

# Prayana: Intermediated Financial Management in Resource-Constrained Settings

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## ABSTRACT

We describe the design of a novel mobile phone-based application for loan management in a resource-constrained setting. In this setting, a social enterprise manages auto-rickshaw loans for drivers, taking charge of collections. The design was informed by an ethnographic study which revealed how loan management for this financially vulnerable population is a daily struggle, and loan payment is a collaborative achievement between collectors and drivers. However, drivers and collectors have limited resources to-hand for loan management. To address this, we designed Prayana, an intermediated financial management app. Prayana shares the principles of many persuasive technologies, such as education, motivation, nudges, but is designed for users with a range of print, technical, and financial literacies and embodies the core design sensibility of enhancing users' agency. Furthermore, it does not put the onus solely on drivers to better manage their money, instead it aims to enhance the collaborative work of loan management, supporting both the drivers and collectors.

## Author Keywords

Ethnography; design; financial capability; financial inclusion; agency; resource-constrained design.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

Mainstream financial services are rarely designed with the needs of low income populations in mind. However, they need to be accessible and affordable to achieve financial inclusion. The widespread availability of mobile phones, has led to the design of some technologically-mediated financial services targeted at low income populations [e.g.49,10]. However, human intermediaries continue to play a crucial

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role in building financial inclusion [25], bridging the gap between mainstream financial services and low-income communities. For example, micro-finance institutions (MFI) [1,2,34] provide financial services adapted for the poorest communities. Beyond MFI, intermediaries may also enable access to mainstream financial services (bank loans, savings, etc.) for excluded populations. Three Wheels United (TWU) [56] is one example: a social enterprise, which acts as an intermediary between auto-rickshaw drivers and mainstream banks, to enable drivers to take out loans to purchase their auto-rickshaws. TWU manages these loans, including collecting payments from drivers.

In this paper, we describe how the findings from an ethnographic study of TWU led to the design of a novel financial management application, Prayana ('Journey' in Kannada). Whilst there are many financial management technologies available they are not typically designed for low income users in resource-constrained settings. Resources in this setting are constrained on many levels. Both TWU's employees and the auto-drivers have a range of technical, print, and financial literacies. For example, half the drivers in our study had finished primary school or had no schooling, with those without schooling being unable to read. Most drivers use feature phones without data, and earn largely in cash. TWU operates on slim margins, with no in-house technical expertise, and consequently was using an ad-hoc mixture of paper and technology, built up over time, to manage their services. Whilst this enables the flexibility that is crucial for auto-rickshaw drivers to pay off their loans, it means that both drivers and collectors had limited information on loan status and progress. Furthermore, we found that loan payment is a collaborative achievement between collectors and drivers. This led us to design an intermediated smartphone application to be used by collectors *with* drivers, overcoming the practical barrier of drivers' limited smartphone ownership, but with the additional advantage of supporting the *collaborative work* of loan payment.

Our initial motivation was to provide more resources for the drivers to help them better understand and manage their ongoing loan. From the literature, information, motivators and nudges seemed promising [11,14,28]. We describe how we adapted these techniques for users with a range of print, technical, and financial literacies. Once we had chosen to

build an intermediated app rather than a solution solely for the drivers, this changed the dynamics of the design. Firstly, to ensure up-to-date accurate loan information was available online we had to largely reengineer TWU's back office processes (reported in [34]). Further, since we wanted the collectors to use the app with the drivers, it also had to be useful to them. We therefore engaged in a number of design workshops with the collectors to include features which would help them manage their set of drivers, as well as to record payments on the app and reduce the data entry duplication of the paper-based processes.

We conclude the paper by describing how we embodied the design sensibilities which came out of our ethnographic understanding of the loan payment context; namely supporting agency and choice, prioritising collaborative work through intermediation not automation, and prioritizing flexibility over formalization.

## **RELATED WORK**

### **Financial management technology**

There are a rich variety of commercially available mobile apps to help users manage their finances. The majority are budgeting applications, for personal financial management followed by educational applications to build financial literacy. However, such apps are not suitable for low resource settings, as they rely on digital payments, and the formal, text-based interfaces and content are not suitable for users with limited print literacy. Perhaps closest to our research are loan tracking apps for end-users or field agents. The first of these, typically provided by the lending bank, enable independent monitoring of one's own loan, showing current-status, transaction history, etc. for end-users with computers or smartphones. These too have not been designed for users with low print and financial literacy. Organisations providing financial services for low income users, such as the Pigmy Scheme [27], may have mobile apps to aid field agents conducting customer collections. However, these are mainly designed to streamline the workflow of the field agents [46,41,2], rather than supporting agent-customer interaction [1]. One feature these apps all have in common is treating financial management as an individual activity, targeting either customers or field agents. However, studies of money management in-the-wild show that it is often a collaborative activity, within families [60,59] and communities [9]. That is, it is important not to forget the social features of money and its management in design [12,13,26].

### **Persuasive technology**

The motivation for some of the features of Prayana came from research into persuasive technologies. The major applications target health and lifestyle, and use information, motivators, gamification [11] or nudges [28] to inform and encourage users towards certain goals. Providing relevant, well-timed [14,22] information and encouraging feedback/motivators has proven fruitful, whether by textual SMS [37,61], or smartphone applications, which include

images and graphical representations, such as charts and progress information [52,54]. Nudges are "approaches that steer people in certain directions while fully maintaining freedom of choice" [53]. We took inspiration from the retirement savings nudges in [20] which provide visualizations of ones' future self, the outcome of which depends on today's choice.

Like the financial management apps, most persuasive technologies have been designed for solo use by users with good literacy [28]. However, forays into low-resource settings have met with some success. For example, persuasive technology, using video, music and motivation, was used in rural India to change women's health behaviour [42]. Similarly, [43,44] use persuasive and motivational ICTs to enable rural health workers to persuade pregnant women to engage in healthy practice (such as, having health check-ups and taking iron tablets). They used videos [43] and various types of audio-visual messages [44] to do this. [24] used gamification in their fitness app aimed at educated low-income users. Like [43, 44], they made use of intermediation. In this case younger family members, who navigated the barriers of their elders limited technical literacy, as well as motivating use. Despite the many financial management apps, there has been little HCI research, outside of nudges, on designing persuasive technologies for finance.

### **Designing for mixed literacies and intermediated use**

Researchers have identified various interface requirements for users with low print literacy [55]. 1) Extensive graphics can replace text [18,31,41], but many low-literate people can read and understand numerical digits [46]. 2) Users often have trouble scrolling [30] and navigating complex hierarchies [29,32]. 3) Intermediation is common in resource-constrained areas [48]. Help may be sought from more digitally and/or print literate members of community, or owners of scarce devices [47].

## **SETTING AND METHODS**

We conducted an ethnographic study at TWU in 2015 in Bangalore, to get a rich picture of loan payment and collection from the perspective of the various actors involved (drivers, field agents and back office staff). Our ethnographic approach is that of ethnomethodologically-informed ethnography [45,7]. These typically consist of shorter more focused field studies than traditional anthropologies, but have nonetheless proved extremely useful in informing design [21,38]. On the basis of the study, we designed a loan management app, Prayana. Our initial design ideas were modified and concretized during an iterative design process, consisting of six design workshops and a user test with drivers and collectors.

