

Minding the Gaps: Cultural, Technical and Gender-Based Barriers to Mobile Use in Oral-Language Berber Communities in Morocco

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ABSTRACT

The proliferation of text-based applications in the Mobiles for Development (M4D) domain tends to privilege the conventional wisdom that texting is a ubiquitous skill among mobile phone users. This view obscures many real and present barriers to using SMS and mobile features, most critically where low literate and/or oral language-dependent communities cannot rely on text as a viable communications system. This paper investigates mobile “utility gaps”– the spaces between high rates of mobile phone ownership and low use of productive features on mobile phones. These gaps preclude the adoption of many text-based development initiatives, which in turn affects the potential impact of such initiatives. Working with low-literate Berber-Muslim women in a predominantly oral-language community in rural southwest Morocco, we have found that an overall lack of functional literacy and numeracy is a major contributor to a mobile utility gap in that community. Non-standard mobile phone interfaces, a complex language environment with both Arabic and Berber dialects and multiple alphabets and gender-specific cultural norms also present significant impediments to using mobile phones as a development strategy in the Berber communities studied. Furthermore, we explore the paradox of social networks where a reliance on others to assist with phone use is often coupled with surveillance and a loss of privacy. These results are potentially relevant to projects involving other indigenous communities in North Africa.

Categories and Subject Descriptors

J.4. [Social and Behavioral Sciences]: Sociology; **K.3.2.** [Computing Millieux]: Computer and Information Science Education --- Literacy.

General Terms

Design, Human Factors, Languages, Theory.

Keywords

ICTD, Mobiles for Development, M4D, mobile phones, gender, Morocco, Berber, HCI, HCID.

1. INTRODUCTION

Mobiles for Development (M4D) initiatives contribute to the approximately nine trillion SMS messages sent in 2012 [1]. With more than six billion mobile phone subscribers around the world [2], M4D strategies are predicated on the assumption that mobile phones can be a “smart catalyst to development” because they are often “the first and the single modern technology personally owned by the poor (p. 1)” [3]. However, the utility of mobile phones – and by extension M4D programs – can only be realized to the degree that end users are not disadvantaged by a “utility gap” [4]. Ownership of a mobile phone does not lead to de facto use of SMS or text-based features. This is especially true among many low-illiterate, rural mobile users in developing countries who have little or no formal education [5-8]. Kang and Maity [3] observe that a high *quantity* of mobile phones in developing regions “does not automatically translate into high quality impact of mobile communication (p. 20).”

Most M4D applications assume a higher level of texting ability and SMS use than we observed in traditional Muslim-Berber communities in southwest Morocco. Bhamidipaty and P. Deepak underscore this observation, noting that mobile devices “assume a reasonable amount of literacy (p. 389)” [9]. Mobile systems such as mPesa [10] rely on basic literacy and numeracy to operate the service. FrontlineSMS [11] services are predicated on the ability to understand and potentially take action on SMS alerts and messages. Many of the features of the Ushahidi [12] crowd-mapping platform employ text-based tools including SMS and social media. UNICEF has embraced the RapidSMS [13, 14] platform to strengthen its programs and is leveraging SMS for data collection, logistics and community feedback. SMS advisories are widely used in mHealth initiatives such as sending drug reminders for HIV/AIDS patients [14]. SMS has recently been used for political activism and social change in North and Sub-Saharan Africa [15, 16], and is widely used to inform vulnerable populations in disaster situations [17]. Many more development-related programs rely on bulk SMS, interactive SMS services, SMS-based crowdsourcing, and SMS-based data collection to reach beneficiaries – applications that require at least a basic level of literacy [18-20].

GSMA notes that mobiles and text-based messaging applications may be particularly beneficial to women in developing communities by providing them with access to market information, mobile remittances, literacy and life skills, maternal

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health and family planning services as well as legal advice and crime reporting. This assumption is supported by the association's prediction that women will be the fastest-growing segment of mobile subscribers in low and middle-income countries [19, 21, 22]. GSMA also warns that a lack of SMS use by women constitutes a utility gap that can threaten development efforts: only 37% of women surveyed by the GSMA in 2012 had sent a text message, as compared to the 77% of whom had made a mobile phone call [4]. Lack of education and low literacy can be substantial obstacles to accessing M4D initiatives. According to the United Nations, approximately 775 million adults – one in every five adults – lack basic reading and writing skills, the majority of whom are women (500 million), incurring a huge development cost [23-25].

