Research Article

Power to the Peers: Authority of Source Effects for a Voice-Based Agricultural Information Service in Rural India

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Abstract

Online communities enable people to easily connect and share knowledge across geographies. Mobile phones can enable billions of new users in emerging countries to participate in these online communities. In India, where social hierarchy is important, users may overvalue institutionally recognized authorities relative to peer-sourced content. We tested this hypothesis through a controlled experiment of source authority effects on a voice-based agricultural information service for farmers in Gujarat, India. Over a two-week period, 305 farmers were sent seven agricultural tips via automated phone calls. The same seven tips were each voice-recorded by two university scientists and two peer farmers. Participants received a preview of the tip from a randomly assigned source via the automated call, and then they played the remainder of the tip by calling a dedicated phone number. Participants called the follow-up number significantly more often when the tip preview was recorded by a peer than a scientist. On the other hand, in interviews conducted both before and after the experiment, a majority of farmers maintained that they preferred receiving information from scientists. This stated preference may have been expressing the more socially acceptable response. We interpret our experimental results as a demonstration of the demand for peer-based agricultural information dissemination. We conclude by identifying design implications for peer-to-peer information services for rural communities in India.

1. Introduction

Indian society has been noted for the prominent role that hierarchy plays in it (Dumont, 1981), leading to a tendency to defer to authorities (Savani, Morris, & Naidu, 2012). This deference effect has been demonstrated in a range of scenarios, from the workplace (Storti, 2007) to family life (Levine, Sato, Hashimoto, & Verma, 1995). As broader segments of the population come online, many of them via mobile phones, this social dynamic could also play out online. In contexts that include information sources from all social strata, norms that place pressure on individuals to

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defer to authority figures may lead people to overvalue authority sources relative to peer-sourced content.

India has also been characterized as a collectivist culture (Verma & Triandis, 1999) with a rich legacy of cooperation and sharing through peer networks. These values are also found in many online communities. Peers have been demonstrated to be scalable, accessible, trusted, and locally relevant sources of knowledge (Mamykina, Manoim, Mittal, Hripcsak, & Hartmann, 2011). Earlier work demonstrates that farmers who were provided access to a voice-based information forum for agriculture engaged in rich exchange and found the information provided to be highly relevant (Patel, Chittamuru, Jain, Dave, & Parikh, 2010). However, while farmers enjoyed hearing the questions and experiences of other farmers, most gave a stated preference for receiving advice directly from authorities.

This article investigates how the authority of an information source affects the likelihood that farmers will follow up on the information. In a controlled experiment (see Figure 1), 305 users of the Avaaj Otalo forum were called with seven farming tips recorded by two types of sources: peer farmers and scientists from local agricultural universities. To isolate the effect of the source's authority on participants' subsequent actions, the tip content itself was held identical across the two sources. After a brief introduction from the source, they heard a preview of the agricultural tip, and then they were told that they would be able to hear the conclusion of the tip recording if they hung up and dialed another number. Participants chose to call back and listen significantly more frequently when the tip was recorded by a peer farmer. Still, participant farmers continued to state in interviews before and after the experiment that they preferred receiving information from authorities. The stated preferences may have been biased by the fact that the interviewers were perceived as authorities, leading participants to provide a more socially desirable answer. The results indicate the demand for peer-based information dissemination.

1.1 Authority in Indian Society

Some have described social hierarchy as a deep-rooted feature of Indian society (Appadurai, 1998; Dumont, 1981; Mines, 2009). Researchers have observed a "deference syndrome" in the Indian work environment, in which subordinates act against their better judgment and struggle to express views independent of their bosses' views (Storti, 2007). While these observations could have come from any work environment, deferential behavior in India may be especially strong. One study of Indian and American college-age individuals found that Indians adjusted their choices in deference to authority, even when the decisions went against personal preference, and even when the subject was told that the authority would never know about the decision; Americans, by contrast, did not (Savani et al., 2012). In another context, researchers found that videos featuring local high-status or authoritative individuals can be highly effective in persuading healthy practices in villages (Parmar, Keyson, & de Bont, 2009; Ramachandran, Canny, Das, & Cutrell, 2010).

