names but cannot read and write, always wait for her 13 year old daughter to walk home from school to read messages and missed calls to her.

Familiarity with each other's routines, names and social affiliations, literacy, relative financial ability and ownership, shapes local phone use in many ways (Bidwell et al, 2011). Inhabitants vary in how long they have owned cellphones and some 45% do not yet own a phone. This contrasts with the, increasingly typical, perspective that cellphones are ubiquitous in South Africa, which derives from assuming certain relationships amongst statistics about people, service subscriptions and phone purchases (e.g. ITU). A few people have owned phones since 2001 but most have owned a phone for less than 5 years, many acquiring them since 2010. Some men, who had worked away from their village, said that prior to owning a cell-phone they phoned or sent Callbacks, using another man's phone, to someone in the village who would walk to take a message or the phone to their wives. A decade ago various systems of passing messages entwined with walking. Older people said children who walked to school posted and collected letters, to/from family members working in mines or cities, at the store in the south of Mankosi. Many asked someone in the village, who they trusted, to write for them as they cannot do so themselves. People obtain work and lodgings away from home via local contacts, so they mentioned systems where migrants conveyed messages for each other: *"he will pass message to me so that he will send a message to his wife or her daughter"*.

This same familiarity embodied through walking shapes cost-free use of phones. For instance, inhabitants buzz and use Callback services, as alerts and to communicate "phatically" (Donner, 2008). Some use Callbacks identified with their name or send highly abbreviated messages. Cost constraints mean that in public inhabitants tend to interact with phones briefly to glance at a Callback text, or the caller ID of a buzz, or receive very short calls, which barely interrupt walking or face-to-face conversations. Familiarity enables inhabitants to determine the suitability of buzzing, using Callback or "Voice-mail lite" (leaving voice messages on phones). For instance, although three women all owned the same model they knew that *"voice mail messages did not show"* on one woman's phones. Occasionally people plan coding systems to pass information for free, for instance: *"When the members of the church they are moving away they used travel on the road they used to buzz, buzz someone to ask where are you now? Are you traveling safe? Something like that."* ... *"and if there is a problem they tell them that they must buzz them to tell them so that can know that there is a problem that happen so they can get information early"*. Familiarity enables people to distinguish the meanings of digital homonyms (Donner, 2008) like buzzes and Callback. Young people use Callback to send messages intended for friends but, because providers allow subscribers to change the text just once a day, they will also send this same message to others, such as a family member, who they intend to alert with the Callback but do not expect to read its text (Bidwell et al, 2011).

An interesting link between walking and phone-use lies in the use of names, which carry information about people's paths in life spatially, temporally and socially. Names associate with homesteads (Bidwell, 2009) and encode social relationships symbolically and syntactically: a child's first name must be unique locally and denotes a family story; a last name may be an ancestor's first name; and, nick-names relate to local anecdotes about them (E.g. Tata Friday, Tata Kingsize). People often have many first names, one given at birth and another at circumcision or to a wife by her husband on customary marriage and some adopt their own English names. This context shapes how people personalize and understand Callbacks (Bidwell et al, 2011); for instance, an older man said that a clan name was formal and might express that the sender was *"really desperate"*. However, naming variety presented difficulties in analysing Station logbooks even if operators knew the names of those dropping-off or collecting phones.

Visibility and Privacy

We do not seek to frame a walking as bucolic bliss (see: Bidwell and Browning, 2010), as ill-health and early death in Mankosi is rife. The nearest clinic is a two-hour walk and many inhabitants consult a bio-

medical doctor once a decade despite health issues from intestinal worms, cholera, TB and a HIV prevalence of 29%. In just 18 months ten people, aged 14 to 75 years, died in different homesteads within a 1Km of our (A1's) home and children's distended bellies and tiny physiques imply poor nutrition in Ridge. None-the-less, without romanticizing, inhabitants value their sense of belonging, security and natural environment. Some never go to town and many say that family members in cities live in fear in townships and will always return to the village they call 'home'. Inhabitants work hard not just to subsist but also to maintain cohesion despite social tensions, such as those emerging around Stations. It often seemed that the Tribal Authority sought to *show* that their decisions were transparent and based on community consensus. Managing bonds demands inhabitants to conform, manage clan feuds and avoid jealousy, gossiping tongues and witchcraft, which like HIV, they do not discuss publically.

