

How Blind People Interact with Visual Content on Social Networking Services

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ABSTRACT

In this paper, we explore blind people's motivations, challenges, interactions, and experiences with visual content on Social Networking Services (SNSs). We present findings from an interview study of 11 individuals and a survey study of 60 individuals, all with little to no functional vision. Compared to sighted SNS users, our blind participants faced profound accessibility challenges, including the prevalence of photos without sufficient text descriptions. To overcome the challenges, they developed creative strategies, including using a variety of methods to access SNS features (e.g., opening the mobile site on a desktop browser), and inferring photo content from textual cues and social interactions. When strategies failed, participants reached out for help from trusted friends, or avoided certain features. We discuss our findings in the context of CSCW research and SNS accessibility as a design value. We highlight the social significance of photo interactions for blind people and suggest design practices.

Author Keywords

Blind users; social networking services; accessibility; assistive technologies; qualitative study.

ACM Classification Keywords

K.4.2 [Social Issues]: Assistive technologies for persons with disabilities.

INTRODUCTION

With 1.44 billion Facebook users¹, 300 million Twitter users², and 360 million LinkedIn users³, enabling people of diverse backgrounds and abilities to participate in Social Networking Services (SNSs) has become a pressing issue. With Facebook users uploading 350 million photos a day [18], sharing visual content has become a bigger part of the experience, with which raises questions about how people with vision disabilities experience SNSs.

Recent statistics show that 2.3% of the U.S. population has

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a visual disability [13]. People with little to no functional vision (from here referred to as “blind”) usually access the web, and SNSs in particular [7,45], using screen readers and screen magnifiers on mobile and desktop platforms. However, despite attempts to make the web more accessible through design guidelines [42], designer awareness [24], and evaluation techniques [27], barriers to access certain content remain [7,23].

Recent large-scale empirical research by Wu and Adamic found that visually impaired Facebook users engaged with major Facebook functions as actively as other users did, with the exception of a few minor differences: they posted and shared photos, but to a smaller extent than the average user, and they also connected more with other screen reader users and used words related to visual impairment more frequently [45].

As a large-scale, quantitative study, Wu and Adamic's work surfaced interesting high-level patterns of how blind people use Facebook, but did not explain the practices, experiences, and challenges behind those patterns. Our work aims to gain deeper insights into these findings by answering questions that have remained unexplored: How do blind people engage with photos and other visual content on SNSs? What strategies do they employ to overcome the challenges? How do challenges related to visual content relate to other challenges faced in their everyday interactions on SNSs?

To answer these questions, we conducted an interview study of 11 people and a survey study of 60 people with little to no functional vision. We asked about their everyday experiences on SNSs, especially about their interactions with visual content. Our participants used SNSs daily or several times per week. Many of them had accounts on more than one SNS, and many also had experience sharing and interacting with visual content in SNSs.

Our work leads to a better understanding of blind SNS users as a unique user group, and uncovers both patterns of successful SNS use and persistent challenges. We

¹ newsroom.fb.com/company-info/

² about.twitter.com/company

³ press.linkedin.com/about-linkedin

contribute to the discussion of web accessibility as a design value, and offer design recommendations to enable blind people to better engage with the increasingly visual-centric web and social media. We also discuss implications for future CSCW research.

RELATED WORK

Web Accessibility Today

Blind users typically interact with computers using screen readers, software that interprets what is being displayed on the screen and reads it to the user. Screen readers exist for both desktop computers (e.g., JAWS – Job Access With Speech by Freedom Scientific), and mobile devices (e.g., VoiceOver for iOS, TalkBack for Android, and Nuance for Nokia phones) [43]. However, a 2-dimensional web page converted into a 1-dimensional speech stream is not easy to interpret. It can be even more frustrating, given the prevalence of websites with insufficient text labeling of graphic content, concurrent events, dynamic elements, or infinitely scrolling pages (e.g., a stream of feeds) [1,2,23].

Although web accessibility can be seen as a universal usability value [36], web designers do not always have the resources to devote to accessibility, or do not see the value in making their sites accessible [24]. Even if they do, they might not know the best way to test for accessibility [27]. Further, even applying web accessibility guidelines does not necessarily improve accessibility [30]. As a result, many websites continue to be inaccessible through screen readers, even those that are intended for broad access such as library websites [26], universities websites [21,31], and, SNSs [7].

Blind Users and Social Networks

Online SNSs are places for people to connect with others through weak ties and to maintain strong personal relationships [12]. The same may be true for blind people, but their offline social networks seem to be structured and to function differently than those of sighted people. In terms of weak ties, for example, blind unemployed college graduates were found to have less extensive networks to help them find jobs compared to sighted people [32]. To achieve life success, they need more support with socialization and career development in the form of structured group activities [33], as opposed to one-on-one conversations [32]. Furthermore, blind people rely more on their physical communities for help, including family members and – in the case of older blind people – in-home help [38]. In terms of strong connections, blind people who receive strong support from their friends have higher self-esteem, similar to sighted people [17]. Unlike sighted people, blind people rely more on family [9] and less on friends [17] as a source of social support.

