How Teens with Visual Impairments Take, Edit, and Share Photos on Social Media

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ABSTRACT
We contribute a qualitative investigation of how teens with visual impairments (VIP) access smartphone photography, from the time they take photos through editing and sharing them on social media. We observed that they largely want to engage with photos visually, similarly to their sighted peers, and have developed strategies around photo capture, editing, sharing, and consumption that attempt to mitigate usability limitations of current photography and social media apps. We demonstrate the need for more work examining how young people with low vision engage with smartphone photography and social media, as they are heavy users of such technologies and have challenges distinct from their totally blind counterparts. We conclude with design considerations to alleviate the usability barriers we uncovered and for making smartphone photography and social media more accessible and relevant for VIPs.

Author Keywords
Photography; social media; blindness; visual impairment; accessibility; Instagram; Snapchat.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; K.4.2. Computers and Society: Assistive technologies for persons with disabilities.

INTRODUCTION
Photo-centric and ephemeral social media like Instagram and Snapchat are becoming increasingly popular, especially among teens [25]. These platforms provide easy editing and sharing tools for personal photographers (nonprofessionals who take photos for sharing and memories) [42]. For example, Instagram provides easy-to-use editing tools [16, 3, 33], while Snapchat's fun filters and drawing tools facilitate in-the-moment photo sharing [35]. These social media trends are interesting to HCI researchers, but most work does not consider the experiences of visually impaired (VIP) users. Indeed, a common misconception is that VIPs are not interested in photography. Yet, VIPs have demonstrated interested in taking photos and teaching other VIPs how to do so by publishing experiences and tutorials online [30, 34]. These examples corroborate a growing body of HCI research accounting how blind people engage with photography and social media [26, 29, 44, 45]. However, most prior work has focused on people who are totally blind, and, further, on how blind adults use Facebook and Twitter. With the aim of expanding HCI research to better understand the experiences of young, VIP smartphone photography users, an especially understudied group, we conducted a qualitative exploration of how they engage with photos and post them on social media.

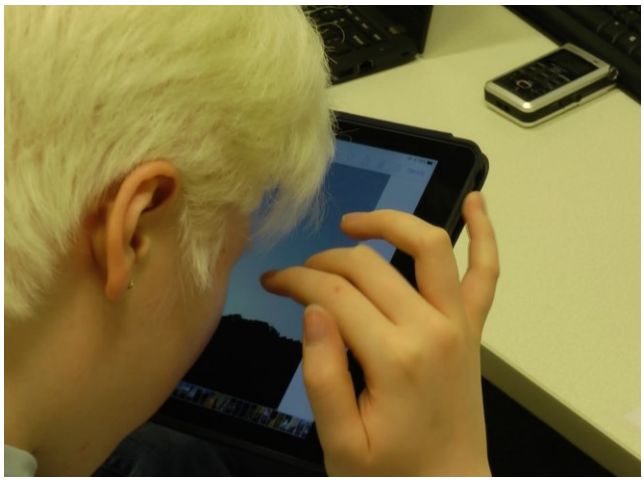

Figure 1. A teen with low vision (P7) holds her phone close to her face to more easily view the screen.

We share findings from an interactive, semi-structured interview study with fourteen visually impaired teens on how they engage with photo-centric and ephemeral social media smartphone apps. Our work pushes back on assumptions that VIPs do not care to engage with photos. Instead, we found that, like sighted teens, our interviewees were heavy users of photo sharing platforms, and where they encountered barriers to access, they implemented workarounds for sharing photos with their sighted and visually impaired peers. Specifically, we contribute: (1) An investigation of how VIPs engage with photo-centric social media for which they take, edit, and share photos, (2) Insights on how visually impaired teens (who fit the target demographic for photo-centric social media such as Instagram and Snapchat) post on such platforms by balancing social norms and vision impairment, (3) design recommendations for developers of these and similar platforms to better include visually

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impaired users, and (4) an expansion of a growing body of work on low vision technology users to complement their more-often-researched totally blind counterparts.

RELATED WORK

In this section, we report briefly on four topics within which our contributions are situated. First, we overview photo-centric social media popular among teens. Second, we share work on making photo capture more accessible. Next, we report on studies focused on how VIPs use social media. We conclude with work focused specifically on how people with low vision access computing devices.

Teens and Social Photoware

Teens have taken to social media faster than adults since the early 2000's, garnering fascination and worry for what these emergent platforms mean for social connection and safety among young people. Danah Boyd's ethnography [8] of social media use and perceptions by US teens pushes back on fears that social media distances them from reality. Instead, she positions social media as a public situated within teens' broader social world. But affordances of social media platforms including data persistence, visibility, spreadability, and searchability, have become spectra which teens negotiate to make sense of what it means to be in publics with others. Boyd contends these negotiations will continue even as new social media emerges. In this paper we focus on two burgeoning platforms, photo-centric Instagram and ephemeral-content-focused Snapchat [25]. By photo-centric, we mean social media like Instagram where photos are the primary content posted, and by ephemeral content, we refer to social media like Snapchat that are premised on posts disappearing from users' view after a short time. There is a large amount of research on sighted users' behaviors with Instagram and Snapchat (e.g., [5, 14, 16, 25, 31, 32, 33, 47]), the social photoware platforms most popular among our participants. In summary, Instagram is a place where personal photographers post a small number of higher quality photos, using editing to enhance photos rather than to correct them. Snapchat is a playful social media and messaging service where users send photos to share in-the-moment happenings with a small number of close ties. We are unaware of any research on how VIPs use these two popular platforms.

Photo Capture for VIPs

Research on blind people and photography can broadly be divided into the use of photography to learn information about an environment, and into improving photo capture by VIPs. For the former, researchers have explored smartphone apps and services that allow users to send a photo to a bot or crowd worker for its contents to be described [6, 7, 9, 10, 11, 20, 24, 49]. Brady et al. [10] analyzed thousands of photos uploaded by VIPs to the object-identification service VizWiz, and Adams [2] analyzed hundreds of photos posted in a Flickr group for blind users. They identified blur, lighting, framing, and composition as components of photo quality with which this user group had difficulty. Researchers [1, 2, 15, 19] have also assessed practices and challenges around blind people taking and sharing photos. Strategies VIPs use to capture a good photo included making an educated guess on where to point the camera, positioning the camera close to the object of interest and backing up, and taking several shots in hopes some will turn out.