Balancing privacy with the noticeable routines that facilitate coordination and cohesion shapes paths of habitation. People use PIN codes on phones to prevent airtime theft when they leave their phone to charge, but may disclose it to close relatives, who they trust with proxy-use. Wider access to phones had changed some inhabitants' patterns of calling to one another or walking between homesteads. An older man said he would "*shout-out*" depending on how "*serious*" was the issue; a middle aged man said if he had airtime he called but, otherwise, buzzed, used Callback, or walked; and, two sisters, in their 30s, and their 70 year old mother, living in neighbouring homesteads, said they used a "*mixture*" of buzzing and vocally calling to one each other, depending upon their reason. They all said that there were no disadvantages to the ways phones helped to make their lives more private than in former times.

After nightfall, and when it rains, paths of inhabiting contract. On pension day or weekends, some she-beens stay open after dark, their generators noisily running a light bulb and, maybe, a CD player. Normally, though, inhabitants are in their homes after 8pm, a paraffin lamp flickering dimly here or there; but most asleep, avoiding the darkness and its ghosts. Living in close proximity, where same-sex family members often share beds, demands carefully protecting privacy even in the dark. People must plan to make private calls and some younger inhabitants secretly use MXit or other chat services. When we pass teenage lovers, some swiftly switch off a torch of phone-flashlight as we approach and one inhabitant said he conceals nocturnal rendezvous by disguising the sound of his footsteps.

Using, Re-purposing, Storing and Sharing Resources

Perspectives on Station use and sustainability reflect a lack of anonymity, co-operating to survive and social norms in performing collectivity, rather than 'being green'. To better understand how inhabitants' walking worked to ground these motivations we now turn to other practices in using and sharing resources. People are unaware of narratives about sustainability prevalent elsewhere, like climate-change or global warning, even though some are, or have been, employed as laborers on government conservation projects, to curb invasion by non-native species at the river mouth and clear up coastal trash. Without refuse collection some people "*throws cans and glass in the forest*" and others burn it with paper, which they amass in a shallow pit, often next to crops or medicinal herbs. They do notice the forests' rapid depletion, caused mostly by their own gathering and goats, and that their crops are affected by changed rainfall patterns. However, norms mean people consider their resource use non-negotiable for survival. Tensions exist between expectations of local and government control of land. Within two weeks at meetings, first with visiting officials and then about a theft in a village, we heard inhabitants express satisfaction about the municipality's plans to install hygienic flush toilets in Mankosi; ways to increase local voter registration to gain another electoral ward and petition for electricity; and, then their need to conceal an illicit income-generating crop, where a Messenger said "*If we are one we don't need police station. There is nothing that can defeat us if we are together*". Unlike the enduring local bonds between the living, and between the living and the dead, most material structures in homesteads last less than fifty years. Indeed, ancestors' graves, in or near homesteads, tend to outlast buildings, fences, gardens or kraals. From dawn inhabitants' daily practices assimilate the fabric of the 'natural' environment into homesteads through, of course, mundane practices of walking. Girls regularly re-surface floors with fresh cow dung, to keep homes warm and dust free, and women take grass ropes to forests to collect firewood, which they stack in woodpiles by their homes. In winter, men make mud bricks where the clay is good and women gather grasses, with which they make brooms and mats or men thatch roofs.