Despite these differences in offline social networks, blind people have significant presence on SNSs [6,45]. While their networks on these sites used to be smaller, denser, and more homogenous than the networks of sighted users,

recent data shows that these differences have diminished over time [45]. However, there are still some unique characteristics of how blind users interact with SNSs. For instance, they upload fewer photos, but in general receive more feedback on their posts [45]. They also prefer to ask crowd workers instead of their networks for help, especially with questions about visual content [5]. These findings leave some unanswered questions around the everyday motivations, experiences, and practices of blind SNS users.

Interacting with Visual Content

With the increasing popularity of visual content on SNSs (more than 350 million photos uploaded daily to Facebook [18]) and visual-centric SNSs such as Instagram and Snapchat, it is important to understand the ways in which blind people interact with such content on SNSs. Advanced technologies offer blind people tools to identify and understand visual content. These include, for example, image recognition [15], tactile graphics [22], and crowd-powered systems [3,6]. Further interaction with visual objects is supported, for example, through tools that help blind people take better photos [8,19,40], and by improving the experience of photo sharing with audio augmentations [16]. However, these technologies have yet to be incorporated into the designs of popular SNSs.

Our study, reported next, aims to gain a rich understanding of not only what blind users do to interact with visual content on SNSs, but also why and how they do it. Through first-hand interview accounts and open-ended survey responses of blind people active on SNSs, we uncover strategies of how they fully engage with others on SNSs, challenges that remain, and opportunities to better support this user group.

METHODS

Pilot Study

We conducted an initial interview study with 12 individuals (7 female, 5 male) in early 2014 to understand their experience with SNSs. Participants included eight blind and four low vision people, ages 22 to 63 years (Mean=47.8, SD=14.6, Median=53), with a variety of occupations. Through 30-40 minute phone interviews, we asked participants about the accessibility technologies they used, and general questions about their usage of SNSs and the Internet. Participants were compensated with Amazon gift cards.

Participants reported varying levels of familiarity and willingness to engage with computers, the Internet, and SNSs. They had the same motivations for using SNSs and derived the same benefits as sighted people: staying in touch with friends, maintaining existing relationships, and accessing and sharing information. However, the findings also revealed a clear distinction between the experiences of participants who were blind and those that had low, but functional vision. Low vision participants who used screen magnifiers were generally more satisfied with SNSs, and

faced fewer challenges than participants with little to no functional vision who only used screen readers to access SNSs.

Most blind participants reported that SNS sites were not fully compatible with accessibility technologies due to their use of JavaScript and dynamic elements. Most had trouble signing up for SNSs on their own due to the additional burden of poorly labeled input boxes and a complicated multi-step validation process, confirming previous findings about Facebook account setup difficulties [7]. When new features were launched without full accessibility support, participants needed to invest more time and effort to understand how these features worked with screen readers. They also had to rely on sighted individuals they trusted—a close friend, a spouse, etc.—to engage with other aspects of SNS use, such as uploading photos.

One limitation to the pilot was that we included people who were not able to successfully setup and use SNS accounts at all. To gain a deeper understanding of blind people's experiences on SNSs, we recruited frequent SNS users in our main study. We also decided to specifically engage people with little to no functional vision, since the pilot study showed that this group of users faced more severe accessibility challenges, particularly when engaging with visual content. Finally, while the pilot study explored general accessibility challenges, interactions with visual content emerged anecdotally through our analysis. Based on these insights from our pilot study and recent findings by Wu and Adamic [45], we constructed the following survey and interview study.

Survey Study

We conducted an online survey to gather data and recruit diverse SNS users with little to no functional vision. Constructed on Qualtrics, an accessible survey platform, the survey was open for one month during February-March 2015. We recruited survey participants through email lists of various organizations including the National Federation of the Blind, asking “blind” SNS users to participate.

Sixty people completed the survey: 41 women, 18 men and 1 undisclosed. Their ages ranged between 16 and 67 (Mean=40.2, SD=14.1, Median=39). All had little to no functional vision. The majority of the participants were from 24 different US states. The remaining participants were from Canada, Germany, and India.

The survey took about 10 minutes to complete and asked questions about everyday use of SNSs, and interaction with visual content. Respondents reported using the following SNSs at least once a week (multiple choice was available):

- Facebook: 100%
- LinkedIn: 60%
- Twitter: 60%
- Instagram: 22%
- Snapchat: 7%
- Tumblr: 7%
- Vine: 3%
- Other: 22%

We anticipated Facebook would be the most used service by blind users, based on its overall popularity [11], and therefore included the following open-ended questions:

- If you have recently posted a photo on Facebook, please tell us about this photo: what it was of, who took it, if anyone helped you post it, what comments you received about this photo, and any other details about it.
- When a Facebook friend posts a photo, how do you know what is in the photo? Do you respond to the photo by liking/commenting on it? Why or why not?
- If you recently posted a news story or article on Facebook, please tell us about it: what was it about, where did you find it, why did you post it, what comments you received about the post, and any other details about it.