### **Setting**

TWU helps drivers in Bangalore and Chitradurga, India to secure loans from mainstream banks to purchase their auto-rickshaws. TWU stands guarantor for the loan at the bank, then manages the entire process, from paperwork, to collections for which they charge a small monthly fee. An

auto-rickshaw costs around 150000 rupees (~2400\$). Drivers take out a main bank loan, plus a smaller Security Deposit Loan (SDL) to cover some of the down payment. Their repayments are split between three buckets: main loan, SDL and TWU fees. TWU partners with three NGOs working in driver communities who help source new drivers. At the time of the ethnography, the NGOs managed loan collections for drivers they sourced. Field agents include a) collectors, who manage a set of drivers: collecting and managing payments and b) community organizers, who run community development activities such as saving schemes, financial education and community building exercises. They may also take loan payments when they meet the drivers as may any representative of TWU, but this is not their core role. Each NGO operated a different model of collections: door-to-door house visits (NGO1); weekly collection meetings (NGO3); unscheduled drop-ins and Airtel Money (NGO2). Since the study, the collectors have been brought in-house, whilst they perform essentially the same work they now report directly to TWU. Most of the current collectors previously worked for the NGOs.

### **Ethnographic study**

We conducted observations of and in situ interviews with the collector(s) in each NGO. We accompanied two collectors from NGO1 (Zoharin and Haniya) on their collection rounds and in the back office; attended loan collection meetings with NGO3's collector Ramesh and hung around NGO2's office, to observe drivers making payments to their collector Priya. We observed community organizers on the streets and in community meetings. Observations were recorded through extensive field-notes, often by two researchers, including a fluent Kannada (Karnataka's local language) speaker. As well as observations of the drivers encountered during collections, we conducted 33 semi-structured interviews with drivers. We asked questions on education; family; technology use; financial situation, and their experiences with the loan. The interviews were conducted in Kannada by the 2nd and 4th authors. All interviews were translated and transcribed.

Our analysis took a broadly ethnomethodological perspective [17]. Ethnomethodological ethnographies explicate the knowledgeable, artful ways in which participants organise their practice and reveal the ways in which technologies and other artefacts are used [8, 45]. The authors read through and discussed all the observations and interviews in various analytic sessions. They organized them into themes as interesting topics began to emerge. The findings outlined here were emergent, coming from the data.

### **Design methods**

On the basis of the ethnographic study, we came up with ideas for an intervention. The design process from concept to working prototype was an iterative, human-centered one.

We mocked up screens on paper and on android phones and conducted workshops with prospective users to understand preferences, obtain feedback, and to elicit information on processes and practices. With the drivers (two workshops), we worked one-on-one; with the collectors and community organizers (four workshops), we held group sessions. Finally, we carried out a qualitative user test where collectors used the app with drivers.

### **ETHNOGRAPHIC STUDY FINDINGS**

We first describe the relevant findings relating to drivers practices, followed by collectors practices.

#### **Paying the loan: Auto-rickshaw drivers**

Drivers had a range of educations, with a consequent range of print literacy. Of those interviewed, five had never been to school, 14 finished primary school, and 14 high school. Only five drivers owned a personal smartphone, and none had internet access. Auto-rickshaw drivers earn small, variable, amounts of cash daily. Our participants reported earning around 600-800 INR (\$9-12) a day, although variability is high. Ola Auto [3] and demonetisation mean some drivers take mobile payments, but cash predominates. Drivers are classified as urban poor [36]. Family size, number of school children and whether they were the sole earner, all impacted drivers' financial wellbeing. Drivers are financially vulnerable, as most can just about cover their daily living costs but do not have spare cash for 'extras' whether medicine, school fees or savings. As NOS<sup>1</sup> explains

*"When I can barely manage to cover my son's educational and household expenses, how can I save?"*

Drivers are mostly just 'getting by'. Nonetheless the loan payments were designed to be manageable, as they were set at the same daily price as renting an auto (200 INR (~3\$)). Despite this, although many of those interviewed reported that they did not miss payments, there was a pattern of late and erratic payments and chronic underpayment of the loan, which is problematic for both the drivers (longer loan time, greater cost and possibly losing the auto to the bank) and TWU (reduced credit worthiness at the banks, meaning new loans are not released). Yet most drivers are behind at some point, and a rather large subset are almost permanently behind. Of the 203 drivers currently on the system, more than 80% (167) of them have arrears, with the amount ranging from 400 INR (~6\$) to more than 70000 INR (~1000\$). Whereas drivers would do their utmost to find the rental fee, because not finding it means they won't earn that day. Taking out a loan changes the dynamic; introducing a 'pay after' model. This brings much needed flexibility, but also creates the problem of under or non-payment. Drivers' irregular, daily, cash income works against them. TWU espouses the principle of daily payments, but less than half the drivers pay daily because cash collections are time consuming and

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<sup>1</sup> Each driver is represented by a 3-letter alias to preserve data consistency across publications.

costly, and forays into mobile money payments met with limited success [39]. Whilst drivers put aside the loan amount daily, this is not the same as making a payment. There is a tendency to either spend some of the money or to put less aside after a bad day, and drivers report often being short when it comes to time to pay. NGO1 and NGO3 had regular cash collection cycles, however drivers paying to NGO2 could pay whenever they wanted. These drivers tended to pay less and less regularly, with many paying monthly. Infrequent payments compound the problems; even drivers with higher income vs. household expenses, such as LOQ, often find themselves short

*“By the end of the month when I make the payment for the loan, I usually have a due of Rs.500-1000”*

Whilst the long-term nature of the loan (three years) certainly makes repayments smaller and more manageable it does have some disadvantages. Firstly, paying correctly typically means sacrificing something else and when faced with competing demands, drivers tend to prioritise the most immediate. Compared to which putting (and keeping) money aside for the loan often suffers. Secondly, some sort of major financial shock is almost inevitable during the loan period, caused by illness, accident, breakdown, weddings or babies. The vagaries of their personal circumstances mean it cannot be expected that the drivers will pay the correct amount month-in month-out. A certain amount of flexibility has to be built into the system if the drivers are to successfully manage competing demands and complete their loans. TWU has a built-in buffer: the five-year bank loan is repaid as if it were three years, so that payments missed to TWU are not noticed by the bank for a while. Further flexibility comes from the way collections are managed.

#### *Understanding the loan and their progress through it*

Although there are multiple mechanisms for tracking individual payments (drivers’ yellow TWU record book, SMS and paper receipts, various ledgers), there is little tracking of progress through the loan. The yellow TWU book only shows the time, date and amount of payments made. The column for adding the total amount paid off is left blank, as are the columns for the different places the money goes (main loan, SDL and TWU fees). This is because the allocation is done in the TWU back office and is not shared with the collectors or drivers. Drivers have no ongoing information on how much they have paid into the various buckets and how much of the loan remains. As OKC said

*“I don’t know how much I have repaid and how much is left. I have been paying for almost 2 years now”.*

The main information collectors convey, is the drivers ‘balance’, i.e. how far behind they are on expected payments. During our observations, many drivers asked the collectors how much was left to repay. For example, the sister-in-law of one driver said

*“I’m not getting any details. I don’t know how to find out the balance I have left to pay.”*

Drivers were told to go to the TWU office or the bank to get this information, an unsatisfactory solution as it eats into working time and uses fuel. TWU tried to address this with a monthly printed account summary to be shared with each driver. However, as described below, this was not successful.

