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# Mobile Persuasive Technologies for Rural Health

by

Divya Lalitha Ramachandran

A dissertation submitted in partial satisfaction of the  
requirements for the degree of  
Doctor of Philosophy

in

Computer Science

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Graduate Division  
of the  
University of California, Berkeley

Committee in charge:

Professor John F. Canny, Chair  
Professor Eric A. Brewer  
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Fall 2010

# Mobile Persuasive Technologies for Rural Health

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Divya Lalitha Ramachandran

## Abstract

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Divya Lalitha Ramachandran  
Doctor of Philosophy in Computer Science

University of California, Berkeley

Professor John F. Canny, Chair

Mortality rates due to preventable tragedies in the developing world are devastatingly high. For example, 99% of maternal deaths due to complications in pregnancy and childbirth - which number nearly half a million each year - occur in developing regions. Enabling health information access is often seen as key to promoting preventive health measures. Yet, deep-rooted traditional values and beliefs often pose barriers to the acceptance of more modern maternal health behaviors, like delivering in clinics, or taking prenatal vitamins. This thesis looks at how technologies can leverage psychological theories of motivation and persuasion and be designed specifically to empower agents of change, in this case rural health workers, to address these barriers and promote maternal health practices in developing communities.

This thesis describes three years of field research studying the maternal health care system in rural India, where gaps in training, accountability and credibility of community health workers limit their effectiveness in convincing pregnant women to utilize free medical services. It presents the iterative design and deployment of persuasive mobile videos to motivate and build the persuasive power of rural health workers. These include testimonials by influential persons in the villages, and dialogic, persuasive videos which directly target clients. The thesis includes findings from two experiments that compare the persuasive power of audio information when presented in a lecture style vs. a dialogic, interactive mode. The results show improvement in health workers' self-efficacy (an important precursor to motivation), knowledge, and ability to provide high-quality counseling about important health information to clients.

The contributions of this thesis are, (1) evidence that dialogic speech-based information presentation is more persuasive than traditional lecture styles, (2) a detailed ethnography of maternal health in India, and a sketch and exploration of the persuasive technology design space in this context, (3) an architecture for designing persuasive messages that improve the quality of health worker-client consultations, and (4) reflections on achieving ICTD research goals amidst challenging, developing world realities.

For my wonderful, loving Amma & Appa,  
Pankajam & Chittoor K. Ramachandran

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# Chapter 1

## Introduction

Globally, half a million women die each year due to complications in pregnancy and childbirth [66]. The greater tragedy is that most of these deaths are due to preventable causes that have been almost completely eradicated in the industrialized world. Access to appropriate health information is often seen as the answer to prevention [49], and the use of information and communication technologies (ICTs) for delivering information in resource-scarce, developing regions settings is becoming increasingly prevalent [59, 21, 39, 31]. The interdisciplinary field of ICTs and development (ICTD) broadly examines the potential of ICTs to improve the conditions of those living in poverty [11].

With the advent of ubiquitous computing, where ICTs are becoming fundamentally integrated with routine practices in the industrialized world, it is difficult to recognize the ways in which they have changed how we interact with the world. However, observing a community in which electricity itself is a recently acquired amenity, such patterns become more apparent. The research presented in this thesis lies at the intersection of human-computer interaction (HCI) and ICTD; broadly, it examines various social phenomena that occur as a consequence of the introduction of ICTs in rural settings, as well as examines how these phenomena can be leveraged to design ICTs that can foster positive socioeconomic change in the poorest parts of the world.

### 1.1 A Persuasive Approach

A straightforward approach to conducting HCI research in the developing world is to practice well-known early stage iterative design practices of understanding users, assessing needs and involving local stakeholders in hope that technologies can be designed that will fit in with local cultural practices, needs and values. The underlying belief is that technology that is an appropriate match to the local culture will be widely adopted and therefore sustainable. Yet, research examining these interventions through a political lens has found that such interventions succeed or fail often for

reasons that have nothing to do with the fitness of the technology in its intended role [35, 37]. ICTs in developing countries are introduced into environments that have highly-stratified power structures, informal economies of exchange, favors and bribes, highly-regimented traditional roles for various groups of people, centuries of traditional practices with relatively little change, and suspicion of outsiders in general, and government in particular. Into these contexts, ICTs bring radically new practices that challenge much of the existing structure and there is considerable resistance to such change. This calls for a very in-depth understanding of the social, cultural and political dynamics of a community, as well careful observation of how ICT adoption is influenced by these dynamics.

We do not claim that this resistance is unique to ICT interventions; rather, any interventions which introduce modern thought or practices inevitably clash with age-old traditions. A prime example, introduced earlier, is maternal health. Deep-rooted traditional values and beliefs pose barriers to the acceptance of more modern health behaviors, like delivering in clinics, or taking prenatal vitamins. We believe that the perception of ICTs only as enablers of information access is too limited; rather, we argue that ICTs can be specifically designed to *persuade* targets of an intervention in favor of change, and *motivate* key community members to act as agents of change. For this, we draw from psychological theories of persuasion and motivation, i.e., [33, 15, 6, 38], and contribute to the growing field of persuasive technologies, or technologies designed to promote behavioral change in the user [26].

In this thesis, we focus on maternal health in India, and the National Rural Health Mission [45] which encourages the utilization of modern medical practices during pregnancy and childbirth. The program mandates that one woman from each village should serve as an *Accredited Social Health Activist* (ASHA) who encourages pregnant women to utilize health services. It provides performance-based compensation for the ASHA and subsidies for poor pregnant women. Pregnant women need to be *persuaded* by the ASHAs to adopt the new health practices and services which the government offers. However, there are many barriers to the success of this program, namely village and household power dynamics, and compliance with traditional practices. Limited by their education, training and status within the community, ASHAs' effectiveness, judged by maternal health indicators, is limited. They are committed to change but need help with *motivation*, because of significant challenges they face in trying to bring change about. We present an ethnography of this context, and an exploration and evaluation of persuasive technologies in this space.

## 1.2 Contributions

The thesis travels through the technology design-cycle, from needs assessment to iterative design to evaluation, highlighting practices and values of rural communities, and how ICTs can or cannot change them. It also touches on a number of aspects

of the design process, with reflections on practicing design research in the developing world.

Chapter 2 introduces persuasive technologies, describing how modifying interaction techniques can impact the persuasive power of information. Chapter 3 introduces the rural maternal health context, demonstrating the necessity of understanding the complex social dynamics of a community of stakeholders before designing appropriate ICT interventions. Chapters 4 and 5 then examine aspects of the potentially powerful role of ICTs to bring about health behavioral change through persuasion. The contributions of this thesis are specifically:

1. Evidence that dialogic, speech-based information presentation is more persuasive than traditional lecture styles (Chapter 2),
2. A detailed ethnography of maternal health in India, and a sketch and exploration of the persuasive technology design space in this context (Chapters 3 and 4),
3. An architecture for designing persuasive messages that improve the quality of health worker-client consultations (Chapter 5), and
4. Reflections on achieving ICTD research goals amidst challenging, developing world realities (Chapter 5).

### 1.3 Thesis Organization

Chapter 2 shows that speech-based interfaces offer a compelling mode of interaction for engaging users and therefore explores how to best present persuasive information using speech interaction. We present a study comparing the persuasive power of two speech-based information systems, one which uses a recorded message-based lecture presentation and another which uses an interactive dialogic presentation which requires spoken input by the user. The results of the study show that **speech interfaces which present information in a dialogic method are more persuasive than interfaces which utilize a more standard, lecture-style approach.**

Chapter 3 sets the stage for the remaining chapters. We describe the context of maternal health in rural India and identify the potential of mobile technologies to deliver health information effectively. We detail two rounds of in-depth qualitative field work, in which we study the efficacy of community health workers in motivating behavioral changes among pregnant women. Many factors beyond the health worker's control contribute to issues in training, acceptance, accountability and influence of the health worker. We end with a **sketch of a rich design space for addressing these issues and building health worker capacity through the provision of innovative reference materials, and tools for establishing credibility, managing community expectations, and strengthening her persuasive ability.**

In Chapter 4 we focus on the context of supporting India's rural maternal health workers described in Chapter 3. Many factors reduce the motivation of health workers and impair their performance. We argue that familiar uses of ICTs for information services in these contexts are less potent than their use for *persuasion* of pregnant women and *motivation* of health workers in order to facilitate change. We present a two month deployment of short videos on mobile phones designed to persuade village women and motivate health workers, as well as an exercise in which health workers record their own videos. This chapter ends with a discussion of results, and an analysis in light of theories of persuasion and motivation. We show **evidence that the creation and use of videos did help (1) engage village women in dialogue, (2) show positive effects toward health worker motivation and learning, and (3) motivate key community influencers to participate in promoting the health workers.**

In Chapter 5, the technologies described in Chapter 4 are improved to incorporate the findings from the study presented in Chapter 2; the mobile, video-based tools are modified to incorporate a dialogic style of information presentation. We present a study which compares three presentations of persuasive health messages: a phone-based lecture-style message, a phone-based dialogic message that elicits user responses, and a discussion with the health worker (without the phone). We find that **dialogic messages significantly improve the quality of counseling sessions and increase discussion between health workers and clients**; however, we do not statistically measure an effect of either phone-based message on health behavioral outcomes. The results are analyzed within **a discussion of the social, cultural and environmental factors in the field and their interactions with the process of technology design and evaluation.**

## Chapter 2

# Persuasive Power of Human-Machine Dialogue

### 2.1 Introduction

Live, face-to-face interaction is an undeniably powerful medium for persuasion. But for human-machine interaction, especially using new technologies such as cell phones and Interactive Voice Response systems, can we recreate some of the important persuasive aspects of live communication? We study the value of spoken voice presentation and contrast a *dialogic* presentation with a *lecture* presentation. In the dialogic presentation, the persuading system makes short utterances in response to the user's prompts. In the lecture presentation, all the information needed to persuade the user on one point is included in a message containing multiple short utterances. The presentation of information for persuasion is a growing area of interest in all sorts of domains, such as physical health, environmental consciousness, finance management etc. The wide range of applications for persuasive information presentation serves as motivation to examine the effects of interaction mode on persuasive power.

In this chapter, we present a study in which we measured the persuasive power of two speech-based interaction modes with 52 subjects. We compared two systems, one which used speech by playing recorded messages (output only), and the other which simulated dialogue with the user (with input also using the Wizard of Oz technique). Both systems contained the same set of sentences recorded by the same actress; they differed only in the way these sentences were grouped and presented to the user, and in the need for user prompting in the dialogue case. We used the NASA Moon Survival Task [32] as a method to measure persuasion and used four different methods for analysis. Using all four methods of analysis (three standard and one novel) we found that the dialogic system is significantly more persuasive with ( $p < 0.05$ ) than the lecture-style system. We also found that the dialogic system presented significantly less information (almost four times less) than the lecture system.

We begin with a section on persuasion theories, and then related work. We then discuss the Moon Survival task, followed by a description of the systems we designed for the study. We then describe how we measured persuasion through a detailed analysis of a new rank correlation method as compared to more standard methods. This is followed by the study design, results, discussion and conclusions from the study.

## 2.2 Theoretical Background

The Elaboration Likelihood Model (ELM) has become an important model for understanding persuasive message processing [52]. The model describes two routes to persuasion - central and peripheral. In the central route, persuasion occurs as a result of effortful processing of information in a persuasive message, where one applies one's own knowledge to rationalize attitude change. Central processing often occurs when the information presented is considered personally relevant. Peripheral persuasion, however, occurs from a more low-effort attitude change, which happens as a reaction to external cues of a persuasive message rather than to the actual information presented.

In the long term, attitude changes due to the central route have been proven to have greater temporal persistence, stronger resistance to counter persuasion, and higher prediction of behavior than those changed via the peripheral route [52]. For example, psychology studies have shown that when subjects play an active role in arguing for or discussing an issue, their attitudes are more persistent than subjects who passively hear a communication about an issue instead [25]. This provides motivation to explore modes of interaction via speech-based interfaces that may potentially engage the user more actively.

## 2.3 Related Work

### 2.3.1 Computers as Social Actors

Nass and Brave have worked on understanding how humans react to computer voices, synthesized and recorded [47]. They have looked at the impact of peripheral cues such as gender, personality, accents and emotion of computerized voices on self-reported measures of likeability, trustworthiness, informativeness, competence, credibility etc. of the voices. In all these studies, subjects tended to rate the synthesized voices in the same way as recorded voices, perceiving the voice as a social actor with social attributes [48]. This suggests that inherent cues in speech can "humanize" an interaction with a computer voice and potentially encourage peripheral processing of persuasive messages. However these studies do not focus on the effects of actively engaging the user in dialogue as we do in this study.

### 2.3.2 Tailored Information

One benefit technology offers for information presentation is the ability to tailor information according to some characteristics of the user. This has been explored extensively using presentation of text information [23][9][19], and personalization of information and feedback has been shown to cause more positive changes, especially in health behavior. These results suggest that a dialogic question-answer based information system can show similar results by allowing users to “self-tailor” information they receive. The Digital Therapy Developer (DTD) [36] is a toolkit for designing behavioral change programs using interactive media that are tailored to an individual’s psychological process of change. Although the DTD has been utilized for different types of interaction (web, e-mail, cellphones, text-messaging) there is no reported comparison of persuasion across interaction modes.

Information tailoring is also rationalized by the ELM [19]. Personal relevance increases one’s motivation to pay attention to, comprehend and mentally elaborate on the information, thus leading to a more focused and effective communication. We believe that dialogic systems could encourage this same behavior by presenting short bits of relevant information through an interaction entirely guided by the user.

## 2.4 The NASA Moon Survival Problem

The NASA Moon Survival Problem is a problem-solving task widely used for measuring group decision making and persuasion [32]. In this task, the participant imagines that he/she is a member of a space crew and is scheduled to rendezvous with the mother ship, but the spaceship crashes on the moon 200 miles away. During the crash, everything is destroyed apart from 15 items, listed in Table 2.2. The participant is given the task of ranking the items from 1 to 15 according to their importance for survival on the moon. Although this task is commonly used to study effects within groups, in our study the participant was asked to do the task first individually and then with the help of an information system. The system was a confederate in the experiment, providing arguments for a particular ranking of the items of which only a subset was based on fact. We drew arguments for the system to use from previous versions of this experiment used to measure persuasion under teleconferencing conditions [65][8]. The participant was asked to rank the items before and after his/her interaction with the system. We used this task to measure the persuasive force of the system on the participant’s ranking of the items.

## 2.5 System Design

The information presented by both systems we designed was the same, differing only in interaction mode. We asked a professional actress who resides in the area to

Recorded Message System	Interactive Dialogue System
<i>We can definitely make use of the rope in multiple ways. We could use it to scale cliffs. We can also, say if one of us gets hurt, tie our injuries together. We could find plenty of uses for this, so it should definitely at least be somewhere in the first half of the list, after the radio and pistols.</i>	<i>Participant: What can I use the rope for?</i> <i>System: We could use it to scale cliffs.</i> <i>Participant: Where should I rank the rope on the list?</i> <i>System: We could find plenty of uses for this, so it should definitely at least be somewhere in the first half of the list, after the radio and pistols.</i>

Table 2.1: Sample interactions for the RM and ID systems. Messages are identical, but grouped and presented differently.

record four to six statements regarding each of the 15 items in separate clips. The scripts were written in the first person, as if the voice was stating a personal opinion. Each statement confidently stated some information about the item, or suggested a rank for the item relative to at least one other item on the list. For one system, we concatenated the four to six statements into one long audio clip and played this back as a recorded message about each item. In the other system, for every question a participant asked, exactly one relevant statement (of the four to six) was played back as a response.

### 2.5.1 Recorded Message System

The Recorded Message system (RM) was designed as a basic GUI with 15 buttons, each labeled with the name of one of the 15 items to rank. When a button was pressed, the recorded message containing four to six statements corresponding to the item was played back. (See Table 2.1 for the recorded message played for the *50 ft. of nylon rope*).

### 2.5.2 Interactive Dialogue System

The Interactive Dialogue (ID) system utilized speech input as well as output. This system was a basic GUI with just two buttons, “Record” and “Stop” which implemented what appeared to be a push-to-talk speech recognition system. However, the recognition was performed using the Wizard of Oz technique. In order to access information, the participant could speak any question into the microphone. The question was sent over the network to the experimenter’s computer in an adjacent room. The experimenter selected the most relevant response from all of the recorded four to six statements for each item. This statement was played back on the participant’s machine. Thus, the responses played back in the ID system were the exact



same recordings that were used in the RM system, only they were played in shorter segments. A sample interaction for accessing information about the *50 ft. of nylon rope* is seen in Table 2.1.

In addition, the actress also recorded some filler phrases which the experimenter played back if no other phrases were appropriate, such as “*yeah*” or “*okay*”. There were also some clarification phrases, such as “*What did you say?*” If the question did not have an appropriate response (i.e. what’s the weather on the moon), the experimenter would choose the response “*Hmm...I don’t know.*” Other than these fillers, the information presented in the ID system was a subset of the information presented in the RM system.

## 2.6 Persuasion Measures

### 2.6.1 Expert and Confederate Rankings

A published expert solution given by the Crew Equipment Research Section at the NASA Manned Spacecraft Center ranks the items in a particular order, shown in Table 2.2 [65]. Previous studies have considered the quality,  $Q$  of a solution as its correlation with the expert ranking ( $E$ ), and have shown that participants generally start with a pre-interaction ranking close to  $E$  [65]. One measure of persuasion captures the participant’s movement away from the expert between the pre-interaction and post-interaction rankings, or the decrease in quality of the solution.

The system (confederate) argued for a particular ranking of the items in the order shown in Table 2.2, which we call  $C$ . Another dimension across which we measure persuasion is the movement of the participant’s ranking towards the confederate’s solution when comparing his/her pre-interaction and post-interaction rankings.

### 2.6.2 Standard Rank Metrics

In order to assess persuasion, we want to compare the user’s ranking with the expert and confederate, both before and after the persuasion event. We expect to see movement in the user’s final ranking toward the confederate and away from the expert, compared to their original ranking. We can use standard rank correlation methods (Spearman Rank Coefficient, Spearman’s Footrule or Kendall’s Tau) in order to measure the similarity between two rankings. For a correlation coefficient  $C(u, v)$  between rankings  $u$  and  $v$ , there is a natural distance measure  $d(u, v) = 1 - C(u, v)$  which increases with distance between the rankings and is zero when they are the same. To assess the change in distance from the expert, we might compute  $d(u^+, E) - d(u^-, E)$ , where  $E$  is the expert’s ranking and  $u^-$  and  $u^+$  are the user’s ranking before and after the persuasion event, respectively. In practice, user rankings are much closer to the expert’s rankings than to the confederate’s [65]. So the distance

Rank	Expert NASA Ranking (E)	Confederate Ranking (C)
1	2 hundred-pound tanks of oxygen	2 hundred-pound tanks of oxygen
2	5 gallons of water	Signal flares
3	Stellar map (of moon's constellations)	Magnetic compass
4	Food concentrate	Food concentrate
5	Solar-powered FM receiver-transmitter	Solar-powered FM receiver-transmitter
6	50 ft of nylon rope	Two .45 caliber pistols
7	First aid kit with injection needles	50 ft of nylon rope
8	Parachute silk	First aid kit with injection needles
9	Life raft	Stellar map (of moon's constellations)
10	Signal flares	1 case of dehydrated pet milk
11	Two .45 caliber pistols	5 gallons of water
12	1 case dehydrated pet milk	Portable heating unit
13	Portable heating unit	Parachute silk
14	Magnetic compass	Life raft
15	Box of matches	Box of matches

Table 2.2: NASA Expert (E) and Confederate (C) rankings of 15 items.

between users and the confederate is much larger than the distance from users to expert. It follows that the relative change in pre-post distance is larger relative to expert than confederate, and it is easier to detect the change with a statistical test relative to the expert.

