Investigating the Appropriateness of Social Network Question Asking as a Resource for Blind Users

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ABSTRACT
Recent work has shown the potential of having remote humans answer visual questions that blind users have. On the surface social networking sites (SNSs) offer an attractive free source of human-powered answers that can be personalized to the user. In this paper, we explore the potential of blind users asking visual questions to their social networks. We present the first formal study of how blind people use social networking sites via a survey of 191 blind adults. We also explore whether blind users find SNSs an appropriate venue for Q&A through a log analysis of questions asked using VizWiz Social, an iPhone app with over 5,000 users, which lets blind users ask questions to either the crowd or friends. We then report findings of a field experiment with 23 blind VizWiz Social users, which explored question asking on VizWiz Social in the presence of monetary costs for non-social sources. We find that blind people have a large presence on social networking sites, but do not see them as an appropriate venue for asking questions due to high perceived social costs.

Author Keywords
Social networks; Q&A; blind users; visual impairment; friendsourcing.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Popular social networking sites (SNSs) like Facebook and Twitter allow users to post short status messages and to view and reply to their contacts' posts. Such services are extremely popular – a February 2012 survey found that 66% of online American adults use SNSs [10]. While the use of social networks by some populations with disabilities has been studied (e.g., the autism community [8, 17]), the use of social networking tools by blind people has been largely ignored in the academic literature.

SNSs are used not only as forums for socializing, but also as a venue for information seeking, such as by posting a question in one's status update in order to receive high-quality, personalized, and trusted responses from friends [22, 23, 31]. The use of social network contacts to accomplish productivity tasks such as Q&A is sometimes referred to as *friendsourcing* [5] (in contrast to *crowdsourcing*, in which strangers such as those on Amazon's Mechanical Turk service accomplish tasks in exchange for pay).

Blind people often recruit assistance from their family and friends in order to overcome accessibility problems in the physical world. Some call their contacts to look up information for them while away from home, while others prefer to run errands outside the house only if a sighted companion can join them [19]. Since blind people already rely on family or friends for information access, making their entire social network available to them while mobile may increase their feelings of independence and security outside of their homes [1].

We hypothesize that friendsourced Q&A has the potential to offer significant benefits to blind users, as this demographic often encounters questions about their environment that they are unable to answer when not in the presence of a sighted companion. For example, blind users found great value in the original VizWiz application [6], which allowed users to send photographs with accompanying audio questions from their smartphones to Mechanical Turk and receive speedy answers. They asked questions like "What denomination is this bill?" and "What kind of drink does this can hold?".

Friendsourcing, rather than crowdsourcing, might improve upon the VizWiz experience by removing the financial cost of the service (which is currently absorbed by our organization) and by improving the quality and trustworthiness of the answers received [23]. Friends may be better able to answer questions because they know the question asker. For instance, fashion questions may be best answered by those who know the user's style. Answerers who frequent the same locations as the user might be able to draw on outside knowledge in constructing an answer. Another potential advantage of friendsourcing is that users can get social value in addition to informational value from their Q&A exchange [22, 23]. But, asking friends can also have drawbacks. Users may appear or feel less independent.

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Imagine, for instance, a blind user asking friends who a letter is from, only to discover it is from an embarrassing source such as a debt collector or medical professional. Users may also create real or perceived social debts; they may not want to feel like a burden or for their friends to feel pressured to answer.

In this paper, we explore the potential of social networking sites as a mechanism for answering visual questions for blind users. The goal of this paper is to better understand the appropriateness of social network question asking for blind people, which may differ from the general population due to such reasons as blind users' increased need for the information, heightened awareness of privacy, and wanting not to appear needy or dependent on others.

We first present survey results on the use of social networks by 191 blind adults and their current practices and attitudes regarding social network Q&A. We then introduce VizWiz Social, a publicly available iPhone app with over 5,000 users, which enables blind users to send photographs and accompanying audio questions to either crowdsourced or friendsourced services. We add to our insights on blind users' attitudes toward friendsourcing through a log analysis of questions asked with VizWiz Social, and through a field experiment with 23 blind VizWiz Social users that varied the pricing of crowdsourced answers on VizWiz Social.

Our results indicate that blind users have a large presence on social networking sites (particularly Twitter). However, despite the availability of personalized answers from friendsourcing and the reduced cost in comparison to crowdsourcing, blind people are extremely reluctant to post questions to their social networks due to high perceived social costs. Their smaller-than-average network sizes may also reduce the quality of their SNS Q&A experiences, further biasing them against viewing their online social networks as an information source.

RELATED WORK

In this section, we discuss related work on the use of social networks by people with disabilities, the original VizWiz application, social network Q&A, and social costs associated with SNS use.

Social Networking and Disabilities

Online social forums like SNSs can be particularly valuable to people with disabilities. For example, the site PatientsLikeMe [patientslikeme.com] enables members to establish connections with others sharing similar medical diagnoses, providing a space for both social/emotional support and information-sharing regarding treatment options, medications, etc. The ASL-STEM Forum [11] is a social network for deaf students, designed to promote a shared awareness of invented sign language representations of scientific and mathematical terminology encountered in advanced courses. Burke et al. [8] identified opportunities and challenges associated with SNS use for adults on the autism spectrum. The SocialMirror [17] is part of a social networking tool for young adults with autism and their caregivers, designed as a safe space to practice life skills.

