VoIP Accessibility: A Usability Study of Voice over Internet Protocol (VoIP) Systems and a Survey of VoIP Users with Vision Loss

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Structured abstract: *Introduction:* Accessibility of Voice over Internet Protocol (VoIP) systems was tested with a hands-on usability study and an online survey of VoIP users who are visually impaired. The survey examined the importance of common VoIP features, and both methods assessed difficulty in using those features. *Methods:* The usability test included four paid participants who are blind and four who have low vision. Four different tasks using four different VoIP systems (two Windows-based, two iOS-based) were presented in random order. The online survey included participants with prior VoIP experience: 50 individuals who were blind and 22 who have low vision. *Results:* Usability test participants found that receiving an incoming call was the easiest task and transferring a call was the most difficult. Those with previous iOS experience had a large advantage with the two iOS systems over those with little experience. For the online survey, most respondents (81%) had used VoIP at home for personal use and 49% had used it in their workplace. The caller ID feature was most important to participants, yet only slightly more than half found the feature easy to use; this feature was the most discrepant between importance and ease of use ($p < .01$). Call management was the most difficult feature for respondents. Generally, those with low vision found features to be more accessible than did those who are blind. *Discussion:* Almost all usability study participants reported that they could use all four systems in a real-world setting. Although some of the features were readily usable, many of the VoIP features that respondents to the online survey considered to be important were difficult for them to use. This finding indicates a serious gap between what is presently offered and what is needed for true accessibility by those with vision loss, indicating the necessity of adding accessible features to all VoIP systems. *Implications for practitioners:* Rehabilitation staff members and teachers of young adults with vision loss should become familiar with current VoIP systems and introduce them to their clients and students in order to increase their future prospects for employment.

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VoIP is a technology that allows voice communication to be delivered digitally using broadband Internet connections instead of using traditional analog telephone lines. VoIP bypasses telephone service providers and is therefore less expensive. A great advantage of VoIP is the large number of features provided that are not available through traditional telephone services. VoIP is likely to replace traditional landline telephones, as it is less expensive and the quality is better than traditional telephone lines (Cuellar, 2013).

VoIP is being used more and more by businesses and for personal use. According to McCue (2012), there are 30 million people in the United States who pay for VoIP service, and the number of VoIP users is even higher because there are free VoIP services available. The number of users is expected to increase about 15% per year. Smith (2013) reports that the United States has the largest number of VoIP users in the world (34 million). Allen (2014) reports that more than three-quarters of American businesses use VoIP telephones in at least one location, and that number has increased 42% in just five years. According to Kowalke (2013), approximately 30 percent of small and medium-sized companies were using VoIP in 2013.

VoIP systems need to be accessible to people with disabilities if they are to be sold to federal government offices due to Section 508 of the Rehabilitation Act, which requires that electronic and information technology be accessible to people with disabilities. Many individual states also require that their electronic and information technology be made accessible. Under the Communications Act of 1934 (as amended), VoIP services and equipment are expected to be accessible and usable by people with disabilities.

The American Community Survey (ACS) reports 42% employment for working-age individuals with visual disabilities compared to 78% of the general population, and fewer of those with visual disabilities are employed full-time (Cornell University, 2015). One of the factors contributing to the high unemployment rate of people with visual impairments (that is, those who are blind or have low vision) may be the inaccessibility of office equipment (Burton & Huffman, 2006). Accessible technology has been shown to increase the employment opportunities of people who have vision loss (Kelly, 2011; Kelly & Wolffe, 2012; McDonnall & Crudden, 2009).