While the lack of basic and technology literacy hinders the efficacy of M4D efforts, especially for women, we have broadened the definition of utility gap to encompass myriad technical, social, cultural and linguistic factors that we have witnessed as impediments to using the full range of functions and services available on mobile phones. Morocco enjoys relatively widespread mobile connectivity and high levels of mobile ownership, but is one of the least gender-equitable countries, ranking in the bottom percentages in global gender development indicators [26-28]. Ninety percent of rural Moroccan women are illiterate [29], and the ratio of male-to-female school enrolment in Morocco is one of the lowest in the world [30]. Illiteracy is not just a problem for adult women in Morocco: fewer than 15% of rural girls are enrolled in secondary school and 60% of Moroccan girls aged 15-24 are illiterate [31]. The 2012 Gender Inequality Index (GII) ranks Morocco 84th out of 148 countries, far below neighboring Tunisia and Libya (46th and 36th, respectively) [32]. These literacy and empowerment indicators quantify the utility gap underlying women's mobile phone use. The remainder of this paper describes how these gaps have their roots in complex gender, culture and socioeconomic contexts that need to be understood prior to local and regional M4D deployments.

2. RELATED WORK

This research is informed primarily by two academic fields – Gender and ICTD (specifically in a Middle East and North African context), and Human Computer Interaction for Development (HCID), with a focus on technology adoption [33].

2.1 MENA, Gender and ICTD

ICTD research involving women in the Middle East and North Africa (MENA), regions where gender inequities are widely viewed as impediments to economic and political development, is generally sparse [34]. Muslim-majority countries in North Africa are under-represented in ICTD research [35, 36]. Of the available ICTD scholarship focused on MENA, studies primarily focus on the intersection of ICT and religious and civic discourse. This includes Bunt's [37] work on the influence of the Internet and other 'cyber-Islamic' spaces in social, political and religious life; Hirschkind's [38] investigation into the consumer culture of religious recordings; and Shirazi's [39] analyses of the correlation between ICT connectivity with education and civil liberties in ten Middle East and Gulf States. Iahiane and colleagues [40, 41] focus on the use of mobile applications by 'bricoleurs' (workers in the informal sector) to tap their social networks for ad-hoc work, noting that mobiles "sustain or create new pockets of entrepreneurship enabling users to piece together economic opportunities that would otherwise be impossible (p. 34)" [41]. Eickelman and Anderson [42] explore the rise of new media among the Muslim middle class and how it shapes ideas about

social justice, identity and gender relations, creating 'porous', non-exclusive zones and channels of communication that open new public spheres.

Publications specific to women and ICTs in MENA include Wheeler's [43] studies of social media and internet café use for young urban men and women's professional and personal development. She finds that young adults in Jordan and Egypt use ICT tools to explore political and social issues, cultural identities, and especially topics that might be taboo if expressed face-to-face [44]. Davis' [45] study of illiterate women weavers who use e-commerce platforms to sell carpets online balances the constraints of illiteracy and lack of ICT skills against the benefits of using ICTs to obtain information or earn money. She argues that women in Morocco have been excluded from many development projects and suggests "general cultural limitations should not be used to rule out participation in ICT projects by one gender – which is most often females" (p. 20). Hassanin's [46] work with female artisans and their use of e-commerce in Egypt demonstrated that ICT-enabled commerce is not a viable sales option for many artisans due to illiteracy and lack of technological knowhow.

The research on gender, ICTD and MENA fits in the larger body of research that explores near-universal women's barriers to ICTD access and use in developing countries, including time, cost, literacy levels, safety and perceived relevance of technology to women's lives [14, 47-51]. Gill et al. [52] identify four barriers that hinder technology adoption by women: exclusion from technology education; little free time; social norms that favor men; and financial and institutional constraints. Other constraints include high total cost of ownership, technology anxiety, and cultural barriers that preclude women from engagement with technology [53]. Despite often-formidable barriers, Huyer and Hafkin [54] emphasize the potentially emancipatory impact ICT use can have on women, such as increased decision-making skills, greater self-esteem and higher self-worth. Huyer, this time in collaboration with Carr [55], advocate in favor of expanding women's access to ICTs and giving priority to using ICTs to support women's livelihoods.

In addition to gender-based barriers to ICT access and use, other researchers focus on how societal inequities can be replicated in the Information Society. Primo [56] notes that ICT efforts must be gender-aware in order to realize their development potential. Odame [57] reviews prevailing discriminatory attitudes that discourage or prevent women from accessing information technologies, stating that ICTs "are neither gender-neutral nor irrelevant to the lives of resource-poor women (p. 13.)" Buskens and Webb [58] critique ICTs for not being "grounded in the realities of women (p. 4)," which can result in further exclusion or ineffective ICTD initiatives. In their book "African Women and ICTs," they introduce a plurality of women's experience with ICTs to accomplish such development goals as challenging gender roles, creating or expanding opportunity and knowledge, and galvanizing women to pursue social or political change.

2.2 HCID

Human-Computer Interaction (HCI) in the context of developing regions, often called HCID or HCI4D, is an effort to design ICTs to meet the distinctive needs of users in low-resource communities while coping with limited infrastructure [33]. HCID operates on the premise that poorly designed machines and poorly understood human behaviors can add, rather than alleviate, burdens on users in developing communities. Marsden's comments that "human-computer interaction (HCI) has a large role to play in empowering users and adapting technology to local needs (p. 48)" [59] is

echoed in the work of other user-centered and contextual designers for developing regions including Ho, Smyth et al.; Winschiers-Theophilus, Bidwell et al.; Maunder, Marsden et al.; and Blom and Chipchase et al. [33, 60-62] all of whom explore the challenge of designing systems and devices to meet circumstances in developing countries. The HCI for Community and International Development discussion at *CHI 2008* called for HCI practices to be adapted or modified to suit unique challenges in developing regions. They advocated for an analysis of users that incorporates an understanding of local context and practices as well as economic conditions [63].