The World Health Organization estimates that 285 million people are visually impaired, 39 million of whom are blind [37]. Relatively little is known about how blind users interact with mainstream social networking technologies. A few social networking sites specifically for blind users exist, most notably Inclusive Planet [inclusiveplanet.com], but in general blind people use the same SNSs as everyone else. An informal 2009 poll of 62 blind people [2] by the American Foundation for the Blind found that about a half used Facebook, a third used Twitter, and a quarter used LinkedIn and MySpace. In a 2010 study, Wentz and Lazar [35] found that Facebook's web site was more difficult for blind users to navigate than Facebook's mobile phone application. The accessibility of various SNSs may impact frequency of use, and some interfaces specifically designed to be more accessible exist for specific sites, e.g. EasyChirp for Twitter [easychirp.com].

In this paper, we add to the knowledge of social networking use by people with disabilities by presenting findings from the first formal survey on blind users' social networking habits, as well as presenting log and experimental data that illustrate how blind users use social networks for Q&A.

VizWiz

VizWiz is a mobile phone application for blind users that allows them to take a picture of their environment, record an audio question about something in the picture, and then have answers read aloud by the phone's screen-reading software [6]. In a pilot study of the application, answers were collected from members of the Amazon Mechanical Turk service [mturk.com]. Mechanical Turk is an online marketplace of Human Intelligence Tasks (HITs) that workers can complete for small amounts of money. Answers took about two-and-a-half minutes to arrive.

Though answers were received quickly and members of the original pilot study found the service useful, there were some drawbacks to the initial design. The VizWiz team spent seven cents for each answer from Mechanical Turk. While this cost was not prohibitive for individual questions, it could add up with frequent use. More importantly, the Mechanical Turk workers were different for almost every question, so no contextual information from previous questions was used to answer new questions, and the workers did not know anything about the question-asker that could allow their responses to be customized to a specific user's needs.

In response to these concerns, we developed VizWiz Social, an iPhone application that allows blind people to choose where their questions should be sent – options include both crowdsourcing (Mechanical Turk, IQ Engines) and friendsourcing (using Twitter, Facebook, or email), or a combination of the two. In this paper, we report on differential use of these crowd- and friend-based options to understand the utility of social network Q&A for the blind.

The original paper describing VizWiz [6] only had a small test deployment with 11 users. In contrast, VizWiz Social has been deployed on the iTunes store for over a year, and we report large-scale and long-term log data from the users to provide insight into ecologically valid use.

Social Network Question Asking

66% of online American adults used social networking sites as of February 2012 [10]. Such sites are commonly used for their namesake purpose of socializing [28], although recent research indicates that many people turn to their social network as a way to "friendsource" [5] their information needs through the practice of social network Q&A, in which users post a question in their social network status update and receive replies from their network contacts.

Morris et al. [22] conducted a survey of Microsoft employees' use of Facebook and Twitter for Q&A, finding that half of respondents had used their status messages to ask questions of their friends. A classification of a sample of questions asked found that subjective questions seeking recommendations and opinions were quite common (51% of questions), followed by those seeking factual knowledge (17% of questions). Answers received from social networks are typically personalized and highly trusted [23]. Social network Q&A is more effective when the asker and answerer know each other well [24, 25], and when the asker has a large network [23, 30]. The practice of social network Q&A appears to extend to a variety of networks, including Facebook [20, 22, 25], Twitter [13, 26], Google+ and LinkedIn [21], enterprise networks [31], and sites popular in Asian countries (e.g., Weibo) [38]. Lampe et al. found that users are more likely to engage in information-seeking on Facebook if they are younger and have larger network sizes [20].

Due to their inability to process information visually, blind users often have an unmet need for Q&A with regard to explicating such visual content [6]; this paper explores whether social network Q&A might be a viable option to fulfill this need. While the aforementioned prior work has studied the use of social networking sites for question-asking by general populations, we explore the new concerns, challenges, and use cases that arise when blind users engage in social network question asking. Though the field experiment performed dealt with photograph-based Q&A, our survey of blind people's use of social networks for Q&A did not specify the type of Q&A that would be performed, so we could compare the results to general perceptions of social network Q&A.

Social Costs

Bonding social capital represents the benefits of the emotional support and companionship from close relationships with family and friends, while bridging social capital refers to the benefits of new information or opportunities that can be provided by a diverse group of acquaintances [7]. Burke et al. found that higher engagement on Facebook was associated with increased bonding social capital and greater overall well-being [9], and that users with higher frequencies of direct communication with specific individuals also had higher bridging social capital [7]. However, these benefits came primarily from directed communication, and there was no effect of broadcasted communication such as Facebook statuses on bridging social capital. Burke et al.'s studies did not address the impact of asking or answering status message questions on social capital. Lampe et al. [20] found that users with more bridging social capital were more likely to seek information using Facebook.

Previous psychology research has found that people might not always be willing to ask members of their social network for help, due to the psychological costs that can arise for both the asker and person asked. People can be reluctant to ask for help if it will incur costs to the person asked or to the asker themselves, or if they think the question they have should be easy to solve [12]. The person asked may develop a lesser opinion of the asker after helping them with their question [36]. These costs may discourage the use of social networks for question-asking, as the questions will be seen by all the users' friends and contacts and the user may feel that they are being judged.

Morris et al. found that users were reluctant to post revisions to their questions on Facebook, due to concerns about spamming friends' news feeds with too many posts [23]. However, a study by André et al. [3] found that tweets asking questions of one's followers were among the types of content that readers found more interesting, suggesting that users' perceptions of the social costs of status message Q&A may not align with those of their networks.