While hierarchy is influential, Indian society also has a strong culture of peer-to-peer exchange, rooted in a group orientation (Sinha, Sinha, Verma, & Sinha, 2001; Verma & Triandis, 1999). The Honey Bee Network

Figure 1. In this experiment, tips from farmers (left) and scientists (right) were alternately sent to rural Indians through automated phone calls. After hearing the tip, subjects were given the option to hear more information by calling a phone number. An experiment captured the number of follow-up calls that were made in response to tips from farmers versus tips from scientists.

has demonstrated that there is both a significant supply of and demand for local knowledge and information to be shared among rural farmers.[1] Digital Green found that including peer farmers in videos of new practices led to increased likelihood of adoption (Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2007). When compared to authorities, peers more easily establish common ground, because they "speak their language." A 2005 nationwide survey by the International Food Policy Research Institute found that "other progressive farmers" were the most popular source of information on agricultural technology. Traditional authority sources (agencies, technicians, NGOs) were at or near the bottom of the list (Birner & Anderson, 2007).

1.2 Information Processing and Culture

Some information processing practices have been shown to vary by culture. For example, studies have found that people in different cultures pay attention (Maddux & Yuki, 2006) and incorporate (Kitayama, Duffy, Kawamura, & Larsen, 2003) different contextual information. The elaboration likelihood model (ELM) was developed by social psychologists to explain how people process various cues while processing information (Petty & Cacioppo, 1986). The ELM differentiates between systematic information processing (where people form attitudes based on the intrinsic strength, quality, or persuasiveness of the message) and heuristic processing (where they rely on heuristics like "authorities should be trusted," "long messages are valid messages," or "majority opinions are usually true"; Chaiken & Maheswaran, 1994). The ELM predicts that people resort to heuristic processing in "low-involvement" situations, or instances where they are not highly personally vested in the outcome.

The applicability of ELM can be influenced by cultural norms. An ELM experiment investigating the effects of the race of information sources found that white American subjects were systematically processing messages in a low-involvement situation when the source of the information was black. In other words, where the ELM would predict that white participants would not pay attention to the content of the message in forming an opinion, they were doing so if and only if the source was black (White & Harkins, 1994). A follow-up experiment concluded that white participants were strongly motivated to attend to the black source to avoid being perceived as racist (White & Harkins, 1994).

2. Experiment Design and Method

2.1 Background

An earlier field study showed that 65% of Avaaj Otalo users expressed a preference for receiving answers exclusively from staff and scientists working with our implementing partner NGO, Development

1. *Honeybee.org*

Support Centre (DSC). The remaining 35% of respondents wanted both authority and peer responses; none said they preferred information only from peers (Patel et al., 2010; Savani et al., 2012). Participants stated that DSC's experts had a greater breadth and depth of knowledge than peers, that experts were more articulate, and that "scientific" knowledge was more reliable than "experiential" knowledge. The prevailing sentiment seemed to be that farmers were unreliable, and even incapable of contributing high-quality responses:

> [Only] when these other farmer's questions will be answered by an expert, then I will get to learn from [answers]. Farmers don't know everything, right? What most of what the farmers talk about is common knowledge to us. So I am interested in listening to what the experts say about the questions on Avaaj Otalo.

After the pilot, DSC recruited staff members and scientists from local agricultural universities to participate as "expert" responders for the service. No farmers were targeted in this recruitment. In discussions with DSC staff, the farmers indicated that staff and scientists would be best suited to provide high-quality, accurate advice. DSC's weekly radio program and quarterly newsletter already routinely profiled farmers, highlighting their innovations. DSC's reluctance to include expert farmers as experts was largely based on logistical concerns, including the complexity of managing a larger and more distributed group of experts. But many DSC staff also shared the farmers' lack of faith in peer-provided advice.

2.2 Research Question and Hypothesis

The farmers' stated preference for information from authorities may be a reflection of underlying social norms favoring authorities. On the other hand, many farmers may also not have had prior access to a consistent, high-quality source of peer information. We wanted to determine whether rural Indian farmers would engage equally with information from their peers if it could be provided with the same quality and consistency as information from experts. To do this, we designed a controlled experiment to answer the following research question:

> *Given the same informational message, are rural Indians more influenced by the information if it comes from an institutional authority figure, compared to a peer?*

Prior field and experimental research (Patel et al., 2010) suggested the following hypothesis:

> *Rural Indian farmers are more likely to act upon information presented by an authority than that presented by a peer.*

2.3 Participants

Participants were recruited from a pool of 1,014 phone numbers that had called Avaaj Otalo at least once during the prior nine months. Two paid assistants fluent in Gujarati and familiar with Avaaj Otalo recruited participants over the phone over a two-week period. Participation in the experiment was introduced as an opportunity to participate in a trial of a new service, Avaaj Otalo Margdharshan Seva (literally, Avaaj Otalo's Direct Information Service).