In turn, researchers [2, 4, 15, 43] have built camera apps that give the user feedback until they have centered the image in the viewfinder. Some [2, 15] also make storage more accessible by allowing a user to record voice memos for non-visual photo identification. These systems have been received well within the blind community, and some features have become available in native and third-party smartphone apps. For example, iPhone users with Voiceover turned on and the native Camera app open receive real-time feedback about how many faces are detected in the viewfinder, and photos are labeled with short, automatically-generated captions. Some third-party apps like Seeing AI [microsoft.com/en-us/seeing-ai] assist with photo capture by narrating whether faces are visible and by reading text in the viewfinder. Additionally, several third-party apps like KNFB Reader [knfbreader.com] are marketed as OCR readers that process and read text in images post-capture. These systems primarily provide feedback for someone to non-visually capture and identify photos, and they do not consider how feedback preferences might change for users who may be able to do some of these tasks visually.

Blindness and Social Media

Researchers have studied how blind people, specifically screen reader users, engage with visual content on Facebook and Twitter. First, Voykinska et al. [44] and Morris et al. [29] found that blind users have similar motivations to use social networking sites as sighted individuals, emphasizing the importance of fostering accessible experiences similar to sighted users. Wu and Adamic [45] ran a large-scale study on photos publicly posted on Facebook by screen reader users. They found that screen reader users posted and shared fewer photos than average. Voykinska's smaller study [44] found that users encountered accessibility challenges navigating large news feeds and often relied on sighted people to either check photo quality or take photos for them altogether. Their participants relied on textual supplements to photos such as location information and comments for clues on photos' content, as captions were often nonexistent or insufficient.

Regarding Twitter, Morris et al. [29] surveyed 132 adults who used screen readers and analyzed their Twitter accounts along with a control group. Of the users who customized their profile picture, about 50% reported getting assistance from a sighted person to choose a photo. Their analysis of profiles and tweets revealed differences in how blind Twitter users engage, namely that they tweet fewer photos, even though photos were becoming tweeted by the general (mostly sighted) Twitter population significantly more often during the study period.

Recent design improvements to make photo consumption more accessible can be summarized in two categories. First, some social media companies have integrated automatic alternative text and captions into their platforms, such as Facebook's automatic alt text [46]. When screen reader users focus on an image in Facebook, they hear the text, which consists of the sentence, "Image may contain," followed by a series of descriptive phrases such as, "three people, people smiling." Second, Twitter has added a caption text box that when activated in the settings menu allows a user to enter a photo caption without a character limit [40]. These enhancements begin to address some challenges associated with photo-sharing but are limited by compliance issues with human-generated alt text and accuracy issues with machine-generated versions [26] and have not considered potential adaptations for users with some vision. In this work, we consider not only accessibility of photo sharing on social media but also of photo capture and editing; we look beyond only screen reader accessibility to also consider accessibility to users with small but usable amounts of residual vision. We also look beyond Facebook and Twitter to more youth-oriented media like Snapchat and Instagram.

Low Vision Access to Technology

Finally, a growing body of work [38, 39, 48] focuses on technology and people with low vision (i.e., people who are not blind, but who have significant visual impairments that cannot be addressed with corrective lenses, such as tunnel vision). Szpiro et al. [38] learned practices and challenges by observing low vision participants as they completed everyday tasks on their technology devices. For example, participants overwhelmingly used software accessibility tools like enlarged fonts or zooming in instead of specialized hardware devices like magnifiers, including using their smartphone cameras to assist them in seeing text and objects as they did everyday tasks [38, 39]. Additionally, social context and the nature of the content they wished to view were important factors in helping them to choose which assistive technologies to use. Participants encountered challenges using their smartphones, such as difficulty zooming and panning, difficulty viewing photos when inverted colors were on, and difficulty using text-to-speech in conjunction with their vision as screen reader gestures assume non-visual interaction. Our findings align with these, but we expand this work with more insights on how low vision people negotiate assistive technologies to post on photo-centric and ephemeral social media.

METHOD

We conducted an interactive, semi-structured interview study with low vision teens in Seattle, Washington, USA. To recruit the teens, we partnered with a government-run summer program that brought blind and low vision high school students together from around the state to practice daily living and professional skills. All 28 teens and their parents received consent forms upon arrival at the program and could choose whether to participate. The teens were eligible if they used social media or took photos at least once per week, and if they were willing to bring their own device to the interview and show us social media posts and content they were comfortable sharing. The first author met with all interested teens whose parents consented to their participation, overviewed what they would be asked to do during the study, and conducted a screener. The screener lasted only five minutes and assisted researchers in scheduling subsequent interviews; we asked which social networking sites they used, how often they used them, and how often they took and edited photos. Since our aim was to reveal user behavior, a broad understanding of use frequency such as daily, weekly, and monthly was chosen to mitigate the limitations of specificity in self-report data.

Fourteen of the 28 teens met our screening criteria and chose to participate (see Table 1). All participants were legally blind, a diagnosis required for admittance to the summer program. Other details about each student's vision impairment were self-reported during the interview. We distinguished severity of visual impairment amongst this set of legally blind students; the four participants who relied primarily on their screen reader for interacting with their phone were labeled *blind* since screen reader reliance, as reported in our findings,, fundamentally changed the photography experience of these users as compared to the other 10 participants whom we refer to as *low vision*, but note that some of our *blind* participants did have some residual vision or light perception. Each participant received a $25 gift card as a gratuity.

All sessions lasted around an hour and were video and audio recorded. Most sessions were conducted with two researchers in a private room at the teens' house, with the others occurring in our lab (since a few of the teens had work assignments near our lab location). We asked the participants to think out loud by telling us what they were doing on their smartphones or tablets the entire time, and we asked them to keep their device on or above a piece of paper taped on a table on which the video camera was trained.

We began by asking participants to show us their profiles on the social media sites they used most frequently. We asked for explanations of a few recent posts, such as what was happening, why they decided to post, and how they edited the photo if they had done so. To participants with an Instagram profile, we asked them to simulate posting a photo to learn if and how they would edit it. Similarly, we asked participants who had a Snapchat profile to simulate using the Snapchat selfie camera if they took selfies. We also asked them to explain how they viewed and responded to timed snaps.