VoIP access has been shown to be used successfully by people with vision loss. Gilson & Rongqiang (2007) reported on the successful use of VoIP by Chinese students participating in courses through the Chinese branch of the Hadley School for the Blind, and the authors found that VoIP is particularly useful for distance learning. Hodges (2008) found several VoIP systems for both work and home that were accessible to people with disabilities. The VON (Voice on the Net) Coalition (2016) reported that VoIP use helped the job performance of people with disabilities, including individuals with vision loss. The National Technical Assistance Center on Blindness and Low Vision (NTAC-BVI) (2015) suggested that hardware VoIP telephones were difficult to make accessible to people with vision loss, but that "soft phones" were a good accessibility option. A *soft phone* is a software program that runs on a computer or mobile device and emulates all

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of the features of a traditional hardware telephone, allowing the making and receiving of calls transmitted through the Internet. Similarly, Preece (2015) noted that soft phones were a good access solution, and identified accessibility problems with hardware VoIP telephones for people with vision loss, including low contrast, small font sizes, and buttons that change functionality depending on circumstances.

Although this paper provides evidence that people with visual impairments can use VoIP systems, the accessibility of VoIP systems in general was not addressed. The opportunity to use technology that is accessible leads to improvements in the lives of people with vision loss by increasing their opportunities for employment and job advancement (Kelly, 2011; Kelly & Wolffe, 2012; McDonnall & Crudden, 2009).

This paper reports on two phases of a study of VoIP systems: a study evaluating the usability for people with vision loss of four existing VoIP soft phones; and a survey of individuals with vision loss who have had experience with VoIP systems, in order to determine the importance of common VoIP features and to assess difficulty in using those features. The survey also included questions about the types of VoIP systems used, where they were used, and how accessible the associated system manuals were.

Usability study methodology

VoIP systems

Four VoIP systems were selected for the usability study, two of which were marketed as accessible. The other two were tested by investigators to ensure that it was possible for essential VoIP tasks to be accomplished without the use of sight (even though some users might have required training or extra time to successfully complete the tasks). The two soft phones marketed as accessible used a desktop Windows computer (Accessaphone, VTGO) and the other two used an iOS app (Linphone, 3CX). All four VoIP soft phones offer standard telephone functionality including call log, contacts, caller ID, and call transfer.

Accessaphone is software that runs on a PC in tandem with a standard hardware VoIP telephone, and it works with many VoIP vendors. It allows a user to control all standard telephone functionality. This software is designed to use keyboard shortcuts for efficient usage. Accessaphone costs $1,500.

VTGO-508 is a Cisco VoIP telephone emulator that runs on a PC. It includes all of the telephone features in the soft phone, and does not have a companion piece of hardware. The interface mimics how the hardware telephone actually works, but allows a screen reader to read the buttons and screen information. It also incorporates keyboard shortcuts. The software works with any system compatible with Cisco IP telephones. VTGO-508 costs $750.

The Linphone and 3CX telephone apps, both of which are free, are two examples of mainstream iOS apps that will integrate with most VoIP systems using a communications protocol called Session Initiation Protocol (SIP). On the iOS devices, the built-in screen reader VoiceOver can be used to access the features of the apps. These VoIP soft phone apps provide a dialer interface for making

VoIP calls that is similar to the built-in dialer for making calls on a cell network.

Participants

The usability study was conducted with eight paid participants ranging in age from 23 to 76 years. Participants included four women and four men, two of whom were retired and one of whom was unemployed. The occupations of the others included editor, employment specialist, nonprofit vice president, program manager, and information specialist.

Four participants were able to read print with magnification, while four could not. For the sake of simplicity, this paper will refer to these two groups as "low vision" and "blind," respectively. All but one participant had used VoIP before the usability test, so most could make use of their prior experience in assessing the VoIP systems.

On average, participants said they had moderate to fairly high confidence when using new computer technology, moderate to fairly high levels of expertise using a Windows PC with assistive technology, and moderate to fairly high expertise with VoiceOver or Zoom on the iOS platform. The two participants who were over 70 years of age had the lowest level of experience with iOS and VoiceOver or Zoom. Approval for the usability study was obtained from the institutional review board at the American Foundation for the Blind, and informed consent was obtained from participants.