Farmers were told that AO Margdharshan would provide them with recorded agricultural tips delivered via automated voice phone calls from the Avaaj Otalo phone number. Participants were told that the tips would come from farmers and scientists across the state who were associated with DSC. After hearing the description, farmers were asked if they wanted to subscribe, at no cost to them. If they agreed, basic demographic information was collected, and their number was included in the trial. All farmers who agreed to participate were accepted into the study.

Basic information for these participants is shown in Table 1. Most participants were small-scale or marginal farmers. All were male, since the original pool led to only male callers. Most of the districts and crops grown in the state were represented. Twenty-eight users participated in a pilot designed to validate our scripts, the usability of the voice interface, and the relevance of the information. Our analysis is based on data from the remaining 277 users. After the study, as a thank-you gift, DSC mailed all participants a booklet with all of the tips in full, along with supplemental farming-related articles and DVDs.

2.4 Study Design

The experiment was conducted entirely over the phone. Each participant received seven tips in the same order, as well as an even spread of tips from each of the four sources (two farmers and two scientists). Participants were randomly assigned to one of four tip schedules (see Table 2), counterbalancing tips and sources to achieve an equal number of every combination.

Table 1. Subjects by Demographics.

N	305
Number of Districts	20 (of 26 in Gujarat)
Age	33 (mean), 30 (median)
Farm Size	10 acres (mean), 7 acres (median)
Education	8th grade (median)
Grows Cotton?	60%
Other Crops	Peanuts, millet, lentils, sesame, beans, corn, castor seed, cumin, mustard, tobacco, wheat, rice (of 26 crops grown in the state)
Keeps Animals	96%

*Table 2. Tip Schedules.**

	Tip1	Tip2	Tip3	Tip4	Tip5	Tip6	Tip7
Grp1	S1	S2	P1	P2	S1	P1	S2
Grp2	S2	S1	P2	P1	S2	P2	S1
Grp3	P1	P2	S1	S2	P1	S1	P2
Grp4	P2	P1	S2	S1	P2	S2	P1

**Subjects were randomly assigned one of the four tip schedules. The tips were assigned to all sources equally. The tips' sources alternated between peer (P1, P2) and scientist (S1, S2) sources.*

2.5 Study Materials

The phone calls for the experiment were executed over an ISDN primary rate interface (PRI) line connected to a commodity UNIX server. PRI lines support up to 30 simultaneous calls, and a single line can map 90 distinct phone numbers. We recorded and assigned a distinct phone number to each tip-source combination (7 x 4 = 28), logging the identity of each inbound call to count the number of follow-ups. Phone numbers were not assigned randomly; each source was assigned a continuous series of four phone numbers for each tip. While we do not believe any specific numbers were easier to recall than others, it is possible that this could have introduced some bias into the experiment.

The tips and the previews themselves were developed by agricultural staff members at DSC, and then they were reviewed for accuracy by outside scientists. The tips were designed to be factually accurate and clearly articulated, offering practical information that was relevant for a wide range of farmers. It was important that the tip content was equally plausible coming from either a scientist or a farmer. To achieve this, DSC staff members recommended using "farmer-friendly language," which was colloquial and playful, avoiding technical jargon. Two tips dealt with cotton, which is grown by a large portion of Gujarati farmers. Two other tips dealt with animal husbandry, which is relevant to nearly all farmers, as most keep animals for home dairy consumption, manure, or labor. The other four tips discussed disease management, orchard promotion, drip irrigation, and soil testing. See the following text for a sample tip preview and the associated tip. The technical terms in English were replaced by colloquial Gujarati words. A local farming expert who had significant experience working with farmers verified the appropriateness of the language.

Preview: Your animals are very much prone to several serious diseases like hemorrhagic septicemia and foot and mouth disease with varying frequency. Once the animal gets sick, there are so many troubles. You need to call the vet, you need to spend money on visits and medicines, it is very much time consuming for you, and sometimes your agricultural activities get delayed. If the sickness is more serious, and the animal gets weakened, then it is a long-term damage. For milking animals like cow and buffalo, milk production will go down. If you want to save your animals from all these troubles and want to ensure health of animals, the very simple and

cheap way is timely vaccinations. To receive information on which vaccinations should be done for which disease, when, and where the service is available, listen to the following instructions.