After, we asked participants to show us some photos they had saved on their devices and discuss the stories behind capturing, editing, and sharing these images. Targeted questions included whether they took photos for functional purposes such as to see things in their environment, and

P#	Gender	Age	Visual Impairment	Onset	Smartphone Accessibility Features Used	Social Media Account(s)		
						Facebook	Instagram	Snapchat
8	F	16	Totally blind	9	Screen reader (*VoiceOver*)	x	x	
9	M	17	Night blindness	3	Larger font, *Zoom*, screen reader (*VoiceOver*)	x	x	
11	M	16	Nystagmus	Birth	*Zoom*, screen reader (*VoiceOver*)	x		x
15	F	17	Sees only large objects, night blindness	Birth	Screen reader (*TalkBack*)	x		x
1	Nonbinary	16	Low vision (low visual acuity with full visual field)	Birth	*Zoom*, screen reader (*VoiceOver*)		x	
3	F	16	Limited visual field, slow adjustment to light changes	Birth	*Magnification*, larger font, increased brightness	x	x	x
4	Nonbinary	18	Near sighted, blurry vision	Birth	Larger font	x	x	x
6	M	17	Poor peripheral vision, night blindness	17	None		x	x
7	F	17	Low vision (low visual acuity with full visual field)	Birth	Larger font		x	x
10	F	17	Light sensitivity, near sighted in one eye, far sighted in the other	Birth	*Magnification*, inverted colors	x	x	x
12	F	16	Nystagmus, low depth perception	Birth	*Magnification*, larger font, inverted colors	x	x	x
13	F	16	Blurry vision, low depth perception	12	*Magnification*, inverted colors		x	x
14	M	17	Poor central vision	15	*Magnification*	x	x	x
16	F	19	Difficulty reading, night blindness	Birth	Larger font	x	x	

Table 1. Participant demographics. P8, P9, P11 & P15 (top, shaded) are considered *blind*, others are *low vision*.

whether they asked others to take photos for them. At the interview's conclusion, we asked them to send us a few photos they had shown us for our reference during analysis. Throughout the study, we reminded participants they could choose not to show us any photos or posts.

Data consisted of audio and video recordings, researcher field notes, and photos sent to us by participants. We took a grounded theory approach to our analysis like that outlined in [13]. The first and second authors transcribed and analyzed audio and video data. They first created an initial code book while reading through transcripts. In regular meetings, codes and themes were presented to the research team where any researcher disagreements were discussed until agreement was reached. The final code book had thirteen higher-level codes each with more specific lower-level codes. Higher-level codes included *use patterns* (assistive technologies, photography, and social media platforms, for example), *perceptions of social media norms*, *challenges* (accessibility barriers, for example), and *practices* (such as accessibility workarounds). An example of lower-level themes for assistive technologies included codes like smartphone-based zooming, app-based zooming, enlarged font, inverted colors, and increased brightness. Final codes were again applied to the data to distill the themes we present below. Our full codebook is included in the Supplementary Material.

Participants

Table 1 shows detailed participant demographics. In summary, we interviewed fourteen visually impaired teenagers: eight females, four males, and two who identified their gender as nonbinary. Participants averaged 16.76 years old (sd 0.89). All participants had a smartphone (six iOS and eight Android) that they brought to the interview, and two (P1 and P13) also brought an iPad. Note that participant numbers end at 16 instead of 14; that is because P2 did not satisfy the screener criteria and P5 canceled their interview. Four of our participants (P8, P9, P11, and P15) relied extensively on screen readers, and for our analysis we consider them *blind*; we consider the other ten *low vision*. Table 1 also shows which assistive technology software participants used; use was quite variable, at times participants would use multiple assistive technologies simultaneously, and other times they would toggle on and off individual settings.

FINDINGS

In this section, we first summarize findings from our blind participants, followed by the low vision participants. We divide the low vision findings as follows: general social

media and photo capture behaviors, challenges taking selfies, strategies and issues related to zooming in on photos and social media posts, how participants edited photos on Instagram, and how they managed ephemeral content on Snapchat.

Blind Participants

As noted above, four of our participants (P8, P9, P11, and P15) relied on screen readers. First, we overview their social media use, summarized in Table 1. Overall, they tried to engage with photos and social media, even when inaccessible. Except for P11 (who only used YouTube), P8, P9, and P15 used Facebook most frequently.

During the study, we observed these participants struggle to use Instagram and Snapchat both when heavily zoomed in and with a screen reader. P15 had only begun using Snapchat a week before the study; it was largely not accessible for her, but she wanted to try using it since most teens in the program used it to chat.

Although they were blind, these participants perceived an expectation that photos be of high quality before posting on Instagram. P9 explained how he cropped a selfie taken in his kitchen to improve its quality. "I didn't want the counter in the frame. They [counters] were kind of messy…. I don't want people to think I live in a messy house. I want to look not really nice but just ok, so people don't make fun of me."

On average, our blind participants took photos monthly (see Table 2). P8 was unique with weekly usage, asking others to take video on her behalf, her preferred medium given its audio content. The other three strongly preferred to take their own photos, concerned it would make them less independent if they were to have others operate the camera.

Affirming prior work including [1, 2, 15, 19], we found that one common photo capture strategy was to take several photos in hopes one would turn out. P15 described her strategies in more detail. She would touch the object of interest, position her phone close to where she perceived the middle of the object, back up, and take several photos. A few days before the study, P15 tried taking her first selfie, and she also described this process to us. She stood by a well-lit wall in hopes her body would contrast well and alternated taking a selfie and bringing her phone close to her face to learn whether her full body was in the photo. The resulting selfie was not of particularly high quality, but it was important to her to use her small amount of remaining vision to confirm that the photo had successfully framed the object of interest (in this case, herself).

These participants barely edited photos. The only editing was done by P9 and P11. Editing consisted of cropping out unwanted objects or cropping to center prominent ones.

In summary, we found that the behaviors of our four *blind* participants both affirmed and expand prior work on social media posting and photo capture [1, 2, 10, 15, 44, 45]. We expand this work with the following: participants wanted to use popular social media even if somewhat inaccessible and photo-intensive, and they posted according to visual social norms surrounding particular platforms. They largely preferred to take their own photos, and they still wanted to use even a small amount of vision (if available) to verify photo quality, some even engaging in light editing.

Social Media and Photo Capture

For the remainder of the findings section, we focus on our ten *low vision* participants, beginning with a summary of their social media and photo capture use patterns. Participants' social media accounts are listed in Table 1. They used these platforms in line with other teens [8, 25]; social media was a public space for them to connect with friends and how their friends used certain social media influenced their use patterns. However, as will be elaborated next, vision impairment uniquely impacted use. First, similar to sighted teens, many had a Facebook account, but they posted on it less often than on Instagram and Snapchat. Instagram was perceived as a place to post high quality photos [3, 14] and Snapchat was considered a platform through which to send in-the-moment photos and videos with close friends [5, 12, 31]. We elaborate how some participant behaviors aligned with these perceptions later in the "Editing" and "Ephemerality" sections.

Photo capture frequency for taking selfies, other photos, and asking someone else to take a photo are in Table 2. Unlike our blind participants, the teens with low vision could mostly see the viewfinder well enough to know whether the intended objects were in the shot. But like the blind participants, they rarely asked others to take photos for them. Specific situations when they would ask another to take their photo included wanting to strike a pose or when they had difficulty taking a selfie (detailed in the following section). Most participants did not have strong reasons for not asking for help, rather they simply did not think to do so or didn't feel comfortable trusting their phone with a stranger. A few, however, did feel strongly about taking their own photos. For example, P12 could not imagine someone else capturing her intended shot, "I can get the lighting and focus the way I want and capture what I want. When you look at the picture, it is almost like an entire essay. You can capture a picture in a certain way that sums up everything." Previous work [1, 29] suggests that blind participants often seek sighted assistance to take photos. With our participants, even three of the blind ones, we found a preference for taking their own photos, both to capture their intended shot and to remain independent.