In studies of how illiteracy affects users' ability to effectively use their phones, Chipchase et al. [62, 64, 65] identified common coping strategies including rote memorization, visual cues and the use of intermediaries to assist in phone use. Chipchase suggests that the adaptive and creative strategies employed by low-literate mobile owners may be harnessed to design ICTs or interfaces for the developing world: illiterate participants may be "lead users for the rest of us (p. 17)" [65]. In devising a new User-Centered Design for Developing regions methodology, Maunder and Marsden et al. [61] stress the importance of developing the technology user alongside of developing support structures in the user's living and working environments through a progressive participatory design approach in order to most appropriately reach and train users. This is made all the more complicated in non-familiar environments. Winschiers-Theophilus and Bidwell et al. [60] investigate the complexity of cross-cultural design in their research on rural-urban migration in southern Africa. They determined that standard ICT functionality based on hierarchical structures and text-based searches did not effectively map onto oral-knowledge communities. Wong and Kodagoda [66] make a critical case for "knowing your user" and reducing abstract functionality and interface complexity. Knoche and Huang's [67] observations of coping strategies and appropriation of mobile devices by illiterate and semi-literate immigrants in Switzerland suggest augmenting rather than eliminating text-based features of ICTs; their results show a positive effect on reading and writing skills. Van Biljon, Kotze and Marsden [68] suggest that while feature overload may increase desirability of a mobile product, it often reduces usability because it adds to the cognitive load on a low-skilled user. They recommend that mobile features be grounded in a user's motivational needs rather than in response to market pressures.

As noted by Medhi, Cutrell and Toyama [69] low-literate users face usability challenges with text-based user interfaces that prevent useful interaction with ICT. These challenges include but extend beyond the inability to read and write, to incorporate "nuanced" issues related to contexts of use, such as "cognitive difficulties, collaboration, cultural etiquette, experience and exposure, intimidation, mediation, motivation, pricing, power relations, social standing (p. 1)". These and other challenges can preclude mobile phone users in developing communities from benefitting from the communication, information and cost advantages of new technologies. Challenges need not always deter a user from benefiting from mobile phone features, though. Smyth et al. [70] present a quantitative study of mobile users in India who exhibited "remarkable ingenuity" and perseverance to overcome obstacles such as complex interfaces and language issues in order to enjoy mobile media sharing services. Similar to low-literate Berber women in this study, the authors suggest that high motivation to use a mobile service, such as media sharing in their case and SMS use in our study, is an important component of successful ICT use.

3. RESEARCHING THE UTILITY GAPS

3.1 Situating the Research—Site Selection and Methodology

We investigated mobile phone use in an Argan Oil Cooperative in Tiznit Province in southwestern Morocco, working in partnership with an NGO interested in understanding if and how Berber women used their phones for livelihood strategies. Traditional life in rural Berber communities in that region revolves around the Argan (*Argania spinosa*) tree, which provides sustenance, fuel, forage and livelihoods opportunities, particularly for low-resource indigenous women [71].

Artisanal Argan Oil Cooperatives in Morocco were set up to provide a reliable source of income for disenfranchised rural Berber women who have few means by which to support themselves [72]. Currently, there are an estimated 120 women's Argan Oil Cooperatives supporting approximately 3500 members, and most of Morocco's Argan Cooperatives are situated in the Souss Massa Draa region of southwest Morocco [73]. An estimated 80% of Argan oil produced in cooperatives enters the global value chain as bulk, wholesale oil for use in beauty products (e.g., lipstick, hair treatments, skin emollients). A small portion of Coop-made exported oil is sold as culinary oil.

Argan oil production is still primarily a manual process done by Berber women at or in Cooperatives. At the cooperative where this study occurred, each member is responsible for manually sorting, cracking, sifting and filtering her own quota of Argan nuts and kernels. To extract the slim almond sliver from the Argan nut, women sit on the floor and carefully pound the edge of an Argan nut (typically the size of an olive) with a fist-sized rock that she uses as a hammer. Women crack the nut open on another, larger rock surface that serves as a work surface. The primary workspace at the Coop is one large interior workroom measuring approximately 7 meters by 4 meters that supports 30-35 workstations where women often work 8 hours a day, five days a week. Women working fulltime may earn between \$60-\$80/month. After kernels are collected and bagged for weighing, they are machine pressed to produce both cooking and cosmetic oil, after which the oil is transferred into jerry cans for wholesale or into small bottles and containers for retail trade. Other Coops and home producers hand roast and stone press the kernels to produce Argan oil to sell locally.