Tip: In Gujarat, we need to vaccinate the animals, especially for foot and mouth disease and HS. The germs of HS may cause the disease while the animal grazes on moist grasses, especially in July and August. The animal should be vaccinated for this disease in the months of April and May. But don't worry if you have missed it, you can do it even in this month. If your area has experienced this disease in previous years, better to vaccinate the animal every six months. While the foot and mouth disease generally occurs in summer, and the vaccination should be done between October and December, better would be to vaccinate the animals at six-month intervals. To protect the animal from brucellosis, heifers with four to nine months of age should be vaccinated once in a lifetime. Vaccination service is freely available from the state government. Please contact the nearest animal dispensary.

We recorded two speakers for each source type to mitigate individual effects. The scientists were both retired professors; one from soil science, the other from agronomy. Both were in their 60s and had prior experience recording scripted agricultural messages for radio programs. The farmers were from two districts in Gujarat. Both had attended DSC-organized events in the past. One was in his 50s, farmed three acres of land, and had been formally schooled through the 10th grade. The other was in his mid-20s, farmed one acre, and was also schooled through the 10th grade.

The four selected individuals had no prior official designation with either DSC or the Avaaj Otalo service. The tips were recorded in quiet office spaces using a Macbook Pro's built-in microphone. We asked the sources to study and practice each tip carefully before recording to ensure a smooth delivery. We also asked them to internalize the message as if they had generated the tip themselves. The tips were re-recorded when a speaker misspoke, stuttered, or was otherwise unnatural in his delivery.

2.6 Procedure

The original automated call provided background and motivation for a topic, but it was limited to a problem statement or high-level description of a prescribed practice. To learn the full solution, including implementation details, participants could learn more information by calling the provided phone number. The AO Margdharshan "system" voice interface was similar to the Avaaj Otalo service participants had previously used. If the participant placed a return phone call at their own expense, the call provided a real-world measure of the participant's assessment of the original message's value. While adoption of the advice is the theoretical gold standard for influence, our approach allowed us to test our hypothesis within a reasonable timeframe and budget.

Figure 2 shows the structure of the automated phone calls used for the experiment. Each call began with a welcome prompt which reminded the user about the service and emphasized that the tips came from scientists and farmers from across the state of Gujarat. The tip source then introduced himself. The farmers spoke their names and locations: village, block, and district. The scientists spoke their name (preceded by the title *Doctor*) and university affiliation, introducing themselves as retired professors. Next, the speakers recited the tip, ending with instructions on how the listener could obtain more information by calling the provided phone number. We marked the initial call as complete if the listener stayed connected to this point. After that, the source re-stated his name to sign off. This repetition, along with limiting farmer introductions to simply name and location, was intended to create a strong authority manipulation. Finally, the system repeated the follow-up phone number and provided the option to listen to this message again. This prompt repeated automatically three times before the call self-terminated.

The seven tips were sent to subjects over the course of two weeks, with a new tip every two days. Twenty-eight participants were randomly selected to pilot the experiment. The pilot confirmed that most of the phone calls were, indeed, being received and completed, and that the follow-up rate was within an acceptable range for data analysis. Pilot participants also responded that that the tips were useful and credible, and that the callback procedure was convenient and affordable. Based on this satisfactory feedback, calls for the remaining 277 participants were scheduled. We began with an initial reminder call about AO Margdharshan, urging subjects to pick up the following calls from this number and listen to the tips carefully. The seven