In particular, the Spearman Rank Coefficient was used in previous examples of this experiment [65]. However, there are statistical problems with using parametric tests such as t-tests on non-parametric rank correlations in low dimensions such as we have here. In our application, the dimension is the number of items to be sorted, 15. Rather than a single correlation, an in-depth study of various rank measures in [22] recommends using multiple rank correlation measures. So we add two more commonly-used measures, Spearman's Footrule and Kendall's Tau [22]. Spearman's Footrule in particular was shown to have better performance on random rankings in low dimensions. There is still the problem of applying parametric t-tests to the rankings, since the latter are non-parametric. To guard against errors, we also ran non-parametric permutation tests [30].

### 2.6.3 A New Measure

We so far considered rank changes between expert and confederate. But neither are really satisfactory since we are interested in the movement away from expert *and* toward confederate. This suggests the development of a new statistic. One natural measure would be the cross correlation between the before-after rank difference, and

the expert-confederate rank difference. i.e.

$$DL_i = \frac{1}{\lfloor n^2/2 \rfloor} \sum_{j=1}^n (c_j - e_j)(a_{ij} - b_{ij}) \quad (2.1)$$

where  $DL_i$  is the statistic for user  $i$ ,  $c_j$  and  $e_j$  are confederate and expert rankings respectively for item  $j$ , and  $a_{ij}$  and  $b_{ij}$  are after and before ranks respectively for item  $j$  by user  $i$ . This distance measure is equivalent to (a constant multiple of) the following expression in terms of Spearman distances:

$$D_i = \rho(c, b) - \rho(c, a) - \rho(e, b) + \rho(e, a)$$

however, a weakness of equation 2.1 is that it weights different rank differences ( $a_{ij} - b_{ij}$ ) by different weights (the  $c_j - e_j$  weight). Using different weights has two consequences: the first is to reduce the tendency of the sum to a normal distribution - this is fastest when the sum adds identically-distributed items. The second is to weight the large rank shifts more heavily in the sum. This is reasonable if users make similar shifts in their own rankings. However, most users start with rankings fairly close to expert rankings. Making large shifts in the rankings of items (away from the expert) is presumably difficult for users since it fights their own intuition. So rather than using a full weighted ranking, we propose to use only the sign of the expert-confederate difference:

$$DS_i = \frac{1}{\lfloor n^2/2 \rfloor} \sum_{j=1}^n \text{sign}(c_j - e_j)(a_{ij} - b_{ij}) \quad (2.2)$$

We might be tempted to further eliminate distance information and take the sign only of ( $a_{ij} - b_{ij}$ ). However, this disregards most of the usable bits in the distribution of user ranks, making statistical estimates much more noisy. Since the term distributions are concentrated at one, two or three values, it also impedes convergence of the sum toward a normal distribution. When we present our results and analysis later in this paper, we will compare the  $DS$  measure with the other standard measures we have discussed.

## 2.7 Hypotheses

**Hypothesis 1: The interactive dialogue system will be more persuasive than the recorded message system.** We hypothesize that by interacting with participants through a mode more natural and conversational, the dialogic system will be more persuasive than the message system.

**Hypothesis 2: Participants will receive less information in the interactive**

**dialogue system than in the recorded message system.** Since the participants guide the interaction in the dialogue system through their questions, we hypothesize that they will hear less information than the participants using the recorded message system.

## 2.8 Study Method

### 2.8.1 Participants

Participants were recruited using services provided by the eXperimental Social Science Laboratory (XLab) at the University of California, Berkeley. The Xlab sends out a recruitment message for scheduled experiments to a database of regular volunteers. Subjects opt-in voluntarily via a calendar of scheduled sessions. There were a total of 52 participants, with 21 male (40%) and 31 female (60%). Of the participants, 46 were students (88%) and 6 were staff members (12%). The average student age was 21 and the average staff age was 33. 28 participants were assigned to the ID condition and 24 to the RM condition in a between-group design.

### 2.8.2 Conditions

**Recorded Message System.** 24 participants took part in the RM condition in two one-hour sessions. In each session, 12 participants sat in a large room at laptop stations separated by dividers. Each participant worked individually and was isolated from the other participants.

**Interactive Dialogue System.** There were 28 participants in the ID condition. Each one-hour session consisted of only one participant who sat in a small room alone. The experimenter controlling the Wizard of Oz system sat in the neighboring room.

Although it would have been ideal to test both systems in identical conditions, some differences were unavoidable. The experimenter needed to control the Wizard of Oz system for each of the ID participants, so those sessions had to be conducted individually. However, limitations on usage of the XLab facilities made it impossible to test the RM system individually as well. For this reason, we attempted to create similar settings by isolating the RM participants with dividers and minimizing the distractions from others in the room.

### 2.8.3 Measurement Instruments

**Persuasion Measure.** We use and compare four methods to measure persuasion in this study: the Spearman Rank coefficient, the Spearman's Footrule, Kendall's Tau and finally the new measure *DS*. Because rank analysis methods are not robust to

all types of data, it is common to use multiple methods for analysis.

**Information Measure.** We measure the amount of information heard by the participant by counting the number of statements that were played back by the system by reviewing logs of each participant’s interaction. In the RM system, although the full message is played back at once, we count the number of statements made within the message, i.e. the oxygen message contains six separate statements.

**Post-Session Questionnaire.** After the study, participants were asked to fill out a questionnaire about their experiences interacting with the system. There were ten Likert scale questions with responses on a scale of 1 (strongly disagree) to 5 (strongly agree), in addition to seven open-ended questions asking them to describe their interaction.

## 2.8.4 Procedure

Each session lasted one hour. The conditions to be run at each scheduled time slot were predetermined by the researcher, so participants were automatically assigned a condition when they signed up. They were not aware of the multiple conditions.

Anyone who was familiar with the task was turned away but given \$10 for showing up. Participants spent five minutes reading over consent materials, and filling out a short demographic survey.

Next, participants were asked to imagine that they were members of a space crew whose ship had crashed, and that they had the responsibility of ranking the surviving 15 items according to their importance for survival. They were given a written copy of the instructions, a table in which to write their solutions, and an envelope with 15 slips of paper with each item written on it. They had plenty of desk space on which to move the slips around while they came to a decision. In both conditions participants worked alone and spent 10 minutes on the task.

After 10 minutes, the researcher collected their solutions. Participants were told that there was an actual optimal ranking of these items that was going to ensure their survival. They could now access some information regarding the items and how to rank them using a computer system, but that the information they heard may or may not be true. In the RM condition, they were told they could click on the GUI buttons to hear information about each item through headphones. In the ID condition, participants were told they could ask any questions about the items and how to rank them into the microphone and that they would hear a response through the headphones. The researcher demonstrated the use of the “Record” and “Stop” buttons. All participants were given a copy of written instructions as well. Participants kept the slips of paper to keep making changes to their orderings, but were not yet given a table to record their final solution. They had 20 minutes to interact with the system. In the ID system, the researcher listened to the participants’ questions and chose appropriate responses from the short statement clips (as described in the system design section). However, participants were not told that the system

Measure	Effect Size	t(50)	P-value (t-test)	P-value (Perm)
<i>DS</i>	0.5977	-2.165	$p = 0.0176$	$p = 0.0181$
Spearman Coefficient	0.5011	-1.813	$p = 0.0379$	$p = 0.0380$
Spearman’s Footrule	0.5849	-2.125	$p = 0.0193$	$p = 0.0191$
Kendall’s Tau	0.4612	-1.668	$p = 0.0507$	$p = 0.0527$

Table 2.3: Cohen’s  $d$  effect size, normalized  $(\mu_{id} - \mu_{rm})$ , between RM and ID. Persuasive force is individually calculated using the four rank correlation methods.

was not automated.

Twenty minutes later, participants stopped and recorded their final rankings in a table. They were given 5 minutes for this task. At this time, they were reminded that their compensation would be scaled by their correlation with the optimal solution.

After this, participants were given 10 minutes to fill out the post-session questionnaire.

At the end of the experiment, participants were shown the expert solution. Those in the ID condition were debriefed about the Wizard of Oz system. Participants were paid \$15 for their hour of participation, and in addition earned between \$0 and \$4 scaled by the average correlation with  $E$  of their pre-interaction and post-interaction rankings.

## 2.9 Results

### 2.9.1 Comparison of Systems

We first tested that there was no difference between the pre-interaction solutions across both conditions. This serves as a baseline to examine the changes seen after the interaction. As expected, and consistent with previous studies [65], for all three correlation methods, with a t-test assuming equal variances, we saw no effect of condition on the correlation of pre-interaction and expert solutions.

We use three standard rank metrics and the new  $DS$  to analyze the persuasive force. As explained in Section 2.6.2, the standard metrics use correlation between the user’s ranking and  $E$  only, but  $DS$  uses both  $E$  and  $C$ . We report the Cohen’s  $d$  effect size for the persuasive force of both systems,  $(\mu_{id} - \mu_{rm})/\sqrt{(\sigma_{id} + \sigma_{rm})/2}$ , where  $\mu$  and  $\sigma$  are the mean and variance of the persuasive force in each condition. Results of a one-sided t-test assuming equal variances with  $\alpha = 0.05$ , and a Monte Carlo permutation test with 10 million random samples are in Table 2.3. With all four methods, results show that the mean persuasive force is greater in ID than in RM (normalized  $(\mu_{id} - \mu_{rm}) > 0$ ), and this result is statistically significant with ( $p < 0.05$ ). The p-value varies across methods, confirming that some rank correlation methods may be more sensitive on this data.

Effect Size	t(50)	P-value from t-test
3.223	-12.58	$p \simeq 10^{-17}$

Table 2.4: Cohen’s d effect size in amount of information heard measured between conditions.

## 2.9.2 Amount of Information Heard

Using a one-sided t-test assuming equal variances, we find that participants heard significantly more information (on average, 102 more statements) in the RM system than in the ID system, as shown in Table 2.4.

## 2.9.3 Post-session Questionnaire

We tested our post-session questionnaire results across conditions using a t-test assuming equal variances and ( $\alpha = 0.05$ ). We found that participants in the ID condition enjoyed interacting with the system significantly more than those in the RM condition, with ( $p < 0.05$ ). Participants in the ID condition also reported that they found the voice to be credible significantly more than those in the RM condition, with ( $p < 0.05$ ). We found no significant difference across the conditions in how useful participants found the system in helping rank the items, how believable the arguments were, how much the system clarified doubts, or how they felt about changing their minds about rankings.

## 2.10 Discussion

### 2.10.1 Revisiting Hypotheses

**Hypothesis 1: The interactive dialogue system will be more persuasive than the recorded message system.** This hypothesis is supported by the results. When using all correlation methods, our results show that the ID system is significantly more persuasive than the RM system. The results also suggest that the new *DS* metric may be a more sensitive measure for this type of experiment, but further cross-validation is still necessary to evaluate the method completely.

**Hypothesis 2: Participants will receive less information in the interactive dialogue system than in the recorded message system.** This hypothesis is supported by the results. In the given interaction time, participants using the ID system heard significantly less information than those using the RM system. Therefore, the actual duration of time for which the ID participants heard persuasive messages was significantly shorter.

### 2.10.2 Future Work

Participants in the ID condition rated the voice to be credible more than participants in the RM condition. Several participant's questionnaire responses expressed surprise at the computer's relevant responses; this could be due to the novelty effect of interacting with a natural language speech recognition system. The results are promising, but we still need to validate these results with an automated system to eliminate any biases of the Wizard of Oz method, including experimenter bias, and the possibility that participants suspected the technique.

We are also interested in further validating our results in other contexts. Since different factors could affect the results, we are interested in replicating this experiment with different tasks in other domains (such as health) to further understand the relation between information presentation and persuasion.

## 2.11 Conclusion

In this chapter, we described a study comparing the persuasive power of two speech-based interaction modes. We found that a dialogic style of presenting information is significantly more persuasive than a lecture style. Our results suggest new motivation for using dialogic, speech-based interfaces for the design of persuasive technologies.

As promoting healthy practices continues to be an issue of concern, using appropriate technologies for persuasive information presentation in many domains looks promising. Specifically, persuasive technologies can play a significant role in suggesting, motivating and advocating certain behaviors. Our results show that dialogic, speech-based systems could offer an advantage to the effectiveness of such technologies.

In the next chapter, we introduce a new context in which the need for promoting healthy practices is critical. The results from this study resurface in Chapter 5, where we compare lecture vs. dialogic health messages in a field study with rural women in India.



## Chapter 3

# Understanding the Role of Technology in Rural Maternal Health

### 3.1 Introduction

Mortality rates due to preventable tragedies in the developing world are devastatingly high [49]. For example, 99% of all maternal deaths due to complications in pregnancy, childbirth and abortions occur in developing regions [66]. There is an undeniable need to provide reliable healthcare information to communities and to those responsible for providing care in these places. In many developing countries, these healthcare providers are community health workers (like village healers, midwives, or government-employed workers) who lack professional training. Even in places where information is available, it is often not seen in practice due to lack of cultural sensitivity and incentives to use it [29].

In the global health arena, there have been many efforts in using technology for connecting health professionals with community health workers, using electronic medical records, supporting community health workers in their daily tasks, and increasing access to emergency care [59, 21, 39, 31]. In this chapter, we describe our experiences in two rounds of field work in rural India during which we used qualitative methods to assess the role of technology for delivering maternal health information through community health workers.

We find that the government employs female health workers in villages essentially as reproductive health “motivators.” Many external factors contribute to the efficacy of health workers, some of which are out of their control; issues of acceptance within the community are great, making their jobs very challenging. In addition, power dynamics within the household give their target clients (women of reproductive age) little decision-making power. We present our findings from interviews with health

workers, their trainers, their clients, and other members of their communities to get a broader perspective of the social context in which they work.

Not all problems that health workers face can be solved with technology interventions. However, we believe that mobile, persuasive technologies can be used to motivate and scaffold the health worker, so she can play a more active role in health promotion, and her build credibility and influential power within the community. Specifically we discuss the use of technology for (1) supporting on-the-job learning and teaching, (2) establishing credibility, (3) managing expectations and (4) presenting interactive, persuasive content. The contributions of this chapter are an in-depth presentation of the social context of maternal health promoters in rural India, and an analysis of broader implications for design in this space.

We begin by presenting some background information about the state of maternal health in India, followed by a discussion of related work. We then present our findings from our two qualitative field studies. This is followed by a discussion in which we analyze our findings based on theories of influence, and draw some implications for mobile, persuasive design in this context.

## 3.2 Background

### 3.2.1 Maternal Health in India

Over half a million women die each year through complications that occur during pregnancy and childbirth [66]. The worldwide maternal mortality ratio (MMR) is 400 deaths per 100,000 live births, where a maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration. The average MMR in industrialized countries is under 10. As 99% of maternal deaths per year occur in developing countries it is clear that nearly all cases could be avoided with access to proper information and care. Yet the risks and complications that can occur during pregnancy and childbirth are not well understood in many parts of the world, and women continue to lack access to necessary medical attention. The fifth Millennium Development Goal aims to reduce maternal mortality by 75%, a goal which is impossible to meet without scaling up the proportion of skilled health workers that attend deliveries [62]. India has the highest absolute number of maternal deaths worldwide, accounting for more than 20% that occur globally [66]. And even now, more than half of all deliveries in the country are conducted at home, without attendance of a skilled birth attendant [34].

The Indian government health system has recently put a large emphasis on providing antenatal care to all women, ensuring that all deliveries take place in institutions, and promoting family planning [34]. The goals of the specific reproductive and child health program include improving the capacity of existing primary health centers by employing a nurse to conduct frequent village visits, and placing a female *Accredited*

*Social Health Activist* (ASHA) in each community who receives performance-based compensation for promoting access to healthcare. The role of the ASHA is to improve access to antenatal care by serving as a bridge between the community and the visiting nurse, and to promote institutional delivery, child immunizations and family planning. A special scheme is available for below-poverty-line families [44] that includes national government-sponsored subsidies for institutional delivery care available both as compensation for the new mother and the ASHA worker (who arranges transport and escorts her).

### **Antenatal Care**

Though it is difficult to identify which pregnancies will have complications in delivery, antenatal care is still an important preventive intervention, particularly for detecting sexually transmitted infections and anemia [67]. This is crucial as nearly a fifth of all maternal deaths in India are attributed to severe anemia [45]. Prenatal tetanus injections have also been shown to be life-saving for the mother. In addition, women can be warned about danger signs and symptoms during labor and delivery by their antenatal care providers. However, even after having received appropriate access to antenatal care, skilled care at delivery time is essential in the case of unexpected complications. Therefore, the role of the ASHA worker in ensuring that women get antenatal care and deliver in hospitals is impactful.

### **Family Planning**

Family planning (the use of any type of contraception) gives men and women the choice to regulate their fertility and avoid unwanted pregnancies. Worldwide, studies have shown that women are bearing more children than they desire to have: a quarter of all pregnancies are unwanted [54, 17]. If the existing demand for contraception could be met, maternal deaths could be reduced by one fifth [17].

However, barriers to family planning come in all varieties, and many are social in nature [12]. For example, one obstacle found in many south Asian countries is the woman's perception of her husband's preferences, and the associated socio-cultural costs. Another major barrier to the use of family planning methods is misinformation. This includes misconceptions about side effects and associated fear. Access to proper information about family planning is essential in places where there is high unmet need, and ASHA workers can play an important role in making this information available.

## **3.2.2 Integrated Child Care**

UNICEF and the World Bank have been supporting the Integrated Child Development Services (ICDS) program across India for a number of decades now [2].

This program focuses on improving the infant mortality rate by creating Anganwadi Centers (child care centers) in each village, run by a local woman from the community, *Anganwadi Worker* (AWW). Food and nutritional supplements are provided for pregnant and nursing mothers, as well as training in health, nutrition and hygiene. The main job of the AWW is to monitor young children, improve their nutrition and foster cognitive development.

Thus, the current Indian health care system uses a change-agent model by employing both the AWW and ASHA workers in their own communities to promote child and maternal health respectively. In this chapter, we present our study of the efficacy of these workers through qualitative field work conducted in rural India.

### 3.3 Methodology

In this section, we describe the set up of our two rounds of field work in rural India in which we studied health worker practices and efficacy.