#### **Collecting the loan: Collectors**

Collectors do not simply take cash from drivers, rather loan payment is a collaborative achievement. A large part of their work is chasing drivers and encouraging them to pay using whatever (fair) means are to-hand. They phone drivers up, visit their houses and expect the drivers to explain why they might miss a payment or underpay. For example, Priya(NGO2) counselled a driver who was making an underpayment of ~1000 INR (15\$) because business had been bad, that he should drive longer hours rather than develop a backlog. Such ad-hoc loan counselling work, which is incidental to payment, is crucial and was a common feature of payment interactions. In another example, on Haniya’s(NGO1) rounds, one family, struggling with daily payments, wanted to move to weekly payments. A long discussion ensued as the collector and her supervisor persuaded them that this was a bad idea, and they would likely fall further behind since if they cannot find the money for daily payments it would be even harder to find the money for weekly payments. More detail and examples can be found in [39]. Incidentally, this interaction hints at the importance to both drivers and collectors of a frequent and regular payment schedule, a point emphasized by Ramesh(NGO3), who conducts weekly payment meetings. He explained how at the end of the meeting he phones all drivers who did not turn up or call him to arrange a time to receive their payment. He keeps trying until he contacts them and once drivers have missed three payments (i.e. after three weeks) he will go around to their houses to take the collections. It is noticeable that with a monthly payment schedule, drivers would not even have been considered to have missed one payment by the time Ramesh is visiting them at home. A key part of the collectors’ job, then, is phoning the drivers to get them to pay. Whilst we observed this work during the ethnographic study, exactly how much it impacts payments only became apparent later. In late 2016 around 100 drivers were persuaded by the banks to pay directly to them, as they could make smaller repayments as they reverted to a five-year rather than a three-year loan term. TWU followed up with these drivers after six months, in the hope of getting them back onboard and was shocked to find that 70% had made only one or no payments in six months, unlike the drivers remaining with TWU who were paying monthly or more frequently.

It was striking how different each collector’s practices were. Besides the NGOs’ different methods (door-to-door, weekly meetings, drop-in), individual collectors defined their own patterns. For example, Zoharin(NGO1) only visited drivers who were seriously behind, the rest dropped by her home, whereas Haniya went door-to-door for all her drivers.

Typical of many organisations in resource-constrained settings, TWU's processes consist of an ad hoc mixture of paper and technical. Almost all the field work was paper-based, aside from an SMS system. Collectors filled in multiple paper records and receipts, and kept their own lists of driver's phone numbers, payments and so on. This was their main source of information about loan status. In the NGO offices, they had to fill multiple challans when depositing their takings. This was time consuming, and there was much duplication of effort. The current non-formalised workflows support the flexibility necessary to collect from this vulnerable low-income population. They enable collectors to develop individual collection relationships with drivers, such as focusing on those needing the most attention, whilst giving better payers more freedom. Paper supports this, as it does not enforce a single workflow, but it has disadvantages, the most important being the lack of to-hand, up-to-date detailed information on the loan in the field. TWU tried to introduce a monthly paper statement for each driver on their loan status but this failed for various reasons. Since not all collectors had strong print and financial literacy, some collectors found it difficult to understand the numerical statement themselves let alone to explain it to the drivers. Furthermore, by the time they would take it to the drivers it was often out of date, this poses two risks for collectors; 1) respect (from drivers) is key to their work and providing bad information risks that respect, and 2) whilst the best collectors can maintain friendly relationships with most drivers, tensions can arise quite quickly as there is no doubt this is a working relationship. Collectors did not want to expose themselves to abuse.

Finally, collectors have few resources to manage their set of drivers - mostly keeping only basic lists of names and phone numbers on paper, and drivers balances and payment patterns in their heads. Whilst collectors' knowledge of 'good' and 'bad' drivers was impressive, there are opportunities to augment it.

#### **OPPORTUNITIES FOR INTERVENTION**

Our intervention has been designed to address the difficulties and opportunities for change identified. Drivers have little information about loan progress, although this is clearly desired. The information they are most readily given is their balance (how far behind they are), which whilst important is rather negative. There is, therefore, an opportunity to show drivers how they are performing, including positive feedback. Secondly, since the loan is always competing with other more immediate demands, we would like to make the impact of decisions about the loan (to pay, underpay or skip payment) more salient. That is, to show the impact of these decisions on loan prognosis. Thirdly, we want to encourage more regular payments. Whilst the ethnographic study reinforces the microfinance principal that regular small payments are more manageable, for various operational reasons many drivers have fallen into paying monthly since late 2016. Unfortunately, their debt has increased as payment frequency decreased, unlike the drivers in Chitradurga who

continued paying more regularly. We therefore 1) implement a payment schedule and 2) provide positive feedback for adherence to it. Fourthly, since even drivers who have been paying well tend to fall behind in the final year, we would like to help keep them engaged. Overall, the design focus for drivers is to help them make more informed choices, in the hope that this will encourage better loan adherence, even with their tight financial circumstances.

The collectors, however, remain a central part of the equation. They already provide personalized, in-the-moment, loan counselling for drivers, and are, therefore, perhaps the best persuasive mechanism of all. Loan payment is a collaborative achievement, and we want to support this vital work, rather than 'designing out' the collectors. We considered various options, including USSD (Unstructured Supplementary Service Data) and SMS (Short Message Service), which fit drivers' current technology use (feature phones) but are text-based and would be driver-centric. We chose instead to build an intermediated smartphone app, as this enables easy presentation of graphical information, which can be more easily understood by drivers and field staff. Since it is intermediated, only collectors need smartphones. We are using a Moto G4 Plus for the trial which costs around 10,000 INR (~150\$), although all collectors and all but two community organizers have their own smartphones. We use JIO SIMs (1GB data/day; unlimited calls and SMS for 103 INR/month). To further support the collectors, our app is designed to reduce data entry and enable them to allow the drivers' flexibility, whilst setting expectations of regular payment. The app supports online and offline use.

Intermediation addresses the practical barrier of drivers not having smartphones, and also has other positive implications: 1) the app will be used during loan payment, a so-called 'teachable moment', where financial advice and training can have most impact [15]; 2) it should prompt more frequent use, even when the driver is doing badly and might prefer avoidance, but where timely information might help him get back on track; 3) collectors can help interpret the information.

#### **THE PRAYANA DESIGN JOURNEY**

Throughout the design, we tried to take into account the range of print, technical, and financial literacy across the user base. The current collectors all have good technical and print literacy. In contrast, the community organisers and drivers are more diverse. Whilst drivers might be financially astute, managing and understanding loans can be complex. We, therefore, need to design for a range of literacies. We were inspired by the text-free design of KrishiPustak, a social networking app for farmers [33]. We aimed to have minimal text except numbers, to use visual representations and colours, and minimise textual data entry. Furthermore, we wanted to reduce both the need for scrolling, create minimal hierarchies [30,29,32] and an intuitive workflow. However, the loan information is complex, and as we shall discuss, the

need for flexibility complicates design, provoking a flexibility-complexity trade-off. Below, we describe the core elements of Prayana, and how they evolved through the design workshops. For ease of reference we discuss them as Drivers' Screens and Collectors' Screens, but as the app is intermediated, the Drivers' Screens are a shared resource. However, the Drivers' Screens were designed to be used by the collectors with the drivers, that is shown to the drivers during the loan payment interaction.