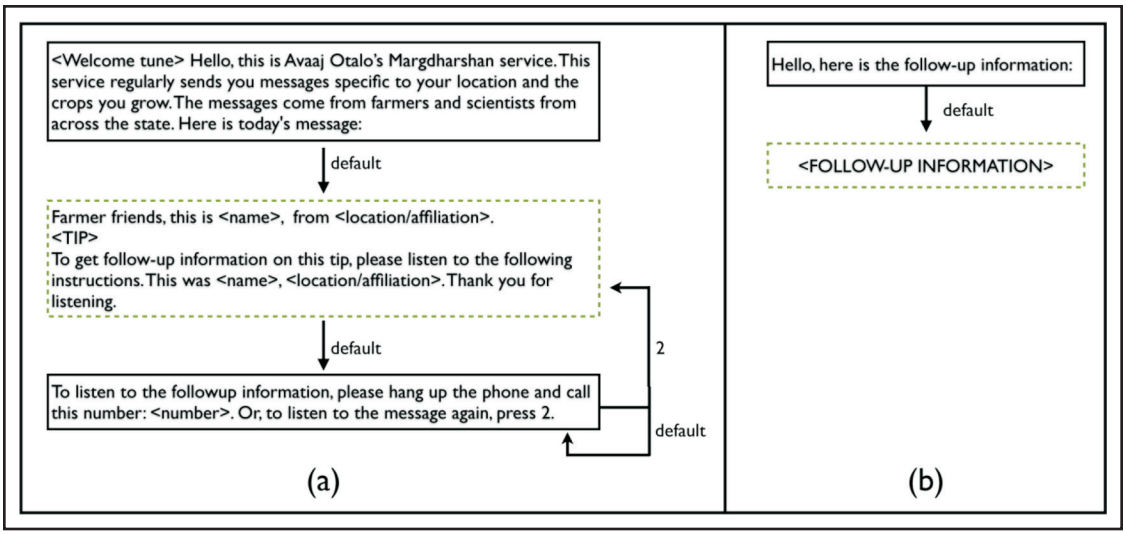

Figure 2. The prompt flows for the inbound tip (a) and outbound follow-up information (b) phone calls. The solid boxes contain prompts spoken by a voice representing the AO Margdharshan Seva tip service. The dotted boxes are the voices of either the peer or authority source. The voice on a tip would be the same voice heard on the corresponding follow-up call.

tips were delivered over a two-week period according to the assigned tip schedules.

3. Results

Of 1,883 total attempts to contact the 277 participants, 1,316 (70%) calls were successful, with the person who picked up listening to the full tip preview and instructions at least one time through. Of 667 successful calls from a peer farmer source, 72 (10.8%) resulted in a follow-up. For the scientist-recorded tips, 53 of 649 (8.2%) successful calls resulted in a follow-up. We analyzed the data using logistic hierarchical linear models (HLMs), treating tip calls as nested within participants. This analysis accounts for dependencies in response likelihood within each farmer, since some farmers might be more likely to respond to any given tip than other farmers. At the same time, this analysis approach assessed the impact of the experimental manipulation on response likelihood (Raudenbush & Bryk, 2001). A dummy variable indicating whether participants called back in response to the tip was the trial-level dependent measure; the source of the message was the trial-level predictor variable. There was a significant effect of source, indicating that farmers were significantly more likely to call back after hearing a message from a peer than from a scientist (log odds = 0.47, odds ratio = 0.64, $z = 2.08$, $p < 0.05$; see Figure 3). Follow-up logistic HLMs confirmed that the two peers elicited a similar rate of response (log odds = –0.10, odds ratio = 0.90, $z = 0.35$, $p = 0.73$), as did the two scientists (log odds = 0.34, odds ratio = 1.40, $z = 1.04$, $p = 0.30$).

3.1 Follow-Ups by Age, Farm Size, and Education

Logistic HLMs showed that participants' ages did not predict their likelihood of calling back, nor did age influence the difference between response rates in the peer and expert conditions. The size of the participants' farmland also did not predict their likelihood of calling back, nor did it influence the difference between response rates in the peer and scientist conditions. Farmers with more education (eighth-grade education or higher) were significantly more likely to call back in response to the tip (log odds = 0.122, odds ratio = 1.13, $z = 2.26$, $p < 0.05$), and they were marginally more responsive to peers than to scientists (log odds = –0.115, odds ratio = 0.89, $z = 1.75$, $p = 0.080$). To explore this interaction further, we split the data by median education and found that, whereas farmers with less than eight years of education were equally likely to respond to peers and scientists, farmers with more education were significantly more likely to

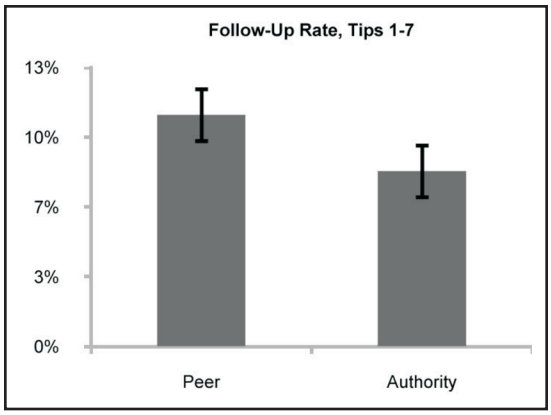

Figure 3. Aggregate follow-up rates by source for all tips.