#### 3.3.1 Field Study 1: January

To begin our needs assessment in India, we visited twelve organizations (eleven non-government and one state health department) in the states of Tamil Nadu, Andhra Pradesh and Orissa that engage in health worker training. In informal meetings and discussions we spoke with trainers at the organizations, two doctors, one midwife, four community health workers and three freelance health worker trainers. The organizations were selected through internet research and personal references, where contacts at one organization would generally introduce us to others. The main purpose of this visit was to get a better understanding of the practices and challenges of community health workers and their trainers.

The organizations we visited were all involved with health worker training, with some emphasis on reproductive health. Some organizations provided supplemental training to government health workers, and others employed and trained their own health workers in villages; all the health workers we worked with were women. These health workers had been selected to work in the villages from which they hailed as health motivators, serving as a sort of bridge between the outside organization and the rest of the community.

#### 3.3.2 Field Study 2: July - August

For our second round of field work, we decided to focus on the state of Orissa. Of the three states we visited on our previous trip, Orissa is by far the poorest, with the state poverty rate at 47.2% [53]. Due to poor performance on most indicators of

reproductive health, family planning and nutrition, Orissa is one among the states that receive targeted interventions from the government.

Our main focus for this round of field work was to get a more in-depth understanding of influences on maternal health decision-making and the role of the health worker. With the support of a non-government organization with headquarters in Ganjam district in southeastern Orissa, we spent one month conducting qualitative interviews in nine villages in the district. We conducted 34 total interviews, each consisting of one researcher, one research assistant/translator, one NGO staff member and between one and three interviewees. We used a snowball sampling method for selecting interviewees. In each village we began by selecting a “pivot” to interview (either a government-employed health worker or pregnant woman) with the assistance of the NGO staff member. With health workers we discussed their background, training, current responsibilities, and perceived efficacy in the village. With pregnant women, we asked about their health service providers, antenatal care providers, trusted contacts for discussing issues during pregnancy, and plans for the delivery. Through these discussions, we identified other key players who were involved in some of the various aspects of health decision making, and tried to interview them as well. We interviewed 10 health workers, 8 pregnant or postnatal women, 4 family members of pregnant women, 4 traditional birth attendants and 11 village leaders and prominent women. The interviews lasted between 15 minutes and 1.5 hours and were conducted in the local language, Oriya. We recorded the interviews using an MP3 recorder, and transcribed them into English for analysis.

## 3.4 Findings

We now present our findings from our two field studies, and describe what we learned about various external factors contributing to health worker efficacy. These are divided into themes of training, acceptance, accountability and household influence.

### 3.4.1 Training

Officially, the Anganwadi Worker (AWW) and Accredited Social Health Activist (ASHA) should receive dedicated training from the government before beginning their work. The AWW receives two months of induction training [2] and the ASHA worker receives 23 days of training in 5 segments over the course of a year [45]. In addition, they are required to attend a *monthly meeting* in which they receive a lesson on some health topic. We had a chance to visit one of these meetings where the topic being covered was sunstroke. Only seven of the 23 ASHAs expected showed up on time, and by the end 14 had arrived. We observed throughout the lecture that only one ASHA was taking notes, and only one other looked at all attentive. The information

Health Worker	Employment	Training Received
AWW	5 years	2.5 months
AWW	1 year	1 month
AWW	2 months	none
AWW	12 years	2 months
AWW	4 years	1 year
ASHA	1.5 years	5 days
ASHA	3 years	1.5 months
ASHA	1.5 years	5 days

Table 3.1: Reported Training of Health Workers

was presented by a man lecturing orally for about forty minutes, with no visual aids. Comprehension was presumably difficult, and it seemed unlikely that much learning occurred. It was clear that ASHAs needed a better method of learning and reviewing information, especially since they are expected to learn new information monthly.

In the villages which we visited, we found that the amount of training reported by these health workers varied widely. These numbers are shown in Table 3.1.

Through discussions with health worker trainers, we learned that despite varying amounts of training, health workers often believe that they have sufficient knowledge; however, this is because they might have difficulty perceiving the applicability of new knowledge to themselves. It was never sufficient just to provide information. As one trainer said,

“Just making the information available to the health workers by no means motivates them to use it. They need to know why to use it, how to use it, why it’s personally relevant, and where to utilize it. Only then will it be of any use to them.”

Most trainers agreed that books, though great sources of information for themselves, were not entirely appropriate for health workers. This is not only because health workers might be of low-literacy levels, but because they simply did not have the confidence in themselves to find and use information from a book; the concept itself of searching through a book was unfamiliar.

Because of this, most NGO trainers engaged health workers in participatory training sessions, using methods like story-telling and role-plays, and providing visual aids, charts, posters and models to teach information. Trainers unanimously believed these sessions were effective, and attendees greatly enjoyed and appreciated them; but as one doctor put it,

“NGOs are excellent for sincerity training, but they’re still not technical experts, so their trainings cannot make health workers technical experts.”

Training sessions were also infrequent because trainers could simply not travel to remote villages on a daily or even weekly basis. In the best case, trainings occurred twice a year. Therefore, health workers still lacked the ability to get immediate feedback about current and relevant problems. Ultimately, trainers said, health workers need this kind of information the most.



Figure 3.1: The ASHA and AWW of one village described their difficulties in getting people to accept what they said.

### 3.4.2 Acceptance

We found that a recurrent theme in many discussions with both health workers and their communities was acceptance. Health workers had to work hard to be accepted as health service providers in their communities, and many factors stood between them and their clients. According to community members, this lack of trust was justified.

#### Selection

The process of selection of the health workers is designed to ensure that they are accepted among community members. According to the guidelines, both the AWW and ASHA are elected by the village council, such that someone with an established rapport with many people in the village is chosen. The government also imposes educational criteria: ASHAs should have passed the eighth grade, and AWW tenth, but this can be overruled if no one in the village can be found.

However, there is a mismatch between the government-defined village (*revenue village*) and the community-defined village. While health workers are employed in revenue villages such that they serve a fixed population, communities have long ago

created their own boundaries based on caste and background within these villages. As such, we found that many health workers, though they are assigned to serve 3-4 villages in a relatively close proximity, tend to be selected only by the council of the village from which they hail. In all the tribal villages we visited, the health worker came from a neighboring non-tribal village, and the tribal villagers reported to have had no say in her selection. The chief of one tribal village told us,

“There are a lot of loopholes. [The AWW] builds up her network of acquaintances. . . Even if someone else has finished [high school], she does not get the job. But [the AWW], having passed just seventh grade manages it. Just pay Rs. 5000/- and get selected. . . The village committee doesn’t even get to know of this. They announce the result that she has been appointed as your AWW.”

As a result, attitudes toward her in the village itself were widely negative. We spoke with the AWW referred to here who described her difficulties in making herself seem credible in this village:

“If a hospital jeep comes by and advertises [a pulse polio drive] then more people are aware of the issue. If we say the same thing, few people turn up. . . I can only convince my village, but it is difficult for me in outer villages. . . if I send notice by word of mouth, their reaction is - the jeep hasn’t come yet.”

Issues in the selection process itself, though not in the control of the health worker or the community members, affects both sides negatively. This creates tension in the health worker-client relationship and hinders service provision.

### **Concrete Resources**

As health workers, the AWW and ASHA distribute prenatal vitamins, malaria pills, and cold and fever medicines. These medicines are supposed to be provided free by the government; however, glitches in this centralized system often make supply of medicines irregular. One health worker complained that authorities would not restock medicines for 2 or 3 health workers in need when 100 of their peers seemed satisfied. Yet, on the ground, health workers are still scapegoated for these problems. As one village chief said about the local AWW,

“The chloroquine tablets come to her regularly - we came to know of this fact from the radio and TV. But she only gives medicine to people whom she thinks are aware of their rights. To the others, she says no and sells the medicines for her personal profit.”

We found that the trusted source for health care information and services was consistently the medicine provider - the one who was able to give something concrete



to cure an existing problem. Not surprisingly, people were always interested in curative health, not prevention. Thus, the AWW and ASHA were only trusted as credible information sources and health providers when they provided concrete resources, like medicines. In all the villages we visited, community members judged health workers mainly on whether or not they provided medicines. However, this problem was taken to another level in two villages where, as one village leader pointed out,

“People have the mind-set that since these medicines are free, they are necessarily ineffective.”

In turn, health workers realized that they needed to prove themselves to the community. As one health worker pointed out,

“Once I give medicines to one patient, then the same patient will tell others about me, and then my name spreads among the villagers.”

Another task of the AWW is to distribute the supply of grains that is supplied by the government to pregnant and nursing women, as well as children under 6. They also cook daily for the children who attend the preschool. Similarly to medicines, community members demand this food as well. One village chief complained,

“Now we don’t even know where does the grains disappear to or the pulses go. All of these go to the AWW. The [supervisors] make their rounds, once or twice a month, so the kids are fed for just these two days.”

However, the AWW explained the difficulty from her side:

*AWW*: “The main problem I face is in the irregular supply of grains. People react strongly to that. . . When I go for growth monitoring of the children they say why weigh them when you don’t give them anything to eat?”

*Researcher*: “Do you think it would help if you could take complaints back to the office because the people have complained?”

*AWW*: “The office can only provide the food stock if they have it. Rather they would say don’t ask questions and just do whatever your duty is.”

*Researcher*: “But this is one of your duties right?”

*AWW*: “I can’t keep pressing on this alone. I understand that the office is out of stock. I try making people understand, and if they get too vocal I advise them to inquire at the office.”

As community members use concrete resources as a basis for judging the health worker’s efficacy, issues in the supply-chain challenge health worker acceptance.

### 3.4.3 Accountability

Issues in enforcing accountability were mentioned consistently by trainers with whom we spoke. Some trainers believed that the lack of accountability was largely due to the lack of incentives to work in such resource-scarce settings. Our findings suggest that discrepancies in perceived responsibilities might also contribute.

#### Roles and Responsibilities

According to the government program, the AWW is responsible for the following roles: distributing supplemental nutritional food for below-poverty-line pregnant or nursing women and children from 0-6 years, providing health check-ups and tracking immunizations for pregnant and nursing women and children from 0-6, running a preschool for children aged 3-6, referring patients to the nearest health center or hospital, and providing health and nutrition education [2]. The ASHA worker, a more recent addition to the community, provides the following services: antenatal and postnatal care, encouraging breastfeeding, immunizations and growth monitoring, counseling on contraception and other health issues, and referrals for institutional deliveries, sterilization operations and other emergencies.

In asking the AWW and ASHA workers whom we interviewed what jobs they performed as a part of their duties, we found that they ranged between various subsets of the official job listing. Their responses are shown in Table 3.2 and Table 3.3. With the AWW, we also found a discrepancy between the jobs which the AWW reported to be doing and the services which community members reported she was doing. There were also roles which the community members knew she should perform, but claimed she was not.

As is clear from the tables, many roles intended for the health workers are not carried out, especially those related to counseling and education. They performed roles which directly led to compensation (i.e. institutional deliveries, immunizations and prenatal care appointments), but the rest lacked sufficient motivation.

We accompanied three ASHAs on their house visits. While we made it clear that we wanted to observe a regular visit, to our surprise, when we arrived at the clients' homes the ASHAs kept asking us what they should say. We realized that "house visits" as we imagined did not generally occur. Whereas ASHAs visited pregnant women when it was time for taking them to appointments or to notify them about village visits from the nurse, they were not regularly visiting the pregnant woman to check for danger signs, monitor medicine intake or provide counseling.

Also, we found varying impressions between what health workers believe their roles are and what the community perceive their roles to be. One village leader explained the situation in this way:

"The problem with the AWW is, we still don't know the exact function of the AWW, like the limitations of her work and things like that. All we know is

	Village 1		Village 2		Village 3		Village 4		Village 5	
	W	C	W	C	W	C	W	C	W	C
Preschool	✓	✓	✓	✓	✓	✓	✓	•	✓	•
Immun.	✓	✓	✓		✓	✓	✓	✓	✓	
Food			✓		✓	✓	✓	•	✓	•
Antenatal	✓	✓	✓	✓			✓		✓	
Growth	✓	✓	✓				✓		✓	
Vitamins	✓	✓	✓	•	✓	✓	✓	✓	✓	•
Referrals										
Health Ed.			✓						✓	

Table 3.2: Roles of AWW as reported by AWW (W) and her community (C). The ✓ indicates that she is reported as performing that role, and • indicates that community is aware she should perform the role but perceives that she is not. Blank spaces indicate that the role was not mentioned.

	Village 1		Village 2		Village 3	
	W	C	W	C	W	C
Antenatal Care	✓	✓	✓	✓	✓	✓
Postnatal Care						
Breastfeeding						
Immun.	✓	✓	✓	✓	✓	✓
Growth						
Counseling			✓	✓		
Inst. Deliveries	✓	✓	✓	✓	✓	✓
Fam. Planning						

Table 3.3: Roles of ASHA as reported by ASHA (W) and her community (C). The ✓ indicates that she is performing that role according to either herself or the community. Blank spaces indicate that the role was not mentioned.

she teaches in school. . . That is why people are not willing to get dependent on her.”

Another issue apparent from the tables is the significant overlap between the roles of the AWW and ASHA workers. This is intended by the government in order for the two workers to support one another, but according to one nurse, this only introduces problems.

“In some places ASHA does the work of AWW, in others AWW does the job of an ASHA. There are places where there is a clash between the ASHA and AWW. Now a rule is formulated that ASHA shall get Rs. 150/- for gathering the kids for immunization. So if the AWW is to gather the kids for immunization, she is asking for some part of that 150. Without the money they are not willing to do the job. This is leading to a clash between them causing problems for us.”

Another interesting conflict was that between roles of the health workers and their incentives to perform them. For example, in one village, a father-in-law did not wish to make use of the government subsidy for institutional delivery that the ASHA worker promoted because she would be rewarded for it too; he did not see why she should be rewarded for his action. And in another case, a village committee member explained to us why villagers were reluctant to take medicine from the AWW:

“People think. . . her duty is to distribute the medicine, that’s why she is distributing them.”

Thus, relationships and interactions between health workers and their clients were largely based on their personal perceptions of what her duties were.

### **Village Committee Involvement**

In all the villages we visited, there was some kind of elected committee or hereditary chief. Village leaders had significant influential power in their communities, making decisions in all aspects of health, education, politics, etc. We understood from our interactions with village leaders that they were largely influenced to accept new ideas within the community when they had seen some proof of the idea in a neighboring village. Being male, however, village leaders saw women’s reproductive health as a women’s matter.

A consistent finding in all the villages was that health workers who were backed by the support of the village committee and leaders were more effective and accepted within the community. For example, in one village, the committee played an active role in both encouraging people to utilize the AWW’s services, as well as keeping her accountable for all the services she was supposed to provide:

“If she doesn’t discharge her duties properly we question her. She is actually doing her duties well. She listens to us, and so do we when she faces a problem.”

She was required to ask their permission to take even a day off from teaching at the preschool. As a result, her acceptance by people in the community was high. In contrast, in another village, a major clash occurred between the committee and the AWW, and the committee had tried to get her fired from her post. The AWW had taken the case to court and won, but the community members still did not utilize her services for fear of what others might say. The health worker complained to us,

“I couldn’t eat from anyone else’s home, no one would help me with my personal problems. . . If someone else talked with me, he would be given the same treatment, so everyone was scared to talk to me and continued the boycott.”

With the current centralized healthcare structure, the health workers are solely accountable to their superiors in the government hierarchy, but not to their clients. As such, her accountability within the community varies according to the attitudes of the village leaders.



Figure 3.2: Left: Antenatal woman planning on delivering at home. Right: Women gathered for monthly immunization camp.

### 3.4.4 Household Influence

The health workers’ target clients, or intended adopters of the ideas she teaches, are women of reproductive age (usually young and newly-married). Our interactions with these women directly showed that they hold very little decision-making power in their own reproductive lives. Between traditional norms (i.e. a girl goes to her mother’s home for her first two pregnancies but stays at her in-law’s place for the third), and household power dynamics (i.e. her mother or mother-in-law decides whether the delivery will be at the hospital or home), the pregnant women themselves are left with little choice but to do as they are told.

Even in our interviews, we found that it was very difficult to have a discussion with a pregnant woman without some number of family members surrounding and interjecting their own responses. Shy young women especially got noticeably more silent in the presence of an in-law. Most women were completely unable to answer questions about healthcare expenditures, and in some cases were unaware of their own age. In addition, we found that they had little awareness of others in the village; for example, when we asked how many of their peers had deliveries at home vs. the hospital, most had no idea.

Health workers also described the problem to us, complaining that they had to make extra effort to provide services to young women:

“In my area even if someone fails to show up for the vaccination I go to her house. The village daughter-in-laws say we won’t come out in the open. I have no other option but to go to their homes.”

Health workers also recognized the importance, but also difficulty, of convincing mother-in-laws in order to create real change in the community.

“I talk to the woman first. If she agrees, then OK, otherwise I have to talk with the mother-in-law as women will listen to their mother-in-laws. I tell the mother-in-law that there is a risk of child death etc. and she should take her for regular checkups and tetanus injections. So the mother-in-law will surely take her. ”

“The mothers often talk with each other and share their experiences, and thus confidence in me increases among the people.”

“In many places, the mother-in-law refers to her own pregnancies and says that she never used any medicine. Then there are all kinds of problems.”

However, health workers also recognized that both parties needed to buy in to any new ideas at different levels.

“But the main thing is to explain to the daughter-in-law as she has to take care of herself. The mother-in-law may not have time to be that careful for her needs.”

Health workers are supposed to promote healthy reproductive behavior among young women, but realize they must widen their target in order to be effective.

## 3.5 A Role for Technology

In the next sections, we present an analysis of our findings from interviews with an array of key players in the villages we visited. Even as we focused on understanding the efficacy of health workers in motivating maternal health among women, a major motivation of our two rounds of fieldwork was to identify areas within this context where we felt that technology could possibly make a difference.

First, we begin by discussing our motivation for using mobile technology in this context, and then give a brief description of some relevant factors of influence from the psychology of persuasion. After this, we discuss four areas in which we believe that the use of technology could help build the capacity of the health worker, and suggest some implications for design in this space.

### 3.5.1 The Case for Mobile Phones

From our discussions with NGO workers and analysis of findings, we believe that the following features of mobile technology could be advantageous for appropriate design. We present a brief description of these features and refer to them later on as we discuss more specific design scenarios.

#### Mobile

Interactions between health workers and other village women tend to be in informal meetings or house visits, not conducive to extended setup time or restrictions on location. The added advantages of growing cell phone infrastructure and robustness to intermittent connectivity encourage utilization of the platform in this setting.

#### Interactivity

Many existing techniques for delivering persuasive health messages provide only one-way communication (posters, TV advertisements, radio announcements). Platforms which support custom software provide the unique opportunity to make information delivery a two-way process. This way, users can engage more in the information by providing input and tailoring the type of information which they receive. This type of interactivity could be achieved on mobile phones which support programs written in Flash, Java or the like.

Designs that leverage the interactive capabilities of technology can help tailor information to user input and thus make it more persuasive, for example by incorporating our findings from Chapter 2. Since we are looking at using speech-based information delivery in this case as well (to avoid too much text), we believe that dialogic technologies can offer increased persuasive power.