The Argan Coop provided an opportunity to study technical, linguistic and cultural challenges to mobile use in a centralized location with a collective of low-literate women. The lead researcher spent approximately 250 hours at the Coop over four months in 2012 and 2013, interviewing a total of forty women from the Cooperative and four surrounding villages, where Argan oil production is one of the primary livelihoods. Participants were recruited through snowball sampling and opt-in participation.

The overall research design was grounded in Ethnographic Action Research (EAR) [74] which requires "a broad and embedded understanding of local contexts and needs (p. 103)." EAR, as it applies to ICTD, requires observation and analysis of how ICTs fit into the lives of the immediate circle of participants as well as wider social contexts. It demands that ICTs be contextualized within specific communities, and requires that the research be guided by local definitions of problems and opportunities. EAR promotes the rich understanding of a specific place "in its own terms (p. 11)." Consistent with EAR principles, this research had a change agenda that was grounded in an understanding of the role mobiles currently play in the lives of participants. In order to

develop a 'thick' [75] understanding of factors that influence women's mobile use in context, the lead researcher employed quantitative mixed methods including semi-structured interviews, participant-observation, key informant interviews and collection of secondary material to gather data on mobile phone use by low-literate Berber women. Interviews focused on all aspects of phone ownership and use, including phone and service type, average expenditures, how often women made or received calls for personal and professional purposes, and to what extent users accessed text-based features such as SMS or the phonebook. We explored the use of 'beeping' and features such as the camera, radio or flashlight [76] and enquired into the range of coping strategies women use to operate their phones, such as whether they receive help from proximate literates to repair their phones, to read and write SMS messages or dial calls.

3.2 Observations

Interview subjects ranged in age from 18 to 80 years old. Most of the forty interviewees were between 25-45 years old and the majority of them self-identified as illiterate or low-literate. Many indicated they were innumerate, although they have used mobile phones for six to ten years. Participants were active and enthusiastic users of voice services for personal, rather than instrumental communication [76, 77]. They used calling for 'kin-keeping' and to maintain contact with friends. Approximately one-third of the respondents reported that they occasionally made a phone call related to work, such as conducting private sales of Argan oil or informing a colleague they would be late for work. Mobile owners stored phone numbers in small phonebooks – literally scraps of paper – and memorized the location of important numbers on those surfaces. Some users recounted that they memorized a few digits of a phone number and trolled through call logs to identify the sequence before making a call. Most participants did not use text-based features such as phonebooks or SMS: 85% women reported that they could not independently write, read or send an SMS message. When they received an SMS they either ignored it or had a child or literate friend read and respond to it. Some semi-literate women reported being able to read portions of incoming texts, but found it difficult to craft and send responses. No participant reported using voicemail.

The women had an eclectic array of simple and low-end feature phones, ranging from basic, small-screen, old-model mobiles, to flip phones with cameras and color interfaces. Smartphones are not always available, affordable or accessible to low-income Berber women¹. Women obtain their phones from a number of sources including the souq (market); as hand-me-downs from family members who bring new and used phones back from Europe; as well as the purchase of counterfeit phones from unscrupulous cellphone dealers. Old, used, simple feature phones in use by Berber women at the Coop generally did not support Arabic script. Their phones only supported languages that use the Latin alphabet (English, Spanish, French, etc.).

Women fund their phone use primarily with earnings from Argan oil production, occasionally spending up to 40% of their monthly income on their phone, depending on the time of year and family circumstances. Calling increases dramatically during the holy month of Ramadan or when family members migrate for work or serve military duty. Respondents rely exclusively on pay-per-use

call packages, installing calling credit on an as-needed basis. Similar to Banerjee and Duflo's [78] findings, women occasionally prioritized spending on their mobile over both personal necessities and discretionary purchases. As one woman stated, *"When you have something that is important to you, you get rid of clothes or things to eat to pay for the phone."* For some women, the mobile phone replaced physical mobility, which was often restricted for financial and cultural reasons.

Women at the Coop openly discussed the importance of their mobiles and were frustrated by their inability to access the range of communication features that they knew existed on their phones but could not use. Many women said they were not "qualified" to use SMS due to their lack of education. Some salient quotes from women included: *"I'm illiterate. How could I text?"* *"I am blocked. I cannot learn how to deal with the phone."* Some women responded that using SMS was out of reach for them because of life complications: *"I don't have any empty space in my brain or my life to learn to text. My head is full of life problems and hard work."*

The majority of women in our study was unable to negotiate letters and numbers on their phone without the help of proximate literates and trusted others. Women reported that they give their phone to others to install calling credits, they rely on children to program their contact list, they seek out trusted contacts to read and write text messages, and they have others dial and answer calls for them. In religiously and culturally conservative Berber communities such as those we studied, female friends and family members play an especially important role as trusted sources of information on mobile phone techniques and services – although these trusted others may also be low-literate and low-skilled. This speaks to the need to raise the skill level of both the mobile user and those in the user's environment, particularly in communities where gender-segregation may be the norm.