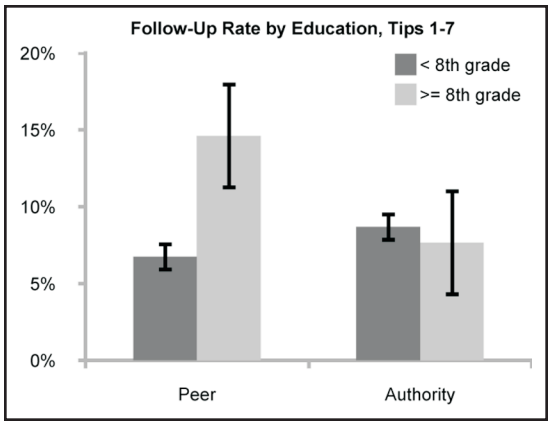

Figure 4. Follow-up rates for each source, split by level of education. Better educated participants followed up significantly more when the tips came from peers.

respond to peers than to scientists (log odds = –0.99, odds ratio = 0.37, z = 3.32, p = 0.001; see Figure 4).

3.2 Post-Study Interviews

Starting one week from the end of the study, 34 randomly selected participants, including both callers and noncallers, were interviewed over the phone using a semistructured protocol. The interview was conducted in Gujarati by a native speaker. At two points in this protocol, participants were asked to state whether they preferred to receive information from scientists or from peers. Of the responses, 42% explicitly stated a preference for scientists, 19% stated a preference for farmers, and 39% said that either they had no preference, or that both were preferable. On the other hand, 26% of interviewees were able to recall some detail about the identity of at least one of the farmer sources (such as name or where they were from), compared to only a 13% recollection rate for the scientist sources. The sample was too small for these differences to be significant.

Those in favor of farmer information cited their practical knowledge and ability to speak from experience. Take one response, for example:

> I usually go by my experience and when farmers talk about their experiences I like that better. We have spent most our lives farming so naturally I would like information from farmers.
>
> Advice from farmers is important, as they have local information. Different areas have different crops, so local experience is important. Scientists have to discover or invent new things in order to give advice. Farmers have experiences every 10–15 days which they can talk about. Scientists take longer to do their experiments and get their results.
>
> [I prefer information from] farmers, because they are experienced. I can give you any information because I am experienced. . . . [W]ithout experience, how can I give you advice? This is farming, anything can happen, whether it rains or floods is in the hands of God. Such situations can only be handled by an experienced person.

Several respondents said they preferred information from peer farmers, because they spoke in a more understandable language (despite the tips being provided in the same language for both). Take another interviewee's response, for example:

> Information given out by farmers is more clear. Scientists will not be able to explain clearly like ordinary farmers. Farmers talk in our language.
>
> When farmers give the message I feel that I can understand, but when scientists speak it is difficult as they speak differently. I like the farmers as they talk in a simple language. Maybe the information from the scientists is better, but I can't understand their high-level language, so what's the point of listening to them?

At the same time, farmers appreciated that the information coming from scientists was backed by the latest facts and more rigorous experiments. One respondent had this to say on that account:

> I trust scientists and authorized people more, as they are dependable. Farmers do trial and error, which is not very dependable.
>
> I think scientists give better information. These

days agriculture and farming have become a very scientific process.

A notable number of interviewees found information from both sources to be valuable. These participants added how the theoretical knowledge of scientists and practical, experience-based knowledge of farmers were complementary. One interviewee offered the following on that point:

> Both [provide good information], as scientists give information which they get from their lab experiments and farmers speak of their actual experience.
>
> [I value] both, as a farmer is also a type of scientist, as he has real life experiences.
>
> I would prefer messages from those people who have tried it and done things practically. Scientists conduct experiments and get results, and farmers also have actual experiences. So information from both of them will prove to be useful.

3.3 Enthusiasm for the Service

Interviews also provided other feedback about what participants liked and did not like about the service, whether the tips were useful, and any other issues or concerns they faced. The service was generally received enthusiastically, with many reporting that the quality and practical usefulness of information provided was its best aspect. One interviewee added the following:

> The information is very useful and was delivered in a timely manner. Animal rearing information was especially useful. When I got the first call I thought the service wouldn't be [very] useful, but I changed my opinion as more information came through the subsequent calls.