Participants had the option to provide further comments and to enter their email address if they wished to take part in the interview study. We donated \$1 to the National Federation of the Blind for every completed survey.

Interview Study

We recruited participants for the interview study among the survey respondents. We contacted respondents who (1) had

Pseudonym	Gender	Age	Age of Vision Loss	Occupation	Facebook	Twitter	LinkedIn	Google+	Other SNSs
Tom	M	21	9	Undergrad student	X	X	X		
Sophie	F	25	5	Grad student	X	X			
Victor	M	26	Birth	Unemployed	X	X			
Naomi	F	28	Birth	Vision rehab therapist	X	X	X		
Lisa	F	28	Birth	Law student	X		X	X	
Marcus	M	32	Birth	Assistive tech specialist	X	X			
Selena	F	35	20	Unemployed	X				
James	M	40	32	Musician	X		X		
Katie	F	49	Birth	Grad student	X		X		
Calvin	M	60	Birth	Paralegal consultant	X		X		
Darcy	F	65	3	Writer	X	X	X	X	Wordpress, Goodreads, Instagram

Table 1. Interview participants and the SNSs they reported using.

little to no functional vision, (2) posted on one or more SNSs regularly (several times a week to several times a day), and (3) provided their email address. Due to a lack of standard measures to assess overall technology skill, we relied on the frequency of SNS use to recruit uniformly skilled users. We continued to contact potential interviewees and conduct interviews until we started identifying clear repetitions in the responses.

Eleven individuals participated in the interview study (6 female, 5 male) (see Table 1). Their ages ranged between 21 and 65 years. Six participants were blind since birth, and the others lost their vision either as children or as adults. All used Facebook regularly and most reported using other SNSs as well. Participants reported using multiple devices and screen reading technologies, including Apple mobile devices with VoiceOver (8 participants), PCs with JAWS (8), Macs with VoiceOver (2) and PCs with NVDA (1).

We conducted semi-structured interviews with questions about the following topics:

- General Facebook use and challenges experienced, *e.g., do you post and respond to others on Facebook? Describe your latest post.*
- Other SNSs used and challenges experienced, *e.g., which sites do you use and what for? What challenges do you face in using these sites?*
- Engaging with photos and visual content, *e.g., do you like or comment on the photos of others? Do you post photos? Describe the last photo you posted.*

All interviews were conducted remotely over the phone, Skype, or Facetime. We asked participants to share their screen with us or to send us screenshots of interactions we discussed. Interviews lasted 45-60 minutes. Interviewees were compensated with a Visa gift card.

Data Analysis

We addressed the limitation of a small interview sample size by analyzing both the in-depth interview data and the qualitative survey. All interviews were audio recorded and then transcribed using professional transcription services. We used an open-coding technique [34], iteratively reading the transcripts and survey responses, highlighting excerpts, and identifying key insights, themes, and patterns that reoccurred in the data. In the findings, we included quotes from both the interviews and the open-ended survey data. Survey respondents are identified with assigned ID numbers preceded by the letter P for “participant,” *e.g.*, P1, P2; interviewees are identified with pseudonyms (see Table 1).

Our findings, reported next, are in two parts. The first part establishes the context for blind people’s interactions with visual content on SNS by reporting on general motivations, accessibility challenges, and the strategies our participants applied to overcome them. The second part reports on the

unique practices we identified in interacting with visual content on SNSs.

CONTEXT: SNS USE PATTERNS

Motivations for Using SNSs

We found that blind users have the same motivations for using SNSs and for engaging with visual content as sighted people. Like sighted users, all of our participants used SNSs to maintain relationships with friends and family. In addition, seven interviewees indicated that they used SNSs for career-related purposes. For example, Naomi used Facebook, Twitter, and LinkedIn to promote her cosmetics sales business. Eight interviewees reported using SNSs as a platform to discuss their experiences as blind persons, to share useful news on the topic, or to advocate for visual impairment awareness. However, similar to anyone with a mixed set of interests, they also blended their interests related to blindness with their other interests (*i.e.*, sports, technology, politics), and engaged with a wide range of topics and communities on SNSs.

Existing Accessibility Challenges

Prior research has discussed accessibility challenges of SNSs [7], and our study focused on questions beyond web accessibility. However, nine of the interviewees reported facing accessibility challenges in SNSs, making this an issue we could not ignore. We describe them to set the context for how blind users interact with visual content.

While a sighted user can quickly scan a webpage and click links anywhere on the page to complete their goal, a screen reader user needs to listen through each page element in fixed order, and cannot easily skip through items irrelevant to his or her task. Visual page elements (*e.g.*, buttons) may have a mismatch between what they visually look like and their alt-text read by the screen reader, making it difficult for a blind user to understand their meaning and function. SNS pages with unstructured visual elements and numerous links, or horizontally and vertically organized content such as photo galleries or infinitely scrolling feeds, make the process of listening to the screen reader even lengthier and more confusing.