Selfies

Nine participants reported taking selfies (both individual and group shots), but six described selfie-capture challenges. Challenges emerged since the camera had to be placed far from their face; as shown in Figure 1, holding their phones close to their face was a common strategy our participants used to view on-screen content. Not only did this challenge increase selfie-capture difficulty, but resulting shots were often deemed poor quality because of the way participants

strained to see the viewfinder. They managed these challenges in multiple ways, including asking others to take group selfies, taking multiple selfies in quick succession, or alternating bringing the phone closer to and farther from their face to check photo quality after each shot.

P10, who is nearsighted in one eye and farsighted in the other, showed us three group selfie attempts taken before being satisfied with the fourth. She described her process for determining quality: "I decide if everyone's looking at the camera. Then I check with the group and see what they think of the photo and then decide if I like mostly how I look. Most of the time when I take selfies my eyes look squinty or my left eye does this weird thing where it goes up into my head when my right eye isn't doing that." Participants with a limited visual field reported similar dissatisfactions with their selfies as positioning their eyes to see the viewfinder meant they would appear not to be looking at the camera.

The Snapchat selfie camera, popular among our participants, is unique in that it shows users augmented reality prompts such as "make a funny face" and offers the ability to overlay a whimsical "lens" aligned atop the selfie, such as adding virtual animal ears or masks. These prompts, which are meant to be silly and fun, made taking selfies even more challenging. P7 demonstrated how she used the Snapchat selfie camera and explained her frustration: "I can't tell which lens is coming up or where I need to click or where I need to swipe for a bunny or pizza face. I'll have to get close to the camera, find the lens, and then back. It takes a long time, especially when they say, 'open your mouth' 'raise your eyebrows' or 'share with a friend.' It [the prompt text] shows up and I already have the phone far away, so I can take the picture. So, I can tell something showed up on the screen, but I can't tell what it was." During her demonstration, she began with the phone at arm's length, brought her phone closer to her face upon seeing a prompt she couldn't read, read the prompt, swiped back so it would reappear by the time her phone was repositioned at arm's length, and performed the prompted action as the phone took the photo.

P#	Photo	Selfie	Have Others Capture	Edit
8	< monthly	< monthly	weekly	Filter
9	monthly	< monthly	< monthly	Crop
11	monthly	rarely	monthly	Crop/Filter
15	monthly	once	monthly	NONE
1	monthly	rarely	rarely	Crop/Filter
3	daily	weekly	monthly	Crop/Filter
4	daily	daily	rarely	Crop/Filter
6	weekly	daily	rarely	Crop/Filter
7	daily	weekly	weekly	Crop/Filter
10	weekly	weekly	rarely	Crop/Filter
12	weekly	monthly	monthly	Crop/Filter
13	weekly	weekly	monthly	Crop/Filter
14	weekly	monthly	monthly	Crop/Filter
16	monthly	< monthly	Rarely	Filter

Table 2. Photography frequency and edit usage. P8, P9, P11 & P15 are considered *blind*, others are *low vision*.

In summary, selfies were popular among our participants, yet most encountered challenges since the camera must be positioned far from their face. Additionally, recent enhancements in cameras like augmented reality prompts compound this difficulty.

Zooming Behavior

In this section, we first describe participants' zooming behavior, and we continue with some challenges they encountered while zooming. We italicize *Zoom* when referring to the name of the *Zoom* accessibility feature in iOS[1] and *Magnification* when referring to the name of the corresponding accessibility feature in Android[2] to differentiate from zooming features built into apps, which our participants also used extensively.

Almost all participants used zoom extensively to enlarge content (see Table 1). They zoomed in while showing us their social media accounts and photos to better see photo features including details in the background, to read text inside photos, and to read text associated with photos such as the location and people tagged.

An unexpected finding was that participants used zooming to emphasize photo content during the study; this appears to be a unique way in which VIPs share photos with collocated people. Participants zoomed in on objects they wanted to emphasize, like P3 who showed us a photographed campfire she thought looked cool. P12 was very insistent that she doesn't take a lot of selfies but showed us a rare exception. "See? I thought 'oh my gosh I have a butterfly on my head.'" Her zooming coincided with "see," making it evident her action was meant to bring our attention to the butterfly (Figure 3).

Next, we observed two main challenges while participants zoomed in to see their screens. First, accessibility modes' zooming and panning gestures conflicted with app-based gestures, resulting in unintended actions by our participants. Second, multiple zoom features became confusing as our participants had difficulty keeping track of which zoom feature afforded them which capabilities.

First, some participants performed frustrating and unintended actions while using *Zoom* and *Magnification,*

[2] *Magnification* is an accessibility feature that can be enabled in the Settings menu of Android devices; when enabled, a triple-tap gesture magnifies the screen. https://support.google.com/accessibility/android/answer/6006949?hl=en

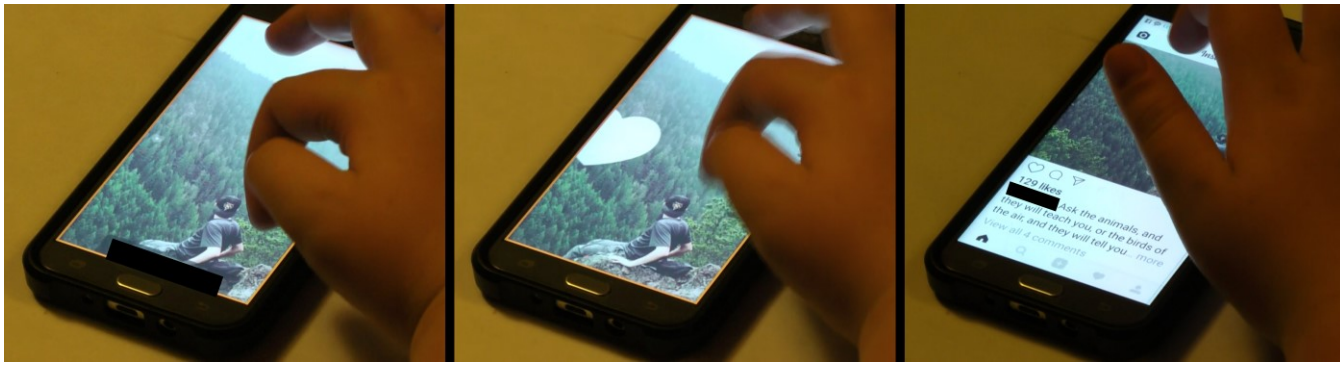

Figure 2. P10 used her smartphone's built-in *Magnification* accessibility feature to view this photo on Instagram. When finished, she did a three-finger tap to zoom out (left). This gesture was interpreted as a double tap, which liked the photo (middle). In frustration, she then zoomed out and un-liked the photo (right).

such as losing track of and accidentally liking photos. However, they still often used these accessibility features on their smartphones instead of Instagram's zoom features. Zooming in to a photo on Instagram requires a user to hold a photo, zooming out as soon as the user lifts their finger. While panning around a zoomed-in photo on Instagram for example, a pan gesture was interpreted as swipe, revealing the messages screen. After this happened to P14, he closed the messages screen to find an updated Instagram feed and the photo was no longer visible.