### Drivers' Screens

One of the core aims of Prayana is to build auto-rickshaw drivers' financial capability by enabling them to better understand what is happening with their loan and the impact of their payment practices on its long-term prognosis.

**Driver home.** Figure 1. This is the main shared screen and will always be accessed as part of the interaction as it is collectors must open it to take payments. It provides an at-a-glance awareness of recent performance, through a payment history showing the last 4-6 payments with date and amount, colour-coded red or green, depending if the payment was the right amount on-time or not. In cases where payments are mainly red, and the driver is underpaying again today, this screen should prompt the use one of the additional resources.

**Loan buckets.** Figure 2. shows how much has been paid off so far, and its allocation between the main loan, SDL, and TWU fees. Colour-coding gives visual feedback about whether the driver is on-track or not. The aim of this screen is to increase driver and collector awareness loan progress. Use of this screen could be prompted by drivers' requesting information, saving them a trip to the TWU office, or by collectors seeing an overly red payment history.

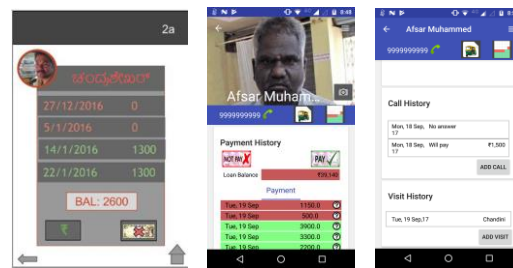
**Nudge.** To make the consequences of today's decision to underpay more salient, we designed a nudge. This shows when drivers would own their auto-rickshaw if they paid on time vs. continuing to underpay, as well as any extra costs. Whilst the enactment is different, the underlying idea of making the future consequences of today's choice salient now is similar to [20].

**Motivators.** To provide positive feedback, we designed two types of motivators. Both are pop-ups that show automatically when milestones are reached. 1) To encourage good payment practices, and capitalise on the widespread love of cricket, drivers can 'score' a hat-trick, four or six if they make the equivalent of number of correct payments (on-time, right amount). We plan to use these in a social competition in future. 2) To encourage drivers over the long-term, we show an auto filling up with colour which pops up each time 10% of the loan has been completed. This provides a visual indication of how far drivers have come and for those near the end that it is just a bit further to go.

### Drivers design sessions

Two sets of design sessions were conducted with the drivers, by the 4th author, in 2016. In the first session, nine drivers from NGO1 and NGO2 met the researcher one-on-one, at

locations convenient to them, from collection centres to bus stops, to discuss a phone-based mock-up of the Driver Screens, plus paper versions of alternative loan buckets. All the screens were in Kannada. Drivers were told that the app was designed to help them understand their loan payment habits. The researcher played the role of a collector in two scenarios: 1) missing payments 2) paying well. Drivers were then shown each screen and asked to describe what it showed, which parts they understood and which parts were unclear, and their preferences between different bucket representations. Sessions were audio-recorded, and notes were taken. Based on the response of the drivers, the screens were modified and the representations that most drivers preferred were used to redesign the app before the second session. The second session was carried out with three drivers, following the same method.



**Figure 1: Driver Home. Initial design for driver workshops (left); Final design: Top (middle), after scrolling (right)**



**Figure 2: Loan buckets. Initial design (left); 1/6 alternatives (mid-left); Second test (mid-right); Final version (right)**

### Session Outcomes

From the beginning, drivers easily understood the Driver Home screen (Figure 1), the green and red was a clear intuitive indication of performance. However, drivers had more trouble understanding the loan buckets (Figure 2). Once they understood the total amount remaining, they were keen to have that information, but the loan bucket representations were confusing, particularly, since our first designs had savings increasing and loans decreasing. Of the different representations, the blocks were by far the most preferred (Figure 2, mid-left). Each block represents a month's payment, and once explained, they liked that they could count the months off. For the second round of testing we redesigned the blocks (Figure 2, mid-right), however drivers found the colour-coding confusing. The final version (Figure 2, right) complies with Android design guidelines, and has more logical colours. Green blocks represent months paid off, red blocks months that should have been paid off

but are behind and white blocks are the months left to pay. The bar at the top shows the total amount for the loan, and each bucket shows the amount paid off and what's left to pay. This version requires scrolling to see all the buckets, which should not be a problem when intermediated by the collectors.

The initial nudge showed a video of an auto-rickshaw driving down a road with a voice-over for three conditions 1) paying the same amount as now, 2) paying correctly 3) paying extra. The animation took around 30 seconds to play, and drivers complained that it was too long. Furthermore, they said that it was impossible to pay extra as they already paid all they could. In the redesign, we designed a slider with two positions 1) paying as now and 2) paying the right amount. For the final design, we have maintained the slider, but have swapped the conditions around, on advice (from Dan Goldstein) that a more powerful nudge shows what you are losing. Finally, the motivators were well received, especially the cricket metaphors. However, non-literate drivers did not understand percentages (filling up auto). We, therefore, removed this from the text, as it is the symbolic representation of progress that is important.

### Collectors Screens

We wanted to design the collector screens to make it easier for them to support their drivers. This involved enabling collections and administrative work, enhancing loan counselling, and supporting collectors' in providing drivers with the necessary flexibility. However, design also had to accommodate the community organizers who were less confident and experienced technically, financially, and for some in print literacy, but who will have to use the app to take payments.

Whereas the Drivers Screens focus on providing information and motivation on loan progress, if the app is to be used at all, the Collectors Screens need to support their work practices. The design of the Collectors' Screens was, therefore, a more interactive process than the Drivers' Screens. We created low fidelity paper prototypes mocking-up some of the collectors' screens (as well as the Drivers' Screens) and used these in half-day workshops with the collectors, TWU management, and community organizers, to provoke discussion. This resulted in considerable redesign before the next workshop held with community organizers and collectors (paper prototypes), then a final workshop with the collectors (app on phone with hardcoded data). Five collectors attended the first workshop and three the second joint workshop. Eight community organizers attended the first session and six the joint session. Finally, we ran a small-scale user test with five drivers and two collectors. For brevity, we present the initial and final designs here.