## Online

A major barrier to health worker efficacy is the inability to be in constant contact with trusted information sources. Mobile phones obviously enable communication with these sources, and in addition could also allow for exchange of short audio clips or visuals (like animations), through which trainers could provide requested information in a timely fashion. They can also provide a social networking platform for connecting health workers to one another. By sharing information, experiences, stories and questions, mobile phones can help generate a community of practice [64], that fosters a sense of belonging and support.

## Hi-tech

The final feature of mobile phones is its perceived “hi-tech” quality. This itself could give the information presented as well as the carrier of the information (the health-worker) more authority. As health workers face challenges in making themselves credible to their communities, they could present information through animated clips to back their arguments.

## 3.6 Theoretical Framework

In this section we review the psychology literature on persuasion and motivation to better ground the ideas in the next section.

### 3.6.1 Persuasion

Persuasion is an area within psychology that focuses on attitude change in an individual, often caused by another’s influence. Cialdini [15] has developed a well-known taxonomy of persuasive mechanisms, and the four most relevant for our work are:

**Social Proof** People are strongly influenced by what others, especially friends and peers, are doing.

**Authority** People will do what they are told by an expert or leader.

**Commitment and Consistency** People like to do what they said they would do, to appear consistent and rational. Since people are usually more willing to say they will do something than to actually do it, commitment/consistency can be used in a graduated persuasion strategy to induce a verbal commitment first, and action later.

**Liking** People are persuaded by those whom they like.



### 3.6.2 Motivation

While the words overlap in meaning, persuasion and motivation are quite distinct areas within psychology. While persuasion deals with mechanisms by which people are induced to change their attitudes (often by another actor), motivation deals with the mechanisms through which beliefs and goals lead to action. Since village women do not seem to believe the merits of clinic delivery or prenatal medications a priori, convincing them to do so is a persuasion task. By contrast, we can assume that ASHAs are already convinced they should perform their work, so improving their performance is a motivation task.

A good recent overview of motivation theory is in [33]. Among modern principles within motivation theory, the most relevant to our work seems to be Bandura's *self-efficacy* theory. Self-efficacy theory revolves around an individual's perception of his own effectiveness with respect to a task. When perceived self-efficacy is high, individuals tend to perform tasks well, persisting in the face of obstacles. When it is low, performance is weaker, and the person may give up easily in the face of obstacles or acquire avoidance behaviors. Bandura cites the following sources of self-efficacy:

**Enactive Mastery** When the subject has personal experience where they perform a task well, their perceived self-efficacy for that task will improve.

**Vicarious Experience** When the subject sees another person have positive outcomes on a task, their perceived self-efficacy will improve.

**Verbal Persuasion** When an individual hears from another that their performance is good, i.e. a testimonial, self-efficacy will improve.

In discussions with ASHAs and their trainers we identified self-efficacy as a potential problem because the ASHA's environment has many negatives with respect to these three factors. First of all, inadequate training is likely to lead to situations in which the ASHA is unprepared. As quoted earlier, ASHAs also had a hard time assimilating information about situations they had not encountered. This is a common trait for unschooled or limited-schooling subjects [40]. Vicarious experience is likely to be poor because ASHAs are quite isolated in their villages. And positive verbal feedback may be rare, while instead the ASHAs receive negative comments since they are regarded as low-status non-experts by many villagers.

## 3.7 A Sketch of the Design Space

We now present several design ideas directly leading from our study of the rural maternal health context. The premise of our discussion here is that although the government system has placed a maternal health change agent (or two) in each village, there are factors affecting her efficacy in the community. Not all the factors can

be solved with a technology intervention, but we believe that technology can (1) persuade her to take on a more active role as a health promoter by improving self-efficacy and (2) help her establish credibility in the community and increase her own influential power. Through our discussion, we strive to demonstrate the complexity of the broader social context in which the health worker interacts with her clients, and the importance of considering this in designing effective technology interventions.

### 3.7.1 On-the-job Learning and Teaching

Our findings show that despite set program guidelines, the government workers receive varied amounts of training. From our discussions with trainers, it becomes clear that simply providing extra manuals and brochures is not likely sufficient for supplementing trainings. Rather, we believe that we can draw from methods used in face-to-face participatory training sessions to design more engaging, relevant, and comprehensible reference materials.

As mentioned clearly in our discussions with trainers, and in previous studies, health workers need information that is directly relevant to a particular scenario of use. Mobile technology offer features for complementing training methods. By being *online*, even intermittently, health workers can receive reference modules to use during their house visits, giving the house visits a clearer purpose. Trainers can send materials in the form of short voice messages, or even animated clips with simple pictures and voiceovers to explain concepts and provide instructions. Thus, we can design to motivate health workers by increasing their *self-efficacy* and making a materials readily available for reference as they counsel their clients, making it a learning experience both for the health worker, as well as her clients.

### 3.7.2 Building Credibility

Health worker credibility is greatly influenced by factors over which they have little control, and as a result their jobs become all the more challenging. Our findings show that community perception of the health worker is negatively affected by issues which occur in the selection process or resource supply-chain. Thus, building credibility is a prerequisite to establishing a relationship conducive to effective information exchange.

From our findings, it appears that community members tend to build trust in the health workers based on the principle of *commitment and consistency*. That is, once they establish a committed relationship with the health worker (based on receipt of some concrete resource), then they remain consistent in their utilization of her services. As designers, we should focus not only on information exchange that can occur after a trusting relationship has been built, but also on helping establish that trust in the first place.

This is a place where the *hi-tech* feature of technology can work in the health worker's favor. As mentioned in the findings, announcements made on TV and radio,

or even through a speaker on a jeep have more credibility than the health worker alone. Thus she can use technology to overcome some of the challenges of working alone and to reinforce her own efforts. For example, the health worker can receive messages directly from sources perceived as trustworthy (like local NGOs, or even government agencies) that support her endeavors by making the resource supply chain more transparent. Even if the technology cannot directly track the medicine or food supply chain, it can at least provide some meaningful status update, thus supporting the view of the health worker as a concrete resource provider. In the end, people not only want the services being provided, but they also want to know they can trust the provider. Thus, the technology can serve as a link to an established *favorite* persuasive source and build help build the health worker's credibility.

### 3.7.3 Managing Expectations

The responsibilities that were being carried out by health workers varied across the villages which we visited. We see in Table 3.2 that there is a large discrepancy between what the Anganwadi Workers perceive as their duties and what their communities perceive. This opens up challenges in the way the workers can interact with the communities because expectations are not clearly set or kept. In addition, the lack of awareness of multiple tasks listed in the government guidelines by both the health workers and community members reveals a clear information gap. But even as we look at using technology for providing information, it is important to consider the complexity of the social situation, i.e. multiple consumers with varying expectations.

We must think about how we can share this kind of information across all parties to help manage expectations. This is complex, and must be considered in conjunction with issues of accountability and motivation. For example, if communities become aware that the health worker should be performing some job, then they can demand the service and hold her accountable to it. In this case, however, there should be enough transparency in the system that health workers are not scapegoated for problems beyond their control. Technology can be used to enforce accountability, but as designers we must be careful not to further detract motivation in these already challenging work settings.

### 3.7.4 Changing Minds

It is quite clear that the *authority* factor plays a key role in influencing the behavior of reproductive-aged women. Therefore, as designers we must think about widening our target to focus not just on our intended users of information but their authorities whose influence is essential. In this case, household authorities (mother-in-laws) need to adopt changes in attitude about what the health worker teaches (i.e. hospital deliveries might be safer), but the daughter or daughter-in-law needs to adopt the actual change in behavior (i.e. go to the hospital for her delivery). House-

hold authorities have more awareness of the financial costs of adopting the change in attitude, as well as more personal experience and traditional values opposing it; in addition, they are slightly removed from the potential threats of not adopting the behavior. That said, convincing the authorities essentially guarantees adoption of the behavior by the target audience.

These findings inspire us to think more broadly about exactly what kinds of content can be presented through mobile technology to supplement interactions between health workers, young women and their families in informal settings or house visits. From what we have learned, what works for the mother-in-laws (like information about what their peers do) may be ineffective for their daughter-in-laws.

For example, our findings suggest that it might be more effective to work on convincing authorities to change broader attitudes by using longer-term financial considerations. One idea is to create interactive stories, modeled after story-telling activities used in participatory training sessions. These stories can present various health issues throughout their plot but stop at key decision points. At this time, the end user can input what choice the main character should take and thus control the outcome of the story. These stories could help them compare the costs of various decisions, (i.e. should they use family planning, or travel to a clinic for a delivery). We can also think about design ideas which convey messages about choices that peers made as a way of leveraging *social proof* for persuasion.

However, young women might need to be targeted with different types of information, like straightforward instructions on how to practice the new behavior (i.e. what types of food to eat). As mentioned in the findings, though they may need permission from their authorities, in the end it is the young women who must take care of themselves. Thus, short interactive reference modules with basic pictures, diagrams and step-by-step instructions might be an effective support tool for health workers to teach young women new behaviors, in parallel to working on changing attitudes of others in the household. Most importantly, whatever the application, using interactive tools could help the health worker engage their clients and stimulate discussions with them in a way that current methods do not.

## 3.8 Conclusion

We have presented our findings from two qualitative field studies in rural India, during which we interviewed health workers, their trainers and the communities they served about reproductive health practices. We learned that many external factors lead to issues in efficacy of the health worker, including problems with training, credibility, accountability and influence.

The main contribution of this chapter is an in-depth sketch of an unexplored technology design space. We believe that mobile technology can be designed to strengthen the capacity of the health worker, but designers must maintain a deep understand-

ing of the complicated social context in which health workers operate. For this we recommend four areas of potential design research, and discuss them with respect to relevant social factors. The key feature of these design ideas is that they are motivated by complex social dynamics that are affecting health worker efficacy; this is unlike most problems in the space of ICTD, which are generally motivated by problems and solutions around information access.

In the next two chapters of this thesis, we explore three of the design ideas mentioned here, *on-the-job learning and teaching*, *building credibility* and *changing minds*. We hope that work described in this chapter provides sufficient motivation for future researchers to explore the area of *managing expectations* as well.

## Chapter 4

# Iterative Design with Rural Health Workers

### 4.1 Introduction

In Chapter 3, we concluded with the recognition that although many of ICTD interventions often focus on immediate affordances of ICTs, like information or knowledge transfer, we believe that ICTs for development can be used to *persuade* targets of an intervention in favor of change, and *motivate* key community members who act as agents of change.

In this chapter, we draw heavily from the findings of the previous chapter. We describe the technology designs which we explored to address these challenges faced by rural health workers. We deployed both short *persuasive* videos (directed at mothers-to-be) and *testimonial* videos (intended to motivate ASHAs) on mobile phones<sup>1</sup> with seven ASHAs; we also asked them to create their own videos starring people in their community. We conducted a preliminary evaluation of the feasibility of using videos on mobile phones to (1) persuade village women to adopt better health practices and (2) motivate ASHAs to improve their performance. We present several findings which are primarily qualitative at this time, but which support the effectiveness of both kinds of video.

Specifically, we found that: (1) videos served as anchors for health discussions that both scaffolded the ASHA and engaged her clients, a necessary precursor for persuasion, (2) creation of videos was motivating and fun for ASHAs, (3) high-status influencers in the community participated in video creation to a surprising extent (4) statistical tests of effects of video viewing on ASHA self-efficacy (a motivation measure) showed marginally significant gains ( $p = 0.06$ ) and (5) modest learning gains by ASHAs were also manifest after video use.

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<sup>1</sup>We chose mobile phones for their prevalence, portability, relatively low cost, and affordances for privacy and interactivity.



Figure 4.1: An ASHA (left) uses a video on a mobile phone to engage her client (right) in discussion.

We discuss the design and deployment of our prototype informed by the findings and lessons from the last two chapters. After describing related work, we provide the findings from our field trial of the prototype, and then analyze our findings in light of psychological theories on persuasion and motivation and through our analysis, distill lessons for promising design directions in this space.

## 4.2 Related Work

### 4.2.1 Technology for Rural Health Workers

Many research projects have looked at the use of ICT to support health workers in developing regions. An overview of many uses of mobile phones for healthcare workers is found in [14]. Healthline is a landline phone system for health workers in Pakistan to get information in their native language using automated speech recognition [59]. In the 1990's a large PDA-based system was developed to support Auxiliary Nurse Midwives (ANM) in India organize and schedule house-visits [31]. Another project in Tanzania called e-IMCI looks at the use of a PDA for guiding health workers through protocols [21]. Results show that using the system, health workers adhere to the protocols more strictly and prefer to use the device rather than flip through paper references in front of patients. These projects in general target health workers with higher training<sup>2</sup> - not limited-schooling health workers among whom issues in training

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<sup>2</sup>The exception is Healthline, which initially targeted poorly-schooled community health workers. However, healthline has not yet studied user-initiated use of the system in field settings, only

and status are far more acute, and motivation comes to the fore.

### 4.2.2 Persuasion, Motivation and ICTs

Recently, a specific area of ICT research called “Persuasive Technology” has been created by B.J. Fogg and others [26]. A good review of work on both persuasive and motive IT is found in [61]. Persuasive IT is used in many domains, i.e. environmental responsibility [68]. Examples of motive IT include tools to help improve physical activity, i.e. [16]. There is also a body of work that examines persuasive games [7], and work looks at persuasive affordances of mobile platforms [27].

Persuasive IT has also been used in the developing world [28, 50]. The latter is a custom personal health information system to change behaviors of rural Indian women regarding reproductive health [50]. We tackle the same problem but by using technology to strengthen the existing system of health workers, accounting for conflicts with the current structure and practices of the community. Exploring motivation from another angle, the qualitative findings in [60] suggest that women employed as rural computer kiosk operators rise in confidence and status in the community.

## 4.3 Persuasion and Motivation for Health

From our needs assessment, it was clear that ASHAs were not performing their consultation tasks with village women. Certainly this hampers their ability to persuade the women, since changing attitudes toward long-held practices takes time. Applying the principles of social proof and authority (discussed in Chapter 3, we determined that persuasive video messages directed at the women should help to persuade them. The use of video allows the marshalling of several influential actors, both higher-status villagers, and also other village women (peers) who may have benefited from the formal health system. A second intended benefit of these videos was to help ASHAs conduct the consultations. And we also hoped that regularly viewing the videos, which contained health information the ASHAs may not know well, would provide a supplementary form of training.

The other main challenge is ASHA motivation. Since we had identified self-efficacy as a strong framework to approach motivation, we sought interventions that can enhance it. The simplest to apply seemed to be verbal persuasion [6]. For this we proposed a second type of video recording, a *testimonial* by an influential village actor. Testimonials by village women who had been helped by the ASHA might also be valuable - since they provide a positive evaluation of the ASHA’s performance by the ultimate “expert” - one of the women she is tasked to help.

For both tasks, we felt that mobile camera phones would be ideal, as they are portable, relatively easy to use, and have become relatively inexpensive. India’s

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laboratory settings in which use is required.



mobile market has taken off at a phenomenal rate, with nearly 400 million mobile phones in the hands of about 35% of the population [20]. What is more remarkable is the growth rate of nearly 75% each year. Therefore it is predicted that higher end phones will be penetrating rural markets soon. In the current design, we use only the video recording features of the phones - so digital cameras could also have been used. However, all of our future design steps (described at the end of the paper) require other features of the phone: interactivity to improve engagement, and networking to allow exchange of videos and to support a community portal.

## 4.4 Designing an Intervention

To test our initial design ideas, we returned to the same NGO in Orissa. We decided to focus only on ASHAs (not AWWs) because it was a newer program and therefore exhibited more consistency across villages. Our main goal for this field trip was to iteratively design prototypes with a small group of ASHAs and conduct preliminary evaluations.

### 4.4.1 Prototype Design

Narrowing in on the idea of creating a prototype to motivate village women and scaffold ASHAs in counseling them, we created a four-minute *persuasive video* with pictures and voice that described the dangers of anemia and actions for prevention. The pictures used were hand-drawn images sketched by the resident artist at our partner NGO, which we later colored using Adobe Photoshop. The background voices were recorded by staff members at the NGO using an MP3 player. We strung the pieces together into a short video with panning and zooming using a combination of Windows Movie Maker and Photo Story. The video was then converted to 3gp format so that it played on the Nokia 3110c Classic ( 100 USD).

For our final deployment, we created seven short persuasive videos, each less than a minute long. These videos focused on danger signs that could occur during pregnancy and immediate actions to take. This time, we created a J2ME application which launched the videos and logged the start and end times of each viewing. Each video was launched from a separate J2ME application, so participants still browsed for the persuasive videos using standard phone menus.

We also made a short *video testimonial* by a village president who had prior experience with an anemia prevention program. We recorded him delivering an eloquent, impromptu speech about anemia and the role of ASHAs in prevention.

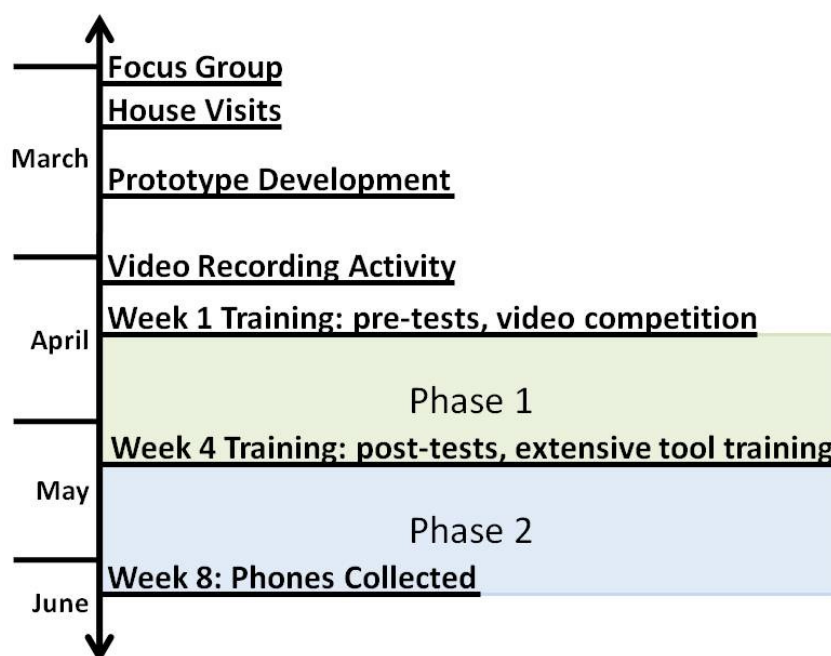


Figure 4.2: Summary of our design and deployment.

#### 4.4.2 Methodology

Our team of a researcher and assistant researcher/translator spent three months in the field interspersing village visits and prototyping. With the assistance of an NGO staff worker, we recruited seven ASHAs of average age 35. Five of the seven ASHAs already owned mobile phones, though none of them were camera phones. All ASHAs continued to participate in our study for three months, with no attrition.

We conducted one focus group session with the ASHAs, and observed a total of six house visits during which ASHAs used both the anemia video and testimonial prototypes (see Figure 4.2.) ASHAs were asked to record their own videos starring anyone in the village they felt would be influential. We shared their videos as a group and voted on a favorite. Later, we translated the videos into English and used the transcripts for analysis.