Social complexities and cultural norms both positively and negatively affect Berber women's mobile phone use. Due to low literacy levels, women rely on assistance from an array of trusted others to help them manage and use their phones. This reliance on a network of helpers, though, often comes at the cost of privacy and independence. This is the 'paradox of social networks': family, friends and acquaintances play a pivotal role in a rural Berber woman's ability to use her phone while simultaneously exerting an oversight role over her phone use.

We found that the use of mobiles can lead to social tension. In this study the existing social structure, which is often repressive for low-educated, low-literate, resource poor rural women, is replicated and propagated through the mobile device. In rural Muslim-Berber areas, conservative traditional and religious values limit communication between unrelated women and men. These restrictions persist despite the device. Limitations on communication between unrelated women and men extend beyond face-to-face interactions to encompass the virtual, digital and electronic spheres. In this study, taboos on mixed-gender communication extended across technological platforms to include phone-to-phone (voice) contact as well as text-to-text exchanges.

Mobile communication challenges and disrupts gender-proscribed communication patterns and have led to new forms of surveillance of Berber women's ICT-mediated communication. This control and oversight mechanism was evident in our observations and conversations in the community where it was clear that male authority figures worried about women's mobile use. Berber men expressed concern that female relatives would be tempted to use their mobiles to

¹ In 2011, 70% of all global handset shipments were low-to-mid-range feature phones that have fewer functions than a smartphone, which has more advanced computing capability. (Mobile Megatrends 2012. Published by VisionMobile.)

interact with men outside of the family, and they made oblique references that mobiles encourage infidelity by women.

It is important to note, though, that the concern that women need to be protected from dishonorable contact with men outside of the family was not just the domain of men. Many mothers we interviewed closely monitored their daughter’s incoming and outgoing calls, while simultaneously depending on their daughters for help using mobiles.

Men and women, fathers and mothers and brothers and sisters all contributed to an atmosphere of suspicion and surveillance of women’s phone use. Surveillance occurs within the family as well as by friends and acquaintances. Berber women often rely on shopkeepers to assist them with tasks such as installing mobile credits, trouble-shooting or phone repairs. Women from the Coop reported that they seek these services from male teleboutique owners and local retailers with the understanding that the service provider is likely to look through their call log and their incoming and outgoing texts. Women reluctantly accept this invasion of privacy in exchange for receiving the mobile service. Women from the Coop and in the villages often expressed a desire for more phone-related independence. They acknowledged, though, that their mobile use is tethered to their social network because that network provides them with a de facto set of ICT trainers, surrogates and proximate literates who support their phone use.

3.3 Phone Training

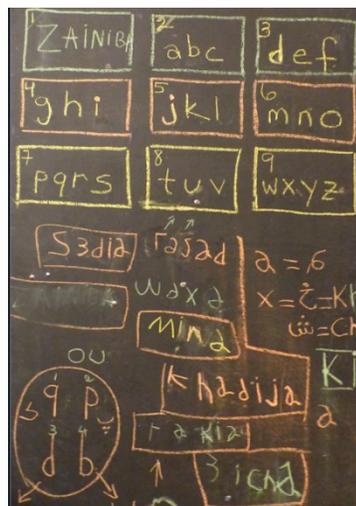
Following the observations and data collection – and at the request of the women – the lead researcher conducted ten mobile phone use workshops tailored to women’s specific interests, which included using text-based features. Seven-to-twelve Coop members participated in each of the workshops. Participants were occasionally offered compensation in the form of SMS recharges valued at 10 Dirham (approximately \$1.20 US) for 100 SMS messages.

Their primary motivation to use SMS was driven by an interest in maintaining and expanding social connections. Workshop participants asked to learn Roman letters as opposed to Arabic or Berber script, because the Roman alphabet would help them get the greatest use of their mobile phones. The potential to save money by sending a text messages was also appealing: making a phone call in Morocco can be five-times more expensive than sending an SMS. A number of women reported that they wanted to improve their mobile phone skills in order to increase their privacy and independence. As one Coop member stated, *“I don’t go out much, so sending messages is appealing. It’s private. When you give your mobile to someone to send a message for you, you are giving them your privacy.”* They also requested lessons on how to install pre-paid calling credits from a scratch-card – a skill that would give them more communication privacy and independence.

The mobile phone was integrated into all skill-building and literacy exercises: women practiced identifying letters on phone keypads and on a chalkboard, and they learned to write names in their phone contact list and in the SMS message field. Participants learned to write their names on a chalkboard using their stored name in the phone as a reference guide. To support the use of SMS, participants devised a list of short, simple, relevant, easy-to-understand SMS messages that included Berber-language phrases for “call me,” “come home now” or “send a *tAabiya* (calling credit).” The researcher created small, individual paper-based SMS message books that contained the sample messages written in Roman letters. Users were encouraged to consult these books to practice sending texts to each other and to the researcher. The workshops also provided Coop members with access to a much-needed handset mechanic. One of the translators was an IT

specialist who provided invaluable services by repairing broken phones, restoring functions and general problem-solving. He trained users to troubleshoot their own phone issues.