Using, Saving and Re-using

Mankosi's inhabitants share similar motivations of finance and comfort as 'low-income' households in urban and developed regions (Dilahant et al., 2009). Households do not access or accumulate bills for cen-

tralized 'utilities' and, in one way or another resource use is almost always 'pay-as-you-go'. Parsimony in using the subsistence basics of water, fuel and food ties to bodily work effort, as there are no switches to flick, kitchen or bathroom taps or ways to store perishable food. So people experience the motivations of comfort more directly than 'low-income' households in urban and developed regions (Dilahant et al., 2009). For instance, using grey washing water on the garden spares collecting more. Perishable foods always involve bodily effort whether that is picking tiny amounts of from gardens (maize, tomatoes, onion, spinach, onions or butternut), if not already eaten by goats, or walking to buy at a spaza (maize, potato, cabbage, fruit). About 10% of homesteads own freezers, powered by pressurized gas tanks, delivered monthly on trucks, but they use this for storing beer and "cool drinks" (Coca-Cola, ginger beer) to sell in shebeens. Many have paraffin rings for fast cooking, but cook dried food staples in caste iron pots on fires. Most people rarely eat meat but not to reduce carbon footprint. A few men hunt "bush-meat" (rodents) in forests or, in south Mankosi, catch illegal undersized fish in the ocean. Families own a few farm animals (e.g. a pig, chicken or goat), which they feed with organic waste and slaughter for holidays or ceremonies.

Survival and social obligations influence how people store, re-use and save. People store non-perishable food and shop in relative 'bulk' on, or just after, monthly pension day, and spend R500 to R1200 per family, in spazas or in Mthatha, if they can afford the bus. All women buy flour, to regularly bake bread, and most buy a subset of dried food (rice, maize meal, samp, beans); food in tins or plastic (fish, mayonnaise, oil); candles and 'Omo'. Women collect more wood in advance of times when they will be too busy to gather it, such as two weeks prior to their maize harvest. People re-purpose some items, using oil containers for storing food or carrying water, wire for toys and wax dripped from burnt candles to start fires. Storing wealth in cows remains significant for 'lobola' (customary bride price) and status, and some older inhabitants say "*its easier to eat money than cows*". Most locally do not have such wealth and households dedicate any cash saved to parents' funeral plans, at around R100/month per person, which is commonly thought to offer meager return. For instance, after a decade of contributions, a grandmother's plan provided enough for a modest burial, a marquee and four sheep to host and feed mourners. However, like lobola, investing in these plans is normalized by social penalties for descendants who cannot cover the hospitality expected at a funeral. Conflicts arise between short-term family obligations and longer-term effects, such debt or keeping one's job. People accumulate tabs at spazas or loans from others and a month before Christmas we needed to, amicably, adjust salaries according to inconsistencies between operators' records of work hours, log-book records and ad hoc observations.

Inhabitants' phone use also directly relates to motivations of cost saving, comfort and deep social bonds. Inhabitants spend on average 10% of outgoings on airtime, at R6 to R18 a week (US\$.75 – \$2.25) using coupons in R5 or R10 values, marked up by R2. At the current lowest rate of R1.50 (US\$.19) per minute, with R6 one can speak for 4 minutes or send about twelve SMS. So, people make only short voice calls, often at cheap times such as at weekends or 4am, and more often use their phones for receiving calls, 'buzzing' deliberate missed calls and using Callback. During the trial people spent the R5 a week, that they would otherwise have spent on charging, on extra airtime only if they wanted to call someone but usually bought food or possibly cheap alcohol. For almost all people electricity use exclusively relates to cell-phones since they have few devices, other than battery-powered radios. When people pay to charge their phones they expect full charge and feedback about batteries on phones helps them to conserve. For instance feature phone owners spoke about how they liked to use their phones to listen to music but they could not listen everyday as they prioritised calls. One young man said "*Yes, if I have a battery I listen to the music*" in the evening, but that he sometimes "*worried*" that he should not listen to music because his battery would run out and another said "*Yes, sometimes when I want to listen to the music, I listen to it, even if I notice that my battery is low!*". People's difficulties in charging phones profoundly shaped research activities and interactions. Often it would take three days of repeated attempts to organize research activities because the phones of people involved were uncharged. The practices of those few people owning solar panels do not support longevity as they have no way to measure voltage so charge phones or watch TV until the battery is flat. People knew not to come to Stations in the rain because they know the battery would not be charging but on the other hand, as one inhabitant said, he "*doesn't mind if the weather is bad*" because he will use his cellphone.