The "norm of reciprocity" may also influence users' likelihood of engaging in social network Q&A, as social scientists have found that people are averse to "over benefiting" from social interactions [32]; this may translate into limiting the number of questions asked to network connections.

These prior investigations of the social costs and benefits of SNS technologies motivated our investigation of the perceived social costs of question asking by blind users of SNSs. Because of their disability, blind users may have less opportunity to build social capital (e.g., by reciprocating in Q&A exchanges), and may be more acutely aware of social costs, and more likely to try to avoid them.

SURVEY OF SOCIAL NETWORK USE BY THE BLIND

In order to learn more about blind people's use of SNSs and their impression of such sites as a potential source of information, we conducted a survey of blind internet users. We created an accessible online survey, which was available for a three-week period in January-February 2012. We advertised the survey via email to North American organizations for the blind (e.g., the National Federation of the Blind, the American Foundation for the Blind, the Canadian Council of the Blind), and raffled a gift card as an incentive. Our recruiting e-mail requested people not share

frequency (Facebook)	log in (read content)	status update	ask a question
several times / day	28.9%	5.9%	2.0%
once / day	28.9%	19.1%	1.3%
weekly	23.0%	27.0%	8.6%
monthly	7.2%	12.5%	10.5%
less than once / month	11.8%	35.5%	77.6%

Table 1. The frequency with which the 152 blind adults with Facebook accounts in our survey sample engaged in various behaviors on that network. Q&A is relatively rare.

frequency (Twitter)	log in (read content)	tweet	ask a question
several times / day	41.4%	25.3%	3.0%
once / day	8.1%	13.1%	9.1%
weekly	12.1%	12.1%	14.1%
monthly	8.1%	9.1%	13.1%
less than once / month	30.3%	40.4%	60.6%

Table 2. The frequency with which the 99 blind adults with Twitter accounts in our survey sample engaged in various behaviors on that network. Q&A is relatively infrequent, though it is more common on Twitter than on Facebook for this demographic.

the survey link through social media (so that our survey sample wouldn't be biased toward social media users).

203 people completed the survey; however, 12 self-reported that they did not consider themselves blind (perhaps identifying with other impairments such as low vision), so their results were discarded. Our analysis includes only the 191 surveys from blind respondents.

Respondents were generally experienced internet users (73% reported using the internet for 10 years or more, and only one reported having less than a year of internet experience). 56% of respondents were female. 19.3% were under age 30, 36.7% were aged 30 – 49, and 44% were 50 or older. The age distribution of our sample likely reflects that fact that many people lose their vision as they age. Note that this means our sample is older than the typical SNS user – a 2012 Pew survey found that 86% of those under 30 had SNS accounts, decreasing to 72% of those age 30 – 49, and down to 50% of those age 50 – 64 [10].

General Use of Social Networking Sites

The use of social networking sites was quite common among our blind respondents – 92% reported using one or more social networking sites. This is an extremely high adoption rate; for comparison, a February 2012 Pew survey found that 66% of online U.S. adults used social networking sites [10], and the proportion decreased with age, which makes this high rate of adoption particularly surprising given the older age skew of our sample. The SNS use rate in our sample is significantly higher than the proportions predicted by the Pew finding, $\chi^2(1, N=191) = 55.88$, $p < .001$ (the adoption rate of SNS in each age bracket is also significantly higher than the Pew proportions, at the $p < .001$ level).

The highest participation was on Facebook (80%) and Twitter (52%). Other, less-frequently-used SNSs included LinkedIn (40%), Google Plus (15%), MySpace (4%), Yammer (3%), Inclusive Planet (3%), and Orkut (1%). Since 85% of respondents used at least one of Facebook or Twitter, we focus the rest of our analysis on their use of those two sites. The high penetration of Twitter, at 52% of our respondents, was surprising, since Twitter is much less popular in the general population (15% of online adults had accounts as of February 2012 [29]); this likely reflects the accessibility of Twitter's simple, text-based interface.

Respondents with Facebook accounts used them actively. 81% reported logging in at least once per week. However, respondents seem to tend towards "lurking" rather than posting; only 52% reported posting a status message at least once per week. 62% of the Twitter users reported logging in at least once per week, while only 51% authored tweets with that frequency. Tables 1 and 2 provide more detail about the frequency of various actions by blind account-holders on Facebook and Twitter.

Network size seems to be smaller than average. Blind Facebook users' median network size was 100, whereas a recent Pew survey found that median network size was 111 [16], and Facebook's own statistics page recently reported a figure of 130 [14]. On Twitter, our sample of blind account-holders reported having a median of 45 followers; finding accurate comparison numbers for the general population has been difficult - a 2009 article reported that users have 126 followers on average [4], though it is not clear whether this average is a median or mean.

Network composition varied between the two services. Those with Facebook accounts reported having networks comprised primarily of friends and family (72%), followed by colleagues (24%). In contrast, only 32% of the Twitter users reported having networks composed primarily of friends and family, and 27% had networks comprised mostly of colleagues; instead, 42% of the Twitter users in our sample reported that the majority of their followers were people they had met on Twitter itself. A Wilcoxon test was used to evaluate whether reported network composition differed significantly between the two services; the proportion of networks comprised mostly of colleagues was similar, whereas Facebook had a higher proportion of

networks comprised primarily of family and friends ($z = -4.37$, $p < .001$) and Twitter had a higher proportion of networks comprised of contacts met on the service itself ($z = -5.11$, $p < .001$).