Usability study procedures

Test administrators described the four VoIP soft phones to participants, and they gave a brief explanation of what the testing procedure would be. Each participant was asked to complete four tasks on each of the four VoIP systems:

- Task 1: identify an incoming caller and answer and end the call
- Task 2: find the latest caller in the call log and call them using the call log
- Task 3: place a call using the contacts list
- Task 4: transfer a call

The order of testing the systems was randomized for each participant. Individuals were told that the tasks would be timed, but that they could take as much time as they needed for each task, and that they could ask questions at any time. Two test administrators took detailed notes as they observed the user testing and assigned success ratings on a scale from 1 (lowest) to 5 (highest), where 1 indicated the participant was not successful at the task, and 5 meant he or she was successful after asking minimal questions or completing the task independently. The test administrators compared notes after each participant completed their usability test in order to make sure they agreed on their observations and that they were each rating similarly. There were no large discrepancies, although interrater reliability was not directly tested. Participants provided their own ratings for how confident they felt while completing the tasks, using a scale from 1 to 5.

Usability study results

Average overall success ratings for each of the four tasks performed were very similar to one another and ranged from 4.0 to 4.5 out of 5.0, as were the confidence ratings (3.5 to 3.9), and the number of questions asked by users (0.6 to 1.4).

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Table 1
Average ratings, duration, and number of questions asked by participants.

While performing four user tasks	Success rate	Confidence rate	Duration in seconds	Number of questions asked
Task 1: incoming call	4.3	3.9	50	0.6
Task 2: call log	4.3	3.6	96	1.0
Task 3: contact list	4.5	3.6	94	1.4
Task 4: transfer call	4.0	3.5	122	0.8
While testing four VoIP systems				
Linphone (iOS-based)	4.7	4.1	65	0.6
3CX Phone (iOS-based)	4.3	3.5	106	0.7
Accessaphone (Windows-based)	4.4	3.8	92	1.3
VTGO-508 (Windows-based)	3.8	3.2	100	1.2
By whether participant has low vision or is blind				
Low vision	4.4	3.9	97	0.3
Blind	4.1	3.4	90	1.5
For Windows-based systems by level of Windows experience				
Low Windows experience	3.9	3.0	99	1.3
High Windows experience	4.2	3.9	93	1.1
For iOS-based systems by level of iOS experience				
Low iOS experience	3.8	3.1	142	1.4
High iOS experience	4.8	4.2	59	0.2

However, the time it took to perform the tasks varied quite a bit, with the task of identifying and answering an incoming call taking an average of 50 seconds to perform, while the task of transferring a call took more than twice as long, averaging 122 seconds (see Table 1). These findings are supported by participants' comments that generally said receiving an incoming call was the easiest task, and transferring a call was the most difficult task. Call transfer could be performed by participants, but it was a more complex task that required more steps. Although the task is achievable by those with vision loss, training would make the task easier for participants, as would better design.

Average success ratings for VoIP systems across the four tasks were highest for LinPhone and lowest for VTGO-508, and confidence ratings followed a similar pattern. The number of questions asked by participants was lowest for the two iOS-based telephones. Looking at the amount of time it took to complete tasks, Linphone required the least amount of time on average, while the other iOS-based telephone took the most time (see Table 1).

Participants were asked if they thought they could use each of the four systems in a real-world setting, and virtually all participants said they could, although many qualified their affirmative response by saying they would need practice or training to do so or could do so if they did not use all of the functions. Linphone had slightly more positive overall responses to use in a real-world setting, and the VTGO-508 had the least positive. Most participants thought Accessaphone would

be the easiest to use, and that the VTGO-508 system would be the hardest to learn. When participants were asked to choose their preferred system, Accessaphone was chosen as often as Linphone (three participants each), and VTGO-508 and 3CX were each chosen by one participant.

Comparing those participants who have low vision with those who are blind, there were only small differences in the overall averages for success rate, confidence rate, and task duration. However, the number of questions asked was greater for those who are blind (see Table 1). There was a slight preference for Linphone as the favored system for those who are blind, and a slight preference for Accessaphone for those who have low vision.