#### Initial design

To enable collectors to manage their set of drivers, we displayed drivers in a photo grid, organized according to whether they had made the latest payment or not (Figure 3, left). Collectors could filter the driver set by 'paid', 'not paid'

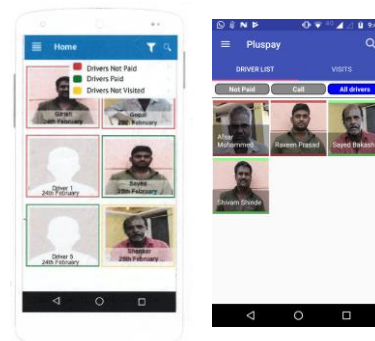
or 'due to be seen'. It quickly became apparent that despite being brought in-house, the NGO legacy continued, and each collector had a different method for collections. However, whether by location or payment due date, all collectors called their drivers first to arrange payments and our design did not support call management. Furthermore, collectors had trouble using the filtering. They were by and large happy with the drivers' screens, although they wanted much more information on the Driver Home (insurance, driving license number, etc.). Finally, we wanted to provide the collectors with motivators and information on their own performance. We discussed what they might like to see, with TWU management suggesting a combination of amount collected and number of drivers who paid.

When testing the same design with the community organizers, they had much more difficulty in using and understanding it. Even the red/green colour coding of the payment history was confusing. They had a lot of trouble understanding the loan buckets. This emphasized the need to keep things as simple as possible. Therefore, we 1) created a community-organizer version removing functionality relevant only to the collector; 2) ensured no scrolling was required to take payment; 3) made the navigation simpler. In the second tests, they understood the payment history colour coding, but were still less confident using it. If problems persist in the field one option is to create a community organizers app just for taking payment, but this needs to be assessed live, as they may learn the features over time.

#### Final design

Our final design is a working app which includes:

**Collector Home Screen.** Figure 3. We redesigned this screen to support driver management through calls. Each driver has a red/green border, providing at-a-glance information on if they are behind or not on their loan. We



**Figure 3: Collector Home. Initial version organized by visit (left); Final version organized by calls (right)**

replaced filtering with three tabs: 1) All Drivers assigned to a collector; 2) Call: drivers due a routine call to arrange payment; 3) Not Paid: drivers who have missed a payment. We also enabled search by name or phone number. Search initially searches drivers assigned to the collector, but they can expand to all drivers to take payment from another collector's driver. This feature is only available online,

whereas their driver set is stored locally on the phone. We simplified this screen for community organizers, who do not call the drivers about payments, to a single home screen with all his/her assigned drivers, plus search.

**Call Feedback:** Figure 4 is a collector only screen, which pops up each time a call is made or received from a driver's number. Collectors can also manually add call feedback. The following trails are recorded 'will pay', 'will not pay', and 'did not pick up'. In 'will pay', collectors enter the amount and date of promised payment; for 'did not pick up' they enter when to call back. 'Will Not Pay' includes a list of common reasons (sickness, vehicle breakdown, poor business, etc.), plus follow-up date. 'Will pay' and 'will not pay' include a confidence rating (five stars), which aims to capture the collectors' tacit knowledge about their drivers (is he making excuses or genuine). Collectors and TWU management are excited about this feature, but we will be following it closely to see how well it works in the field. All the information captured is pushed to the back-office server, which in turn allows the back office to get a clearer view of field operations.

**Payment schedule:** Drivers will have to commit to a payment schedule with the collectors. This remained one of the most controversial features as the suggested schedule is paying *at least* weekly and collectors are concerned that drivers will resist. However, as mentioned regular, frequent payments are most effective. Furthermore, we need to balance the aim of setting good expectations for new drivers with managing existing drivers' practice. The payment schedule impacts how and where drivers appear on the app (colour coding, not paid, etc.), but does not impact their flexibility to pay in other ways.

**Motivators/progress reports:** 1) A pop-up at the start of the day shows at-a-glance information on progress achieved against targets. The intention is to motivate, and many existing drivers are behind, so we show performance against previous weeks and months rather than absolute performance. 2) A screen showing progress on various (changeable) parameters including: number of drivers paid/total expected, amount collected/target collection. TWU can modify information and incentives as required.

**Transfer Money (Bank/Person):** To enable collectors and community organizers to transfer money to one another and the bank, including taking a photo of the bank deposit slip automatically sent to head office.

**Driver Home:** Figure 1, mid and right. This was the toughest to design and underwent multiple iterations, because it contains information essential to the driver, collectors and community organizers. The collectors wanted a whole host of driver information here, but taking payment and the payment history need to be clear and visible without scrolling to ensure ease of use for community organizers and display to drivers. We, therefore, created a separate page with extra driver information and included photo

functionality (for capturing drivers' documents to send to head office). This is also the place to access the nudge and loan buckets, and we moved from a menu functionality to clear buttons for the most important navigations.

### User test

We conducted a small-scale user test with two collectors and five drivers (two completed primary and three secondary education), using the live application tied to their loan data. The aim was to see how well the collectors could use the app in real use scenarios and whether the drivers could understand the information presented. We asked drivers about their loan (last payment, balance and expected completion date), then the collectors completed the following actions 1) Take a picture, 2) Take payment, 3) Explain loan buckets, 4) Explain nudge 5) Explain payment history. Collectors were confident using the app and could complete all these actions without trouble. Afterwards we asked the drivers, the same questions on their loan: Three drivers corrected the date of last payment (they already knew the amount); two corrected information about balance (one knew, one was incorrect, and one did not know) and three drivers learned that the loan will complete later than expected. Drivers requested additional information related to vehicle license, permit and insurance expiry and requested a driver's version of the application to keep track of their progress. Whilst this is a very small-scale test, we are confident that the collectors will be able to use the app in the field to inform their work with the drivers.

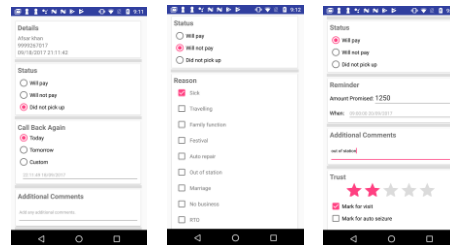


Figure 4: Call Feedback Screens

### DISCUSSION

Common to [1,2], we found the relationship between field agent and client important for successful loan management. However, our setting was rather different. Auto-rickshaw drivers are a notoriously difficult group to provide financial services to: whilst they are above the lowest poverty line (of one dollar a day), they still live in poverty. Banks will not typically lend to them, because of high default rates and lack of credit rating, and we would argue, contrary to [5], that the problem here is not in fact absence of a credit rating system. A credit rating would almost certainly rule out loans to a high percentage of the drivers TWU lends to. This is evidenced by all the work that TWU and its field agents must do to ensure loan payment: without this work, the system falls apart. Loan counselling was an acknowledged part of the collectors' work and loan payment is a collaborative achievement, by both the collector (calling up, nagging,



persuading, loan counselling), and the driver and his family (saving up, answering the phone, turning up to pay, discussing problems). Furthermore, we highlight how flexibility in process and practice is important so that collectors can accommodate their drivers, whose irregular income and financial vulnerability mean missed payments are inevitable. Conversely too much flexibility can be a bad thing, with drivers slipping into infrequent payment habits which are harder to manage.