P10 explained her frustration when she accidentally liked photos on Instagram while zooming in. "I accidentally liked this photo because I double tapped on the picture when I was trying to zoom in. Zoom in [with *Magnification*] is triple tap. If I'm tapping three times sometimes it interprets as two and it likes. It's frustrating at times." (see Figure 2).

Additionally, some participants became confused about which gesture to use while zooming with their phone's software versus the app-based zoom feature. For example, while browsing Instagram with his phone's *Magnification* software activated, P14 tried to zoom in by pinching instead of the required triple tap gesture (Instagram's zoom feature, which P14 also uses, is activated by pinching on a photo). Another confusion came in managing which zoom feature could zoom in to what content. For example, unlike the *Zoom* and *Magnification* software built into phones, Instagram and Facebook's zoom features only allow users to zoom in to photos. This made reading text content annoying for our participants. Attempting to use Instagram's zoom feature, four participants tried to zoom in on operational buttons, for example, to better see filter thumbnails. P13, who only occasionally uses her smartphone's *Zoom* software, was delighted to discover Instagram's zoom feature during her interview. While zooming into photos on her Instagram feed, we noticed her pinch some accompanying text like location information and friends tagged, which did not successfully zoom in.

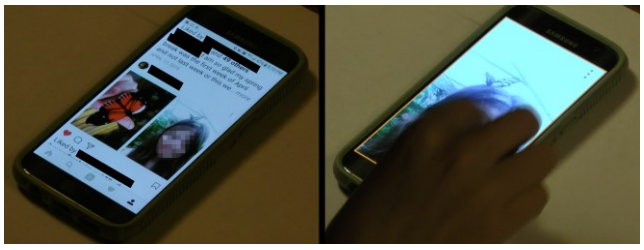

Figure 3. While telling researchers a story about her photos, P12 zoomed into the right photo in this collage to emphasize the butterfly on her head.

Overall, zooming was the most common way our participants accessed content. In fact, we observed a unique application of zooming, to emphasize objects in photos shown to the researchers. Unfortunately, frequent use of the *Zoom* and *Magnification* accessibility features led to unintended actions. Additionally, app-based zoom features were not robust enough for our participants' needs, and keeping track of multiple zoom features became confusing.

Editing

Here, we describe how six of our participants edited their photos before posting them on Instagram. P7's sentiment highlighted the value of editing for this subgroup as not to correct photos, but to make the photo more fun and add finishing touches representative of their personality or social media aesthetic [3]. "I normally never post a picture that doesn't go through editing. I feel like a filter… just kind of finishes a photo."

We extrapolated two main themes. First, some participants' photo editing was influenced by their visual impairment. Second, some edited photos to project an image they perceived their audience would appreciate.

Some participants made editing decisions that helped them to see the photo better. P4 edited a selfie during the interview explaining, "I changed the brightness, contrast, and structure to make it more natural. I increased the warmth because my eyes work better with warmer colors." P10 was similarly motivated as she decided between two Instagram filters that both brightened a group selfie. "I really like this one [filter she chose] because it just makes it a bit brighter. If it starts bothering my eyes because it's too bright, I don't post it."

Additionally, some participants temporarily filtered photos they did not intend to post to see them better. P3 occasionally saved photos that her friends had posted on social media and increased their brightness to better recognize people.

Participants tailored their posts to fit the image they wanted to project on Instagram. For instance, P4 made editing decisions to appeal to their followers. "I decided to spike my hair one day, and I made the photo really crisp so everything that I was wearing, and my friend was wearing, we had studs on our jacket, was very pronounced. I put filters on it. It's very defined." P4 put a black and white filter on a different photo because of seeing that filter applied on several photos their friends had posted.

Some participants instead endeavored to share photos that looked as close to what they remembered seeing with their eyes as possible. P6 explained how he attempted to capture a nature scene he wanted to share, "There's a mountain in the far distance. If I position it at a certain angle, then it shows more definition. So, it shows the shadows, what the picture really is. If you take it full on you don't see the 3D part of it." He did not edit the photo before posting. Interestingly, P12 had the same motivation, but spent several minutes with us editing a photo until it better matched her memories.

Like previous work on Instagram [3, 17, 27], our participants edited photos not to correct them *per se*, but to enhance them to increase engagement on Instagram. Editing for their Instagram audience and to achieve a particular aesthetic shows that our participants had similar perceptions of Instagram to their peers as a place to post high quality photos. But we noticed that editing practice was sometimes uniquely influenced by their visual impairments, and that editing was sometimes used in a temporary manner for accessibility rather than aesthetic purposes.

Ephemerality

In this section, we share how our participants managed ephemeral content, most often viewed on Snapchat. In summary, timed posts were difficult for them, despite features like replay [28] meant to give users more time to view snaps. These challenges were compounded by participant perceptions that screenshotting ephemeral content violated a sender's privacy, a tension also noted in literature on sighted users of Snapchat [47]. P12 explained why she avoided screenshotting: "I will get annoying messages from friends, 'You screenshotted it.' and I'm like, 'Yes, because you put a time limit on it for your blind friend.' One time my friend sent me a picture of a boy she likes and I screenshotted it and it scared her." A counter to these challenges came in the teens' Snapchat group for their summer program; the culture was that no messages be sent with time limits.

P14 summarized the two main challenges participants had viewing snaps with assistive technologies, which led most to abandon them or use the limited time to view what they could see: "If there is a caption I am trying to read I'll have to triple tap, zoom in [with *Magnification*], and swipe through the screen, and a lot of times it's not fast enough. Reading the captions is super annoying. If you tap three times sometimes you'll tap one too few or many and click out of the photos." As mentioned in the "Zooming" section, unintended actions were frustrating, but they became more consequential with ephemeral content; toggling on assistive technologies took valuable time and could accidentally exit them from a snap, removing it forever.