Social Network Q&A

In addition to asking respondents about their general use of social networking sites, we also asked about their current practices regarding using such sites to ask questions of their online social networks. When asked about SNS Q&A in general ("Do you think questioning on a social network site is an effective way to get answers?"), only 55% of respondents answered positively, indicating that they perceived this approach could be either "very" or "somewhat" effective (on a five-point Likert scale ranging from very effective to very ineffective). Our questions did not specify any particular method of Q&A (eg. textual or image-based).

Status message Q&A ("How frequently do you post questions in your [statuses on Facebook/tweets on Twitter]?") was relatively infrequent, particularly on Facebook, where only 12% of account-holders reported asking questions at least once per week (Table 1). In contrast, 26% of Twitter users reported asking questions at least once per week (Table 2). A Wilcoxon test (used due to the non-parametric nature of Likert scale responses) found that the reported differences in the frequency of posting questions to these two networks was significantly different ($z = -2.16$, $p = .03$). As a point of reference, a recent survey of sighted users status message Q&A habits [21] found that a similar proportion of Facebook users (15.4% compared with 12% in this survey) asked questions at least once per week, but only 9.5% of Twitter users did so with similar frequency (as compared with 26% in our survey).

Of those who asked questions on Facebook, only 34% reported that many or all of their questions received answers; this number was 33% for the Twitter users. This appears to be a low response rate in comparison to other studies – for example, Morris et al. reported that over 90% or those posting a question to Facebook or Twitter received answers [22], while a controlled experiment by Teevan et al. [30] found that over 75% of questions posted on Facebook received answers. (Paul et al. [26] reported a response rate of 18.7% in a study of questions on Twitter, but that study included a high proportion of rhetorical questions, which presumably would not elicit an answer, and may account for the low answer rate they found.)

On a five-point Likert scale ranging from "very comfortable" to "very uncomfortable," only 37% of the Facebook users reported feeling "very" or "somewhat" comfortable with posting questions to Facebook. In contrast, 54% of the Twitter users indicated a similar level of comfort with the concept of posting question tweets (though this difference was not statistically significant).

Motivations for Limiting SNS Q&A

To better understand the concerns that blind people associate with SNS Q&A, we also asked whether those with SNS accounts had ever intentionally limited the number of questions they post to such sites, and, if so, to explain why in a free-text response. 16.4% of the Facebook users and 17.0% of the Twitter users reported having actively limited the number of questions they ask in these venues. We categorized their free-text explanations of this behavior using a grounded theory approach [15] with a two-pass process; in the first pass, we developed a labeling scheme based on common themes in the responses, and in the second pass we applied a label to each response.

The most common reason for limiting Q&A for both Facebook and Twitter users was *social costs* (mentioned by 10 users and 5 users, respectively). Explanations illustrating concerns about social capital included a respondent's statement that he limited his question asking because, "my followers' time is important and I don't want to waste it on something I could figure out myself." Another noted, "People will not respond to too many questions asked at a go." A third observed, "I think it's annoying to post too many questions without also helping other tweeters along the way. Karma, reciprocity, etc."

Usability and accessibility issues were another source of question-limiting on both Facebook (7 users) and Twitter (3 users), with users stating that "Facebook is very difficult to use as a blind person," and "[it's] slower with a screen reader."

As suggested by the response to our earlier survey question about comfort levels surrounding asking personal questions on SNSs, *discomfort with public question-asking* was another theme in participants' responses (6 Facebook users and 3 Twitter users). For example, one user said, "I will only ask people who I am close to privately." Another said, "I am not sure the network is the place to post questions I can get answered by an e-mail."

Poor response rates were also discussed by 2 of the Facebook users and 1 Twitter user, who indicated they limited questions for reasons such as "lack of response from prior questions."

Three Twitter users also cited the *short format of tweets* as a deterrent to engaging in Q&A on that site, noting discouragement due to the "limited number of characters."

Discussion of Survey Results

Our survey findings represent the first formal study of the use of social networking sites by the blind. The high adoption rate of these technologies, with 92% of our 191 respondents using SNSs, is quite surprising, particularly in light of the challenges of using such sites with a screen reader [34, 35] and in light of the relatively advanced age of our audience. Perhaps the ability to interact asynchronously, at a comfortable pace, increases the appeal of SNSs to blind people (CMC theory suggests that

selective self-presentation is a benefit of asynchronous communication for general users [33]; this effect may be heightened for users with disabilities). The ability to connect with physically distant contacts may also be particularly appealing to this population, given the restricted mobility and travel challenges that can accompany blindness. The use of social networks to reach out and meet other members of the visually impaired community may be another factor driving high adoption rates – our findings regarding network composition suggest, however, that users' networks consist mostly of friends, family, and colleagues, rather than of new contacts met online.

The adoption rate of Twitter in this population was also unusually high. This may reflect the fact that Twitter's simple, text-based interface is more accessible to screen readers than the rich visual and multimedia experience of using Facebook. Twitter also fared better in blind users' perceptions as a venue for Q&A than did Facebook. This preference might also reflect fundamental accessibility issues. Another explanation may be due to the differing network compositions of our respondents on each service, combined with this demographic's concerns about social costs – since Twitter users were more likely to have networks comprised of contacts met online (as opposed to family or colleagues), they may have felt more comfortable "bothering" these weaker ties with their questions.