Using most material resources involves bodily effort, which limits consumption, but storing digital resources requires discipline and dilemmas arise in choosing what digital media to retain when storage capacity is limited. For instance, in discussing her photos of animals a young woman, who owned a feature phone, said, "*Yeah, I like them very much. The problem is the space, sometimes I want to keep them, then when I see something that is interesting in other time I have to deleted the pictures, some of the picture and*

captures.” And a young man explained “I have these nine songs in my phone and I think they are from long time ago, then there is a new one that I heard now, so I’m just excited to hear that song, so I have to delete, even if I like it or not, I have to delete it.” Some phone owners are aware of different data stores and spoke about moving music to make space for other media, but not all have memory cards or know how much media their phones can store. Of course, practices in balancing long-term storage and short-term use vary. A woman feature phone owner found it difficult to choose what to delete but seemed to favour novelty: “Mm, it’s very difficult when I have to choose because I have to think, I have to think, because you see I like everything that I captured in my phone, so mm, I have to decide whether, about at the time say oh ... Then I have to think that oh this one I have got a long time, I’ve captured this thing for a long time “...” So I’ve been looking for a picture for many, many days, so I have to delete it.” In fact, practices suggest that young people, at least, value that which is “fresh”, a local idiom for things that are new and/or energetic; as they borrow popular branded clothes from each other for novelty. With respect to digital resources many said that they deleted music they had listened to ‘enough’; for instance, a young man explained: “Yeah, if my phone is filled up I used to delete the ones I use, I kept mostly long times, so that I want to take new stuff, something new, something fresh, so I delete the old stuff and input new stuff yeah”.

Sharing and Owning

Social norms dictate, at least a facade of, sharing but perspectives vary between and within families. All inhabitants are involved in cycles of exchanging favours and some in lending and borrowing money. These vary from mundane interactions within villages to more deliberate gifting of a bottle of brandy or crate of beer to the Tribal Authority to obtain a local job opportunity. Obligations for mutual hospitality mean sometimes people conceal resistance. Family members eat together at lunchtime and serve themselves from the pot when they are hungry at night, but if they eat chicken they tend to do so after dark to avoid sharing. Elder brothers inherit the financial responsibility in families, and are obliged to support unmarried and widowed sisters, and their children, as well as siblings in education. These responsibilities are normalized locally, but differ for those who have experienced greater autonomy. For instance, one LR contentedly said that he gave his only warm coat to his brother studying in university while another, unrelated, well-remunerated city-based student felt disgruntled by expectations from home for support.

Inhabitants are familiar with the few things that people own individually and a powerful social contract limits local theft and damage to property. Inhabitants always know and protect each others’ animals and complain to owners if any enter their garden. Operators always diligently turned phones off to avoid accusations of airtime theft. Homes are often left unlocked, though spazas and established shebeens have grilled doors and barbed wire fences. Some people have reputations for pilfering, including from family members but, generally theft locally is spoken about as committed by, or in collaboration with, tostsies from beyond the village such as drivers repairing trucks in Ngogo. Inhabitants reiterated that the “*community must work together*” on matters of theft; and, we retrieved a project phone stolen from our desk, and buried in bushes out of view, by agreeing not to disclose the thief’s identity or report him to the police or Tribal Authority.