For one illiterate participant, the service was useful enough to go to significant lengths to keep track of the various callback numbers:

> Yes, I had no problems listening to the message. In fact I have been waiting eagerly for these phone calls for many days. The service seems to have stopped since few days, why is that? I used to write the number on the phone and ask someone to type in the numbers as I am illiterate and cannot recognize letters. I sometimes assign a character to every phone number so that I recognize that it is from that particular person. In fact I saved [AO's] number that way when you had called me previously, so this time when you called I knew it was you. I store very few numbers so this system works.

The most common complaint from participants was that the full informational message was not provided in a single call, requiring them to use airtime for the follow-up call. One interviewee shared his perspective:

> The information in the message is not complete, and we have to call the number which we get charged for. I have made several calls, and I have lost 50 to 60 rupees' credit in getting this information.

Many interviewees (44%) mentioned that the cost of the outbound phone call factored into their decision to follow up. Several participants reported that they wanted to call back, but were either concerned about their airtime balance or didn't keep any balance at all, using their phone only for inbound calls. Few reported difficulty in recording the callback phone numbers, which was done either with pen and paper, or by entering the number directly on the phone.

Some callers not included in the original recruitment also called the follow-up numbers (these callers are not included in the data analysis). These farmers had gotten the numbers from a friend or relative who was a participant. Interviews also revealed that participants were using call-recording capabilities built into their phones to store the tips, later replaying the tips for friends, family, or themselves.

The enthusiastic response to AO Margdharshan Seva prompted DSC to retain it as a regular service after the study, with tips recorded mostly by staff members and farmers who are permitted to record responses.

4. Discussion

This study's main finding is that the information source did, indeed, matter for farmers, albeit not in the expected manner. Farmers followed up significantly more frequently when presented the same information by peer farmers compared to authorities. In this section, we discuss our results and provide some explanations for the discrepancy between the farmers' behavior and their stated preferences as collected from interviews.

4.1 Authorities in Word, Not in Deed

Farmer responses during the interviews may have reflected some social desirability bias (Fisher, 1993). Farmers may have been answering based on what

they believed to be the most socially acceptable answer or that which reflected most positively on them. There also could have been a response bias—answering questions based on what the interviewee thought the interviewer wanted to hear (Paulhus, 1991). Subjects likely viewed the researchers, who were conducting the interviews, as scientific authorities, as well. On the other hand, the decision to follow up on a tip was made without social sanctioning from authorities. Researchers have noted that social norms are situationally activated, particularly those injunctive norms that guide behavior based on how one thinks others perceive their actions (Cialdini, Reno, & Kallgren, 1990).

4.2 The Power of Peers

Agricultural extension programs in India focus on training agricultural scientists from universities to disseminate technologies and practices. This experiment showed that farmers followed up on information provided by peers more than on the same information when it came from scientists. This study corroborates prior work (Gandhi et al., 2007; Patel et al., 2010) suggesting that farmers should be more deeply integrated into the knowledge diffusion process for effective knowledge transfer in agriculture. A common sentiment expressed during interviews was that experience-based knowledge from other farmers is a necessary complement to the hard evidence-based recommendations of scientists. In recent years, the Indian government has experimented with more participatory approaches to extension, including working through local farmer groups and NGOs, and even enlisting local government *(panchayat)* officers as para-extension workers (Sulaiman, 2003).

While farmers commonly exchange advice informally with friends and neighbors (Birner & Anderson, 2007), word-of-mouth can lead to misinformation. Relying on one's immediate friends, relatives, and acquaintances limits the potential quality and breadth of information that can be obtained. We have directly observed farmers unacquainted with knowledgeable and innovative farmers living just a few kilometers away, often farming the same crop. This study shows that receiving information from peers can have higher demand than receiving the same information from scientists. Combining crowdsourced ratings and moderation to these rich peer-to-peer exchanges represents a "best of both worlds" scenario, ensuring quality while maintaining consistency, scale, diversity, and breadth.

Most ICT4D projects are coordinated with local partners embedded in the target communities. It is common for ICT4D researchers to defer to the expertise of these local partners, particularly in matters related to local practices or culture. Throughout our partnership, DSC relied on its well-trained staff, whom it trusted to answer questions and provide content for Avaaj Otalo. While this approach has been successful in providing a useful, efficient service to farmers, our results indicate that, together, we may have underestimated the demand for peer information exchange. We are working with DSC to design ways for farmers to participate more effectively in responding to questions and content. This includes providing incentives and recognition, and lowering the costs and other barriers for farmers to participate.