Overall, however, social network Q&A by blind people appears to be much less common than among more general populations [22, 26, 31, 38]. Concerns about social costs may account for some of this, as many users reported actively limiting the number of questions they asked due to such concerns. The smaller-than-average network sizes of blind users may also factor into their negative view of SNS Q&A – for example, the low reported response rates to questions asked may be due to having a smaller network, as past studies have found that network size impacts the number and speed of responses received to questions on Facebook [23, 30].

When interpreting this survey data, readers should bear in mind the inherent accuracy limits of self-report. Readers should also bear in mind that, while we have compared and contrasted our findings of blind users' SNS habits with findings from studies of SNS use by general populations, such comparisons must be interpreted critically due to the fact that demographic factors are not controlled across the different studies and due to variations in the methodologies across the studies. Additionally, it is possible that our sample of the blind community is non-representative (i.e., it is possible that people who subscribe to the mailing lists of the organizations we contacted may be more technologically savvy, better educated, or differ in some other systematic way from the "average" blind person).

Our survey provides background information about blind people's use and views of social networking sites, which provides helpful context for interpreting our findings on how they used them in practice via the VizWiz Social app.

VIZWIZ SOCIAL

We have created a variant of the VizWiz concept [6], which we call VizWiz Social. VizWiz Social was released to the public on May 31st, 2011 as a free app for the iPhone and has been installed by 5,392 people since its release. Every day, an average of 74 questions are asked by 36 users.

VizWiz Social's design is optimized for use with Apple's built-in VoiceOver screen reader technology. Using the phone's built-in camera, VizWiz Social prompts users to photograph the object about which they have a question (a challenging, but accomplishable task for the blind [18]). Users then record an audio caption that asks a question about the contents of the photo (Figures 1, 3a, 3b). Users are then prompted to select from among the available answer sources (and may choose as many as they wish) (Figure 3c). The main difference between VizWiz Social and the original VizWiz is the addition of new answer sources (crowdsourcing via "web workers" was the only answer source in the original VizWiz, whereas VizWiz Social also offers "friendsourcing" via social sources). When an answer arrives, users receive a notification, and the responses can be read via VoiceOver (Figure 3e).

There are two types of answer sources available for VizWiz Social questions: anonymous crowdsourced sources and social friendsourced sources. In the current version of VizWiz Social, all questions can be sent to any source free of charge (all financial costs, such as fees for Mechanical Turk workers, are absorbed by our organization). The response time and quality of the answers received depends on the selected source(s).

Anonymous (Crowdsourced) Sources

VizWiz Social offers two sources of crowdsourced, anonymous answers: *web workers* and *IQ Engines*.

The *web workers* source sends HITs to Mechanical Turk. Using an on-demand workforce to speed crowdsourcing [6], answers take a median of 98 seconds to arrive. However, the workers are given no contextual information about the user besides the question itself, so answers are not personalized. The VizWiz Social team pays workers five cents for each HIT answered.

The *IQ Engines* source uses a human-backed image recognition product offered by VisionIQ [iqengines.com]. If the vision algorithm cannot recognize the image, it falls back to human workers who manually identify the object. IQ Engines can recognize barcodes and commercial products quickly, but cannot answer more complex non-identification questions. The VizWiz Social team pays a monthly subscription fee to this service, which averages to about one cent per question.

Figure 1: A photograph submitted by a VizWiz Social user. The accompanying audio question was: "What color is this sleeping bag?" Answers received from Facebook included "black," and "It looks navy blue to me."

Social (Friendsourced) Sources

VizWiz Social offers three sources of friendsourced answers from a user's own social circle. Questions can be sent to a specific friend via e-mail, or can be posted to social network contacts via a Facebook or Twitter status update (Figures 1 & 2). All posting is done by the VizWiz Social service (once the user has initialized this option by providing necessary account names and passwords), and the answers are also pulled from the social network and reported back using our accessible interface, so there are no additional technical or accessibility barriers to using social networks in this way. There is no cost for access to the Facebook or Twitter APIs, so these services are free to the VizWiz team.

While the user's social network provides a free source of answers that may hold greater personal significance, response rates and speeds are dependent on the user's contacts. If a user has a small network, their question may receive few (or slow) answers. Time of day may also impact response rate and timing, such as if a question is asked while contacts are generally asleep or at work.

Types of Questions Asked

In the first year since VizWiz Social was released, over 40,000 questions have been asked. In order to learn about the scenarios prompting question-asking by VizWiz Social users, we developed a categorization scheme for the questions. We randomly sampled 500 queries (5 were excluded from analysis due to image or audio quality issues). Four researchers were provided with the resulting set of the 495 image and transcription pairs, and clustered similar queries together to create a bottom-up affinity diagram. Queries could be similar in terms of image content, question content, or both. The researchers then refined the clustered queries into 22 groups, and formed four overarching query categories to encompass all the groups. These four categories were:

Identification questions (44%), which asked for an object to be identified by name or type. Examples included "What is this?"; "What kind of pizza rolls are these?"; and "Please identify this ready-meal package."

Figure 2: The answering interface for a VizWiz user's Facebook friends. The question ("what color are these flowers?") appears embedded as a video on the friends' news feed and on the user's profile page. Responses are entered as comments on the Facebook post.

Description questions (26%), which asked for a description of a visual or physical property of an object. Examples included "Is there a picture of something? [on a piece of paper]"; "What color is this shirt?"; and "Can you please describe in detail what's on the [TV] screen?"