Over the course of three months, Coop members who attended the workshops made progress toward narrowing their personal mobile utility gap: those who had some SMS skills improved their ability to send texts; a handful of entirely an-alphabetic women developed the ability to write their name in their phone, on paper, and on a chalkboard.



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Figure 1. The mobile keypad drawn on a chalkboard provided a useful reference to learn the Roman alphabet. Note the visual similarities between some lowercase Roman letters and the use of numbers and letters to indicate Arabic phonemes.

4. UTILITY GAPS

While a lack of literacy presents the overriding barrier to women’s use of text and more advanced phone features, our observations and subsequent training sessions support extending the standard definition of “utility gap” to include specific technical and sociolinguistic barriers that exacerbate the difficulties low-literate women have with their phones. While these gaps can be studied and addressed individually, they are often related and occur in combination with one another. These related barriers to more advanced phone use need to be understood within the context of cultural factors that are more and less immutable. The following enumeration of these barriers demonstrates how researchers and practitioners pursuing ICTD interventions might understand how literacy, gender, economics and culture affect intervention adoption.

Table 1. Barriers that Contribute to the Mobile Phone Utility Gap

Technology Barriers	<ul style="list-style-type: none"> • Myriad vendors and operating systems • Interface clutter • Poor quality phones
Sociolinguistic Barriers	<ul style="list-style-type: none"> • Multiple spoken dialects • Multiple written languages • Multiple numbering systems • Unsupported Arabic script • SMS messages written in “Arabish”
Social and Cultural Barriers	<ul style="list-style-type: none"> • Shared phones • Low-priority access to devices • Lack of smartphones

4.1 Technology Barriers

One set of barriers to women's advanced phone use is technical. A top-level concern for mobile users is the operability of their ICT devices: the mere presence of a mobile phone, whether it is new or used, does not guarantee that the device is usable. Below we identify a few of the technology-related challenges that hindered the use of mobile by low-literate, low-skilled users.

4.1.1 Myriad Vendors and Operating Systems

Mobile phones in circulation in southwest Morocco represent myriad vendors and operating systems, thus interfaces and functions are not standardized. Phones ranged from newer-model Nokia and Motorola feature phones to simple Samsung handsets. Some phones required as many as eight steps to send an SMS message; some mobiles supported icons in the phonebook; some handsets had text-based interfaces, others had icons. Pre-programmed shortcuts and hot-keys vary across phone models. For example, on some phones it was possible to access a function by holding down a key, but the result was not always the same depending on the phone model. The range of devices, settings and operating systems made it difficult for novice users to share advice or train each other on how to operate their phone.

4.1.2 Interface Clutter and Low Repair Skills

Many participants were confused by the array of buttons and menus on the phones. Small, over-cluttered alphanumeric keypads made it difficult to easily locate letters and numbers. Retrieving phone numbers from a call list or navigating to the SMS text field often required multiple steps through puzzling phone menus. These cumbersome processes often discouraged women from experimenting with the features of their phones.

4.1.3 Poor Quality Phones

Further complicating the lack of standard interfaces is the poor condition of most phones. The simple feature phones in use were primarily second-hand purchases or gifts that were not always fully operational. Many phones had features that were broken or jammed: keys would stick, navigation toggles did not work and it was difficult to see menus through cracked and cloudy screens. Counterfeit phones were an additional problem: merchants often target illiterate, marginalized buyers who are unable to distinguish between scams and legitimate hardware. A number of women reported that they unwittingly spent meager financial resources on fake phones. One low-literate Coop member was justifiably troubled when the camera on her new phone did not work. The vendor had assured her she was purchasing a Motorola brand phone, but in fact he sold her a 'Mobiola' phone. The purchaser said she recognized the letters 'M' and 'o' and thought she was buying a Motorola. She did not have sufficient reading skills to identify the correct brand name.

4.1.4 Maintenance and Troubleshooting Problems

Often, mobile owners could not use phone features because they were unable to troubleshoot problems. Old, broken and counterfeit phones require substantial maintenance, and low-literate women did not have the skills to repair their own phones or restore functions. (Phone owners sometimes unwittingly changed their own phone settings and were unable to recover original or familiar settings.) Fake and second-hand commodities of questionable provenance do not come with instructions or manuals. The lack of documentation meant that even when illiterate users have access to a proximate literate, that surrogate often did not have the benefit of a user's manual (unless they had access to an internet connection, which is rare in rural Morocco).



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Figure 2. A Berber woman using her mobile to learn to write her name.

4.2 Sociolinguistic Barriers

In Morocco's polyglot communities, ICT users face myriad challenges related to a complex, layered language environment. For low-literate mobile users in oral-language communities, new, second-hand and counterfeit mobiles have text and voice-based features that are in languages that differ from the ones they see, hear or speak.