Our participants with a limited visual field had to prioritize which part of the screen to view in the given time. P6, who only has central vision, explained, "If it's not in the middle, I have to refresh [replay] and look at the top or bottom of the screen because sometimes my peripheral vision misses it." Some, like P4, preferred to justify screenshotting, "I can't zoom into the captions. So, a lot of that time I take a snapshot of it and I hope they don't get a notification that I just took a snapshot of their picture. If they're going to say anything, I have a pretty legitimate excuse, I can't see." Though P4 was comfortable justifying their decision to screenshot, they also mentioned enjoying screenshotting Instagram posts, an action that does not notify the poster.

Finally, some, like P13, responded as if they understood the snap, even when they were not able to inspect it in the allotted time. "If I don't get the whole message but get the gist, I'll say 'haha' or a weird face that, based on the part I read, makes sense. If it's funny, I'll stick my tongue out [use a tongue-face emoji]. Sometimes replaying it is enough to get it. If not, I will send question marks or nod it away."

Our participants used Snapchat as much as they could. But cumbersome assistive technologies, time limits, and awareness of social norms around Snapchat screenshotting presented significant barriers in accessing the ephemeral content popular among their friends.

Functional Photos

Our final finding concerns functional photography, one of the most common types of photos our participants captured. We take up functional photography from Kindberg *et al.* [23] and adopt a narrower definition for those taken by our participants, photos they took to better see things in their environment. Unlike prior work on functional photo capture by blind people [6, 7, 10, 49], our low vision participants did not have difficulty capturing the intended image or interpreting its contents. They primarily used functional photography to quickly capture a photo of something they could not see in their environment, view its contents, and immediately delete it. Some participants used the camera built into Snapchat instead of their phone's native camera because it facilitated quicker access to the taken photo and an onscreen option to delete the photo immediately. P4 explained a time-sensitive incident when they used their Snapchat camera functionally, "I was across the street and trying to make my bus. I didn't want to rush into traffic, so I used my Snapchat camera to see if the light was red or green. I took a picture and then I could instantly see it after I zoomed

in on it and I realized, 'oh, I can walk if I walk right now.'" Functional photography was important for our participants, decreasing their use of external hardware magnification devices.

DISCUSSION

Our findings help to upend misconceptions that visually impaired people are not interested in engaging with emerging photo-centric and ephemeral media. Instead, our VIP teens represent a user group that frequently edits and posts photos on these social media platforms, having similar motivations as more widely-studied sighted teen users. They frequently take photos, preferring not to ask for assistance. They make choices to project a socially-acceptable image while balancing their access needs with social norms surrounding Instagram and Snapchat.

This paper revealed interesting questions for future work, especially given the limitations of our in-lab interview methodology. We encourage researchers to expand on our contributions with other methods such as those outlined below. First, our participants performed photo sharing [41, 42], tailoring social media use according to norms among their friends even when their visual impairments made this inconvenient. For example, P9, a blind participant, cropped unattractive objects from a photo to ensure it was Instagram quality. Yet our participants also performed collocated photo sharing uniquely by zooming into important objects in photos during their interviews. Future work in this area could more deeply engage with VIPs to learn how they expand our knowledge of photo sharing performance. Second, Kindberg's [23] taxonomy of photo categories suggests functional photos are mainly captured to remember something for the future or to share information with someone else. We expand the purpose of functional photos to represent our participants who primarily took them for quick reference and deletion, a personal ephemeral content of sorts. Third, we encourage more research at the intersection of VIPs and ephemeral content. Similar to prior work [12, 47], our participants tried to prevent loss of information, but they leveraged these strategies to prevent losing content they had never seen as opposed to saving it for repeated viewing. This important difference can help HCI research to consider ephemerality more flexibly according to different user needs.

Next, our participants encountered challenges managing different assistive technologies while using social media. However, they were so interested in using the same photo-intensive and ephemeral social media sites as their sighted peers that they developed workarounds. As such, we believe this user group highlights exciting opportunities for accessibility design improvements for casual photography and social media.

Design Recommendations

Here, we offer ideas for design improvements that might make photo-centric and ephemeral social media sites more inclusive of visually impaired users.

First, evidenced by our participants' variety of visual impairments and by prior work [38, 39], it is important for designers to be cognizant that visual impairment is a variable condition, meaning that visually impaired people use a variety of assistive technologies. Choosing the best assistive technology, if any, depended on a user's goals (viewing photos versus reading text, for example) and considerations of whether assistive technologies are compatible with certain app features (e.g., Instagram's zooming not working while a user edits a photo). We highlight photo-centric and ephemeral social media sites as a particularly important place for accessibility features to be built in. Several users had different accessibility settings that enabled either the best text viewing or the best photo viewing, but not both; however, viewing text and photos simultaneously is particularly important for many social media. These platforms could allow users to zoom in not only on photos, but text content as well (including buttons and menu items), zoom on photos even while preparing a post, and invert colors of text while preserving photos in their original state. P7 pointed out the "night mode" feature on Twitter that only inverts text[3]; along with iOS's recently-launched Smart Invert Colors [21], we offer these as examples existing potential solutions.

An interesting way our participants applied filters was to see photos better. While filters have thus far been designed into camera apps and social media sites to enhance photos for sharing, similar enhancements could be made available to visually impaired users to temporarily apply to photos posted by others for easier viewing. Additionally, it may be valuable to investigate designing new types of filter options that offer visibility benefits to people with varying types of visual impairments.

Taking selfies was cumbersome for our participants. We propose that non-visual feedback be built into selfie cameras so people with low vision do not have to activate their phone's screen reader solely for this task. Possible inspiration could come from the Lumia Selfie App [22] for Windows phones, which enables a user to take a selfie with the back camera; the app alerts the users by beeping until they're centered, at which point the app automatically takes the selfie. In the case of augmented reality selfie cameras, such as that on Snapchat and the Camera app in iOS 11 [37], we propose that users be able to pause moving augmented reality content on the selfie camera. This option would allow a user to move their screen closer for easier viewing before re-extending it to take the photo.

[3]https://www.engadget.com/2016/08/22/twitter-night-mode-for-ios/

One of the biggest challenges for our participants was viewing ephemeral content. We first especially recommend building accessibility features into social media, since toggling on smartphone-based accessibility software meant participants sometimes lost access to content before even seeing it. Additionally, Snapchat could default snaps to a longer time limit if it senses the use of assistive technology options on a recipient's phone. Further, Snapchat could consider allowing recipients to customize how messages are presented; for example, users with poor peripheral vision may choose to realign the placement of any overlaid text near key areas of photos (e.g., faces, main objects), so they don't have to choose whether to focus their central vision on reading text or viewing key areas of the photo.

Finally, our participants took functional photos to quickly see something and then wanted to delete them as soon as they obtained the desired information. We propose that camera apps, like the Snapchat camera, show the user their photo immediately after capture and position a delete button conveniently to streamline this process.

CONCLUSION

In this paper, we presented a qualitative investigation of how visually impaired teens engage with smartphone photography and social media platforms popular among their peers. Though they encounter challenges using these apps, they leverage several compensatory strategies that inspired our design recommendations.