Reading questions (23%), which asked for text to be read from an object or electronic display. Examples included "What does this package say?"; "What's the expiration date?"; and "I need to determine the CAPTCHA code in this image."

Unanswerable questions (7%), such as when the photo did not include the information required to generate an answer.

The makeup of the questions indicates the complexity of the questions asked and the usefulness of having human workers to answer questions, since less than half of questions were simple *Identification* questions.

Use of Social Sources

The use of social sources has been somewhat limited. In the month before our user study, 702 users asked a total of 3116 queries, for an average of 4.44 questions per user in a month (median 2). Only 15% of users ever tried any social source (this drops to 10.7% if e-mail is not counted).

Of the 3116 questions from that month-long period, only 156 (5%) were sent to social sources (with 94 sent to Twitter, 47 to email, and 26 to Facebook). Only three of the questions sent to Facebook and Twitter received

answers, with a median response time of two hours and fifty-five minutes. In contrast, nearly all crowdsourced questions were answered: web workers had a 100% response rate with a median response time of 98 seconds, and IQ Engines had a 96.4% response rate with a median response time of 15 minutes, 46 seconds. There was no significant pattern in the distribution of question types (identification, description, or reading) to crowdsourced vs. social sources.

Our field experiment was designed to examine why social sources were so infrequently used, and if their value as a free source of answers to VizWiz users might increase if the true costs of crowdsourced answers were not absorbed by the VizWiz team.

VIZWIZ SOCIAL FIELD EXPERIMENT

In order to further explore the question asking behavior of blind users, we designed a field experiment. We recruited active users of VizWiz Social to participate, and placed financial restrictions on the anonymous answer sources in the service. These financial restrictions mirrored the cost of the Mechanical Turk and IQ Engine services (currently absorbed by the VizWiz team), and were implemented to see the value of each source to the users. We then examined their question-asking behaviors under these new conditions, and gave a post-study questionnaire to better understand their motivations in choosing whether to send a question to their social network or use the anonymous answer sources. A key goal of this experiment was to understand whether the low adoption of friendsourcing we observed in our log data analysis was a by-product of the artificial economics of VizWiz Social (in which the costs of crowdsourcing were absorbed by our organization rather than end users), or whether other factors were preventing blind users from successfully harnessing the benefits of friendsourcing.

Study Design

We hypothesized that the relatively low use of the social sources identified in our log analysis could be explained in part by the fact that participants did not pay the true costs associated with the anonymous answer sources (*web workers* and *IQ Engines)*. In order to see how VizWiz Social users weighed the social costs of asking questions to members of their social networks under more realistic circumstances, we associated a financial cost with sending questions to the anonymous sources.

At the beginning of the month-long study, each participant was given a balance of $25 to spend on VizWiz Social questions. To enhance the validity of the economic decision-making process, users were told that they would receive a gift card containing the unused portion of this balance at the completion of the study (in addition to a baseline participation gratuity of $10).

Users were placed into one of two conditions: the *cheap* condition, where questions sent to web workers cost five cents each and those sent to IQ Engines cost one cent each; or the *expensive* condition, where questions sent to web workers cost twenty-five cents each and those sent to IQ Engines cost five cents each (Figure 3c,d).

The costs in the cheap condition were based on the approximate costs of the current VizWiz Social service (which until this point had been paid by our organization). Users were able to send each question to as many of the available answer sources as they desired, as long as their available cash balance permitted it. $25 was chosen as the starting account balance in order to make it possible for users who relied on the service to continue to ask questions at their normal rate for the one-month study period (our most active user asks about 100 questions per month).

The study ran for one month starting in April 2012. We also compared the behavior of users in the experiment to their usage in the previous month as a control.

Recruitment

Potential participants were chosen from the set of active VizWiz Social users in the month preceding the study. Users were eligible if they had asked at least four questions in the last month. The study was limited to this set of users so that their question-asking behaviors in the experimental month could be accurately compared to their previous question-asking behaviors. We released an update to the application that identified potential participants and presented them with an invitation to join the study. If they accepted, they were randomly assigned to the cheap or expensive condition and began participating in the study immediately.

A sample size of 30 participants was chosen for the study. 207 VizWiz users had asked at least four questions in a month-long period from March to April 2012, so they were eligible to join the study. Once the recruitment period began, any of these 207 users who had installed the latest version of VizWiz would be presented with an invitation to join the study. Of those 207 users, 60 were active during the recruitment period and received the study invitation; 30 agreed to join the study (participation was not mandatory, since many people rely on VizWiz Social for daily activities, and we did not want to force a modified experience upon them). 23 of the 30 asked at least one question during the course of the month-long study (11 in the cheap condition and 12 in the expensive condition). We first present the pre-study behaviors of these 23 users, and then discuss their behaviors during the study and their responses to a post-study questionnaire.

Pre-Study User Behaviors

We analyzed the pre-study question-asking behavior of the 23 active study participants. During the month before the study, these 23 participants asked a total of 217 questions, with an average of 9.86 questions per user. Users in the cheap condition asked an average of 9.1 questions, while users in the expensive condition asked an average of 10.8.

The majority of these 23 users' questions in the pre-study period were sent to web workers (81%) and IQ Engines (93%) (note that percentages total to greater than 100% since a single question may be federated to multiple answer sources). 14% of the questions were sent to social sources, with 21 (10%) going to Facebook, 7 (3%) going to Twitter, and 2 (1%) going to email. However, the majority of the socially-directed questions were asked by two users – 20 of the 21 questions sent to Facebook were asked by the same user (cheap condition), and all 7 of the questions sent to Twitter were asked by another user (expensive condition).