4.2.1 Linguistic Complexity

Three alphabets and three different scripts are in use in Morocco: the Arabic script, the Roman-letter alphabet and Tifinagh, the Berber alphabet [79, 80]. In southwest Morocco, Arab-Berbers speak two dialects that have no widely accepted written form: Tachelhit (the Berber dialect) and Darija (colloquial spoken Arabic). The two spoken dialects differ from the country's two official spoken and written languages – Modern Standard Arabic (MSA) and French – that are used in official documents, newspapers and international commerce. Vernacular Darija is an amalgamation of Arabic, French and Spanish words and syntax that has no standardized written form. When used in social media exchanges or SMS texts, Darija is written in the Arabic or Roman alphabet, or a mix of both. Numbers present an additional challenge to mobile phone use. In addition to Western numerals, which are historically referred to as Arabic numbers, Moroccans also use the Arabic-Indic numbering system that is not supported on most keypads.

4.2.2 Used Phones Display Unfamiliar Languages

Berber women often possess used phones from Europe, which may display any of a number of Western European languages. Phones are primarily, although not exclusively, programmed in French – a vocabulary not echoed in daily life. One Coop member explained that she could not send an SMS because "My phone only speaks French. I don't speak French." The written words a user sees in her daily life bear little resemblance to the French words she sees on her phone screen such as *effacer* (erase), *supprimer* (delete) and *annuler* (cancel).

4.2.3 Confusing Letter Shapes and Sequences

Additionally, letter sequence and letter shape can be confusing. Low-literate mobile phone users are exposed to both Arabic (written and read right-to-left) and French (written and read left-to-right),

which complicates the task of writing text messages, reading interfaces and dialing numbers. Capital (uppercase) Roman letters look significantly different than their lowercase counterpart. This led some women in the workshops to mistake the letters for two different alphabets. Some women struggled to match the name of a letter to its corresponding image on the keypad. This required the user to match the name of a number to the image of the number on the keypad, and to match the sound of a letter to its written form (i.e., tap the '5' two times to get the letter 'k'). Having little to no formal education, participants were confused by number shapes and number sequences: some low-literate Berber women were not familiar with the concept that numbers *follow* one other. Due to the bi-directional complexities of multiple languages, suggestions such as "8 comes after 7" were not useful. For some women, it was difficult to discriminate between the similarly shaped numbers 6 and 9 and similarly shaped lowercase letters such as b,d,p and q.

4.2.4 *Unsupported Arabic Script*

Some mobile users were able to read a limited amount of Arabic, but owned phones that did not support Arabic script. On phones that could support Arabic script, the device had to be set to display that language – a task often beyond the reach of even literate users. Changing the language setting on a phone requires multiple key taps and an understanding of menu hierarchy. Sending and receiving texts in Arabic also required higher-level skills: in order to display Arabic-script SMS messages, phone parameters must be set to 'full character support.' (Factory settings are normally set to 'partial character support,' the minimum required to display Roman languages.) Without full character support, an incoming Arabic text message will either not display (i.e. the text field will be blank) or will display as a series of garbled symbols. It is not possible to write an Arabic-script text when phone parameters are set to half character support. Character support is complicated by the fact that Arabic letters change shape depending on their position in a word. Additionally, phones that support Arabic script may not have Arabic-letter keypads – typing in Arabic characters required scrolling around a small display screen hunting for the correct letter and letter-form to use.

4.2.5 *SMS Texts Blend Languages and Symbols*

The mobile form factor lends itself to shorthand and symbols. This convention, which keeps text messages shorter and less costly, makes it difficult for semi-literate and emerging literate mobile users to 'correctly' learn new words and phrases. SMS messages often use numbers to represent Arabic letters and phonemes. Because there is no direct transliteration of Arabic words into Latin letters, and neither Darija nor Berber have a written form, text messages are often written in 'Arabish' – a creative, non-standard, informal writing style that blends alpha-numeric code and mixed-language words [81]. Thus, for low-literate users in oral-language communities, texting syntax becomes another language in an already complex linguistic environment.

4.3 Other Social and Cultural Barriers

The mobile phone as artifact and possession affects the way women use their phones. Access to mobile phones is often determined by family dynamics and gender-related factors as well as economic considerations.

4.3.1 *Shared Phones*

Participants often shared their phones with other family members. Device availability depended on the number of phones in a household, amount of credit on the phone and gender-based hierarchies of use. While shared phones can be an efficient use of equipment, multiple users lead to inconsistent settings. Children changed phone settings to suit their preferences; phones got

locked by previous users; mobiles were sometimes programmed with "free" ringtones and call-waiting music that ceased to be free after initial trial – which created a recurring cost to users who were not aware they were paying for the service. Additionally, advanced users often programmed the SMS setting on a borrowed phone to T9 predictive text. This was problematic for novice texters: many women in our study were surprised by what appeared to be 'runaway writing' that appeared in the SMS text field. Additionally, husbands, sons and brothers often have priority over operational phones and more sophisticated devices, including smartphones.