Ambiguities arise with respect to sharing and protecting communal resources. People expected the Sub-Headmen’s family to provide access to their home and the station situated in their role, rather than business. Fifteen older and younger women said that the fee to charge at Ngogo Station would cover replacing broken components and only three younger, and mostly more technologically literate, women recognised the operator’s work. When we (A1) asked what would happen if a person insisted on charging at the Station when the battery was low in order to make an urgent call inhabitants energetically and unanimously agreed that the s/he is “*aiming to destroy*” it. Given the breakage at Ngogo after the end of the trial we conjecture that aspects of access reflected the operator’s sense of responsibility for the Station. Until deploying Prototype 2 few people used the Ngogo Tablet, as indicated by the lack of media content uploaded and scratching on the screen protector. Indeed, the operator stored it out of view, was reluctant to let go of it, even in supervised workshops, or to young men who came to use it. We also had to reflect with the Headman that his protests, when LRs took the Tablet around Ngocobo, to register people, might contribute to concerns about his use of Prototype 2 in meetings. There are however, tensions between communal and individual territory and shared resources. The Tribal Authority, in discussions with residents, grant people land on which build homesteads and references to such territory arose in discussing ownership. Women in all groups agreed that water, collected from a zinc roof in a barrel, belonged to the roof or the barrel’s owner assuming that he was the householder; but if, hypothetically, the roof encompassed many households the women agreed that water was communally shared, much as in village dams or taps. However, earlier when we outlined the process of solar energy transduction and asked “who” owned the power in a Station’s bat-

tery a larger group of less technologically literate younger women swiftly, unanimously, decided that residents all owned the power in the battery and three older women (mean age: 50 years), who first said that all community-members own the power, decided to differ: one suggesting the battery owns the power and another that the sun always owns it. The six more technologically literate women (mean age: 29 years) also differed; half said power belongs to the battery and the remainder said it belongs to the sun. The women engaged in these riddles as amaXhosa often do, with laughter and amiable disagreement, and we did not extend the paradox to ask if the sun's energy in a battery related to the territory occupied by the panels.

We speculate that the ambiguities that arise with respect to sharing communal resources may reflect the way people construct self less autonomously than in the West (Bidwell, 2010). The Sub-Headmen's wife said that she could not undermine the decision to house the Station because her husband "*is the owner of the household*". In customary marriage, variously interpreted these days; the male line literally "*captures*" the desired wife when she walks on an errand, usually by prior agreement with her family. Tribal Authority and many other people said, repeatedly in wide ranging contexts that a person who records another owns the media recorded. When people share media, such as using Prototype 2, recipients all own the media shared or, as one group, expressed "*it is not her's, it is everyone's*". Should a person object to sharing media of them "*there will be a fight*" or "*trouble*" that requires negotiation with the recorder. Recording incurred occasional resistance. Some people in meetings objected to the Tribal Authority's avid use of Prototype 2 to document meetings, sometimes participants in interviews consented to audio, but not video, recording² while young people explained that people covertly take photos of others without permission. Indeed, we (A1) had to insist, in several situations, that no one, such as well-intentioned LR's, should ever insinuate that project equipment could covertly record or track users.

LOCAL LEGIBILITIES AND NARRATIVES

Our account of everyday routines in inhabiting and using, re-using, storing and sharing resources foregrounds how inhabitants walking creates the fabric Mankosi and embodies sociality. We now seek to make sense of how inhabitants' repetitive encounters with their environment perform community and shape meanings. Dourish and Bell (2011) apply the term "local legibility" to the way we work in, engage with, and make use of our everyday settings, objects and actions. They refer to Scott's (1998) description of polycrop farming which ensures sufficient yield by drawing on a store of knowledge and practices grounded in an African farmer's long-term, repetitive encounters with the local environment and narratives about it. In Mankosi people ground knowledge about practices in using Stations in their own habitation and their own walking or, in other words, legibilities emerge within different paths that both interconnect and diverge in performing community. Thus, next we offer two analytic categories to show how social roles tuned the literacies of Station users and non-users.