In-Study User Behaviors

The 23 active study participants asked a total of 170 questions, with an average of 7.3 questions per user (stdev 7.6) during the month of the study. The 11 participants in the cheap condition asked a total of 95 questions, while the 12 in the expensive condition asked a total of 75 questions. The number of questions asked by participants dropped during the month of the study for both the cheap and expensive conditions. However, these numbers were not significantly different than the number of questions asked in the pre-study period. Users in the cheap condition asked an average of 7.8 questions, while users in the expensive condition asked an average of 6.8 questions; the difference between questions asked in each condition was not significant.

141 of the questions were sent to web workers (83%) and 76 were sent to IQ Engines (45%). 47 of the questions were sent to both web workers and IQ Engines. Only 2 of the questions, both asked by the same user (in the expensive condition), were sent to friendsourced sources (Facebook), but both were also sent to at least one crowdsourced source.

Despite the monetary incentive to send questions to SNSs, these results highlight a strong reluctance to use social networking sites for question-asking, but do not provide any insight into the reasons for the limited number of questions that were friendsourced. In order to learn more about our participants' motivations to use (or not use) crowd- and friendsourcing, we sent out a questionnaire to the active participants after the completion of the study period.

Post-Study Questionnaire

We asked participants in our field experiment to complete a questionnaire about the types of questions they did and didn't ask with VizWiz Social, the sources that they used and preferred, and general demographic information. Twelve participants completed the entire questionnaire. Seven were male and five were female. Six were aged 30-39, while four were 20-29 and two were 50-59. Almost all (83%) had used the internet for more than 10 years. 75% of were members of Facebook, with an average network size of 176.1 (median 184.5), and 67% were members of Twitter, with an average network size of 245.5 (median 102.5). Network sizes were self-reported, and may be rounded or estimates.

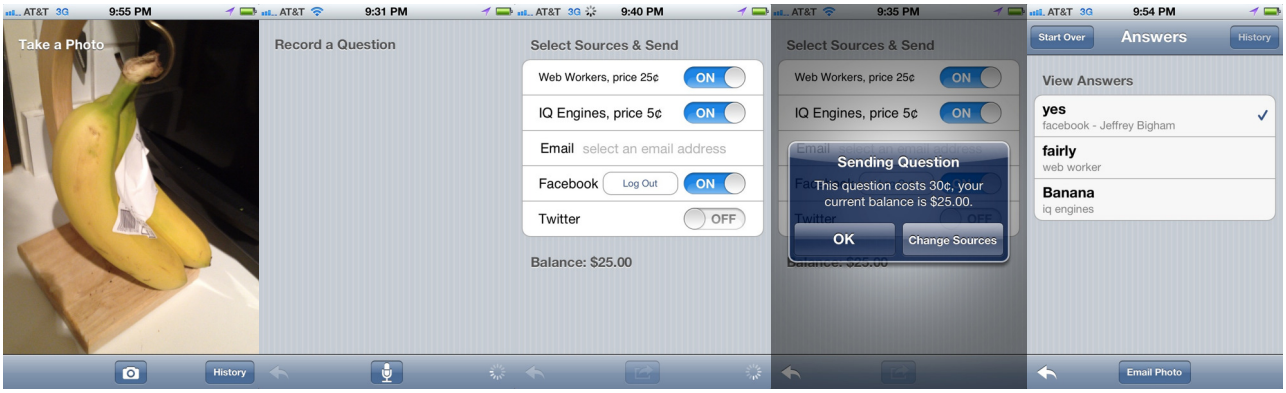
Responses

Though all of the participants in the questionnaire reported being members of at least one social networking site, most were reluctant to use the sites for question-asking.

Users reported strongly preferring the crowdsourced answer sources. When asked to choose a single preferred source, all respondents chose crowdsourced sources (with ten choosing web workers, and two choosing IQ Engines). Given a chance to elaborate via free-form text response, one participant explained that their preference for using web workers stemmed from the availability of human answers that weren't necessarily contextualized by accessibility:

"Humans are much more reliable, in my opinion, and Web workers are entirely anonymous. They might necessarily not even know that they're dealing with an accessibility application if Amazon Turkit [sic] is involved."

9 of the 12 respondents reported that they "much preferred" to send their questions to web workers, while 1 "somewhat



(a) **(b)** **(c)** **(d)** **(e)**

Figure 3: A participant in the "expensive" condition (a) takes a photograph, (b) records their question ("are these bananas ripe?"), (c) selects the sources they want to send the question to, (d) confirms the cost of the question and gets their current balance, and (e) waits for answers. All instructions and buttons can be navigated with the iPhone's built-in screen reader.

preferred" web workers over friendsourcing, and 2 had no preference. Respondents were allowed to fill in a free-form response section indicating why they preferred to ask questions via crowdsourcing over friendsourcing, and were able to give as many reasons as they wanted. The 10 respondents who preferred crowdsourcing mentioned its technical advantages, such as the speed of response (3 participants), accuracy and quality of responses (4), or the photograph-taking feedback the web workers gave when a picture was not focused on the correct object (1). The availability of web workers is important for contextual or time-sensitive questions, as mentioned by one participant:

"[I preferred web workers] because there's no guarantee that a facebook or twitter post would get you an immediate answer. When I need something identified like a can or TV Dinner I am going to use it now, not whenever my friends get around to telling me what it is. :)"

Others preferred to send their questions to crowdsourced answer sources specifically to avoid friendsourced response sources: either they wanted their questions to be anonymous (2), didn't want to broadcast the question to a large group (1), or didn't like using social networking sites in general (1). The user who had earlier preferred the web workers source overall for not drawing attention to the accessibility aspect of the questions voiced similar reasons for preferring it more than friendsourced sources:

Web-workers are completely anonymous, and there is sometimes no reason to think they are actually assisting with a disability related question.