We deployed our second set of seven persuasive videos for a total of eight weeks in two phases (Phase One lasted from Weeks 1-3, and Phase Two was from Weeks 4-8). At the beginning of each phase we had a group meeting where we conducted two pre and post tests respectively, one on knowledge of pregnancy danger signs, and one which measured self-efficacy. For both tests, the questions were asked orally, but responses were written by the participants. One participant could not read or write, so

her responses were verbally stated and transcribed by an NGO staff in a neighboring room. The self-efficacy instrument was derived from a Hindi translation of the *General Self-Efficacy Scale* [57], which we then translated into the local language, Oriya. We adapted the scale to include more questions specifically about ASHA activities as suggested in [6]. Each of the 13 questions received a score between 1-100. We used images of cups with increasing amounts of liquid to illustrate the scale. In Week 8, the NGO staff worker returned to the seven ASHAs' homes and collected the phones.

The results from the pre-test and post-test were translated into English for analysis and scored. We also compiled the logs of the seven persuasive videos, and counted all incidents where at least two-thirds of the video had played. In addition, we collected all photos, videos and music which were on the phone, and compiled the sequence of phone usage incidents over the 8-week deployment.

### 4.4.3 Findings

Despite government guidelines that all ASHAs should have completed the eighth grade, our participants' education levels varied quite a bit, with five having studied only until 5th or 6th grade, and the others through 9th and 12th.

Although it was necessary for us to do some training for the specific tasks we designed, the phones were used extensively for other tasks. They took on average 35 photos and 23 videos each, and in total downloaded 148 MP3s and 74 video clips. Even while various capabilities of the phone were clearly familiar, there was still a lot of excitement surrounding its use. ASHAs were not the only users of the phones; in fact, when we went to collect the phones from two different ASHAs, the phone was out with their children.

### Teaching the Use of the Tool

We initially tested whether teaching with persuasive videos would come more naturally to ASHAs than with materials they currently received. When we deployed the videos in Week 1, we only trained the ASHAs in how to access the videos and gave them instructions to show them to their clients. We were curious to see to what extent they would embrace the idea with minimal instruction.

When we collected the phones after the initial deployment phase in early Week 4, we found that the video logs were sparse. One ASHA never watched a single video, and only three had watched all seven videos at least one time each. We also discovered that, possibly due to non-use of the videos, only two of the seven ASHAs (the youngest and most educated two) could access the videos with no assistance from us. In fact, one ASHA told us that she kept forgetting how to play the videos, so her son accompanied her on house visits to help.<sup>3</sup>

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<sup>3</sup>We recognize that general use of the phone by other family members could have confounded these results; however, in the long run, we believe the dissemination of the messages to *anyone* in

During the Week 4 meeting, we individually trained the ASHAs on how to access the videos until we were sure that each could perform the task by herself. In addition, we spent about 45 minutes training the ASHAs to use the videos when they went on house visits. We watched each video as a group on a laptop and asked questions about the video. We replayed the videos until we were sure they understood the points. We explained that they should not just show the videos to their clients, but facilitate a discussion with the client, using the video as an aid. The graph in Figure 4.3 shows the increase in the number of times the videos were watched after this training session. We do see a drop off towards the later weeks, which makes sense: they only had a limited number of videos, and they might have simply felt they had “completed” their task.

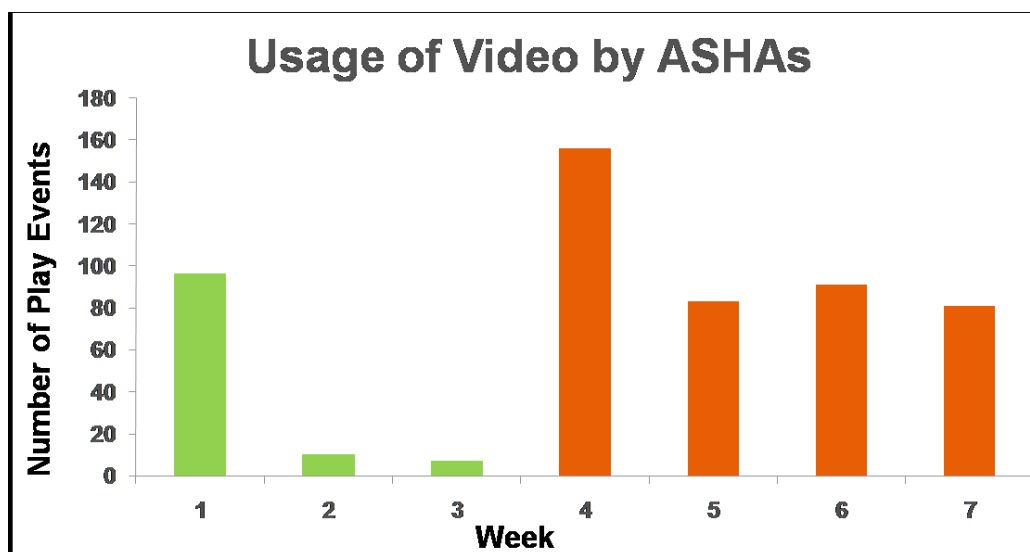


Figure 4.3: This graph shows the total number of times ASHAs watched the seven short persuasive videos over the 8 week deployment.

### Motivating Discussion and Enhancing Persuasion

As described earlier, when we first observed ASHAs on their house visits, they had no idea what to say or do. We asked the same ASHAs to show the anemia video to their clients and observed this interaction in six homes. At first, the ASHAs would simply watch the videos along with their clients. But as we coached them on pausing, asking questions and ensuring that their clients had understood, the interaction began to improve. For example, in one situation, the mother-in-law of a pregnant woman stood at a distance watching the ASHA and client talk, but did not engage in the discussion, even when she was invited. When the ASHA started the video, the mother-in-law came closer and began watching over her shoulder and

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the community has value.

commenting. Meanwhile, the pregnant woman's husband joined the discussion. By now the ASHA was pausing and repeating the points shown in the video. When the topic of iron pills came up, the husband got up to bring the bag of medicines which his wife was taking, and got the ASHA's opinion on them.



Figure 4.4: Left: ASHA's son helps her use the video camera. Right: ASHA engages pregnant woman, her husband and mother-in-law.

Many ASHAs also took photos and videos that documented their work activities. Among these, one video showed a long discussion between an ASHA and her client about danger signs, and from the timestamp on this video, we could see that this discussion took place after the ASHA had shown the persuasive videos to her client.

### Measuring Learning

After our observations of the ineffective training sessions at monthly meetings, we hoped that ASHAs would learn more information as a result of using the videos when talking to clients. We analyzed the results from the pre and post tests on knowledge of danger signs conducted during Weeks 1 and 4. We saw that all ASHAs appeared to have learned an average of 3.3 new points (SD = 1.7): we measured this by counting the number of points covered by the videos that appeared in the post-test answers but not the pre-test.

### Measuring Self-Efficacy

We hoped to show a direct effect of video use on self-efficacy. We administered a self-efficacy survey before and after the first phase of the phone deployment (i.e.,

during Week 1 and Week 4). We do not have pre-test results for one ASHA, as she was absent when we administered it. Another ASHA was illiterate and her answers were transcribed: we observed that the transcriber during the pre-test was prompting her greatly. We believe that this was responsible for an improbably high initial score. A different transcriber processed the post-test for this ASHA, and that score is likely to be more realistic. This ASHA's data is probably best ignored. For the remaining ASHAs ( $n=5$ ), a one-sided t-test results in ( $p=0.06$ ). While this is indicative of some effect of the videos on self-efficacy (and indeed a strong effect to manifest with such a small sample), a larger study is needed to establish and quantify the effect with confidence.

Our qualitative observations hint some improvement in self-efficacy, as we found that ASHAs became more active in their discussions with clients once they started the videos. The video testimonials also seemed to improve self-efficacy. One ASHA stated that watching the testimonial by the village president made her feel proud about her role. We also observed the ASHAs' enthusiasm for showing their own videos to each other and us during the meetings. Some even got a bit competitive when the favorite video was selected.

### **Involving Influencers**

The creativity and enthusiasm put into the creation of videos was astounding. When we convened for a meeting two days after assigning the video recording task, we had a total of ten videos; only one ASHA had not created a video, and that was because she was with her sick daughter in the hospital. By the end of Phase 1, every ASHA had created at least one video, and by the end of Phase 2 we had 16 videos.

The participants were very imaginative. Most of the videos would be categorized as testimonials on the ASHAs, but some were persuasively targeted towards pregnant women. One ASHA staged and recorded a teaching session between the local nurse and three pregnant women. Two ASHAs recorded a traveling street play which came to their villages spreading awareness about the ASHA program. A complete breakdown of the "influencers" portrayed in the videos are shown in Figure 4.1. "Youth leaders" were elected officers of village youth groups, and "Women's Group Leaders" were officers of women's self-help groups. Both of these groups were organized by our partner NGO.

The content also varied. While videos of pregnant clients talked about personal experiences with ASHAs, videos of leaders touched more on fundamental problems in the village, the reasons and excuses people use for not listening to ASHAs, the threats of pregnancy complications, and how the situation can be improved. A breakdown of the content types is seen in Table 4.1. The tone also varied in the videos. While pregnant clients related their experiences, the leaders and nurse took on a more persuasive role, framing the message as a personal request to the audience. The following excerpts exhibit this difference:

Count	Influencer	Count	Content
3	Pregnant Client	6	Roles of ASHA
4	Streetplay	6	ASHAs make a difference
1	TB Patient	2	Threats to health
3	Village Leader	3	Personal request to comply
2	Youth Leader	4	Personal experience
1	Nurse Midwife	1	Instructional
2	Women's Leader	1	Reasons for non-compliance

Table 4.1: Influencers Starring in Testimonials (left) and Testimonial Content (right)

“I was pregnant for the first time two years ago. Because they did not check me properly at the hospital, I had some complications . . . Now there are ASHAs and we get all kinds of help. Now there are no difficulties.”

“Anemia has a bad effect on women and also on their babies during delivery. Some of them die . . . Because of this, throughout Orissa, ASHAs are doing great work in every village and their role is very important . . . If women don't eat iron tablets, they can get anemia . . . That's why I implore every pregnant woman in our village to take iron tablets . . . Our ASHAs are always there to help.”

During our limited observations of ASHAs using our video testimonial prototype with their clients, we saw that though it was longer than the persuasive videos, the testimonial held clients' attention longer. The clients commented that they liked the video of the village president because he talked about his personal experiences with his wife's pregnancy.

## 4.5 Discussion and Implications for Design

In the following, we discuss our key findings and distill lessons for future designers.

### 4.5.1 Primary Role of Persuasive and Motive ICTs

We argued that especially for innovations that target the rural poor, a major challenge for ICTs is their conflict with traditional practices and power structures. We argued further that it is essential to design *persuasive and motive ICTs* which confront these challenges and help to facilitate the adoption process. Our specific example was the rural maternal health care system in India, where a specialized worker, the ASHA, acts as a change agent toward village women.

We believe this a good example of a more general pattern: an innovative practice is introduced (modern medication, clinic deliveries) which conflicts with tradition, and it is mediated by change agents (ASHAs). This is also the canonical pattern in the initial diffusion of innovations [55]. The resistance to change affects both the target audience (village women) and the change agents (ASHAs). The most effective strategies to overcome this resistance will be those that act on both the targets of the innovation (through persuasion) and the change agents (through motivation). **ICTs can be very effective vessels for the creation and consumption of persuasive and motive content.** Many videos made use of social proof and authorities by depicting peers (pregnant women) and influencers (leaders). The testimonials by influencers motivated ASHAs through the mechanism of verbal persuasion. In addition, the persuasive videos enabled improved ASHA-client discussions, and video creation encouraged the participation of other key community players. While the videos were specific to the ASHA’s task, we believe the approach is quite generic.

### 4.5.2 Engaging Influential Actors

One of the most surprising and encouraging results of the field work was the ease with which we and then the ASHAs were able to recruit subjects for the persuasive and testimonial videos. While the willingness to participate as subjects in videos echoes findings from the Digital Green project [28], we were surprised at the large fraction (nearly half, much higher than their presence in the village population) of high-status influencers in the group. Part of this surprise stems from the fact that these are high-status individuals while the ASHAs’ status is quite low, but the ASHAs were nevertheless able to recruit them to do a significant favor for them by making a video. Also, the degree of support for the ASHAs manifest by these individuals in the videos seemed much higher than what the ASHAs normally received in the village. We do not yet know the reasons for their high degree of willingness to participate - perhaps the camera is itself a strong intrinsic motivator. More likely, *this particular group* i.e. high-status influencers, are highly-motivated to express their views on camera. For this group, the videos provide a new means for them to influence others and this may already be a strong intrinsic motivator for them.

If this is actually true, then it creates a powerful channel for persuasion *of the influencers*. The videos provide an opportunity for them to express their views and influence others, but only if they express views that are favorable to the ASHAs (or the videos will not be used).

Furthermore, we know that through the commitment and consistency mechanism from persuasion theory, actors who express certain views verbally are more likely to enact them in future. The videos are very strong commitments because (i) the actors in them give detailed reasons for their views (ii) they may be shown to many viewers (iii) they may be long-lived and (iv) the actors know that they are long-lived and seen by many others. Consistency is particularly important for influencers, since



inconsistent behavior hurts their credibility and weakens their status as influencers. Thus they are strongly motivated to support the ASHAs in the future.

If this can be verified, it is a wonderful design implication: first of all, influential actors in the village (who initially may be ambivalent about the ASHAs work) are intrinsically motivated to express positive views about them in the videos that ASHAs make. Secondly, having done so, they will be strongly motivated to follow through. With very little effort, the ASHAs may be able to recruit an array of powerful allies which we have seen is important for their mission in the village. Furthermore, this mechanism seems again very general. **By gathering testimonials from influencers, the change agents for an innovation may be able to recruit them to their cause.**

### 4.5.3 Motivation and Training

While we found that ASHAs were not regularly visiting their clients for counseling sessions, the persuasive videos enabled them to grasp the practice and perform it, engaging not just their clients, but also family members (the health decision-makers). This pattern of use: video viewing with mediation and discussion, follows the pattern used in several successful ICTD projects, namely Digital Study Hall [3] and Digital Green [28].

We saw an apparent increase in ASHAs' knowledge of health practices due to use of the persuasive videos. By contrast, the monthly training updates which had a didactic (and non-motivating) format appeared to be doing little (we did not attempt to quantify this however). The lesson here is that **for limited-schooling users, motivation and training/learning are closely related** - much more so than for a schooled learner who has the meta-cognitive skills to self-motivate and contextualize new knowledge. The use of persuasive and motive technologies such as videos provides an exceptional opportunity to integrate ongoing training, without even requiring any new practices.

### 4.5.4 End-User Authoring and Play

Our results showed a sharp contrast between the slow initial use of videos produced by us, and the very fast (in just two days) creation of videos by the ASHAs. The ASHAs clearly enjoyed the latter process, and it stimulated a round of exchange and rating of videos which they also seemed to enjoy very much. ASHAs also used the phones for some non-work-related videos, and even shared them with family members. Their productivity on the video production task strongly suggested that it was motivating them. The lesson here is to **encourage participation and play. This taps two important intrinsic motivators - sense of agency or control, and fun.**

## 4.6 Conclusion

We began by asking whether technology could stimulate a social practice where lack of motivation is the primary barrier. In Chapters 3 and 4, we have presented our work over two years studying the context of maternal health in rural India, and designing an initial intervention to motivate ASHAs to be better health promoters in their communities. By providing ASHAs the ability to watch and record videos on mobile phones as a means of discussing health topics with their clients, we have seen that not only ASHAs, but their clients and communities are more willing to engage. We stress the importance of valuing technology for its motive power, and have distilled lessons for future researchers on how to approach this in design.

While promising, many of results presented in this chapter are still preliminary, and provide motivation for further exploration. Perhaps the biggest caveat from work described here was the need for a great deal of hand-holding and in-context instruction before the ASHAs started to use the videos as intended (pausing and discussing them). To resolve this, more interactivity can be built in to the seed videos that are given to the ASHAs. Instead of a simple linear video, an application can play the video as a series of clips and halt itself regularly to pose a question using audio, and possibly prompt for a multiple-choice answer. We explore and evaluate such possibilities in Chapter 5.

## Chapter 5

# Mobile Persuasive Messages for Rural Health Promotion

### 5.1 Introduction

Building on the work described in Chapter 4, we present an in-context study which investigates the persuasive power of mobile-phone based messages to improve maternal health practices in rural India. Specifically, we design an architecture for, and investigate the use of dialogic messages, which engage rural women in conversations about their health practices by drawing from the art of rhetoric [38], and other persuasive tactics. We use mobile phones as a platform conducive to speech-based, dialogic information exchange.

In our study, we asked rural health workers to present 52 clients with two persuasive messages on pregnancy-related health practices. We compared the use of a lecture-style message, dialogic message, and a message delivered by the health worker, without the assistance of the phone. We observed the quality of the counseling sessions, as well as the engagement of the clients. After one week, we followed up with the clients to assess the persuasive power of the messages by measuring health behavioral outcomes. We found that the counseling session was significantly improved when health workers used the dialogic messages with ( $p < 0.001$ ). However, the measures of client engagement and persuasive power across the three cases were not statistically significant.

We designed this study after months of deep qualitative field work, iterations of prototype development, careful design of content through consultations with numerous stakeholders, and in-depth analysis of respected theories of psychological persuasion (as described in Chapters 3 and 4.) Yet, the realities of the environment in which we ran the study constantly challenged the rigor of our research design. This chapter presents a detailed account of the iterations which went into not just the design process, but the evaluation process as well, and highlights the tight coupling of social,



Figure 5.1: A health worker presents a mobile phone-based persuasive message to her pregnant client.

cultural and environmental factors at every step along the way. We analyze our results in light of these factors, and end with a discussion of the compromises we made in the face of these challenges, and how they relate to the field of ICTD at large.

## 5.2 Persuasion

The science of persuasion through dialogue dates back to the works of Aristotle on classical rhetoric [38]. Most relevant to our work on designing persuasive messages are his writings on *logos*, or the persuasive power of a speech based on its ability to prove a truth, or apparent truth, through practical arguments. Rather than rely on logic, *logos*-based arguments appeal to the listener’s practical reasoning, presenting the desired action as direct implications of the listener’s own salient beliefs. As is seen in the next section, we draw from the art of rhetoric to design dialogic messages that specifically address rural women’s arguments and beliefs. In addition, we also draw from Cialdini’s factors of influence, specifically targeting the idea of commitment and consistency, which states that once one commits to an action, one is more likely to remain consistent with that commitment [15].

Practitioners in the field of public health have long been examining theories of communication and persuasion theories to design and present health messages [41]. Below, we list several relevant guidelines drawn from approaches in this space based on theories of persuasion and motivation. Health messages should:

- appeal to the listener’s self-efficacy, or perceived ability to perform an action by recommending simple and achievable actions [6],
- induce behavior change by addressing the underlying set of salient beliefs that cause a specific behavior [4],

- maximize involvement and personal relevance of the listener to encourage central processing of the message, leading to more lasting attitude change [52], and
- use positive affective appeals to arouse more positive feelings and acceptance toward the recommended action.