Legibility in Gendered Walking

We propose the meanings that inhabitants' made about phone charging were, in part, situated in the walking practices that make routines and social commitments legible and these are shaped by gender. We refer to both the discontent of Ngogo's Sub-Headmen's wife with the Station in her home and local meanings generated about who charged phones. Our observations and logbooks suggest that women visited both Stations more frequently than men. This is consistent with local population statistics, as there are more women locally, since men are more likely to work in cities further away. However, it does not correlate with phone ownership statistics as only 56% of females but 76% of males over 14 years own cellphones and across all age groups male phone-owners spend more on airtime than females and make more calls (Bidwell et al, 2011). Further, each site had different gendered characters. Women operated Ngogo Station and were always very visible, doing chores, but men operated Ngcobo Station near the office where men, and some women, come for business and at least 15Metres from where the Headman's wife's does her chores. Accusations that Ngogo's operators prioritized charging their friends phones came from men who had been unable to charge but the women said that they had few problems. But, importantly, at Ngogo, while men brought at most two phones the women brought the phones of their households including their husbands, and rarely owned more than one phone themselves. Both women and men less frequently bought other family member's phones to charge at Ngcobo. Women in Ngogo also adopted patterns of charging approximately once a week, which enabled them all to charge. In the age group 14 and 24 years females do

² A1 strictly adheres to a principal of non disclosure of audio-visual material unless she obtains specific permission explained in direct relation to the venue in which she publishes it

spend more on airtime than males (Bidwell, et al 2011), but men more than women said that if their phone was uncharged they would miss calls and sometimes they were unable to find, by walking in villages, the person they sought to call. We speculate that men's greater access to phones, time spent talking together and that, during Station operating hours, they were further from homesteads meant they were less likely than women to notice movements to, from and around Ngogo Station. Further, their literacy in reading Station routines was influenced by local narratives about male territory.

Legibilities in Age

Although children often brought others' phones for charging younger phone-owners, particularly those aged 12 to 22 years, had less access to Ngcobo than Ngogo Station, due to the formality associated with the Headman's homestead and the way operators enforced rules. At Ngcobo the younger operator, who lives most locally, sought to act responsibly and with respect to protocol and asserted that people must come to the Station to charge phones. However, youth are not at ease with socializing at the Headman's homestead and elder authority also made it difficult for younger operators to assert some rules when older people dropped off phones and, perhaps, to engage older people in learning to operate the Station in ways that would sustain it. Older people said that younger people's phones require charging more often, since they "played" on MXit, Callback, games and listened to music. Yet, the gap between elders and youth critically effects designing for sustainability, cohesion and stability in Mankosi since there is a dramatic generation gap caused by the effect of AIDS-related illness and migrant working practices.

TUNING OUR LITERACIES BY WALKING ALONG

Men, women, young and old in Mankosi are oriented by communalism but their choices and actions along the way are situated in how walking performs social roles and are legible through their own routines. People did not defy the rules of operation, by sending children or taking several phones, merely to resist intentions of community and sustainability but because social norms effected their practices. That is, even in a society where necessity and/or values privilege visible conformance and co-operation, the nuances of shared and unshared routines gave rise to different perspectives on access. Our modest theory on how social roles tune legibility through walking leads us to consider tensions between local and external legibilities revealed by our (A1) inhabiting Mankosi. The categories of gender and age refer to local protocols but our account generalizes observations within a Western reality (see: Verran, 2002). As designers and researchers we draw on standard schema, such as about work, land or resources, which help us to order elements of settings coherently and make sense of diverse settings. Indeed, often we embody understandings tuned by the "panoptic legibility" of modernism and central planning that Dourish and Bell (2011) describe by citing Scott (1998). In contrast with local legibility this "view from without" is characterized by dislocation and distance and, as we show next, brings with it tensions.