Our participants reported that they experienced the aforementioned challenges, but their perceptions of the accessibility of SNSs varied. For example, some participants tolerated structural complexity to varying degrees and found some SNSs easier to use than others. Their experiences improved over time as they got used to different features and developed strategies to overcome challenges. However, the same features could become difficult again over time due to frequent or unexpected interface changes:

Just when I figure out how to maneuver around, they go and change things. Changing status, making things public or private is more difficult to discern than it used to be. (P58)

Some participants were intimidated by accessibility challenges to such a degree that they did not even try to use SNSs features that they expected to be inaccessible. For example, Selena assumed Facebook games were not accessible: *“I think there is a lot of Facebook games that I’m not even aware of and I don’t think I could probably do those. I just assume they’re not accessible, I don’t even know what they are though.”*

Overall, accessibility challenges frustrated our participants, and left them feeling excluded or incapable of participating in what they considered cultural mainstream:

It is frustrating for me to use these websites that take up longer (much longer) to carry out simple tasks. I feel that I am missing some of the fun stuff on social media, but I don’t want to waste too much time. (P50)

Strategies for Overcoming Accessibility Challenges

In an attempt to overcome some challenges, the majority of interviewees first reported accessing SNSs through a combination of interfaces (i.e., the mobile site, the main site, the mobile app) and platforms (i.e., mobile and desktop). Each of these interface-platform combinations had different strengths and weaknesses in terms of accessibility.

Most participants reported that the Facebook mobile site (m.facebook.com) was particularly accessible, and many used it exclusively on a desktop browser to avoid the structural complexity of the main site. The mobile site did not support all the functions of the main site, but people still used it even if this meant that they forwent functionality, or resulted in having to switch between the desktop and mobile versions. Katie explained an intricate system she used to access different functionalities through different interfaces:

If I want to tag a specific friend or a specific page in a particular status update, I’ll use the ... full Facebook site. Then if I’m just reading and scrolling through, I’ll use the mobile version on the PC. If I’m posting a picture or a video, I will use the iOS app... It’s much easier to upload pictures and videos from the iOS app... Then if I’m just scrolling or browsing, I’ll use the mobile site on the PC. (Katie)

To reduce structure complexity, some participants reported accessing SNSs through other applications. For example, Naomi used an accessible client application for Twitter, but wished that other SNSs such as Facebook also had a dedicated desktop client to *“de-clutter the interface.”* Another potential access point was email. Instead of going to Facebook and scrolling through updates, Calvin reported entering Facebook when he got a notification of interest via email. Several survey respondents also reported interacting with Facebook friends via email rather than through the site:

I try to interact by replying to email as much as possible, rather than going through the site, as I find FB complicated and hard to navigate, even the supposedly less visual and less complex mobile site. (P40)

A second strategy for overcoming accessibility challenges was getting help from sighted individuals. The majority of participants reached out to close friends, spouses, or other family members to get help with challenging tasks. Their closest friends and family knew them well and understood their ways of using screen readers to assist when needed:

The thing that I find frustrating about LinkedIn is I cannot figure out how to efficiently manage my connections. [...] I can’t figure out how to delete them without having sighted assistance. [...] I may ask a neighbor. If we’re on Skype, I can share my screen and then he can see what I’m doing. He’s very into how I use a computer and how I use my devices versus how somebody who is sighted lives life and that sort of thing. He or a couple of friends that I’m very close with I’d probably ask them for help with that sort of thing. (Katie)

Finally, when workarounds were not possible and help was not available, participants avoided SNS features that they found inaccessible: *“I do not poke, as I think it is too hard to figure it out.” (P58)*. Lisa managed to figure out Google+, but was limited in how she used it to interact with her friends: *“I’ve never posted anything. I only use it to look at what my friends, who I’ve managed to figure out how to add, have posted. It’s completely one-sided.”* Three interviewees said that they did not use Google+ at all, explaining that they could not figure out how to perform elementary tasks such as adding connections. Avoiding features and/or entire SNSs prevented them from having more connections and interactions with their friends, and contributed to making them feel neglected by the designers and developers of these services.

INTERACTING WITH VISUAL CONTENT

SNSs enable users to communicate through various types of visual content including photos, videos, and graphics (e.g., image memes, emojis). Although our participants were not able to perceive the visual content in the way that sighted users did, they were fully aware that visual content is an important part of SNS experiences. As Marcus mentioned, *“when it comes down to doing things people do on Facebook, it’s more about the photos.”*

Consistent with findings from previous research [45], we found that blind people engaged with photos on SNSs. Most of the blind people we interviewed and surveyed posted photos and responded to visual content that was shared by their friends. However, to fully engage with visual content, blind people needed to first overcome accessibility challenges associated with the visual content through workarounds or with help from family and friends. They needed help to determine the content of the photos, and to take and post photos of their own. Due to these hurdles,

some chose to forgo engaging with photos, or chose to selectively do so when convenient. In this section, we describe our participants' approach to visual content, the challenges they experienced with it, and the strategies they employed to overcome these challenges.