In addition to preferring crowdsourced sources, respondents were also more likely to restrict themselves from asking questions to social sources. 8 of the 12 respondents reported choosing not to ask at least one question to friendsourced sources, while only 4 respondents reported the same for crowdsourced sources. When asked why they did not want to send questions to Facebook or Twitter, some users mentioned the social costs of asking questions on the sites. One responded,

"Not my friend's job to tell me that stuff. Plus it clutters up people's timelinesand [sic] they might not like it."

DISCUSSION

Our survey of blind users' social networking habits and attitudes, combined with our log analysis and experimental manipulations of the VizWiz Social application, provide perspectives on the potential of friendsourcing as a resource for blind users. While each of these methods (survey, log analysis, field experiment) has limitations, our intention in combining them is to create a more rich, nuanced understanding of the possibilities and challenges in harnessing the power of friendsourcing for the blind community. In addition to offering insights into this scenario, our findings also raise new questions, suggesting directions for future inquiry.

Both the survey findings and our experiences with the VizWiz Social app indicate that sending questions to Facebook and Twitter for answers is viewed as undesirable by blind people. This result is in spite of the fact that friendsourcing could be a valuable supplement to existing Q&A services for blind users that rely on crowdsourcing (e.g., [6]) by reducing costs, increasing answer quality, and offering social in addition to informational value [23].

Our finding that blind users have smaller than typical social networks may contribute to this negative attitude, as prior work has shown that answer speed and quantity are dependent on network size [23, 30]. The poor speed and response rates of social sources in VizWiz Social seems to justify this concern. Poor response speed seems particularly problematic for this audience in light of our log analysis of the type of questions asked with VizWiz Social, which suggests that most questions reflect an immediate need (e.g., an object that needs to be identified for immediate use or decision making). Smaller networks may also indicate reduced social capital [9] among this demographic, which can also reduce the likelihood of trying SNS Q&A [20].

Perceived social costs play a role, as well. Participants' comments in our survey and experiment indicated that they were reluctant to "bother" their networks with questions. A desire to appear independent, despite disability, may be heightening this concern, since disabled people understandably do not wish to give an impression of being helpless [27]. Blind users' reduced ability to reciprocate in SNS Q&A exchanges may also lead to concerns about incurring unpayable social debts; prior work shows that this concern is not be unfounded, as anticipated reciprocation is a key motivating factor in SNS Q&A [22, 38] (indeed, people are hesitant to violate norms of reciprocation in a variety of social scenarios [32]).

Our findings also suggest next steps for further exploring the potential of SNS Q&A as a resource for the blind. Interview studies could provide more nuanced understanding of the factors shaping this group's aversion to harnessing the power of their social networks. Further experimentation using the paradigm explored in our field experiment (such as by changing the costs associated with non-social answer sources or altering users' starting cash balance) could perhaps quantify the perceived social costs of Q&A in financial terms. Different technical solutions might also make this potentially valuable resource more palatable – for instance, perhaps framing requests to friends not as questions but as a competition or game would reduce their stigma, or perhaps routing questions only to a particular subset of a network (e.g., close family members) might be viewed more favorably. Exploring ways in which friendsourced answers could be produced more quickly would also be particularly important for enhancing the informational value of SNSes to the blind community, whose information needs are more immediate than the more general SNS Q&A examples discussed in prior work (e.g., [22]).

CONCLUSION

In this paper, we synthesize survey, log, and experimental data to gain insight into the suitability of social network question-asking as a tool for blind users. The contributions of this work include:

- a survey study of the general social networking habits of 191 blind adults, with a particular focus on their habits and concerns regarding social network Q&A;
- an introduction of the VizWiz Social system, a freely-available iPhone application that allows blind users to send audio-visual questions to either crowdsourced or friendsourced answer sources;
- a log analysis of the types of questions asked on VizWiz Social and the use of the social Q&A features "in the wild";
- an experimental study in which the price of crowdsourced answers was manipulated in order to see how pricing impacted blind uses' motivations to use social Q&A

Our findings indicate that despite the financial, personalization, and social benefits from friendsourced answers, the blind people who participated in our surveys and study were reluctant to use social networking sites to get answers to their questions. This seems to be due to a combination of objective challenges (e.g., inaccessible design of some social networking sites, low response rates due to small network sizes, and slow response times for real-time information needs) as well as some subjective challenges (e.g., concerns about imbalances in the potential or reciprocating, appearing overly dependent due to one's disability, and privacy).

These findings can help shape the design of future accessibility technologies that utilize social networking infrastructure. For example, blind users could trade access to each other's social networks for more private, but high quality, question-answering. Another avenue for future work is experimentation with signaling the urgency of a question, either explicitly or implicitly through careful wording, as this may be an avenue for understanding how to make SNSes more responsive to the particular types of Q&A exchanges that blind users engage in.

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