Those who had experience with using a Windows PC with assistive technology had slightly less trouble performing tasks on the two Windows-based systems, based on the ratings, duration, and number of questions asked. However, those who had experience using the iOS platform with VoiceOver or Zoom had a large advantage over those without this experience (see Table 1).

Survey methodology

An online survey was developed that included nine demographic background questions and 34 questions related to VoIP use. Included was a list of 11 common features of VoIP systems, for which participants were asked to rate both ease of use and importance of each feature. Contact lists, maintained by the American Foundation for the Blind, at which the second author is employed, that were likely to include technology users with vision loss were used to e-mail individuals and invite them to participate in the survey if they had VoIP experience. An announcement was also placed in the institution's newsletter to recruit participants with VoIP experience.

Between September 2013 and January 2014, the survey was answered by 50 individuals who primarily used speech output or braille or both to read, and 22 individuals who used their remaining vision or magnification tools or both to read. For this survey, these groups will be referred to as "blind" and "low vision," respectively.

Participants

Participants in this study included 38 women and 34 men, ranging in age from 18 to 64 years, with an average age range of 35 to 44 years. Sixty-eight percent of respondents were White, 18% were Black, 6% Asian, 4% Hispanic, and 4% were other ethnicities or multiple ethnicities. The majority of respondents were visually impaired from birth (57%), and an additional 10% were visually impaired before the age of 5 years. Almost all respondents (96%) were from the United States, with the rest from Canada.

The group was highly educated, and the largest number had completed graduate school (33%), an additional 32% had completed college, 26% had some college experience or attended technical school, and only 8% had a high school education. Almost half were working full-time (44%), 21% worked part-time, and more than a third (35%) were not employed. More than a quarter of participants had a household income of less than $20,000 (27%), and only 13% had incomes over $80,000. The average income range was $20,000 to $40,000 per year. IRB

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approval for the online survey was obtained from the Institutional Review Board at the American Foundation for the Blind, and informed consent was obtained from participants.

Survey results

VoIP experience

Participants were asked how they accessed VoIP, were given several choices, and were allowed to choose more than one. The majority of respondents (71%) said they accessed VoIP through their computer. About half (49%) accessed VoIP through a smartphone; 46% through a traditional telephone connected to a VoIP adapter; and 23% through a special VoIP telephone.

Only a quarter had used the Cisco VoIP system (24%), and 35% of those individuals used Cisco's accessibility solution called Tenacity Accessaphone, for a total of only 8% of all respondents. Even fewer respondents had used the Avaya VoIP system (11%), and half of those respondents (50%) had used Avaya's accessible solution called Universal Access Phone Status (UAPS), for a total of only 6% of all respondents.

Respondents were asked to name the brand or model of the VoIP systems they had used. Vonage was the system cited most often (21%), followed by Skype (18%), Magic Jack (10%), and Cisco (8%). The vast majority of respondents (81%) had used VoIP at home for their personal use. Almost half of the respondents (49%) had used VoIP in their workplace. Thirty-two percent used VoIP for employment in their home and an additional 4% indicated that they had used it elsewhere.

Accessibility of manuals

Only about a quarter of participants (26%) reported that their VoIP system had a manual or user guide that was accessible. Respondents reported that the manual or user guide for their VoIP system was available in the following formats: HTML (29%), PDF (24%), plain text (14%), and Microsoft Word (6%). A third of the respondents (33%) said they did not know in what format their manual was available.

Importance of VoIP features

Respondents were asked to say how important they thought 11 different VoIP features were. The features were: caller ID, call transfer, call hold, call forwarding, call waiting, call log, call blocking, call management, conference call, last number dialed, and contact list or telephone book. For features that might not be obvious from their titles, a short explanation was given to respondents. For instance, for the VoIP call management feature, the survey indicated, "This feature allows you to create various rules for answering or routing incoming calls." For each feature, respondents were given a 5-point rating scale ranging from "very important" to "very unimportant."