We (A1) encountered dilemmas in the representations that facilitate very basic aspects of research. For instance, to support Station operation by paying for people's work we adopted a representation of time that demands a legibility that was often incompatible with local practice. Firstly, people do not use watches or clocks other than on cellphones but often sense time through movements and sounds, like human and live-stock patterns, the sun's travel, cockerels and birds stirring and stilling. Secondly, as we have noted before, rural Africans manage time "polychronically", or in relation to social relationships (Bidwell et al, 2011; Bidwell and Winschiers-Theophilus, 2012). Finally, in Mankosi time is effected by, and understood through, walking. Our research activities rarely started at an scheduled time; as typified by our (A1) final meeting, arranged around a airplane flight: we waited two hours for participants to arrive and then half an hour more as one drunk tea after his long walk. Of course, we sought local appropriation of the representations embedded in our research and, just as much as de Certeau's pedestrians' tactically resist city planners by moving along, the Headman and everyone else flouted the Station's operation times.

In everyday life our (A1) use of technologies manifested various norms, some local and some embodied through sociality as researcher, whether or not we actually socialized with other Western researchers. This sensitized us to how technologies, shaped by non-local legibilities, can be incompatible with local practice. In designing Charging Stations we (A3) were constantly aware of trying to transcend developed-world experience of 'good' systems in creating something optimised for sustained adoption and appropriation by communities with different priorities (Marsden, 2008). Yet, embedded in our design were certain narratives about 'situated displays' and certain relationships between artefacts and mobility and between portability and security. The Tablet is portable and inhabitants stored it securely with a responsible person and situated use, especially of Prototype 2, in meetings in different places. The wheels on the sack trolleys, however,

have limited mobility in Mankosi and tethered the Station to a location, although they rolled well on a suburban lawn. Thus, the Charging Stations and Tablets “spatialized” (Dourish 2006) in different ways. Our representations of mobility and security, embedded in the Station, interacted with existing spatialisations that produce, and are reproduced by, local social roles. We might have designed in more appropriate relationships between mobility, security and access by considering how local people walk; for instance, by mounting phone charging on a donkey to move along the paths of people of different genders.



Figure 8: While A3 designed the Solar Stations in a home in Cape Town (a) the Headman’s family members and neighbours prepare a sleigh to carry produce (b) and inhabitants of Mankosi walk (c)

Our representations reveal and obscure choices and actions, which not only constrain design ideation but also tune research paradigms and methods. Consider how we often collected data at discreet geographic milieu, which we later integrated in constructing knowledge. Many of our methods sampled practice in abbreviated and stationary ways at an array of points. So, without referring to walking our methods produced spaces that were constituted by the “*intersections of mobile elements*” (Dourish, 2006:117) rather than the going along that interrelates “*differentiated positions*” (Dourish, 2006:97). Locations and intersections are linguistic, mathematical and tangible conventions and tools that help us to manage the fact that inhabiting is topo-kinetic, not topographic. So even though origins, intersections and termini order narratives they do not neatly punctuate our mundane practices. Technologies and methods continuously reproduce and legitimize knowledge that is built up from such abstractions and classifications. Ingold terms this “occupant” knowledge which “*is upwardly integrated founded upon a categorical distinction between the mechanics of movement and the formation of knowledge, or between locomotion and cognition*” (Ingold, 2000: 229-30). We (A1) gained insights about electricity, sociality and saving phones as much as by inhabiting Mankosi and co-ordinating research activities as by interviewing at loci; and, local researchers (A1, LR) naturally interviewed along paths, roads and gardens (Bidwell et al, 2011). But, to accumulate data in short research visits external researchers’ (A6) interviewed inhabitants indoors.