Taking and Posting Photos and Videos

Seven interviewees and 23% of survey respondents reported that they posted photos. Three interviewees reported that they also posted videos. The process involved composing and capturing the image, confirming that they had the right file selected to upload, and then posting it online. Each of these steps had unique challenges and all participants reported seeking help from sighted individuals in some parts of the process. When help was not available, some either delayed the task or gave up on it altogether.

Taking Photos

To take a photo, participants first faced the challenge of composing the photo and correctly capturing their target. Naomi explained: *"There's just no way for me to know that whatever I'm photographing has been properly centered or the lens is in [focus] to take a good photo."* Since content shared on SNSs is seen by a large audience, not just close friends, our participants worried about the emotional and social consequences of sharing an imperfect photo or a different photo than the one intended:

I have practiced taking selfies and now I am quite good about it, but I am afraid to share except [with] my close friends, as even though I can take good selfie, it might not be perfect as others would take, and if I do something wrong I don't want to be a joke. I do remember recently I shared my selfie on WhatsApp. And I forgot to switch on the front camera, and I just took the photos and shared it. My close friends told me that they can see the wall and not me. As they are my close friends and family members no one laughed at me. It may not be the case with FB. (P9)

As a result, only a small number of participants took photos by themselves. Most reported asking friends or family members to take photos or videos of or for them. Parents, significant others, and close friends were particularly trusted. Just like sighted people, participants cared not only about the content of their photos, but also about the aesthetic elements and the quality of photography:

Some people don't always understand completely that when a blind person asks you to take a picture for them you should do it with the same the way that you would take it for yourself. Some people aim it at the thing and take a picture and be like 'okay it's done.' Certain ones of my friends understand that I care about the way things look and that sort of thing and so they'll take it the way that they would take it if they wanted to post it or if they wanted to share it. (Lisa)

Katie highlighted the crux of the challenge: *"I do wish there was a way to, for a person who is totally blind, to be able to take good pictures or good videos. There's sort of a*

disconnect there." Participants did not seem to be aware of tools developed to help blind people take better photos [19,40]. Further, our participants cared about "looking good" in the photos, a judgment that tools could not provide.

Selecting and Editing Photos

Once acceptable photos were taken, participants had to identify the correct photo from the photo storage on their phone or computer to post and share online. Accidentally posting a different photo from the one they intended had negative consequences: *"I accidentally posted the wrong pic from my photo album on my phone and didn't realize it until I read the comments."* (P3)

In some situations, participants were able to select their photo independently, for example, when the desired photo was the most recent one: *"I just knew it was the picture just because it was the last photo that was on the camera roll."* (P4) In other cases, participants reported that someone else took the photo and sent it to them via email, and they were able to identify the photo because it was attached to the message. In all these cases, participants relied on non-visual cues in selecting the correct photo.

In most cases, participants reached out to a trusted sighted person to help identify the correct photo or photos to share. Some waited until they had a batch of photos for posting, and then sat down with a sighted friend or family member to go over them. Unfortunately, this was perceived as time consuming, and therefore sometimes delayed or deterred a blind person from posting. Sophie described the reason for not posting a set of photos: *"[I need someone to] help me understand which picture is that. Then I will rename it, and then if there is some editing, then I have to keep on asking 'could you cut the picture? Could you edit it? Could you do this?' ... That becomes kind of difficult."*

As Sophie recounts, the process of selecting photos to post involved more than just identifying what is in the photo: participants wanted their friend to judge in which photo they looked best, they wanted to avoid blurriness or incorrect composition, and they sometimes wanted to edit the photo: to crop, rotate, or to use other editing features. This was only possible with the help of sighted individuals they trusted, who would spend the time to help them out.

Posting Photos

Most of the participants reported sharing photos or videos on Facebook more than on other SNSs, and some of them were able to post photos or videos without help. P2 describes his process of posting a photo to Facebook that was taken by someone else on his phone:

I ask a family member or friend to take the picture using my iPhone's camera. Once the photo has been taken, I turn VoiceOver back on and post the picture using the built-in sharing features in the native iOS camera app. (P2)

Facebook's mobile app was considered by most participants to be easier than the main site for posting photos, especially because the photos were already on their phone. However, additional interactions with the photo upload process, such as tagging people, were considered difficult: "I couldn't access the area where you tag friends" (P20). Further, if photos needed to be edited before being uploaded, for example, to meet the size requirement, this was a particular challenge that required help from others:

When I'm promoting an event, a performance of my band, I can't generally do the photographs to add a photo to the event. It's the whole, the-photo-has-to-be-a-certain-size issue. I can't find a way to edit it myself to make it fit into the Facebook requirements. (James)

Following up on previous work [45], our findings demonstrated that sharing photos is part of the SNS experience for blind users, but that they did so through unique practices that almost always involved getting help from trusted sighted contacts. When help was not available, participants often delayed or avoided sharing photos, resulting in fewer opportunities to interact with friends through photos.