Caller ID was the most important feature for both the blind and low vision groups (94% and 96%, respectively) (see Table 2). The next most important feature to the blind group was the contact list or telephone book (81%), although the group with low vision found this feature to be much less important. Both groups found the conference call feature to be the next most important feature (70% blind and 74% low vision). The least important features were call forwarding, call

Table 2
Percentage who responded that feature was easy to use vs. important to be able to use.

Feature	Blind		Low vision	
	Very or somewhat easy to use	Very or somewhat important to be able to use	Very or somewhat easy to use	Very or somewhat important to be able to use
Caller ID	53	94	57	96
Call transfer	42	51	61	58
Call hold	56	66	70	57
Call forwarding	48	48	38	38
Call waiting	48	61	69	68
Call log	34	68	65	65
Call blocking	50	54	36	39
Call management	16	50	30	40
Conference call	48	70	56	74
Last number dialed	42	54	58	55
Contact list or phone book	50	81	39	56

management, last number dialed, and call blocking, although this is not to say they were not important features to participants; 38% to 55% of respondents felt these four features were very or somewhat important.

Comparing the blind group to the low vision group, the largest difference in importance was for contact list or telephone book (81% versus 56%, respectively), a statistically significant finding ($p < .04$), followed by call blocking (54% versus 39%, respectively), which was not statistically significant. The former finding may be explained by respondents with low vision having more options to look up contacts without the use of the VoIP system. For the latter finding, those with low vision may not feel call blocking is as important as those who are blind because some may be able to see readouts that displayed the caller's name and can choose whether to answer or not; blind people with inaccessible call displays do not have that option, but might be able to get around it with call blocking.

Ease of use of VoIP features

The survey asked about the ease of using the 11 features discussed in the previous section. For each feature, respondents were given a 5-point rating scale ranging from "very easy" to "very difficult." Clearly, call management was the most difficult feature to use by both blind and low vision respondents (only 16% and 30%, respectively, found it easy) (see Table 2). Findings for the ease of features show that the two groups were very different from one another, which was not the case for feature importance. Those with low vision generally found features to be more usable than did those in the blind group. For the call log feature, 65% of low vision respondents felt it was very or somewhat easy to use, versus only 34% of blind respondents (statistically significant at $p < .02$.) For call waiting, the figures were 69% versus 48%, respectively, which was not statistically significant. On the other hand, there were three features that blind people found to be

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Table 3
Discrepancy between importance and ease of use.

Feature	Blind		Low vision	
	Percentage discrepancy	Statistical significance	Percentage discrepancy	Statistical significance
Caller ID	41	$p < .001$	39	$p < .008$
Call transfer	9		−3	
Call hold	10		−13	
Call forwarding	0		0	
Call waiting	13	$p < .035$	−1	
Call log	34	$p < .001$	0	
Call blocking	4		3	
Call management	34	$p < .001$	10	
Conference call	22	$p < .013$	18	
Last number dialed	12		−3	
Contact list or telephone book	31	$p < .001$	17	

Note: Blank cells indicate a lack of statistical significance.

easier to use than those with low vision: call blocking (50% versus 36%), contact list or telephone book (50% versus 39%), and call forwarding (48% versus 38%), although these differences were not large enough to be statistically significant.

The majority of features were found to be usable by less than half of the blind participants; they found the call management feature least usable by far (only 16% found it easy), followed by the call log feature (34%), call transfer (42%), and last number dialed (42%). The call hold feature was considered the easiest to use for this group, yet only 56% found it very or somewhat easy to use. Caller ID was found to be easy by 53% and contact list or telephone book by 50%.

Four features were found to be usable by only a minority of the low vision participants: call management (30%), call blocking (36%), call forwarding (38%), and contact list or telephone book (39%). The easiest features for this group were call hold (70%), call waiting (69%), and call log (65%).