### **Intermediated behaviour change in low resource settings**

The aim of Prayana is to improve loan adherence, by encouraging more regular payments, closer to the correct amount, so that drivers have less frequent and less sizable backlogs. Given their tight financial circumstances and precarious income, drivers are unlikely to achieve perfect loan adherence. Nonetheless, drivers from all backgrounds can and do complete the loan; whilst driver's agency is limited by their circumstances, it is not non-existent, however drivers do not have access to the financial information that users of internet banking, for example, would take for granted. Like research in other low-income communities [e.g. 9,4], we found that drivers' unpredictable, low, cash income makes loan management difficult. Prayana provides resources intended to help loan management. It uses techniques found in persuasive health technologies, adapted to be understandable by drivers with a range of literacies, presented at critical 'teachable moments', in a single financial management app. Whilst we hope these features will directly help drivers when making financial decisions, we do not delegate persuasion and encouragement to the technology, nor put the onus on the driver alone. Instead collectors remain a crucial part of the process, they can personalise advice according to the driver's circumstances and make suggestions to address their particular concerns. Prayana provides them with additional resources with which to do this. We capitalise on the social contract between collector and driver, which plays a core role in encouraging payment.

The few persuasive technologies designed for users with low print literacy tend to use video and audio for communicating generic health messages [43,44]. Since we need to communicate information related to individual financial status and behaviour, we took a different approach. With an extensive use of graphics and minimal use of abstract representations, such as charts and graphs, text (apart from numbers), and scrolling. Furthermore, our foray into animation in the first nudge design was not well received. Like other financial settings [16], time is of the essence, and it is important to provide information that is quick and easy to understand. The payment history, cricket motivators and final nudge, seemed intuitive. However, the loan buckets were less so, illustrating the difficulty of representing relatively complex financial information in an intuitive way. We hope that, with collectors' help, drivers will come to understand the loan buckets over time. Intermediation promises to bring additional benefits by 1) *promoting use*

even when drivers' loans are not doing well; 2) *maximizing teachable moments* as app use is fundamental to collections meaning information is provided when it has most impact [15]. [24,43,44] have had some promising results with intermediation for behaviour change in health settings. Like many behaviour change apps, non-usage was a problem for [24], even in their small field trial. In our case, as Prayana combines functional elements central to collector's work (taking collections, transferring money to the bank, and collecting driver's documents), it should at least be used. Furthermore, the payment screen provides at-a-glance information on payment performance, which should be hard to ignore. Nonetheless, it remains to be seen how this information is used in the field and what impact this has on payment practices.

Interestingly, designing for intermediation both simplified and complicated the design in this setting. Simplification came from loosening the constraints for immediate, untrained understanding of representations of financial information. The complication came from balancing the needs of the drivers and community organisers for simplicity, with the needs of the collectors for adequate information to do their job. Consequently, the driver's home screen underwent multiple iterations. The recent payment history needed to be up-front, so that it could provide at-a-glance information to all actors. Community organizers need to take payment from this screen, easily and intuitively, without scrolling. We put the payment buttons on top of the payment history to be immediately visible. Collectors need extensive additional information: we, therefore, put the call history below payment history (as scrolling should not be a problem for collectors) and extra driver information on a separate page, creating a deeper hierarchy, but maintaining simplicity on the payment screen.

### **Design sensibilities**

The design of Prayana was informed by a deep ethnographic understanding of loan management, from the perspectives of the payer and TWUs agents, particularly the loan collectors. In this section, we reflect on the consequent design sensibilities in the hope they will be useful to researchers, whether designing for low or high resource settings.

#### *Designing for agency*

Like others [23], we believe that workplace technology should enable agency, that is it should enhance the users' capacity to act [51], rather than controlling and constraining practice. A number of Prayana's features reflect our concern to support driver and collector agency. The app does not enforce rigid workflows, rather tools such as the nudges and loan buckets can be used as required. Even the loan payment schedule is designed to support the social contract between driver and collector. As payment day approaches, the driver is marked for a call. Missing the scheduled date only impacts the colour-coding of the payment history, and puts the driver into the 'not paid' screen for the collector's attention. When the collector calls the driver, any agreement made will

override the payment schedule removing the driver from ‘not paid’. Given drivers’ precarious financial situation, the aim of the app is to help make their choices between competing demands for money more informed, not to force them to pay.

#### *Augmentation not automation*

Whilst our intervention shares the principles of many financial management apps, such as education and motivation, our system has been designed to acknowledge the social character of financial management. Loan management in this resource-constrained setting, with this financially vulnerable community, is a collaborative activity. Our approach to digitization is to support and enhance the human work of loan management, rather than to design it out. Without examining the work of collectors, it would be easy to underestimate their role in loan management. Of course, this is what ethnography, especially ethnomethodologically-informed ethnography, specialises in: revealing the work to make things work [6], which when not taken into account can lead to systems failure or widespread workarounds [6, 7, 8, 40]. Like [1,2], our study points to the importance of human intermediation in financial management and how technology should enable this work rather than automate it. Prayana has been designed to do just that.

Rather than creating a wholly technical solution to a complex socio-technical problem, we chose to use technology to augment the work of TWU, an organisation which already has in place processes and practices to address this complexity. It is their work in entirety which enables auto-rickshaw drivers to access mainstream financial services and whilst we, and TWU, hope that Prayana can help, it is only one small part of the picture. In this respect, we agree with [57,58]: technology alone is unlikely to solve social and development problems, rather technology serves as an amplifier. In this case, we hope that technology can amplify the collaborative human work of loan management, such that more loans can be successfully completed.

#### *The formalization problem*

Collectors’ work is currently highly independent and variable. It might, therefore, be tempting to formalise it by implementing set workflows in an attempt to eradicate human error and variability, and standardize processes. However, this is likely to prove counter-productive since flexibility is key in managing drivers’ loans. Loan management is all about relationships, which are necessarily individual and personal. In the micro-finance arena, technology is often used to formalise processes, although as [2] reports, this often fails. This does not mean to say that the work of collectors cannot be improved. We aim to do this by giving them a) more tools to manage their set of drivers (who to call, who is late paying, to capitalize on their knowledge of individual drivers and to understand their own performance), and b) more information to support individual drivers (through shared resources). The requirement for a simple application, usable across different levels of literacy, leads us to ask how do we design technology to support work

practices, without overly formalizing them and thereby losing their flexibility? Raising questions that lie at the very heart of CSCW and HCI. How do we support work without either overly constraining it with rigid workflows or miring it in a bog of complexity? Of course, however bottom-up and iterative design is, computer systems *necessarily formalize*. Supporting all possible actions is rarely viable as the resulting system becomes too complex to learn and use. Furthermore, even without a workflow system, digitization still makes visible what previously was unseen [50], for example, making collectors performance easily visible to management. Unfortunately, we do not pretend to have a solution, our only aim is to do this as sensitively as possible, keeping in mind the possible consequences of any intervention. We believe the ethnographic approach, which reveals the hidden taken-for-granted skills and work of the various prospective users, can help us with this.

#### **CONCLUSION AND FUTURE WORK**

In many ways, TWU represents the challenges typical to small business and NGOs operating in low resource setting, including an ad hoc mixture of process and practice built up over time, limited resources to invest in technology, and a rapidly changing business model. We, therefore, believe that our design sensibilities - to support agency, rather than to control and direct; sensitivity to the problems of formalization, and the complexity/flexibility trade-off, and the use of technology for amplification rather than automation of human work - have a wider applicability.