Interpreting and Responding to Visual Content

Seven interviewees—those who posted photos—and more than half (52%) of survey respondents reported that they tried to interpret the photos posted by their friends, and that they liked and commented on the photos as a means of interacting with their friends. However, participants faced various challenges in understanding the photos. In particular, the frequent lack of useful contextual information such as photo descriptions often prevented participants from engaging with most visual content.

Interpreting Visual Content

To understand the content of a photo, participants read the names of individuals tagged in it, the description posted by the author, comments posted by others, and the geo-tag of the photo. Author-generated descriptions were considered by far the most informative:

When people include descriptions, it makes it so much easier for somebody who's blind to know what's going on and more fully participate in the posting of that picture or responding to that picture or video. (Katie)

However, participants mentioned that most photos posted on Facebook did not have clear descriptions or a description at all, and included only some of the contextual information described above. As a result, participants used partial clues to connect the dots and make sense of the photo based on the information available. For example, when faced with a photo without a description, Marcus deduced that "it must be from [his friends'] trip because they went to Mexico and that's tagged in Mazatlán." Our participants reported relying on very few clues to interpret photos in order to participate in the interactions around them:

If a person leaves a comment with their picture, then there's something in it that gives me a [clue]... I remember a friend of mine, I don't know what it was, she said, "I hope you enjoy this picture of Bill and I." I wrote back something like, "as long as you're together, I don't care where you are." I had no idea what the picture was of, but as long as they were together, that's good enough for me. (Darcy)

In many cases, the information provided was not sufficient to allow the blind person to make successful guesses. In these cases, some sought more information, especially if the photo seemed interesting or was posted by a close friend. Some reached out to a nearby friend or family member to ask them to describe the photo. Others reached out to the photo's author, but only when the relationship was intimate enough. They did so either directly, or by commenting on the photo:

Normally I'll do it in a teasing way because we talk about accessibility all the time, my sighted friends and I. Normally, if I ask them, I'll make it into sort of a joke about how I don't know what they're talking about. (Lisa)

When no information was provided and help was not available, many participants ignored photos and other visual content. This was common with content that was not easy to describe with words, such as images that featured text (e.g., screenshots or memes), graphics-based emojis that were not captured by screen readers, and humorous videos:

Sometimes people post videos that they think are funny but they're very visual, and I don't really understand what's so funny about it, so I don't bother. (Naomi)

While many participants accepted this situation, others were frustrated when their friends did not describe the photos and other visual content they posted: "I have found it useless to ask family and friends to make sure their photos include description, because they usually ignore this request." (P34)

Again, they felt left out of the SNS experience: "I cannot see the photo, and people rarely ever describe it. They assume everyone on planet Earth has working eyes. If your eyes happen not to work, too darned bad." (P40)

While some emotional and humorous content in photos and videos may be difficult to convey with screen readers, some of it could be made more accessible with existing technologies as we will describe in the design implications.

Responding to Visual Content

Participants' decisions on whether to respond to a photo by "liking" it or commenting on it were based on a number of factors. First, they generally responded to photos if they were able to interpret the photo content or context in some way. As described above, participants reported relying on various cues such as descriptions, comments, or people tagged in the photo, to interpret the photo and decide if they wanted to respond to it. P9 describes that the number of "likes" on a photo and others' comments on it give her

enough clues to determine whether to like or comment on the photo:

I decide how to like [a photo] on the basis of the likes that has received. If the photo has more than 100 likes it means it's safe to like. For commenting there [are] two parts. You understand the context by looking at the comments of others. At that time you could say something by guessing what others have wrote. So for example, my friend had a haircut and many people commented so I wrote "new style ha!" Secondly, if you do not understand anything mostly it is safest to write "super like, nice pic, etc, etc". I think having a visual tool to communicate with your friends helps you a lot in socializing. (P9)

The last sentence of P9's comment (as shown above) demonstrates a second factor in making decisions around responding to visual content: *building and maintaining social relationships*. Even when there were not enough clues to interpret the visual content, participants sometimes "liked" the photo or posted comments because this engagement provided emotional and social benefits:

[I like] mainly photos that I'm tagged in. If a friend posts a photograph that I'm not involved in, sometimes I'll 'like' it if they mention one of their kids. It depends on how I'm feeling that day. If I see something and I say, "I miss that person," then maybe I'll like the photograph just because of that. (James)

Our participants were aware that interacting with others through visual content was an important aspect of the SNS experience, and they wanted to be included. As a result, despite the challenges, they found ways to be part of these interactions and experiences.

DISCUSSION

Our findings revealed that blind people engage with visual content on SNSs (particularly photos) in various ways, consistent with previous research [45]. They take photos, post them, tag people in them, comment on them, and "like" others' photos. Although they cannot see the photos, their social networks include a large portion of sighted friends, and they want to take photos that look good, want to look good in the photos taken of them, and want to interact with others through the visual content prevalent on SNSs.