Through our interviews with visually impaired teens, we aimed not to provide representative experiences of this user group, but rich accounts that push back on misconceptions about how people with visual impairments experience photography. We learned that teens who are blind or low vision are not disinterested in photography. In fact, they were interested in engaging with photos visually as much as possible, as P4 succinctly described, "I'm a really visual person for being visually impaired." Despite visual impairment, these teens enjoy smartphone photography and social media apps popular among their peers, even when they are premised on photos and ephemerality. We hope these findings serve as motivation for other types of studies on how visually impaired people, and particularly young people who are heavy technology users, engage with popular technologies and social media.

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REFERENCES

1. Dustin Adams, Lourdes Morales, and Sri Kurniawan. 2013. A qualitative study to support a blind photography mobile application. In *Proceedings of the 6th International Conference on Pervasive Technologies Related to Assistive Environments* (PETRA '13). ACM, New York, NY, USA Article 25, 8 pages. DOI=http://dx.doi.org/10.1145/2504335.2504360
2. Dustin Adams, Sri Kurniawan, Cynthia Herrera, Veronica Kang, and Natalie Friedman. 2016. Blind Photographers and VizSnap: A Long-Term Study. In Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '16). ACM, New York, NY, USA, 201-208. DOI: https://doi.org/10.1145/2982142.2982169
3. Saeideh Bakhshi, David A. Shamma, Lyndon Kennedy, and Eric Gilbert. 2015. Why We Filter Our Photos and How It Impacts Engagement. In ICWSM, 12-21.
4. Jan Balata, Zdenek Mikovec, and Lukas Neoproud. 2015. BlindCamera: Central and Golden-ratio Composition for Blind Photographers. In Proceedings of the Mulitimedia, Interaction, Design and Innnovation (MIDI '15). ACM, New York, NY, USA, Article 8, 8 pages. DOI: https://doi.org/10.1145/2814464.2814472
5. Joseph B. Bayer, Nicole B. Ellison, Sarita Y. Schoenebeck, and Emily B. Falk. 2015. "Sharing the small moments: ephemeral social interaction on Snapchat." Information, Communication & Society: 1-22.
6. Jeffrey P. Bigham, Chandrika Jayant, Hanjie Ji, Greg Little, Andrew Miller, Robert C. Miller, Robin Miller, Aubrey Tatarowicz, Brandyn White, Samual White, and Tom Yeh. 2010. VizWiz: nearly real-time answers to visual questions. In Proceedings of the 23nd annual ACM symposium on User interface software and technology (UIST '10). ACM, New York, NY, USA, 333-342. DOI=http://dx.doi.org/10.1145/1866029.1866080
7. Jeffrey P. Bigham, Chandrika Jayant, Andrew Miller, Brandyn White, and Tom Yeh. 2010. VizWiz:: LocateIt-enabling blind people to locate objects in their environment. In 2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition-Workshops, pp. 65-72.
8. danah boyd. 2014. It's complicated: The social lives of networked teens. *Yale University Press*.
9. Erin L. Brady. 2015. Getting fast, free, and anonymous answers to questions asked by people with visual impairments. SIGACCESS Access. Comput. 112 (July 2015), 16-25. DOI=http://dx.doi.org/10.1145/2809915.2809918
10. Erin L. Brady, Yu Zhong, Meredith Ringel Morris, and Jeffrey P. Bigham. 2013. Investigating the appropriateness of social network question asking as a resource for blind users. In Proceedings of the 2013 conference on Computer supported cooperative work (CSCW '13). ACM, New York, NY, USA, 1225-1236. DOI=http://dx.doi.org/10.1145/2441776.2441915
11. Michele A. Burton, Erin Brady, Robin Brewer, Callie Neylan, Jeffrey P. Bigham, and Amy Hurst. 2012.

Crowdsourcing subjective fashion advice using VizWiz: challenges and opportunities. In Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility (ASSETS '12). ACM, New York, NY, USA, 135-142. DOI=http://dx.doi.org/10.1145/2384916.2384941

12. Luiz Henrique ~~C.B.~~ Cavalcanti, Alita Pinto, Jed R. Brubaker, and Lynn S. Dombrowski. 2017. Media, Meaning, and Context Loss in Ephemeral Communication Platforms: A Qualitative Investigation on Snapchat. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17). ACM, New York, NY, USA, 1934-1945. DOI: https://doi.org/10.1145/2998181.2998266
13. Kathy Charmaz. Constructing grounded theory. Sage, 2014.
14. Emilio Ferrara, Roberto Interdonato, and Andrea Tagarelli. 2014. Online popularity and topical interests through the lens of instagram. In Proceedings of the 25th ACM conference on Hypertext and social media (HT '14). ACM, New York, NY, USA, 24-34. DO=http://dx.doi.org/10.1145/2631775.2631808
15. Susumu Harada, Daisuke Sato, Dustin W. Adams, Sri Kurniawan, Hironobu Takagi, and Chieko Asakawa. 2013. Accessible photo album: enhancing the photo sharing experience for people with visual impairment. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13). ACM, New York, NY, USA, 2127-2136. DOI: https://doi.org/10.1145/2470654.2481292
16. Kjersten L. Hild. 2014. Outreach and Engagement through Instagram: Experiences with the Herman B Wells Library Account. Indiana Libraries 33, 2 30-32.
17. Yuheng Hu, Lydia Manikonda, and Subbarao Kambhampati. 2014. What We Instagram: A First Analysis of Instagram Photo Content and User Types. In Eighth International AAAI Conference on Weblogs and Social Media.
18. Instagram. About. https://www.instagram.com/about/us/ Retrieved 9/12/17.
19. Chandrika Jayant, Hanjie Ji, Samuel White, and Jeffrey P. Bigham. 2011. Supporting blind photography. In *Proceedings of the 13th International ACM SIGACCESS Conference on Computers and Accessibility* (ASSETS '11). ACM, New York, NY, USA, 203-210. DOI=http://dx.doi.org/10.1145/2049536.2049573
20. Hernisa Kacorri, Kris M. Kitani, Jeffrey P. Bigham, and Chieko Asakawa. 2017. People with Visual Impairment Training Personal Object Recognizers: Feasibility and Challenges. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA, 5839-5849. DOI: https://doi.org/10.1145/3025453.3025899
21. Jordan Kahn. 2017. New for Accessibility: 'Smart Invert Colors' in iOS 11, macOS Onscreen Keyboard, Text and Photo Detection for Voiceover and More. https://9to5mac.com/2017/06/08/wwdc-accessibility-ios-11-macos-high-sierra-keyboard-smart-invert/ Retrieved 9/12/16.
22. Anand Khanse. 2015. Download Lumia Selfie App for Windows Phone, to Capture Your “Selfie” Moments. http://www.thewindowsclub.com/lumia-selfie-app-windows-phone Retrieved 9/13/17.
23. Tim Kindberg, Mirjana Spasojevic, Rowanne Fleck, and Abigail Sellen. 2005. The ubiquitous camera: An in-depth study of camera phone use. IEEE Pervasive Computing 4, 2 42-50.
24. Walter S. Lasecki, Phyo Thiha, Yu Zhong, Erin Brady, and Jeffrey P. Bigham. 2013. Answering visual questions with conversational crowd assistants. In Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '13). ACM, New York, NY, USA, , Article 18 , 8 pages. DOI: http://dx.doi.org/10.1145/2513383.2517033
25. Amanda Lenhart, Maeve Duggan, Andrew Perrin, Renee Stepler, Harrison Rainie, and Kim Parker. Teens, social media & technology overview 2015. Pew Research Center [Internet & American Life Project], 2015.
26. Haley MacLeod, Cynthia L. Bennett, Meredith Ringel Morris, and Edward Cutrell. 2017. Understanding Blind People's Experiences with Computer-Generated Captions of Social Media Images. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA, 5988-5999. DOI: https://doi.org/10.1145/3025453.3025814
27. Lydia Manikonda, Venkata Vamsikrishna Meduri, and Subbarao Kambhampati. 2016. Tweeting the Mind and Instagramming the Heart: Exploring Differentiated Content Sharing on Social Media. In Tenth International AAAI Conference on Web and Social Media, 639-642.
28. Bret Molina. Your Snaps Can Now Last To 'Infinity' with Snapchat’s Latest Update. https://www.usatoday.com/story/tech/talkingtech/2017/05/09/your-snaps-wont-disappear-quickly-snapchat-update/101473094/ Retrieved 9/12/17.
29. Meredith Ringel Morris, Annuska Zolyomi, Catherine Yao, Sina Bahram, Jeffrey P. Bigham, and Shaun K. Kane. 2016. "With most of it being pictures now, I rarely use it": Understanding Twitter's Evolving Accessibility to Blind Users. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 5506-5516. DOI: http://dx.doi.org/10.1145/2858036.2858116
30. Sandy Murillo. 2016. How do Blind People Take Pictures of Things?