Although not widely field tested yet, the design of Prayana is deeply grounded in the findings of an ethnographic study and an iterative design process. At each stage of the design and user testing, we found improved understanding and ease of use by participants. Furthermore, we have just started a field deployment and TWU has transferred its entire collections (currently consisting of four collectors, eight community organizers and around 200 drivers) onto Prayana, giving a clear indication of perceived benefit. This, and the fact that these methods have proved successful elsewhere [38], gives us confidence in the validity of our design.

In future work, we will report on the results of the field trial, where we are collecting quantitative data (driver survey, payment data, use logs) and qualitative data (ethnographic observation of the system in use, including field agents and back office staff, interviews with drivers and their families, collectors and community organizers). Finally, we hope to introduce a social competition for drivers and collectors, as well as to release a driver’s app for the increasing number of drivers with smartphones.

#### **REFERENCES**

1. Muhammad Adeel, Bernhard Nett, Turkan Gurbanova, Volker Wulf, and David Randall. 2013. The Challenges of Microfinance Innovation: Understanding ‘Private Services’. In *ECSCW 2013: Proceedings of the 13<sup>th</sup> European Conference on Computer Supported*

- Cooperative Work*, 21-25 September 2013, Paphos, Cyprus. Springer, 269–286.
2. Muhammad Adeel, Bernhard Nett, and Volker Wulf. 2010. Innovating the field level of microfinance: a Pakistan case study. *In Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. ACM, 1.
  3. Syed Ishtiaque Ahmed, Nicola J Bidwell, Himanshu Zade, Srihari H Muralidhar, Anupama Dhareshwar, Baneen Karachiwala, Cedrick N Tandong, and Jacki O’Neill. 2016. Peer-to-peer in the workplace: A view from the road. *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 5063–5075.
  4. Abhijit V. Banerjee and Esther Duflo. *Poor economics: A radical rethinking of the way to fight global poverty*. Public Affairs, 2011.
  5. Jaijit Bhattacharya and Richa Singla. 2007. Microfinance: A technical framework for cross border credit in India. *In Proceedings of the 1st international conference on Theory and practice of electronic governance*. ACM, 179–182.
  6. John Bowers, Graham Button, and Wes Sharrock. 1995. Workflow from Within and Without: Technology and Cooperative Work on the Print Industry Shopfloor. *Proceedings ECSCW’95*. (1995).
  7. Graham Button. 1993. *Technology in working order: Studies of work, interaction, and technology*. Routledge.
  8. Graham Button and Wes Sharrock. 1997. The production of order and the order of production: possibilities for distributed organisations, work and technology in the print industry. *In Proceedings of the Fifth European Conference on Computer Supported Cooperative Work*. Springer, 1–16.
  9. Daryl Collins, Jonathan Morduch, Stuart Rutherford, and Orlanda Ruthven. 2009. *Portfolios of the poor: how the world’s poor live on \$2 a day*. Princeton University Press.
  10. Gabriel Demombynes and Aaron Thegeya. 2012. Kenya’s mobile revolution and the promise of mobile savings. (2012).
  11. Sebastian Deterding, Miguel Sicart, Lennart Nacke, Kenton O’Hara, and Dan Dixon. 2011. Gamification. using game-design elements in non-gaming contexts. *In CHI’11 extended abstracts on human factors in computing systems*. ACM, 2425–2428.
  12. Jennifer Ferreira and Mark Perry. 2014. Building an Alternative Social Currency: Dematerialising and rematerialising digital money across media. *In Proceedings of HCI Korea*. Hanbit Media, Inc., 122–131.
  13. Jennifer Ferreira, Mark Perry, and Sriram Subramanian. 2015. Spending time with money: From shared values to social connectivity. *In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. ACM, 1222–1234.
  14. Brian J Fogg. 2002. Persuasive technology: using computers to change what we think and do. *Ubiquity* 2002, December (2002),
  15. Centre for Financial Inclusion. 2016. Teachable Moments: Reach Consumers When They Are Making Financial Decisions. (2016). Retrieved from <https://cfiblog.org/2016/04/19/teachable-moments-reach-consumers-when-they-are-making-financial-decisions/>.
  16. Rinku Gajera and Jacki O’Neill. 2014. Ethnography in parallel. *In COOP 2014-Proceedings of the 11<sup>th</sup> International Conference on the Design of Cooperative Systems*, 27-30 May 2014, Nice (France). Springer, 259–275
  17. Harold Garfinkel. 1967. *Studies in Ethnomethodology*. (1967).
  18. Sally Grisedale, Mike Graves, and Alexander Grünsteidl. 1997. Designing a graphical user interface for healthcare workers in rural India. *In Proceedings of the ACM SIGCHI Conference on Human factors in computing systems*. ACM, 471–478.
  19. Juho Hamari, Jonna Koivisto, and Tuomas Pakkanen. 2014. Do persuasive technologies persuade? A review of empirical studies. *In International Conference on Persuasive Technology*. Springer, 118–136.
  20. Hal E Hershfield, Daniel G Goldstein, William F Sharpe, Jesse Fox, Leo Yeykelis, Laura L Carstensen, and Jeremy N Bailenson. 2011. Increasing saving behaviour through age-progressed renderings of the future self. *Journal of Marketing Research* 48, SPL (2011), S23 -S37.
  21. John Hughes, Val King, Tom Rodden, and Hans Andersen. 1994. Moving out from the control room: ethnography in system design. *In Proceedings of the 1994 ACM conference on Computer supported cooperative work*, pp. 429-439. ACM.
  22. Stephen S Intille and others. 2004. Ubiquitous computing technology for just-in-time motivation of behaviour change. *Medinfo* 107 (2004), 1434–1437.
  23. Joseph Kasera, Jacki O’Neill, and Nicola J Bidwell. 2016. Sociality, Tempo & Flow: Learning from Namibian Ridesharing. *In Proceedings of the First African Conference on Human Computer Interaction*. ACM, 36–47.
  24. Ntwa Katule, Melissa Densmore, and Ulrike Rivett. 2016. Leveraging intermediated interactions to support utilization of persuasive personal health informatics. *In Proceedings of the Eighth International Conference on*