4.3 Did the Tip Content Inherently Favor a Source?

If the tips' content or linguistic structures were not believable for the speaker, then a participant may have been motivated to call out of curiosity or incredulity ("Does this farmer know what he's talking about?"). There was no evidence in the post-study interviews that the credulity of the tips' sources was in doubt. As an additional check, the tip content was independently rated by 20 Gujarati readers on Amazon's Mechanical Turk.[2] The Turkers were presented with each tip's introduction in Gujarati script. The task first asked for a summary of the tip as a check to ensure it was understood and the Turkers were putting sufficient effort into the task. The Turkers were then asked to answer two questions for each tip:

1. Who is most likely to have given this tip: a scientist or a farmer?
2. Who is more appropriate to provide the resolution information to this tip: a scientist or a farmer?

For each question, seven options were given. The first option was, "A farmer is very likely/very much more appropriate to give this tip/resolution." The seventh option was, "A scientist was very likely/very

2. See mturk.com

much more appropriate." The intermediate options substituted "moderately," "slightly," and "equally" as descriptors for likelihood and appropriateness. For the 15 surveys that provided correct summaries for the tips, no significant deviation was observed for either question when t-tests were applied comparing the mean and variance to the midpoint of the scale. We caution that these results are only suggestive, given the small sample size and ambiguity about how qualified the participants were to judge the content.

4.4 Limitations of the Study

A future study will investigate what aspects of peer-sourced information yielded a higher follow-up rate. Farmers may have been more attracted by the familiarity of the accent, the novelty of the source, or some sense of camaraderie with fellow farmers. Participants may have been curious to hear advice from a farmer that they typically would receive from an outside expert.

Participants may also have been unclear about what would happen in the follow-up call, especially the first time they decided to follow up. The initial call did not explicitly state that the follow-up call would deliver the conclusion, and that it would be another recorded message. Participants may have called back with the expectation that the tip would be delivered by a different person, or perhaps that they would speak with a live person. On the other hand, these uncertainties would have been resolved for any farmer who called back the first time. In post-study interviews, no participant indicated that such a confusion existed at any time, which was asked explicitly in several interviews. Still, the overall follow-up rate was also low (9.5%), perhaps reflecting farmers' frustration in having to pay to access a service that was originally advertised as toll-free.

To avoid disclosure of the design in advance of the experiment, study participants were invited to opt into a trial of a new information service, rather than a research study. After the study, DSC sent all participants a booklet with the full content of all the tips, along with supplemental articles and DVDs, as a thank-you gift. DSC had used scripted content in other media projects without explicitly disclosing this scripting to people; this study elected to do the same. The design was approved through a standard university IRB (institutional review board) process. However, it is important to note that the researchers considered the steps taken above to be appropriate, given the beneficial nature of the content and the tips provided, and given our experience working with the partner organization and participant community. Using subjective judgment for a study's appropriateness relieves some of the incompatibilities between the nature of ICT4D research and the IRB process (Sterling & Rangaswamy, 2010). However, going this route puts the onus on researchers to vet their choices with local partners to employ ethically appropriate procedures.

Future research is required to generalize these results, as the Gujarati farmers may not be representative of all farmers. In particular, their perceptions of authorities and their willingness to seek information may differ from other farmers in India. These specific farmers, who were all connected to DSC in some manner as early adopters of Avaaj Otalo, may not even be representative of farmers in Gujarat. The way in which users interact with the message board is also likely to change and evolve over time, reflecting their experiences and learnings within and outside the system.

5. Conclusion

This article presents a controlled experiment testing the influence of authority on agricultural information dissemination to rural Indian farmers via a voice-based phone information service. Contrary to stated preferences, farmers followed up significantly more to agricultural tips when they were delivered by peer farmers, as compared to when the same information was presented by agricultural scientists. This result demonstrates that there is a significant unmet demand for high-quality peer-provided information for farmers in rural India, and that in some sense, this demand is greater than that for information from established authorities. ■

Acknowledgments

The authors thank Development Support Centre, Jigar Patel, and Hiral Shah for their assistance in developing and implementing this research. This research was funded by Nokia Research and the National Science Foundation under Grant No. IIS-1054332. This is a revised version of an earlier article that appeared in the *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development.*

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