## 5.3 Persuasive Message Design

In this section, we describe how we drew from the persuasive frameworks described above to directly address the challenges faced by ASHAs through the careful design of culturally relevant persuasive messages.

### 5.3.1 Health Outcomes

We focused on two important pregnancy-related issues that were prevalent and relevant locally, and that had measurable outcomes within a reasonably short-term. Through interviews with ASHAs and pregnant women, we identified anemia as a prevalent yet preventable health issue. Over 80% of women are anemic, and ASHAs are provided with iron tablets to distribute for free to all pregnant women [34]. We targeted the outcome of increased consumption of iron tablets.

The second outcome we focused on was also taken from the ASHA's core responsibilities, and has been the focus on many previous public health interventions: birth-preparedness [43, 46]. Preparations include (1) arranging for transportation to the hospital in case of an emergency, (2) identifying a blood donor, or nearest blood bank (3) identifying a facility which can perform emergency caesarean section, (4) setting aside money in case of an emergency, (5) identifying a skilled birth attendant or making arrangements to deliver in an institution. From this list, we targeted the outcome of increased emergency money savings.

We now describe how we created content with the goal of persuading pregnant women to adopt these two very relevant and impactful pregnancy-related behaviors.

### 5.3.2 Existing Materials

Many projects have explored new methods of delivering existing health content using ICTs [59, 58]. These projects often utilize content from resources like Hesperian [1] (a non-profit publisher of health handbooks) to create new materials which utilize text, pictures, audio, video, etc. However, as we describe below, we believe that even when starting from such an excellent source of content, the message itself should be restructured to specifically include persuasive elements to improve its impact when presented in non-textual formats.

### 5.3.3 Culturally Relevant Arguments

Through discussions with ASHAs and pregnant women, we understood that women do not take their iron tablets for a number of reasons, many of which were based on traditional beliefs or practices. In addition, in general their attitude towards birth was that it was an extremely normal process, and few women were aware of or did anything to prepare for potential emergencies. The arguments used by women against these actions were of two types: *myths* and *barriers*. Therefore, we decided that addressing these specific arguments rhetorically in a culturally relevant manner would be critical for an effective persuasive message.

### 5.3.4 Recommending Actions

In Chapter 4, we described short persuasive videos about pregnancy danger signs which drew largely from the Hesperian publication, "Where Women have No Doctor" [10]. We asked a local artist to illustrate a number of the points, and recorded a voiceover in the local language, Oriya. We strung these together using Microsoft Photo Story, and deployed them. However, we observed that these videos often contained too much information to parse in one audio message; this was particularly hard when the content included a number of conditional phrases, for example:

"It is normal for your feet to swell, but if after resting your feet at a high place for a few minutes they do not improve, or if when you wake up in the morning your feet are swollen, then this could be a danger sign."

We found that both pregnant women and ASHAs were able to recall only one point from this message, that was the *action*: resting feet at a high place. The minute details about differentiating normal vs. dangerous swelling was lost. Therefore we decided that every message should contain an explicit action, along with some kind of *motivation* for the action to improve self-efficacy.

### 5.3.5 Architecture

We designed a message architecture based on the persuasive frameworks described above as well as on our own previous field experiences. We detail the elements identified below.

#### Myth-Correction-Action

A widely-believed *myth* is introduced and immediately followed by a *correction* to that myth. This serves as the motivation for a recommended *action* that follows.

### Barrier-Solution-Action

A relevant *barrier* is addressed, followed by a *solution* for dealing with that barrier. This again provides motivation for a recommended *action* which is stated in the closing.

### Task-Instruction-Reward

The persuadee is provided *instructions* to perform a very specific *task* in order to make the recommended actions even more concrete and easy to remember. This is followed by a reminder of the greater *reward* that will result from performing that task (and provides the positive affective appeal of the message).

### 5.3.6 Lecture vs. Dialogic Style

Keeping the content of the myths and barriers consistent, we designed two forms of persuasive messages. Building on our study described in Chapter 2 as well as the theories of rhetoric and other paths to persuasion discussed earlier, we believed that audio-visual messages which provide information in a dialogic way and require direct input or responses from the user would be more persuasive than longer lecture-style recitations of information (as is often done when moving from text to audio-based presentation). In order to ensure user responses in the dialogic version, we inserted *rhetorical question tags* after each piece of information, which elicited a “yes” or “no” response from the user. We designed an architecture for building lecture and dialogic style messages, while still presenting the same content. This is illustrated in Figure 5.2.

## 5.4 Study Site: Kalahandi, Orissa

The degree to which health problems and poverty affect villages in Orissa varies widely depending on proximity of main roads, industries, active NGOs, and even individual leaders. Therefore, even after two years of working in Orissa, we still felt we had not encountered the bulk of the health and other issues which placed Orissa so far below national averages in many development indicators, and which could most benefit from an intervention.

Therefore, we decided to work in the district of Kalahandi, which lies within the tribal belt of Orissa. Kalahandi has the unfortunate distinction of being the poorest district in Orissa, the poorest state in India. We chose to work in the block (subset of 265 villages) of Thuamul Rampur, which borders the small town of Bhawanipatna, the district headquarters, as this is a major project area of our partner NGO.

	Lecture	Example	Dialogic	Example
<b>Myth</b>	General Statement	<i>Many women believe that &lt;myth&gt;.</i>	Question about personal beliefs	<i>Do you believe that &lt;myth&gt;?</i>
<b>Correction</b>	Explanation	<i>&lt;myth&gt; is not true; in fact, &lt;correction&gt;.</i>	Explanation with rhetorical question tags	<i>&lt;myth&gt; is not true; in fact, &lt;correction&gt;, did you know that?</i>
<b>Action</b>	Instruction	<i>You should &lt;action&gt;.</i>	Request for personal commitment	<i>Will you &lt;action&gt;?</i>
<b>Barrier</b>	General Statement	<i>Many women face &lt;barrier&gt;.</i>	Question about personal experience	<i>Do you ever face &lt;barrier&gt;?</i>
<b>Solution</b>	Suggestion	<i>If you ever face &lt;barrier&gt;, you can &lt;solution&gt;.</i>	Instruction with rhetorical question tags	<i>If you ever face &lt;barrier&gt;, you can &lt;solution&gt;, okay?</i>
<b>Action</b>	General Instruction	<i>You should &lt;action&gt;.</i>	Request for personal commitment	<i>Will you &lt;action&gt;?</i>

Figure 5.2: The persuasive messages are based on relevant myths and barriers, and presented in dialogic and lecture styles.

### 5.4.1 Social Hierarchy

Thuamul Rampur block is home to three different communities of people: scheduled tribe (ST), scheduled caste (SC) and other backward caste (OBC), so named during British rule. Traditionally, SC and ST communities have been at the bottom of the Indian social hierarchy [56]. According to the Hindu caste system, the OBC category refers to the lowest caste of laborers; SC communities are ranked below the four castes, and have been previously considered “untouchables.” In villages in Orissa, tensions between Hindu caste and SC communities are still prevalent. While SC communities have predominantly suffered from socio-cultural oppression, ST communities have struggled with economic and educational problems. ST communities are basically tribal people, who have lived by their own traditional means for centuries; they tend to inhabit hilly and foresty areas, are still mostly illiterate and uneducated, and have been isolated socially and uninfluenced by other communities. The population of Thuamul Rampur block is predominantly ST (56%); in addition 25% are SC, and 19% are OBC.

### 5.4.2 Maternal Health

The Orissa state government has placed special focus on this district, and therefore many ASHAs and AWWs have been appointed; however, the maternal and infant health indicators are still dismal. In Kalahandi, 1356 ASHAs are appointed and trained to, among other things, promote immunizations, institutional deliveries, and





Figure 5.3: People gather at hello points to make mobile phone calls.

distribute iron supplements. Yet, in the year of 2009, 37% of all births took place at home (this rate was as high as 55% in the block which we selected). Only 69% of pregnant women received their tetanus toxoid injections, and only 76% of targeted women received iron tablets. For the same year, the maternal mortality rate in the district is 209/100,000 live births, and infant mortality is 62/1000 live births. We collected this data from the district health department.

### 5.4.3 Technology Infrastructure

Most of the villages in Thuamul Rampur block do not have electricity. However, the state government has recently launched a rural electrification project to bring grid power and other forms of electricity (solar and micro-hydro) to all villages in the block. A few households nearest to the main road have been connected to the grid in the previous month; in addition, our partner NGO has implemented micro hydro systems in a handful of villages. We found that a number of villagers have solar panels and car batteries, which have been distributed through an earlier government program, and some people even owned television sets and audio speaker systems that could be powered through the battery.

Cell towers operate in the towns of Bhawanipatna and Rampur, which lie about 80 kilometers apart. All the villages we selected fall between these two towns. En route from one place to the other, there is practically no cell reception. However, there are what are called *hello points* - small patches which receive reception from towers in one of these two directions, shown in Figure 5.3. Surprisingly, these patches are sufficient to motivate a number of villagers to buy mobile phones. It is common practice for people to gather at these places to make their calls. We spoke to some of the young men making calls at one of the hello points; apparently they had traveled from nearby villages, and one said he came twice a day - in the morning and afternoon. His village did not have electricity so he used a solar battery-powered charging station which

was shared by the village.

## 5.5 Iterative Prototype Design

In Chapter 3, we described our reasons for focusing on mobile phones, and reiterate that rationale here. We selected mobile phones for their:

- *Portability*, which supports the ad-hoc meetings and house visits during which counseling generally occurs,
- *Growing popularity*, not only as a communication device, but as a platform for supporting many other rural health worker tasks (i.e.,[21]),
- *Interactability*, which provides affordances for two-way communication and dialogic information presentation, and
- *Low cost*, relative to all other ICTs that have these features.

In addition, in this particular context, mobile phones appeared to be the most popular form of ICT owned in the village, second only to radio. While lack of either electricity or money were often cited as a reason for not owning a TV, lack of cell towers were more generally stated as the main reason for not owning a mobile phone.

### 5.5.1 Flexible Architecture for Rapid Prototyping

The prototype designed for this study is written in Java 2 Micro Edition (J2ME), and runs on the Nokia 3110c mobile phone. The application supports the presentation of messages through audio (with optional images) or video. The application is designed in such a way as to support the message architecture described earlier, by creating a structured object for storing information associated with each message element. It also supports both lecture and dialogic styles of presentation.

Information objects are parsed from an xml input file which lists associated media files (audio, image, video), and descriptive attributes such as category (myth, barrier, task) should it be necessary to treat these elements differently. To allow the health worker to elaborate on a particular point in the message, a toggling pause-and-play button is displayed when audio or video messages are playing.

When played in dialogic style, the user's response guides the flow of the application, so an additional response field is added to the information object. This field stores information regarding branching, i.e. which information object should be played next, depending on whether the user has responded with a "yes" or "no." All button presses and play or pause events are logged to a text file. The log also records the user's response time for the dialogic style.

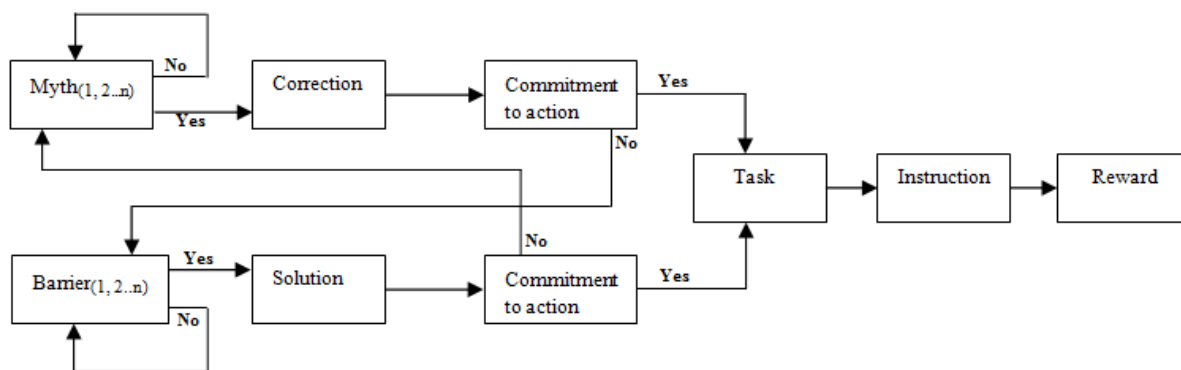


Figure 5.4: A flow diagram showing the user response-based transitions between information objects (myths and barriers) used in our initial prototype design

### 5.5.2 Branching

We originally intended an important feature of the dialogic version of the message to be its branching based on the response of the user. Based on previous work on health messages, we believed that tailoring the message according to the user’s responses would more effectively persuade and engage them in the material [9, 19]. Therefore, we created an architecture (shown in figure) that presents a sequence of arguments from myth, to barriers, to final task, skipping ahead if either (1) the user responds positively to the arguments, or (2) if the user does not find a particular argument relevant. Figure 5.4 illustrates the flow.

However, during our initial pilots, we realized that client responses were not always honest; they did not always admit to believing a myth or facing a barrier if they did not feel it was socially acceptable. This phenomenon has been seen by [13], specifically when responses are directed to a health worker with a mobile device. Other times, the response was influenced by the presence of other important personalities, such as the mother-in-law or husband of the client. Therefore, we decided that regardless of the “yes” or “no” response of the user, it was important to play all elements of the message for all users. Although our prototype supports branching, we did not use this feature for our study.

We also found during our study that very often the health workers would click on either the “yes” or the “no” button consistently regardless of the response of the user; they recognized these two buttons simply as ways to progress through the message, and did not bother to accurately represent the clients’ responses.

### 5.5.3 Dealing with Language Woes

Recording audio voiceovers for the prototype ended up being a much more involved process than we originally intended. Because our selected study site was mostly tribal, we felt initially that we should record all of the messages in the local tribal language, Kui, rather than the common local language, Oriya.

Finding a fairly educated woman who could speak both Kui, as well as communicate with us was not easy. Therefore, we had to add an extra step of recording our scripts into Oriya, so they could be easily understood and translated by a Kui speaker. We recorded half of it with the help of some NGO staff; however the process was very involved, and so another staff member wrote the translations for the rest. We later realized these scripts were written in a dialect of Oriya not spoken in Kalahandi, adding yet another degree of translation.

We identified a young woman who had previously attended a residential tribal school which our partner NGO runs, and was currently a teacher there. As she had been living away from her family from a very young age, she was no longer very fluent in Kui. While we suggested that she just listen to the Oriya recordings, and speak the Kui translation naturally, she felt uncomfortable with this idea. Therefore, she first wrote what she heard in Oriya, then transliterated the Kui translation using Oriya script (as Kui does not have one), and read it out loud for the recording.

However, when we took our first prototype to the field, we learned that many of the ASHAs were not tribal, and therefore could not speak or understand Kui: they spoke only Oriya. Therefore we decided to go back to the same school teacher and request her to redo the same recordings in Oriya, and we implemented a language toggle button so that both ASHAs and their tribal clients could hear the message in their own language.

### 5.5.4 Culturally Appropriate Prosody

Given that so many translations had been written before the recording was completed, we were worried that the natural prosody of the message would be lost. Our gold standard was, in fact, a recording we had done months prior in an attempt to derive the message architecture described above. This recording had been done by a very well-educated woman, who had a natural knack for speaking convincingly. We had field tested the scripts (through one-on-one conversations with pregnant women) and written arguments based on their responses. We then recorded the audio which was spoken naturally, without using a fully written script. However, we could not use this same woman to record the audio again, as she did not know Kalahandi Oriya or Kui.

In comparison to the original recording, our new ones sounded very rehearsed. There were often long pauses, and the voice sounded to us to be lacking emotion and prosody. While we kept on trying to improve the recordings, our local contacts

kept insisting that these recordings were better. When we finally relaxed a bit on this constraint, we came to realize that what they were attempting was simply more culturally appropriate. As one staff member remarked, “Tribal women are simple people, they don’t need emotion, they just need a clear message.”

## 5.6 Persuasion Tasks

We designed two sets of content using this prototype to target the two health outcomes described earlier - anemia and birth preparedness - with the following metrics:

- Are pregnant women taking iron pills?
- Are pregnant women saving money to be prepared for delivery-time emergencies?

The content presented myths and barriers for these two actions, coupled with corrections and solutions respectively. In addition, it suggested a specific task for remembering to do both of these. In order to remember to take iron pills, women were given a poster to attach to their wall, and a marker pen. On each day, after taking a pill, the message instructed her to draw one feature of her baby’s face (first eye, second eye, nose, mouth, face, first ear and second ear). The associated reward was that after one week, the entire face of her baby would be seen smiling at her, and she would know that she had taken good care of her baby. For saving money, the women were given a clay “piggy bank” (referred to henceforth as money bank) in which they were instructed to put one coin per day. In the case of an emergency, the money bank could be broken to retrieve the money. And as a reward, in the event that all went smoothly, she would have money to spend to buy new clothes or other items for her baby.

We utilized these two tasks to help assess whether the action had been performed, i.e. whether persuasion had occurred.

## 5.7 Iterations in Study Design

We considered it a priority to evaluate the persuasive power of these messages which we had carefully constructed in a controlled manner. We wished to test the persuasiveness of the dialogic vs. lecture presentation of messages using a within subject design (i.e. each client would receive one message in dialogic style and one message in lecture style.)

Our target was to recruit 50 pregnant women through approximately 15 ASHAs. Each ASHA would be assigned to be either a persuader or guide. We would accompany the ASHA on a house visit to her client’s home, where the ASHA would counsel



Figure 5.5: All participants were given a clay money bank as well as poster to draw the face of their baby.

her client using the prototype. We created four sets of messages (as seen below), of which each participant would see two, one dialogic and one lecture.

- Take iron pills, in lecture style
- Take iron pills, in dialogic style
- Save money, in lecture style
- Save money, in dialogic style

At the time of the visit, we would provide each participant both with the poster for drawing the baby's face, as well as the clay money bank for saving money. One week later, we would follow up (without prior notice) to collect data on whether the persuasion tasks had been performed.

However a number of changes occurred in the study design due to realities of the environment in which we were conducting the evaluation. These changes are described below.

### 5.7.1 Participant Selection

We originally intended to recruit participants and ASHAs first by gathering data from the primary health center about where ASHAs were posted, and how many pregnant women were registered in each of their villages. However it was extremely

difficult to find data in a reasonable way in advance, as whenever we visited the health center, there was absolutely no one there. Therefore, with the help of our partner NGO, we selected ten villages that were reasonably accessible by road, and literally went to each village in search of health workers (ASHAs, AWWs, or nurses) and data. Nurses were supposed to have lists of all the pregnant women registered in their villages, however we found it was often difficult to actually find the nurses in their assigned centers. With the help of some health workers, we eventually gathered enough data to estimate how many villages we needed to visit in order to recruit our target of 50 pregnant women. This obviously influenced the “randomness” of the selection process, as we were limited to more accessible villages, and places where the health workers and ANMs were more active and available.