- Information and Communication Technologies and Development*. ACM, 19.
25. Anjini Kochar. 2016. Branchless banking: Evaluating the doorstep delivery of financial services in rural India. (2016).
  26. Deepti Kumar, David Martin, and Jacki O'Neill. 2011. The times they are a-changin': mobile payments in India. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1413–1422.
  27. Sohamsaa Systems Pvt. Ltd. 2017. Pygmy MicroFin. Android Playstore. (2017). <https://play.google.com/store/apps/>.
  28. John Matthews, Khin Than Win, Harri Oinas-Kukkonen, and Mark Freeman. 2016. Persuasive technology in mobile applications promoting physical activity: a systematic review. *Journal of medical systems* 40, 3 (2016), 72.
  29. Indrani Medhi, Meera Lakshmanan, Kentaro Toyama, and Edward Cutrell. 2013. Some evidence for the impact of limited education on hierarchical user interface navigation. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2813–2822.
  30. Indrani Medhi, Somani Patnaik, Emma Brunskill, SN Gautama, William Thies, and Kentaro Toyama. 2011. Designing mobile interfaces for novice and low-literacy users. *ACM Transactions on Computer-Human Interaction (TOCHI)* 18, 1 (2011), 2.
  31. Indrani Medhi, Archana Prasad, and Kentaro Toyama. 2007. Optimal audio-visual representations for illiterate users of computers. *In Proceedings of the 16<sup>th</sup> international conference on World Wide Web*. ACM, 873–882.
  32. Indrani Medhi, Kentaro Toyama, Anirudha Joshi, Uday Athavankar, and Edward Cutrell. 2013. A comparison of list vs. hierarchical UIs on mobile phones for non-literate users. *In 14th International Conference on Human-Computer Interaction (INTERACT)*. Springer, 497–504.
  33. Indrani Medhi-Thies, Pedro Ferreira, Nakull Gupta, Jacki O'Neill, and Edward Cutrell. 2015. KrishiPustak: a social networking system for low-literate farmers. *In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. ACM, 1670–1681.
  34. Apurv Mehra, Sambhav Satija, Jacki O'Neill. 2017. Prayana: A Journey Towards Financial Inclusion. *In Proceedings of the Ninth International Conference on Information and Communication Technologies and Development (ICTD '17)*. ACM, New York, NY, USA, Article 26, 5 pages. DOI: <https://doi.org/10.1145/3136560.3136591>
  35. Jonathan Morduch. 1999. The microfinance promise. *Journal of economic literature* 37, 4 (1999), 1569–1614.
  36. Subhashree Natarajan and TKT Sheik Abdullah. 2014. Social Organizations: Decongesting the Muddled Economies of Auto-Rickshaw Drivers in India. *World Applied Sciences Journal* 30, 7 (2014), 831–837.
  37. Jami L Obermayer, William T Riley, Ofer Asif, and Jersino Jean-Mary. 2004. College smoking-cessation using cell phone text messaging. *Journal of American College Health* 53, 2 (2004), 71–78.
  38. Jacki O'Neill, Stefania Castellani, Frederic Roulland, Nicolas Hairon, Cornell Juliano, and Liwei Dai. 2011. From ethnographic study to mixed reality: a remote collaborative troubleshooting system. *In Proceedings of the ACM 2011 conference on Computer supported cooperative work*. ACM, 225–234.
  39. Jacki O'Neill, Anupama Dhareshwar, and Srihari H Muralidhar. 2017. Working Digital Money into a Cash Economy: The Collaborative Work of Loan Payment. *Computer Supported Cooperative Work (CSCW)* 26, 4-6 (2017), 733–768.
  40. Jacki O'Neill, David Martin, Tommaso Colombino, and Antonietta Grasso. 2011. When a little knowledge isn't a dangerous thing. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1667–1676.
  41. Tapan Parikh, Kaushik Ghosh, and Apala Chavan. 2003. Design Studies for a Financial Management System for Micro-Credit Groups in Rural India. *CUU '03*. November 10-11, 2003. Pp. 15-22.
  42. Vikram Parmar, David Keyson, and others. 2008. Persuasive technology for shaping social beliefs of rural women in India: an approach based on the theory of planned behaviour. *In International Conference on Persuasive Technology*. Springer, 104–115.
  43. Divya Ramachandran, John Canny, Prabhu Dutta Das, and Edward Cutrell. 2010a. Mobile-izing health workers in rural India. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 1889–1898.
  44. Divya Ramachandran, Vivek Goswami, and John Canny. 2010b. Research and reality: using mobile messages to promote maternal health in rural India. *In Proceedings of the 4th ACM/IEEE international conference on information and communication technologies and development*. ACM, 35.
  45. David Randall, Richard Harper, and Mark Rouncefield. 2007. *Fieldwork for design: theory and practice*. Springer Science & Business Media.
  46. Aishwarya Lakshmi Ratan, Kentaro Toyama, Sunandan Chakraborty, Keng Siang Ooi, Mike Koenig, Pushkar V Chitnis, and Matthew Phiong. 2010.

- Managing microfinance with paper, pen and digital slate. In *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. ACM, 37.
47. Nithya Sambasivan, Ed Cutrell, Kentaro Toyama, and Bonnie Nardi. 2010. Intermediated technology use in developing communities. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2583–2592.
  48. Nithya Sambasivan and Thomas Smyth. 2010. The human infrastructure of ICTD. In *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. ACM, 40.
  49. Anja Smith, Doubell Chamberlain, Herman Smit, Sandisiwe Ncube, and Grieve Chelwa. 2010. *Kenya microinsurance landscape*. The Centre for Financial Regulation and Inclusion (2010).
  50. Susan Leigh Star and Anselm Strauss. 1999. Layers of silence, arenas of voice: The ecology of visible and invisible work. *Computer supported cooperative work (CSCW)* 8, 1 (1999), 9–30.
  51. Lucy Suchman. 2007. *Agencies in technology design: Feminist reconfigurations*. Unpublished manuscript. Retrieved on 30<sup>th</sup> November 2017 from [https://www.researchgate.net/profile/Lucy\\_Suchman/publication/27336947\\_Agencies\\_in\\_Technology\\_Design\\_Feminist\\_Reconfigurations/links/00b7d520038ad34bcc000000.pdf](https://www.researchgate.net/profile/Lucy_Suchman/publication/27336947_Agencies_in_Technology_Design_Feminist_Reconfigurations/links/00b7d520038ad34bcc000000.pdf)
  52. Sunny Consolvo, Predrag Klasnja, David W McDonald, Daniel Avrahami, Jon Froehlich, Louis LeGrand, Ryan Libby, Keith Mosher, and James A Landay. 2008. Flowers or a robot army? encouraging awareness and activity with personal, mobile displays. In *Proceedings of the 10<sup>th</sup> International Conference on Ubiquitous Computing*. ACM. Pp. 54-63.
  53. Cass R Sunstein. 2016. Do people like nudges? (2016).
  54. Tammy Toscos, Anne Faber, Shunying An, and Mona Praful Gandhi. 2006. Chick clique: persuasive technology to motivate teenage girls to exercise. *CHI '06 Extended Abstracts on Human Factors in Computing Systems*. ACM. Pp. 1873-1878.
  55. Indrani Medhi Thies. 2015. User interface design for low-literate and novice users: past, present and future. *Foundations and Trends® in Human-Computer Interaction* 8, 1 (2015), 1–72.
  56. Three Wheels United. Retrieved on 19<sup>th</sup> September 2017 from <http://www.threewheelsunited.com/>
  57. Kentaro Toyama. 2010. Can technology end poverty. *Boston Review* 36, 5 (2010), 12–29.
  58. Kentaro Toyama. 2011. Technology as amplifier in international development. In *Proceedings of the 2011 iConference*. ACM, 75–82.
  59. Vines, John, Mark Blythe, Paul Dunphy, and Andrew Monk. Eighty something: banking for the older old. In *Proceedings of the 25th BCS Conference on Human-Computer Interaction*, pp. 64-73. British Computer Society, 2011.
  60. Dhaval Vyas, Stephen Snow, Paul Roe, and Margot Brereton. 2016. Social organization of household finance: Understanding artful financial systems in the home. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. ACM, 1777–1789.
  61. Silje C Wangberg, Eirik Årsand, and Niklas Andersson. 2006. Diabetes education via mobile text messaging. *Journal of telemedicine and telecare* 12, 1\_suppl (2006), 55–56.