Ease of use versus importance

It is important to look at the degree of discrepancy that exists between respondents' ratings of a feature's ease of use and ratings of importance. The size of these discrepancies should help manufacturers in focusing on those features that are the highest priority for making their products accessible. It is most important to make sure that the features that are important to people with visual impairments are accessible before addressing additional accessibility problems. Large differences in the direction of a feature being very important but not very usable point to the most problematic features of VoIP system accessibility. Low importance and low usability or high importance and high usability are much less problematic, as is high usability and low importance. Table 3 shows the amount of discrepancy for each feature (that is, the percentage of respondents who felt the feature was very or somewhat easy to use, subtracted from the percentage who felt it

was very or somewhat important). The lower the discrepancy, the more similarly respondents rated a feature's ease versus its importance. Negative discrepancies demonstrated higher usability with lower importance.

In general, discrepancies were lower for those who have low vision than for those who are blind because the former group found most features easier to use than did the latter group (therefore, larger numbers were being subtracted from importance, resulting in lower discrepancies). A McNemar Test for paired data was used to determine if there was a statistically significant difference between how likely participants were to say a VoIP feature was easy to use versus how likely they were to say that being able to use the feature was important (see Table 3).

Caller ID was, by far, the feature that was most discrepant between importance and ease of use (41% discrepancy for the blind group and 39% discrepancy for the low vision group), and was statistically significant ($p < .001$ and $p < .008$, respectively). This feature was considered important to approximately 95% of all respondents, yet only slightly more than half thought it was easy to use. Other statistically significant discrepancies for the blind group included call log (34%), call management (34%), contact list or telephone book (31%), conference call (22%), and call waiting (13%).

For those with low vision, the next highest discrepancy after caller ID was conference call (18%). This group had four features for which the usability was actually rated higher than importance (negative discrepancy): call hold (−13%), call transfer (−3%), last number dialed (−3%), and call waiting (−1%). This was not the case for the group of blind individuals.

Visual impairment and VoIP use

Overall, 75% of participants reported that they had at least some degree of difficulty or limitation using the features of VoIP systems because of their vision loss. Looking separately at respondents with low vision and those who are blind, only 50% of the former reported some degree of difficulty, while a full 85% of those who are blind reported having difficulty.

Asked to describe the difficulties they experienced because of their vision loss, the most common issue for those with low vision was difficulty reading text. Blind respondents mentioned many accessibility issues, including screen reader problems, not being able to access certain features, and having to memorize layouts that kept changing. Below are some sample responses from participants (the first three from the low vision group, the remainder from the blind group).

> Most of the features are not usable to me because the system we use is not accessible. However, my sighted colleagues love the system and seem to be having no problems.

> My issues are related to the text size. Large print is best for me. Good contrast is important. Sometimes, the system "times out" and this is frustrating and makes me essentially start over with my task.

> I can't read any of the caller ID information, the call logs, or directory. I have to commit the buttons to memory if I need to use a button and then learn

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how to use the buttons without being able to read the prompts.

I had to have scripts written to increase the accessibility of the Avaya system I use at work. I can only review call times and numbers with the JAWS [Job Access With Speech] cursor and cannot switch phone status reliably when on a call.

Every time a new upgrade installs I have to relearn the whole layout.

Caller ID as well as call log or history are two features which are not accessible on the carrier being used by my employer. Considering the advantages offered by VoIP, I would love to see some progress towards a more universally accessible experience.

Lack of talking caller ID is my biggest issue. It makes it difficult to manage workflow when I either have to send all calls to voicemail or answer all calls. There is no way to differentiate between internal and external calls either.

The features on the VoIP phones are more difficult to use as they are embedded in inaccessible menus and, therefore, require that you memorize the sequence of button presses.

Discussion

The most popular VoIP system used by survey respondents was Vonage, followed by Skype and Magic Jack. None of the survey respondents had used any of the four systems tested in the usability study. This is not surprising, since there are a vast number of VoIP options on the market, and Skype, Magic Jack, and Vonage are targeted to home users while the usability test targeted VoIP options more often used by businesses. There are new options constantly being made available, particularly soft phone options. The main intention of the usability study was to test whether soft phones are a viable option for people with vision loss, and the results show that they are.

Most survey respondents had used VoIP at home for personal use, and half used it in their workplaces. Of the 11 common VoIP features that survey respondents were asked about, the most important feature for all participants was caller ID.