In addition, as described later, we were unable to visit a consistent number of clients per health worker due to the variability in their own willingness to spend time, sincerity to visit all of their clients, and accessibility of houses and villages.

### **5.7.2 Limited Access to Health Workers**

We found that ASHAs were not present in each village, but rather, they were assigned to clusters of villages based on population. Therefore, we found that in our ten pre-selected villages, there were only five ASHAs operating. The large distances between villages and lack of reasonable accessibility to many of them made it difficult for us to recruit more ASHAs in other villages. However, we did find that many a few villages had AWWs who were still active in maternal health work, and so we recruited two of them. One additional AWW we tried to recruit was not receptive, as she felt it was the “ASHA’s” work.

As will be seen later in the results and discussion, the low number of health workers became a major limitation.

### **5.7.3 Special Attention**

We piloted the initial design with five participants. At this time, we realized that our visit along with the ASHA, was giving the participant “special attention” which she was not at all accustomed to. Many people crowded around, and everyone was quite engaged in discussion. While we see all these as positive consequences, it also created a difficult environment for controlled research as a number of factors were at play. We felt that in this setting the interplay between the within subjects factor of lecture vs. dialogic would be too great; that is, if the ASHA had already engaged the audience with a dialogic message, then this would influence their engagement in the following lecture message, and vice versa. Therefore, we decided that this factor should be measured in a between-subjects manner, so that each participant would see both messages in either lecture or dialogic style. In addition, we were curious whether the phone itself was the reason for this “special attention” and therefore

added a third control group, in which the health worker spoke with the participant without the assistance of the phone.

## 5.8 Hypotheses

We proposed the following hypotheses for our experiment based on our pilots and previous findings:

### 5.8.1 Persuasive Power

#### Hypothesis 1.i (H1.i)

*The dialogic-style message will be more persuasive than the lecture-style message.*

#### Hypothesis 1.ii (H1.ii)

*Both dialogic and lecture style messages will be more persuasive than health workers without the assistance of the phone.*

The *persuasive power* of the three messages on the clients is defined using the following metrics:

- Consistency of iron pill consumption by clients in seven days (measured by both drawing of baby's face and number of pills missing from package), and
- Amount of money saved by client in seven days.

### 5.8.2 Quality of Counseling

#### Hypothesis 2 (H2)

*The quality of counseling by the health worker will be higher in sessions using the dialogic-style message than in sessions using lecture-style.*

In order to measure the construct of *quality* precisely, we use the following metrics:

- The amount of time for which the application is paused, i.e. both user-initiated and application-initiated pauses. The assumption here (as seen in our pilots) is that all pause time serves as discussion time between the health worker, client, and other observers, thus improving the quality of the counseling session. Finally, in addition to the time logging built in to the application, we also propose one metric observed and recorded by the researcher:
- The activity of the health worker, recorded as how often the health worker stops, explains or elaborates on a point in the message, according to the following scale: *every line, every 2-3 lines, every 4-6 lines, rarely, never*.



### 5.8.3 Engagement of Client

#### Hypothesis 3 (H3)

*The client will be more engaged in sessions using the using the dialogic-style message than in sessions using lecture-style.*

We use the following metrics, recorded through observations by the researcher to measure *engagement* of the client:

- Client’s direct response to voice on the phone, where response is in the form of either nods and gestures, or spoken utterances. The frequency of these responses is recorded by the researcher on a scale of: *none, rare, occasional, often*.
- Client’s response to the health worker, in the form of questions, responses, nods and gestures. Again, the frequency of these responses is recorded by the researcher on a scale of: *none, rare, occasional, often*.
- Client’s alertness throughout the counseling session. The alertness of the client is recorded by the researcher on a scale of: *distracted, in and out, full time*.

## 5.9 Methodology

After health workers (ASHA and AWW) had been recruited, a suitable date for house visits was scheduled with each of them. On that day, the primary researcher (female) asked the health worker to familiarize herself with both messages completely, and then trained the health worker to use the prototype in both lecture and dialogic modes (specifically, how to pause, restart, and respond to the “yes” and “no” questions). Then, the primary researcher accompanied each health worker (ASHA or AWW) to the homes of three to 15 clients each. We visited a total of 52 client participants.

On some occasions, an additional male assistant researcher and/or male translator accompanied as well, but they did not directly observe or interact with the participant or health worker during the consultation in order to minimize any discomfort they might have felt.

We decided that in order to minimize confusion for the health workers, they would switch between lecture (L), dialogic (D) and control (C) arms exactly twice. Prior to the scheduled visits, each health worker was randomly assigned an ordering in which she would counsel her clients. For example, a health worker assigned the ordering “CLD” would counsel her first set of clients using no phone, then for the second set would counsel with the lecture-style prototype, and then finally counsel the last set with the dialogic-style prototype. Before each set, she was refreshed on usability. In addition each health worker was also randomly assigned a message ordering for their

	Caste	# of Villages Served	Breakdown of own Village (%)			Breakdown of all villages served (%)		
			ST	SC	OBC	ST	SC	OBC
ASHA 1	ST	1	[not available; however, we know the village was predominantly ST]					
ASHA 2	ST	1	89	8.5	2.5	89	8.5	2.5
ASHA 3	SC	4	64	23	13	73	20	7
ASHA 4	OBC	5	16	17	67	42	17	41
ASHA 5	OBC	4	16	3	81	55	9	36
AWW 1	OBC	1	89	8.5	2.5	89	8.5	2.5
AWW 2	SC	4	64	23	13	73	20	7

Figure 5.6: The caste breakdown of ASHAs and the villages they serve.

first client, i.e. anemia (A), then birth preparedness (B), or vice versa. After this, they alternated between AB and BA for each client.

The health worker decided the ordering of house visits according to her own convenience (usually based on location). We initially decided on the number of C, L and D participants based on the number of participants we expected to visit each day. However, this number was almost never accurate: sometimes participants were not home, other times the health worker found out about new pregnant women and insisted on visiting them, and other times health workers said they were busy and stopped early. In such cases, we prioritized balancing the number of C, L and D participants, which often meant that health workers ended up switching between the three arms more than the planned two times.

In the end, there were a total of 22 clients in the C arm, 16 in the D arm, and 14 in the L arm. Unfortunately, we could not balance the AB ordering as easily, because during control sessions, health workers automatically defaulted to the AB ordering. Therefore, there were 35 in the AB group, and 16 in BA. Due to a logistical complication, one client was exposed only to A.

## 5.10 Participants

### 5.10.1 Health Workers

We recruited seven health workers total, 5 ASHAs and 2 AWWs. They ranged from age 23 to 36. Of the ASHAs, one had not gone to school, three had studied until only 5th grade, and the other until 9th. The two AWWs were more educated, having studied until 8th and 10th grade. While most of the client base was of the scheduled tribe community, only two ASHAs were ST. Of the rest, two were SC and three were OBC (see Figure 5.6).

None of the health workers had electricity in their homes, but two owned a solar panel and battery. Five health workers stated that there was at least one person in their village owned a mobile phone, two of which belonged to their own family members.

### 5.10.2 Clients

Participants were recruited from 11 villages served by the selected health workers. The average household income in these villages was around 200 USD per year. Of the 52 participants, 44 were from the ST community, 3 SC, and 5 OBC. One participant had studied until 9th grade, four had attended school until 3rd grade or less, and the remaining 46 had never gone to school. Nine participants knew how to write only their names, two could write more than their names, and the rest were illiterate.

Only two of the participants' homes were connected to the main grid for electricity. 35% of the remaining owned solar panels and batteries; the rest had no form of electricity whatsoever. 42% of the participants stated that they listened to (or owned) radios; 15% stated the same about television. Four participants stated that someone in their family owned a mobile phone.

All participants were between two and nine months pregnant. We had originally planned to recruit only participants who were less than seven months pregnant, but health workers did not feel this was necessary, and wanted to visit all their clients. All the women were planning to deliver at home; only one woman had previously delivered at a hospital.

## 5.11 Results

### 5.11.1 Persuasion Metrics

As mentioned earlier, we measured the persuasive power of the messages by following up with clients after seven days to gather data on the number of iron pills consumed and amount of money saved. We were able to follow up with only 42 of the 52 women; six were not home, three had given birth in the elapsed seven days, and one refused to speak with us. In addition, two others claimed their children had taken the iron pills to school that day, so we could not gather their iron pill data. The iron pill results stated below includes data from 40/52 women, and the money saved refers to 41/51.

We found that many women had been very confused about how to draw the face, posters had been ripped by their children, etc. and so this was not a reliable measure for iron pill consumption. Therefore, we only counted the number of iron pills that were missing from their tablet strips. An ANOVA single factor test for the three arms yields  $F(3, 2) = 0.179$ , which is not a statistically significant result. We also

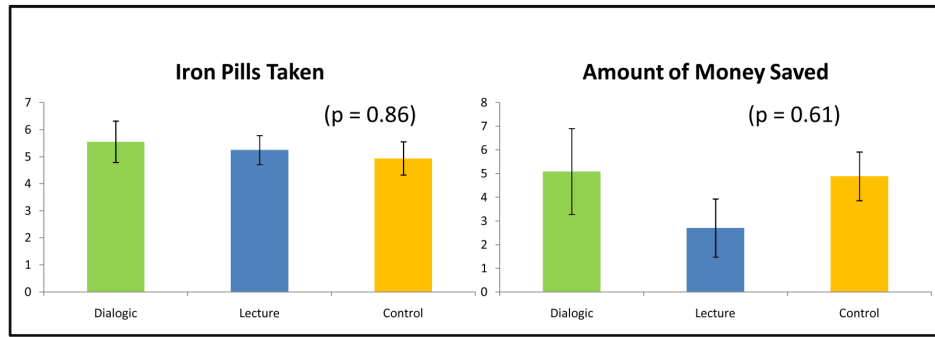


Figure 5.7: Graph of persuasive power over three conditions, measured by the number of pills taken and amount of money saved.

Metric	Effect Size	df	t Stat	p-value
<b>Total Pause Time</b>	170.23 (s)	53	3.75	0.0002
<b>HW Activity</b>	2	26	-4.71	9.08e-6
<b>Response to Phone</b>	0.428	26	0.98	0.16
<b>Response to HW</b>	0.286	26	0.986	0.16
<b>Alertness</b>	0.286	26	1.20	0.12

Table 5.1: Results from parametric one-sided T-test for metrics of counseling quality, and client engagement. Total length and pause time are calculated using values from both messages (2 per client), while the rest are recorded only once per client.

analyzed the difference across the three arms for the amount of money saved by the participants. An ANOVA single factor test for the same yields  $F(3, 2) = 0.504$ , which is also not statistically significant. Figure 5.7 shows these results.

### 5.11.2 Quality of Counseling

We evaluated the quality of counseling between the D and L groups based on the three measures defined above. Using a parametric one-sided T-test, we found that the pause time during the counseling session was significantly greater in D over L ( $p < .001$ ). The activity of the health worker was also greater in D over L, ( $p < .001$ ). These results are shown in the Table 5.1 and in Figure 5.8.

We observed that the increased session and pause times corresponded to more in-depth conversations between the health worker, client and whoever else was observing, improving the quality of the persuasive interaction. There were fewer silences in the D group; health workers were constantly repeating and elaborating on what had been discussed in the message, and also eliciting responses from their clients. At times,

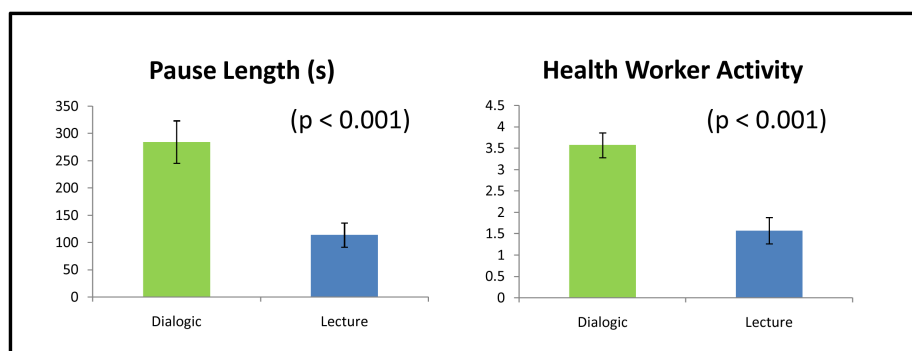


Figure 5.8: Graph of quality of counseling over lecture and dialogic conditions.

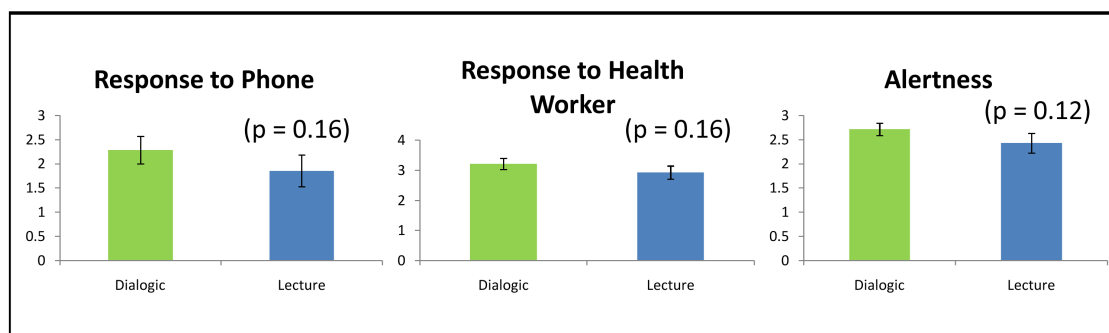


Figure 5.9: Graph of client engagement over dialogic and lecture conditions.

however, the health worker would skip ahead without waiting for a response until she got to a point of more interest. In the L group, health workers would often wait for a good stopping point, and by then forget to discuss a number of points that had been mentioned. We also observed that they often echoed the last few words of each sentence, rather than stopping and explaining further. In three L cases, the messages were never paused.

### 5.11.3 Client Engagement

We compared the engagement of the client in both the D and L groups. We did not find any significant difference between the groups in the clients' response to the phone, response to health worker or alertness (see Table 5.1 and Figure 5.9).

However, from our qualitative observations, we noticed that women often responded directly to the voice on the phone in D, but not in L. In two cases, they actually even folded their hands in a greeting gesture in response to a greeting from the voice. While some clients immediately responded to the phone from the start of the message, others were hesitant; however, we noticed that in D, by the end of the

message, they would respond without the health worker's prompting.

An unexpected finding was that clients who never listened to the radio were significantly more responsive to the phone directly, than those who either listened to the radio more frequently. This result was statistically significant with ( $p < 0.05$ ).

#### 5.11.4 Health Worker Variability

The seven health workers themselves varied quite a bit in their work ethic, motivation, treatment of clients and treatment of us. Because we had such a small number of health workers, we tested whether we measured a difference in persuasive power across health workers. For the anemia task, a single factor ANOVA yielded  $F(7, 6) = 2.555$  ( $p = 0.038$ ), a statistically significant result. The analysis for the money saving task, however, was not significant, yielding  $F(7, 6) = 0.8358$  ( $p = 0.551$ ). We further investigated various recorded characteristics of the health workers to understand which (if any) might have caused the difference. A single factor ANOVA analyzing the persuasive power of health workers by their community (ST, SC, OBC) yields  $F(3, 2) = 5.187$  ( $p = 0.01$ ), where ST health workers were significantly more persuasive than those of OBC or SC (SC was the least). We found no significance when comparing the health worker's education levels.

We also observed that clients were more open and friendly with health workers who were most similar to them (in terms of either caste or education); in turn, those health workers approached their responsibility with more focus and sincerity. In contrast, the more educated health workers bonded with us more, and were more aware of our presence during the counseling sessions, confirming frequently with us about whether they were performing well.

It was interesting to observe the varied usage of the language toggle. The three health workers who knew Kui chose to use it for their tribal clients. The other health workers sometimes gave their clients a choice; most tribal clients, when given the choice to hear the message in Kui or Oriya, chose Kui, even if they knew Oriya as well.

Experiences with the other four health workers varied. ASHA 5, though she did not speak Kui, felt that it was important that her clients hear the message in their native language, and always opted for it. She developed a process in which she would play a portion of the message in Kui, and then ask her client to translate. While she used this tactic to ensure that her clients had understood, she motivated them to translate by saying she could not understand.

However, all three of the more educated health workers who could not understand Kui expressed some discomfort in using it. They did not want to replay the message in both languages as it wasted time. All three of them would either fall silent for the duration of the message, or eventually switch back to Oriya so that they could engage in explanations and discussion more comfortably. One health worker felt guilty when she played it in Kui too long, as she felt we would judge her lack of activity.

### 5.11.5 Quality of Control Sessions

Though we did not specifically hypothesize on the quality of the control sessions being lower than those with the phone (as the measures cannot be compared fairly), we did collect some observational data. The control sessions on average lasted ( $\mu = 12.33|\sigma = 4.01$ ) minutes, much less than the average lecture sessions of ( $\mu = 23.47|\sigma = 6.02$ ), and average dialogic of ( $\mu = 23.47|\sigma = 12.01$ ). We also kept track of the points covered by the health worker during the counseling session; out of the eight main points (four for each topic) emphasized by the recorded messages (including corrections to myths, solutions to barriers, and instructions for tasks), on average the health workers covered ( $\mu = 4.91|\sigma = 1.1$ ) points without any prompts from us.

### 5.11.6 Preferences

All health workers stated that they preferred to conduct counseling sessions with the phone, and specifically with the dialogic version, because it was easier to engage the clients. One health worker was much more comfortable with the phone, and expressed concern that she might forget some of the points if she did not have it. At least three health workers were noticeably more quiet during control sessions. In another control case, after a particularly confrontational client flatly refused to take iron tablets and would not even hang the poster in her house, the health worker commented that if the client had heard the message through the phone in her own language, Kui, she would have been more receptive.

### 5.11.7 Content Relevance

In all but ten of the counseling sessions, other onlookers were present (between 1 and 6, not including the researcher, health worker or client). Many clients and others listening to the message commented on how relevant the content was to their own lives. For example, we often observed that particularly in the general statements presented in the lecture-style messages, people would comment on how many people did believe the myths. Other common responses were, “True!” and “It is saying everything!”

On one occasion, during the pilot phase, a mother-in-law got very upset by the statements being made and confronted the health worker and researcher angrily, stating that the baby would indeed get too big, and that she had seen cases of it before. At this, her daughter-in-law started arguing openly with her. We also found that a handful of participants decided to bury their money banks so that the money would not be stolen (a barrier mentioned in the message) by their alcoholic husbands and fathers-in-law.



Figure 5.10: The study often attracted a number of onlookers.

### 5.11.8 Iron Pills - A Closer Look

Only 10 of the participants we recruited had actually received iron tablets prior to our visit. All the rest were given iron tablets during our visit. Therefore, if they believed in the myths or faced the barriers mentioned by the message, it was not likely through personal experience during their current pregnancy. In short, a large number of clients were compliant: of the 40 participants with whom we followed up in one week, 28 took iron pills more than five times.