4.3.2 *Lack of Smartphones*

Only two of the forty women we interviewed owned a smartphone, in part due to the technology 'pecking order' in their families. Women are often the last person in the family to receive upgraded equipment (multiple household members may have multiple smartphones before an adult woman has access to one), and out of a sense of duty, women may 'gift' an upgraded phone to other family members. Cost is another factor: few women were prepared to buy a new smartphone because that may cost anywhere from 3-months' to more than one year's salary, excluding talk and data plans [82, 83]. Furthermore, a low-literate woman may not want an upgraded device. The prospect of a new phone with additional functionality highlights many of the gaps discussed above and presents what are perceived to be insurmountable challenges to phone use leading women to reject upgraded equipment.

Cost, gender hierarchies, fear of sophisticated devices, complex language environments and poor quality equipment all impede the use of mobile phones by marginalized, low-resource women in traditional and conservative societies. Individually and in combination, these barriers to use can create a profound utility gap for low-literate, low-skilled women who possess and value their mobiles but struggle to use them.

5. DISCUSSION AND CONCLUSIONS

Semi-literate Berber women who primarily communicate in oral languages are acutely aware that simple phones are not simple to use. For low-resource illiterate women, the inability to access life-improving benefits such as sharing information in a cost-effective way or taking advantage of mobile-based development services can further marginalize these women. There are widespread and persistent technological, social and linguistic barriers that limit the usefulness of text messaging and other mobile phone features for these women.

Our catalog of barriers is not exhaustive, but indicates that there are significant technical, social and cultural barriers to participating in the many communication benefits that mobiles provide. We have observed that the primary barriers to mobile use fall into three categories: low-quality, non-standard devices; a multiplicity of languages; and social constraints, each of which contributes to the mobile phone utility gap. Technical barriers, including broken phones and confusing interfaces represent some of the more obvious impediments to accessing text-based features of mobiles. Gender-based barriers are often more nuanced: they include lack of financial resources, low literacy levels due to lack of educational opportunities, and culturally-prescribed gender hierarchies that can impede the use of mobile phones by women.

Barriers to using mobiles for advanced features that expand communication and save both time and money are often magnified in the context of oral-based and/or language-dependent and polyglot communities where multiple alphabets are in use. This is not a rare

phenomenon: as many as 7,000 languages are spoken today, two-thirds of which do not have a written form [84-87]. Mobile use is complicated by this linguistic context, thus requiring thoughtful interface and application design to enable low-literate users to access SMS and text-based features on mobiles.

Despite the barriers to use, illiterate and semi-literate women were eager to get greater value from their mobiles –often extending the mobile literacy workshops into three-hour sessions that ran beyond normal operating hours at the Coop. These training circles, which were developed in response to grounded observations and data, were predicated on developing the individual user and a larger set of users around them. The collaborative and shared learning environment helped promote the use of text-based features while supporting women’s efforts to learn numbers and letters; women were able to gain confidence by experimenting with technology and practicing the skills they wanted to learn. Co-learning and co-teaching extended to mobile phone repair skills that had an immediate impact on the women’s ability to use their phones.

We endeavored to understand the utility gaps in a specific population of semi-literate Arab-Berber women in a detailed, immersive, ethnographic study of their mobile phone use. The study was designed to explore the ways in which oral languages facilitate the use of the mobile for voice, but complicate text-based tasks. Many of these findings, obtained from a specific group of low-literate Berber women in an oral-language community also apply to other communities in developing countries where there is a utility gap between high mobile phone ownership and low usage of text-based phone features.

Our hope is that the findings are relevant to researchers, practitioners and policymakers who are engaged in mobile-based literacy initiatives for the 500-million illiterate and low-literate women in the world today. Additionally, our observations and findings may be relevant to others working in developing communities where indigenous oral languages co-exist with other languages taught in schools or represented in formal speech or publications. These conditions not isolated to rural Morocco. Furthermore, while this is not a policy paper, we hope that mobile experts in the policy arena will see in this research a helpful framework for devising strategies that address the problem of low-literacy through innovative uses of mobile technology.

6. FUTURE WORK

Our findings from the Argan Oil Cooperative lay the groundwork for future action-oriented research on the mobile phone utility gap in southwest Morocco. The next phase of work will involve designing the ICT components and information system to manage a new fog water catchment and distribution system that will provide supplemental water to villages in the Anti-Atlas Mountains. The system will be designed to accommodate multiple devices and a wide range of mobile skills and literacy levels. The fog water information system also needs to address cultural barriers that limit face-to-face, voice and text-based communication between unrelated men and women. Currently water managers and water users cannot call each other’s phones to discuss system status, nor is there a universal set of vocabulary or symbols to communicate about the catchment system when voice-based communication is not appropriate. Our understanding of the richer context of the mobile phone utility gap will inform the design, deployment and evaluation of this innovative Mobiles for Development initiative.

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