Three-quarters of survey respondents overall reported that their vision loss caused some degree of difficulty or limitation in using the features of VoIP systems (85% of participants who are blind and 50% of those with low vision). Common problems included difficulty in reading text, screen reader problems, lack of access to particular features, and needing to memorize layouts that continually change. However, in the usability study there were few differences between the performance of those who are blind and those with low vision, other than that the former needed to ask more questions.

Call management was the most difficult feature to use according to the visually impaired survey respondents. Similarly, among those in the usability study the task of transferring a call had the lowest success and confidence ratings, and the longest duration among the four tasks performed.

The majority of features asked about in the survey were found to be usable by less than half the blind participants. Those with

low vision generally found features to be more accessible than those who are blind. The call log feature was significantly easier for the low vision survey group to use.

Among blind respondents, there were six features that showed a significantly large discrepancy between importance and ease. Participants felt these six features were very important and not very usable: caller ID, call waiting, call log, call management, conference call, and contact list or telephone book. For those with low vision, only caller ID had a significant discrepancy. Note that because there were many fewer participants with low vision, it was more difficult to find statistically significant differences. It may be that with a larger sample additional differences would be found to be significant.

Features most discrepant in the direction of high importance and low ease of use highlight the most problematic features of VoIP system accessibility. These features are the most critical to resolve in order to make VoIP systems more usable for people with vision loss.

It was surprising to find that three features appeared to be easier for blind survey participants to use than those with low vision (call forwarding, call blocking, and contact list or telephone book), although these were not statistically significant. Additional hands-on research might lead to more insight about this finding.

In the usability study, individuals who had more experience using iOS with VoiceOver or Zoom performed much better on the two iOS telephones than those with less experience. The former had a higher success rate and higher confidence, asked fewer questions, and took much less time to complete the tasks. Since the iOS soft phones work very similarly to the iOS native calling system, those who were already proficient with iOS would be likely to have an easier time learning the soft phone. Because the usability study was conducted with only eight participants, it was limited in drawing inferences and generalizations to the larger population. Future usability studies would benefit from using a larger number of participants with vision loss.

In general, since there are many VoIP solutions to choose from, it would be advantageous for individuals to choose devices that function similarly to those they are already using. For personal VoIP use, the individual has many choices; however, in an employment situation choices may be more constricted since the VoIP system must be compatible with whatever technology is being used by the employer's information technology (IT) department. A soft phone solution should be considered over a hardware telephone, since it is likely to provide a greater number of accessible features due to the existing screen readers on desktop and mobile devices. Although compatibility may be an issue, IT departments should be expected to research and consider all options for employees in order to provide reasonable accommodations in the workplace.

Implications for Practitioners

Crudden, Sansing, and Butler (2005) believed that successful job placement depends on clients having equipment available and being given proper training before employment starts. Rehabilitation staff members working with individuals with visual impairments should become familiar with the latest VoIP equipment and understand the access issues involved, since VoIP is increasingly being used in

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the workplace and employees will be expected to be able to use this equipment and its various features to the fullest extent possible. Increased knowledge about the VoIP systems and having experience working with various systems should be beneficial to clients when seeking employment. A soft phone solution may be the best option for people who have vision loss, including soft phones that run as "apps" on a smartphone.

Those who teach young adults with vision loss should be aware of the available VoIP systems and should introduce some of them to their students. Familiarity with VoIP systems may increase their future employment prospects.

Conclusion

The results of the online survey point to the importance of ensuring that VoIP systems are accessible to those with vision loss, and the results of the usability study demonstrate that VoIP soft phones can successfully be used by people with visual impairments. The use of VoIP systems continues to grow, and they are increasingly being used in the workplace. In order to make sure that people with vision loss have access to the same tools as others, and to ensure that this equipment does not remain one of the barriers to employment, there needs to be a strong effort to address the usability problems identified in this study and to ensure that, going forward, all VoIP systems are fully accessible.

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