Photos serve important social purposes for all SNS users. For example, posting a photo from an event is a way to document and notify others about attending it. "Liking" a photo one has been tagged in is a way to express appreciation to the poster and, consequently, to maintain the relationship with the poster. Extending previous findings from sighted Facebook users [20], our findings demonstrate that interactions around photos are crucial to the SNS experience and to maintaining social connections for blind users, just as they are for sighted users.

Through our participants' accounts, it became evident that knowing the content of a photo is one important component in this social process, but perhaps not the most important one. The metadata, such as who posted the photo, who is in it, where it was taken, and others' responses to it, were fundamental to their social interactions with the photo. People have seen the value of photo annotations and tagging in the context of the audience selection and organization of photos [1]; our findings indicate that such practice can also make a significant difference in blind people's experience with photos.

Implications for SNS Design

Given the importance of blind users' interactions with visual content on SNS, existing technologies could be used to fix or alleviate challenges that blind people encounter when interacting with visual content.

First, functionality could be incorporated into SNSs to give blind users greater autonomy when taking, selecting, editing and uploading photos. Technologies have been developed to help blind people take better photos through automatic detection of image focus, framing, rotation, and lighting [8,19,40]. Recording and appending audio notes to photos can both remind blind users of a photo's content, and serve as a photo caption [16]. In addition to incorporating such tools into SNSs, further work could take the form of creating editing tools to achieve desired photo quality: cropping, applying filters, and more.

Second, to allow users to better interpret visual content, alternative text for images could be made available for all relevant visual elements that are part of the SNS experience, including emoji and Facebook stickers. Computer vision algorithms and Optical Character Recognition (OCR) technology could also be used to automatically generate alternative text for photos and videos. Our findings showed that blind people make decisions to respond to visual content based on little information, so these technologies have the potential to produce useful additional information, despite accuracy limitations. Facebook has already begun to consider OCR [28], but the capability should be extended to other SNSs, especially ones that are image heavy, like Instagram and Pinterest. Existing functionality could also be enhanced (e.g., allowing the users to tag regions of the photo with comments instead of only with people), which has shown to be useful in helping blind people explore photo content [23,46].

Third, when faced with issues that technology cannot yet address, such as conveying the emotional content of an image or judging its aesthetics, SNS developers can still support blind users through design. For example, when posting a photo, the design could make the caption field salient, as a reminder for users to describe the photo. Designing SNS functionality to better support photo sharing within a small, intimate group within the SNS can also help alleviate blind users' concern for the aesthetic quality of

their photos, and can make it more comfortable and convenient to share and ask friends for feedback [29].

We summarize these design opportunities in Table 2. Many would serve users with a range of abilities [14], including sighted users, and could offer new interactions around photos and other visual materials to all SNS users.

Implications for CSCW Research

One set of implications of our findings is for research on social processes around sustaining meaningful relationships in asynchronous communication media. Unlike most empirical bases for such research, our participants only had access to textual cues while their interaction partners had access to both textual and visual cues. This asymmetry in access to information is an interesting direction to take in the research on social relationships in computer-mediated communication and SNSs.

In sharing visual content, we found that blind users care about the aesthetics of the photos they shared, and wanted to have control over the messages delivered through photos. Without seeing the photos they shared, blind users delegated this control to sighted individuals with whom they had strong, intimate relationships and therefore trusted. In other cases, we saw evidence of self-censorship [37], where blind users chose to not post photos, or chose to share photos with a smaller audience, such as close friends on WhatsApp, instead of sharing them broadly on Facebook. Previous work found that participants of group interactions experienced less trust of one another and more vulnerability in text-based media compared to visual-based media and face-to-face communication [4]. Our work highlights the role of trust in a visual-based medium in which not all participants have access to the visual cues.

In accessing shared visual content, blind users interpreted

the meaning of the visual content based on textual cues in metadata about the photo. Based on the hyperpersonal model, communicating through limited-cue channels is associated with forming more positive impressions of one's interaction partners [41]. Adding a text description to a photo was shown to worsen the impressions of others online [39]. In contrast, our findings suggest that blind people prefer photos with more text descriptions. This also raises the question of whether blind users perceive their interaction partners the same way as sighted users do, and whether this might impact the perceived social value blind SNS users derive from these interactions.

Future work could explore these questions in order to understand the impact of channel accessibility limitations and asymmetry in computer-mediated communication. Further, we call researchers to continue to push the boundaries of CSCW research by examining the use of social technology by various user groups with special needs beyond those of the general population.

TAKING A STEP BACK: THE LONG JOURNEY TO ACCESSIBILITY

Despite tremendous research efforts on web accessibility and the development of standards, frameworks, and legal requirements, our findings demonstrate that a long journey lies ahead before accessibility is implemented as a universal value. Most of our participants are comfortable in using technology, but found it challenging to do everything they wanted to do on SNSs. Due to structural complexity, limitations in photo selection and editing, and increasing amounts of visual content, participants had to use unique practices to interact with others on SNSs.