https://sandysview1.wordpress.com/2016/01/14/how-do-blind-people-take-pictures-of-things/ Retrieved 9/16/16.
31. Lukasz Piwek and Adam Joinson. 2016. “What do they snapchat about?” Patterns of use in time”-limited instant messaging service." Computers in Human Behavior 54: 358-367. http://dx.doi.org/10.1145/2818048.2819948
32. Franziska Roesner, Brian T. Gill and Tadayoshi Kohno. 2014. Sex, lies, or kittens? Investigating the use of Snapchat’s self-destructing messages. In *Financial Cryptography and Data Security*: 64-76. Springer Berlin Heidelberg.
33. Danielle Salomon. "Moving on from Facebook: Using Instagram to connect with undergraduates and engage in teaching and learning." College & Research Libraries News 74, no. 8 (2013): 408-412.
34. Sight Unseen: International Photography by Blind Artists. 2009. University of California, Riverside
35. Snapchat. Create and Send Snaps. https://support.snapchat.com/en-US/a/create Retrieved 9/8/2017.
36. Nick Statt. 2016. Twitter Brings Night Mode to it’s iOS App. https://www.theverge.com/2016/8/22/12586178/twitter-night-mode-feature-ios-app-update Retrieved 9/15/2017.
37. Nick Statt. 2017. Apple shows off breathtaking new augmented reality demos on iPhone 8. https://www.theverge.com/2017/9/12/16272904/apple-arkit-demo-iphone-augmented-reality-iphone-8 Retrieved 9/12/17.
38. Sarit Felicia Anais Szpiro, Shafeka Hashash, Yuhang Zhao, and Shiri Azenkot. 2016. How People with Low Vision Access Computing Devices: Understanding Challenges and Opportunities. In Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '16). ACM, New York, NY, USA, 171-180. DOI: https://doi.org/10.1145/2982142.2982168
39. Sarit Szpiro, Yuhang Zhao, and Shiri Azenkot. 2016. Finding a store, searching for a product: a study of daily challenges of Low Vision people. In Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '16). ACM, New York, NY, USA, 61-72. DOI: http://dx.doi.org/10.1145/2971648.2971723
40. Twitter. 2016. Making Images Accessible for People on Twitter. https://support.twitter.com/articles/20174660# Retrieved 9/6/2017.
41. Nancy A. Van House. 2009. Collocated photo sharing, story-telling, and the performance of self. International Journal of Human-Computer Studies 67, 12 1073-1086.
42. Nancy A. Van House. 2011. Personal photography, digital technologies and the uses of the visual. Visual Studies 26, 2 125-134.
43. Marynel Vázquez and Aaron Steinfeld. 2012. Helping visually impaired users properly aim a camera. In Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility (ASSETS '12). ACM, New York, NY, USA, 95-102. DOI=http://dx.doi.org/10.1145/2384916.2384934
44. Violeta Voykinska, Shiri Azenkot, Shaomei Wu, and Gilly Leshed. 2016. How Blind People Interact with Visual Content on Social Networking Services. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16). ACM, New York, NY, USA, 1584-1595. DOI: https://doi.org/10.1145/2818048.2820013
45. Shaomei Wu and Lada Adamic, *Visually Impaired Users on an Online Social Network*. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14), 3133-3142.
46. Shaomei Wu, Jeffrey Wieland, Omid Farivar, and Julie Schiller. 2017. Automatic Alt-text: Computer-generated Image Descriptions for Blind Users on a Social Network Service. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17). ACM, New York, NY, USA, 1180-1192. DOI: https://doi.org/10.1145/2998181.2998364
47. Bin Xu, Pamara Chang, Christopher L. Welker, Natalya N. Bazarova, and Dan Cosley. 2016. Automatic Archiving versus Default Deletion: What Snapchat Tells Us About Ephemerality in Design. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing* (CSCW '16). ACM, New York, NY, USA, 1662-1675. DOI: https://doi.org/10.1145/2818048.2819948
48. Yuhang Zhao, Michele Hu, Shafeka Hashash, and Shiri Azenkot. 2017. Understanding Low Vision People's Visual Perception on Commercial Augmented Reality Glasses. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA, 4170-4181. DOI: https://doi.org/10.1145/3025453.3025949
49. Yu Zhong, Walter S. Lasecki, Erin Brady, and Jeffrey P. Bigham. 2015. RegionSpeak: Quick Comprehensive Spatial Descriptions of Complex Images for Blind Users. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI ‘15), 2353–2362. https://doi.org/10.1145/2702123.2702437