Despite the fact that nearly all participants agreed to the fact that “other” women believed in the myths about iron pills and faced the barriers stated by the message, only six of the 40 admitted it themselves. In addition, another six appeared to be receptive during the counseling session, but consumed four or less iron pills throughout the week. When examining only these 12 so-called “outliers” and comparing the control arm to both the phone arms, the phone appears to have a positive effect toward persuasion ( $p < .07$ ). A larger difference might have been detected had we singled out non-compliant clients only for the study; however, further investigation is necessary to make any conclusions.

More details about how these 12 clients reacted to the health worker and phone are found in Figure 5.11.

### 5.11.9 Saving Money - A Closer Look

During the counseling sessions, 15/51 participants either laughed out loud or sarcastically asked “What money?” when they were told to save a little money daily to be prepared for an emergency. In these cases, health workers would negotiate a commitment to save money “whenever they could find it.” All 15 of these participants



Group	Reaction During Session	Follow-up Results
C	Made her vomit. refused; argumentative; would not allow poster to be hung	Took none; sent us away
C	Receptive and interested to learn	Took none; said she lost them
C	Receptive and interested.	Took only 3; forgot rest
C	Listened, but was not very interested.	Took 2, did not like taste so stopped.
C	Was scared, as she didn't like the taste and it made her nauseous.	Took 2, then vomited due to taste. Got scared and stopped.
D	Made her vomit; giggly but argumentative	Took 5 tablets, forgot rest
D	Believed baby would get big; continuously refused; giggly but stubborn.	Took 7, one each day.
D	Thought baby would get too big, but stopped arguing when she heard the recorded message and became receptive.	Took only 3; forgot rest.
D	Repeatedly said she was scared and flatly refused; never explained why she was scared.	Took none; finally explained she was scared it would get stuck in her throat; did not know how to swallow tablets with water.
L	Very interested and willing to learn.	Took only 1, then vomited due to taste. Got scared and stopped.
L	Listened, but was slightly distracted.	Took 3, forgot rest.
L	Was not very interested, but did not argue.	Took 4, forgot rest.

Figure 5.11: Reactions of selected clients towards iron pills.

were of the scheduled tribe (and poorest) caste. However, four of them actually did save money.

Given the general reaction to the money-saving task, it was not surprising that a total of 20/51 participants did not save any money. The reason was always that they simply did not have any to save. The recorded message did address the barrier of not having enough money by trying to explain how even the smallest amount of money per day would be sufficient, and health workers often tried to elaborate on this. In most cases, the health workers used their judgement based on their knowledge of their clients' economic status to decide how much to push on this issue (in fact the health workers would often explain to us that the clients were very poor). However, we noticed that the two most educated health workers (and also most well-off) responded with comments like "What, you can't find one coin each day?" and other less sympathetic responses.

## 5.12 Research and Reality: The Bigger Picture

Our results show that dialogic messages significantly improved health workers' ability to provide informative and effective counseling to their clients. However, we were unable to measure the impact of this improved ability on their clients through the behavioral changes we defined. Throughout this paper, we have discussed changes,

iterations and compromises that we had to make to our own research goals in response to real, challenging factors in our study environment. This is often a disadvantage in field studies which attempt to maximize realism, and consequently have limited control over extraneous factors [42]. In the following section, we analyze our results in light of these factors, and discuss general tradeoffs of prioritizing methodological rigor over accurately preserving the interactions of contextual realities.

### 5.12.1 Truly Rural

We faced a number of challenges because the site we selected for the study was rural. Apart from the cluster of villages which were relatively accessible by road, most villages required hours-long hikes over mountains.

Previous work refers to the tradeoffs of choosing truly rural, hard-to-access field sites [5], and recommends the advantages of a rural site be weighed against logistical disadvantages that add unnecessary burdens to the research. In our case, we selected Kalahandi as our site because, along with its rurality, came poor maternal health outcomes that could benefit most from our intervention. We compromised by selecting villages that for the most part minimized the additional need for long hikes. The tradeoff for this decision was that we could not recruit a larger number of health workers, but rather were restricted to the seven who served the more accessible villages; with this small number, the variability across health workers introduced an undesired, albeit interesting effect, as described next.

### 5.12.2 Cutting across Castes

Although our results are limited by the low number of health workers, the statistically significant findings with respect to persuasiveness and caste of the health workers are surprising. The ST health workers were likely most persuasive because the majority of the client base. We also observed that they were more friendly with their clients. The least persuasive health workers were SC, with OBC falling in the middle. A possible explanation dates back to traditional divides between these castes. Anecdotally, we heard of more rifts between the SC and OBC communities, whereas OBC people in general were more sympathetic towards ST. However, SC communities, having been oppressed by the higher castes, have historically been seen to exploit ST communities in turn [56]. While this is still highly speculative, the findings more generally emphasize the importance of evaluating ICTD interventions within contexts that preserve extraneous factors and consider how they might be coupled with outcomes.

Had we decided to measure only the persuasive power of the messages on rural women, we could have eliminated the health worker entirely from the picture, and shown the messages to the women directly ourselves; instead, we deliberately decided to build on the existing model of health workers as agents of persuasive messages,

consequently inheriting generations of traditional attitudes about caste. The interactions of individual characteristics of the technology “agents” with the acceptance of the intervention itself are not unlike previous results on the success of telecenters depending greatly on similar characteristics of the associated entrepreneur [51].

### 5.12.3 Unidentified Foreign Researchers

Reflexivity on influence of the researcher is emphasized in qualitative research [18], and of particular importance in ICTD where there is a wide gap between the researchers and the communities they research [11]. We found our personal interactions with health workers and clients had unexpected influence on both, possibly affecting persuasion.

Our study required that we accompany the health worker to each client’s home to ensure that she delivered the persuasive message (using D, L or C treatment), to mediate any usability issues, and to observe the counseling session. However, our presence also introduced other effects which may have boosted the persuasiveness of both the health worker and her message. The primary researcher was unfamiliar, and therefore appeared important. She was often seen as the true bearer of the message; some health workers even believed, and told their clients, that they were delivering the message on behalf of the researcher, because she did not know the local language. Other times, the voice on the phone was associated with the researcher, and viewed as a local-language translation of the researcher’s message.

In the cases of more educated health workers, the researcher’s presence introduced a Hawthorne Effect; they tried to impress the researcher by explaining each point in the message carefully. In addition, the researcher’s own sincerity sometimes motivated the health workers to be more sincere about their own jobs: once, when the researcher arrived at a village at the break of dawn to visit women before they headed to the fields, a health worker commented, “You woke up in the middle of the night to get here this early, of course I’ll make time to visit a few houses with you.” Another health worker used the researcher’s dedication to try and motivate clients, stating, “She has come from so far to deliver this message to you - it must be important then, right?”

### 5.12.4 Research Study, or Intervention?

Even as the research study was designed to preserve as much context as possible, it introduced a number of additional interventions. Because we were counting iron pills, we needed to provide pills to all the clients, raising the number of recipients from the norm we observed (20%) to 100%. This in itself was an intervention, and previous work has shown that messages are more impactful when the effort required to obtain the object in question is low [24]. The study also enforced that health workers visit clients in all their assigned villages, though we learned that they otherwise rarely did

this: half of our participants were from outside villages. We also brought additional props - posters and money banks. While these were all purchased locally, they were still new, and caused a stir. Many women often gathered to watch, whether or not the phone was being used, and engaged in discussions.

Therefore, even as we attempted to compare the effects of three interventions within a realistic, field context, we introduced a number of changes to the norm. It is nearly impossible to isolate the effects of the persuasive message amidst them. The question that arises, then, is whether that is necessary. The house visits and iron pill distribution that took place as a result of the research study are in fact mandated by the government program; health workers had iron pills - they were just not consistently delivering them.

Had the persuasive messages on mobile phones been introduced as an intervention, rather than a research study, then perhaps they would have still introduced similar changes. For example, health workers would receive new usability training, and probably by new trainers. It would be only logical to take advantage of logging functionalities on the phone and track health worker activity, thus imposing an additional level of accountability. The sheer excitement of having the phone or something to share might also affect the health worker's sincerity.

Should we be motivated only by the goal of creating impact, then these are not confounds, but simply features of the intervention. ICTD interventions rarely come alone, and often their success depends on the other factors which are natural counterparts [63]. The impact of this research study, in that case, is that 34/52 women began taking iron pills, and 31/51 women began saving money for the birth of their child.

## 5.13 Conclusion

In this chapter, we described a field study which applies the results of the study presented in Chapter 2, and follows from the work described in Chapters 3 and 4. The first contribution of this chapter is the definition of a persuasive message architecture, which draws from our field research, theories of persuasion and the results of Chapter 2. Evaluating the architecture on three metrics (quality of counseling, client engagement and persuasive power), we present statistical evidence that the quality of counseling is improved when using the dialogic message architecture.

At the end of this chapter was a discussion about the challenges of balancing scientific rigor amidst unexpected field realities. While we attempted to show that persuasive power and engagement would also be improved with the dialogic messages, we could not generate statistical evidence for this. We discuss how a number of additional factors in the environment, and cultural factors which are affected by our research design can interplay with the results we seek scientifically. We consider this discussion the second contribution of this chapter, as our analysis highlights a

number of issues that are by no means unique to our study, that affect ICTD projects at large, and that should be considered by the greater community when judging the impact of ICTD. The most important takeaway is a recognition that ICTs cannot be isolated from the social, cultural and environmental factors that already exist within the context where they are introduced, and that the success of ICTs is not based solely on the technology, but on the changes that ICTs bring with them to an existing community.

# Chapter 6

## Conclusion

This thesis has explored and evaluated the use of technologies for presenting health information effectively and persuasively. Beginning with a lab-based study comparing information presentation styles (lecture-based vs. dialogic), it delves into the context of maternal health in rural India, motivating the use of persuasive health information delivery through the case of poorly trained community health workers. The in-depth analysis of this context provides strong motivation for using persuasive and motive technologies to tackle some of the complex social barriers that stand between pregnant women and safe maternal health practices.

Research in the ICTD space has typically focused on connecting people to information over long distances, taking advantage of obvious features of new and evolving technologies. In this thesis, we emphasize the need to look beyond this role of ICTs, to think about how complex social dynamics can be changed or improved through the careful design of appropriate technologies. We incorporate theories of interpersonal persuasion and motivation into our technology designs by using (1) video testimonials portraying authorities and peers that create scenarios of verbal persuasion, for building health worker self-efficacy, and (2) dialogue-based messages that incorporate ideas from rhetoric to scaffold health workers in persuading their clients effectively. Thus, we use ICTs to create an improved social practice between health workers and their clients.

### 6.1 Future Work

There is still room for exploration in this space. Below, we outline a few next steps.

#### 6.1.1 Largescale Evaluation

Although, we measured an increase in counseling quality by health workers, it still remains to measure statistical evidence for the persuasive power of the dialogic

persuasive messages described in Chapter 5. For this to be measured without the interference of many external factors, it is necessary to run a largescale pilot, wherein pre and post surveys are conducted with clients, but ASHAs are not observed during their counseling sessions. The design and implementation of such a pilot is in progress, where 75 ASHAs will be recruited, along with 3 to 5 of their clients each. The clients will be followed over the length of their pregnancy. The randomized controlled pilot will include three arms, with 25 ASHAs receiving mobile videos, 25 receiving a flip chart, and 25 receiving no additional tools (control). Persuasive power will be measured through health outcomes, specifically, baseline and endline surveys will be used to measure specific outcomes that include changes in knowledge (for both ASHAs and clients) and rates of birth preparation behaviors by clients (iron pills taken and birth preparations made). ASHA self efficacy and client attitudes towards ASHA capability will also be measured. The study will suggest whether or not the use of counseling using mobile phone videos facilitates better knowledge uptake and spurs more birth preparation activities compared to verbal counseling or counseling with low-tech aids. It will generate statistics (effect size and variability) that can be used by other randomized, controlled studies of teaching aids for community workers and their clients in many health realms (e.g. family planning, reproductive health, infectious and communicable disease transmission) as well as non-health realms (e.g. financial literacy).

### **6.1.2 Video Exchange**

In Chapter 4, we noted that viewing and rating each other's videos was a pleasant and motivating activity for the ASHAs. It also seemed to enhance their sense of community. An interesting next step would be to create a service to archive the videos from ASHAs to support this practice. This can be part of a more general portal described next.

### **6.1.3 A Community of Practice Portal**

A sense of belonging to a community has positive impacts on many aspects of a person's life [64]. This is certainly true in village life, and most people are very closely tied to their clan and to their craft, which will be shared by several others in the village. ASHAs on the other hand, are the sole actors in the village who perform their craft. Furthermore, while other actors are in contact with the peers in their community of practice for decades, ASHAs have an induction lasting a few weeks at best and then they are on the job alone. The monthly training provides some ongoing support, but less than half the ASHAs attended the meetings we observed. A community of practice typically provides strong enhancers of self-efficacy: verbal persuasion, vicarious experience, timely advice to help improve direct experiences, and help coping with negative experiences. Enhancing a community of practice is an

intuitive and promising next step. The exchange of videos described earlier provides an ideal seed practice for the portal. Other features would be a newsletter (possibly in audio format) from their nurse, a list of upcoming events, a “FAQ” from ASHAs to the nurse, and a general discussion list.

## 6.2 Contributions

At the beginning of this thesis, we laid out four major contributions of this work. To reiterate, they are:

1. Evidence that dialogic, speech-based information presentation is more persuasive than traditional lecture styles (Chapter 2),
2. A detailed ethnography of maternal health in India, and a sketch and exploration of the persuasive technology design space in this context (Chapters 3 and 4),
3. An architecture for designing persuasive messages that improve the quality of health worker-client consultations (Chapter 5), and
4. Reflections on achieving ICTD research goals amidst challenging, developing world realities (Chapter 5).

In conclusion, we elaborate on the significance of each of these contributions.

### 6.2.1 Dialogic Information Presentation

For improving health, perhaps there is nothing more persuasive than having a face-to-face conversation with a respected health care provider, who can convince an individual that he or she is at-risk, and persuade them to practice preventive measures. For such a scenario to take place, many assumptions have to be made: that such a respected health care provider exists, that the health care provider is sincere enough to spend the time and effort to convince the at-risk individual, and that the individual is seeking out information on how to improve his or her condition. Unfortunately, in the global health context, none of these assumptions are generally true. Rather, such scenarios are plagued with disinterest from both sides - the health care provider, and the at-risk individual.

Many ICT solutions focus on the idea of health information access. However such a model also makes some assumptions: that appropriate, useful health information exists, as does a demand for it. Yet, what we have seen time and again is that neither of these assumptions are true. We have explored the use of dialogic information presentation in two different forms, because we recognize that improving accessibility (i.e. through speech) is not the answer; rather, the information needs to be produced



and presented in such a way that it captures the persuasiveness of a face-to-face conversation. Our results from comparing dialogic with lecture-style information presentation provide evidence that this can be done. We have shown that rather small changes to interface design techniques can transform the idea of information access to one of persuasion. We believe this technique can be used in any domain where behavioral change is the primary goal.

### **6.2.2 Persuasive Technologies for Rural Maternal Health**

Our in-depth ethnography of the context of maternal health in rural India revealed that many barriers to improving health are social in nature. There is little demand or interest in improving health; rather, traditional health practices are still highly respected, and modern medicines are generally rejected. On top of this are issues based on politics, caste, status and corruption, which make the government struggle in its efforts to improve maternal health. The ASHAs, employed as change agents, lack critical persuasive power. Our sketch and exploration of the design space for building the persuasive power of ASHAs shows preliminary, promising results of improved engagement of clients and influential community members, and increased self-efficacy and knowledge of ASHAs themselves.

An important aspect of our design approach is the tight integration of the ICT solution with existing social practices. That is, rather than introduce a technology which attempts to communicate with and persuade pregnant women directly, we recognize that building the capacity of the ASHAs is a more appropriate solution. By helping the ASHAs become better persuaders, we increase the impact of the whole solution, retaining the powerful human aspect of the persuasive process. Empowering individuals in the community also makes the solution more sustainable, as it generates local demand for improving health conditions. Together, our ethnography and exploration encourage an approach to ICTD which works to improve the impact of existing social practices, rather than introducing new practices which cannot be sustained.

### **6.2.3 Persuasive Message Design**

Narrowing in on the effort to build the capacity of health workers by arming them with both reference information as well as tools to improve their persuasive technique, we built an architecture for designing persuasive messages. The significance of this contribution is really the focus on content, and a recognition that tools for information delivery go nowhere unless the content they deliver is appropriate. Unfortunately, content is perceived by many technologists in this space as a black box - which can be easily generated, localized (through translation) and updated. While this might be true about some information, the need to also make it persuasive requires an understanding of, for example, myths about and barriers to adopting that

information.

Digital information libraries enable search, a seemingly invaluable feature; yet, search is only as valuable as the demand for information. In our context, clients were never really approaching ASHAs for information, and were generally disinterested in it. A prerequisite to increasing the demand for information is establishing the ASHA as a valuable health resource, and scaffolding her ability to convey information to clients in such a way as to change health behaviors. Therefore, we have focused on a few aspects of designing persuasive messages that increase the quality with which ASHAs are able to counsel their clients, such that they engage in more discussion, and establish themselves as intelligent and credible health resources.

#### 6.2.4 Reflections on the ICTD Research Process

The fourth and final contribution of this thesis is a discussion about the process of conducting research in ICTD, and tradeoffs between maintaining scientific rigor and achieving impact. Of utmost necessity, now, in the space of ICTD is evidence that ICTs can bring about positive socioeconomic change. The study presented in Chapter 5 is an attempt to prove one aspect of this. The idea of research itself is an abstract concept far removed from the goals and needs of the communities in which we work; yet, we are motivated to conduct this research due to some intrinsic feeling that this research can improve some aspect of their lives. Proving this, however, is hard. Factors such as rurality, politics and caste can affect study results, especially studies with limited resources and time. In addition the research study process itself, which often necessitates exclusion of groups (for control), cooperation from local stakeholders with varying degrees of sincerity, and the presence of seemingly “important” outsiders with hi-tech toys creates a stir in the environment that is bound to create confounding effects.

This is not to say that ICTD projects should not be held to the rigorous scientific standards, but rather to recognize that all factors must be considered when evaluating the success (or failure) of ICTD projects. Many projects do not attempt rigorous evaluations, but are dubbed successes based on high levels “usage” or “liking” by communities. While these may be important measures, they say little about ICTs and *development*.

Field studies preserve realities which are essential to judging the sustainability and scalability of ICT solutions. Confounds reveal what factors must be considered in a real deployment, for example, whether caste will effect the success of a kiosk, or acceptance of a health worker’s message. As technologists in ICTD, our role is not only to innovate, but to design an entire technology solution, as well as a delivery mechanism. It is critical that we recognize that there is a balance that we must strike between achieving scientific rigor, and achieving real impact. By focusing too much on *control*, we can overlook important contextual factors that are tightly coupled with results, but by focusing only on measures of *usage and acceptance* of

a technology, we forget to assess development outcomes. A recognition that neither the design process, evaluation methodology, deployment plan or sustainability of an ICTD solution is independent of existing social, cultural, political and environmental factors is essential.

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