Participants developed and used various strategies and workarounds to overcome difficulties. We saw creative solutions, such as opening the mobile version of an SNS

Design Opportunity	Impact	Example
Extend SNS functionality and design practices that are successful with blind users to other SNS platforms and to computer mediated communication services.	Supports all users	- Extend image-tagging capability to other SNSs, especially ones that are image heavy, like Instagram and Pinterest. - Keep SNS API open to allow developers to create accessible tools (e.g., Chicken Nugget Windows client for Twitter).
Augment SNS functionality with existing technologies to give blind users greater autonomy when taking, selecting, editing and uploading photos.	Supports blind users but may be appropriated by any user	- Incorporate existing technologies that help blind people take better photos through automatic detection of image focus, framing, rotation, and lighting [8,19,40]. - Implement ability to record and append audio notes to photos to both remind blind users of a photo's content, and serve as a photo caption [16]. - Create accessible editing tools to achieve desired photo quality: cropping, applying filters, and more.
Augment SNS functionality with existing technologies to allow blind users to better interpret visual content.	Supports blind users	- Implement alternative text for images for all relevant visual elements that are part of the SNS experience, including emoji and Facebook stickers. - Use Optical Character Recognition (OCR) technology to automatically generate alternative text for photos and videos. - Allow users to tag regions of the photo with comments, shown to be useful in helping blind people explore photo content [23,46].
Leverage design principles to tackle issues that technology cannot yet address, such as conveying the emotional content of images or enabling blind users to pass judgment on its aesthetics.	Supports blind users	Make the photo caption field salient to remind users to describe a photo they are about to post.

Table 2. Design opportunities to improve interactions with visual content.

website on a desktop browser, and relying on geo-tags and other clues to interpret photos and make decisions about whether to respond to them. In these ways, participants *appropriated* SNS designs meant for one use to another. Keeping these designs open to unexpected appropriations is important [10]. For example, allowing one to open the mobile version on a desktop browser without redirecting to the full desktop version downplays the single authoritative interpretation of the designers about which versions should be used on which devices, and opens up new possibilities and experiences [35].

However, workarounds did not always work, and help was not always available. Whereas some participants accepted that they could not fully access SNSs, others felt frustrated and discouraged, and that they were missing out on the social benefits of fully participating on SNSs. Our participants were especially irritated when SNSs introduced new dynamic, visually-oriented features without full compatibility with assistive technologies. Designers should be aware of how the features and services they create work for a variety of user groups: who they are designing for and who they are leaving out.

However, we acknowledge that there is no single ideal approach to designing accessible services. A recent survey of screen reader users showed that over 40% of respondents use the screen reader-friendly versions of websites often or whenever they are available [43]. In practice, our participants reported liking and using the mobile site of Facebook even on desktop browsers, which serves as the de facto “accessible” version of Facebook. However, there are several potential problems with this “separate-but-equal” approach. Similar to previous findings [44], the participants who used the mobile site on their desktop were also aware that some features were missing, and perceived that they were getting a discounted experience. The only way to eliminate the trade-off between accessibility and richness of experience is to provide a unified, accessible site for all users, sighted and blind.

Calls to create one universally usable site highlight accessibility as a design value [36]. A universal interface is easier to maintain and more likely to be up-to-date with all new features, while separate websites will require more development and maintenance. Furthermore, interacting with a universal interface would incentivize screen reader makers to evolve their product along with web technology trends. At the same time, the linear nature of screen readers might be considered a constraint to the aesthetics of the design and contrary to experiences that are familiar to and preferred by sighted users. Further, this approach does not fare in practice with increasingly visual-centric web content and SNS designs.

The goal of this paper is not to solve accessibility issues related to web technologies and SNSs. Instead, we contribute to the discussion by offering insights and accounts of blind people’s experiences around visual

content in SNSs. By describing their practices, challenges, and creative solutions, we hope to keep the discussion around SNS accessibility open.

CONCLUSION

We presented a qualitative study of blind people who use SNSs, and explored their practices, challenges, strategies, and experiences through their interactions around visual content in SNSs. Their motivations to use SNSs were similar to those of sighted people, which have been reported in prior literature, and include maintaining social relationships and expressing their identity through social interactions. However, blind SNS users faced challenges in interacting with SNSs due to pervasive visual elements, complicated page structure, and infinitely scrolling feeds that are incompatible with screen readers. The desire to fully participate in a mainstream SNS experience that centers on shared visual content exacerbated these challenges.

Our participants developed and applied creative strategies to overcome the difficulties they faced: they used multiple devices and entry points to access and interact with different features; they inferred visual content and made interaction decisions based on non-visual cues and social exchanges around visual content; and they ultimately sought help from a small group of trusted individuals, close friends, and family members. However, when strategies failed and help was not available, participants had to forgo desired interactions.

Our findings shed light on the significance of social interactions around visual content in SNSs, but also brought up questions about perception and trust when interaction partners on SNSs have asymmetrical access to cues in a computer mediated communication service. We hope to enable future research and to inspire designers to consider designs that would improve social networking for all users, with and without disabilities.

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