We are often quite unaware of how knowledge about practice is configured through representations and how our embodiment of representations obscures continuities in the practices we seek to understand. Consider how our use of visual media in research contributes to a certain legibility that eliminates local variables and patterns. For instance, we (A1) communicated with external researchers using a Google map; but, when LR mapped the sites where they interviewed they drew stick-figures on hills and football pitches as much as buildings and paths. Indeed, few older people in Mankosi can read aerial view maps but know where families live embodied through walking, talking and ‘reading’ the furniture of rural life through so-

cial relationships (Bidwell, 2009). A foreign visitor experiences this as an aural 'scape', at distance, especially if they do not speak isiXhosa and, indeed, Pink (2008) shows how urban mobilities and routes have influenced visual culture. Some external researchers, but not all, were deaf to our (A1's) concerns for oral legibility and repeatedly framed print-illiteracy as a deficit, shaped by values propagated by print-facilitated culture (Finnegan, 2007, Kascula, 2002). Yet, visual media, including printed text, invoke spatio-temporal summaries, boundaries and separations; distancing us from our going along within settings and isolating us from how we construct the world continuously in movement (Ingold, 2008).

Our SA-UK collaboration illustrates how the parochialities of Western technological culture privilege certain legibilities. Dilemmas can make visible the power we assert; for instance, inhabitants proposed a fee to charge during the trial and, while we were all uneasy about undermining local business, we also thought payment would compromise access to Prototype 1 and our software agenda. Politics shape legibilities and affect understanding practices. External researchers assumed local use of Callback services meant print-literacy and projected this onto likely adoption of MXit, which is prevalent amongst people in low-income areas in SA (Kreutzer, 2009). As a result Prototype 1 was unsuited to Mankosi. Similarly, the implications of a solar-only solution and delaying research to the wet season were illegible to those who had not looked disconsolately at an overcast sky, wishing to harness the wind that whipped spectacles from our face, slipped down muddy hills in gum boots or unbogged cars on wet days!

CONCLUSION AND FURTHER WORK

We cannot claim to know yet what sustainable HCI means to Mankosi's inhabitants rather we seek to provoke greater reflexivity in the going along through which research and design creates environments. In Mankosi homes and household essentials, such as water, wood, grass and mud, are assimilated by the land, unlike the toxic un-biodegradable chemicals of spent deep-cycle batteries, and practices of use extend across homestead boundaries. Thus, the meanings that emerge, amidst inhabitants' own, and their ancestors' footsteps, differ from those embodied in the ways Western researchers and designers inhabit households. In constructing meaning about sustainable practice we recognize not only how we negotiate with, and are positioned relatively to, the settings and people we study but also the historical processes and theoretical traditions that influence our assumptions, motivations, and methods. Such reflexivity demands us not just to turn insights back on ourselves but then turn the insights we learn about ourselves back again on the contexts we study. For instance, we were sensitized by ways of walking to the spatialising effects of our methods and designs and provoked to read practices differently.

We have described data on some of the temporal qualities in the ways that walking shapes sociality and resource use but not depicted the details of people's paths made around the Charging Stations. However, we hope that by illustrating how walking shapes legibility and helped us to interpret practices, that unfolded around community-based cellphone charging, our case-study will promote a more 'alongly' integrated approach to gathering data on sustainable and unsustainable practice. Every intervention aimed to explore and design for sustainability must account for the ways resource consumption and information transmission entwines in moving through. Sustainable practices in Mankosi are motivated by cost and comfort but also by communalism, and all are grounded in a sociality that is embodied in walking. As a result of access to electricity and phones domestic spaces will inevitably contract; and this will alter practices of sharing and belonging. Thus, we encourage researchers exploring shared practices and norms to appreciate that "*Not only then do we walk because we are social beings, we are also social beings because we walk*" (Ingold and Lee, 2006:2). And, we ask those designing in the periphery of HCI to notice that it is walking that connects human's and non-human's bodies and routines to the earth and the sky, the wind, the rain and the sun.



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AUTHOR STATEMENT

This article is completely original and we have no other closely related prior papers or concurrently submitted papers. The theme of ‘walking’ features in Bidwell’s prior work over the past decade, though not in the context this paper describes. Bidwell and Tucker have published our work in this setting before, as shown by our prior work which we comprehensively cite. None-the-less all the design and data we present and our analysis is a completely novel contribution.