

Help Supporters: Exploring the Design Space of Assistive Technologies to Support Face-to-Face Help Between Blind and Sighted Strangers

Yuanyang Teng
Columbia University
New York, NY, USA

Yves M. Tseng
Columbia University
New York, NY, USA

Avery Reyna*
University of Central Florida
Orlando, FL, USA

Connor Courtien*
Hunter College
New York, NY, USA

Jacqueline Gibson
Columbia University
New York, NY, USA

Rajan Vaish
Easel AI, Inc.
Los Angeles, CA, USA

David Angel Rios
Columbia University
New York, NY, USA

Maryam Aziz*
Duke University
Durham, NC, United States

Brian A. Smith
Columbia University
New York, NY, USA

ABSTRACT

Blind and low-vision (BLV) people face many challenges when venturing into public environments, often wishing it were easier to get help from people nearby. Ironically, while many sighted individuals are willing to help, such interactions are infrequent. Asking for help is socially awkward for BLV people, and sighted people lack experience in helping BLV people. Through a mixed-ability research-through-design process, we explore four diverse approaches toward how assistive technology can serve as *help supporters* that collaborate with both BLV and sighted parties throughout the help process. These approaches span two phases: the connection phase (finding someone to help) and the collaboration phase (facilitating help after finding someone). Our findings from a 20-participant mixed-ability study reveal how help supporters can best facilitate connection, which types of information they should present during both phases, and more. We discuss design implications for future approaches to support face-to-face help.

CCS CONCEPTS

- Human-centered computing → Accessibility technologies; Empirical studies in collaborative and social computing.

KEYWORDS

mixed-ability, social collaboration, community-based intervention

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Yuanyang Teng, Connor Courtien, David Angel Rios, Yves M. Tseng, Jacqueline Gibson, Maryam Aziz, Avery Reyna, Rajan Vaish, and Brian A. Smith.

*Author performed this work while at Columbia University.

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1 INTRODUCTION

Blind and low-vision (BLV) people face many challenges in their daily lives when venturing outside of their homes. These include understanding what is happening around them [9, 13], getting descriptions and directions of their environments [13, 51], and deciphering what signs and other public displays around them say [46]. BLV individuals often must struggle with these difficulties on their own and they would greatly appreciate it if getting help face-to-face from surrounding people could be easier.

As the popularity of remote volunteering platforms such as BeMyEyes [3] shows, there are many people who are willing and eager to offer help to BLV people. The sighted volunteer base for BeMyEyes is thirteen times greater than the number of BLV users seeking help on the platform, according to their website in 2023. Ironically, despite the plethora of opportunities for BLV people and surrounding sighted strangers to collaborate in public, the sad reality is that such collaborations seldom happen in times of need. We ask: *Why does help for BLV people not happen more often?*

Prior research suggests that social challenges are the root cause. When it comes to finding help, which we call the *connection phase*, BLV people often report being anxious and hesitant about asking other people in their surroundings for help [9, 25, 46]. Sighted people are often unsure when and how to offer help due to their misunderstanding of BLV people's needs and abilities [20, 46]. When it comes to the process of helping itself, which we call the *collaboration phase*, the two parties face additional challenges. Sighted people struggle to communicate effectively using non-visual descriptive language [25, 27, 31, 43], leading to confusion for the BLV person. Sighted people also struggle to honor the BLV person's boundaries and preferences [15, 34], such as offering their elbow to guide them and not touching their white cane.

The problem of facilitating sighted help for BLV people is fundamentally a social problem rather than a technical one. In order to

make headway on this problem, our community must understand how to reduce the social barriers for both parties.

Recent theoretical advances, specifically the interdependence framework [5] and the concept of “community-based accommodation” [28], offer a promising direction for solving the social challenges faced by both BLV and sighted people. The concept of community-based accommodation [28] expands the legal definition of assistive technology [48], arguing that assistive technology should not only provide people with disabilities with support, but also people without disabilities so that the latter can better work with the former. Furthermore, the interdependence framework [5] argues that the goal of making the world accessible is not solely shouldered by assistive technology but can be a shared goal toward which people with disabilities, technology, surrounding people, and environmental infrastructure collaborate to achieve. Recent social computing research [14, 38, 53] has explored leveraging technologies as social agents to improve teaching and other team collaboration, but to the best of our knowledge, no work has explored how assistive technology can support face-to-face help between BLV and sighted strangers.

In this work, we undergo a research-through-design process [17, 57] to imagine and explore the design space for a new category of assistive technologies that we call ***Help Supporters***, whose purpose is to accompany both BLV and sighted people in person to address the social barriers that prevent help. We frame the design goals in terms of the two phases of help: the ***connection phase*** where the BLV person and sighted stranger establish contact, and the ***collaboration phase*** where the two parties work together in person. During the connection phase, the two parties must identify each other in the environment, greet each other, and determine whether the sighted individual is capable and available to meet the needs of the BLV person. During the collaboration phase, the parties must communicate effectively and respect each other’s boundaries. Additionally, the sighted helper must be aware of the BLV individual’s social etiquette preferences.

Our team of mixed-ability co-authors conducted an internal co-design process to identify six major design attributes for *help supporters* (Table 1), each of which could be assigned different settings to result in very different *help supporter* designs. Through an iterative design process, we arrived at four prototypes (two for each phase) to explore different regions of the design space. These prototypes are unconventional but allow us to explore the following major research questions:

Connection phase:

- RQ1. Should *help supporters* encourage BLV people to make face-to-face requests or app-based requests for help from nearby strangers?
- RQ2. What types of information should help supporters give BLV and sighted people about each other for the purpose of connecting?

Collaboration phase:

- RQ3. What types of information should help supporters provide to sighted helpers during help?
- RQ4. Where should help supporters situate the information during help?

Our objective with the two connection phase prototypes is to explore how technology should help during this phase (RQ1) and to uncover the information that should be exchanged between BLV individuals and nearby sighted strangers (RQ2). Our first prototype, the ***Person-Finder Glasses***, encourages face-to-face requests for help. It uses computer vision and audio cues to enable BLV people to detect and approach others around them. Our second prototype, the ***Volunteer Platform***, explores the use of a mobile app platform to facilitate requests and offers for help. The two parties are matched via the app before they meet in person.

Our objective with the two collaboration phase prototypes is to explore how technology can support BLV and sighted people to communicate better during the help process, once they are already together in person (RQ3 and RQ4). The two prototypes explore the types of information that should be facilitated (RQ3) and how that information should be placed for the sighted helper (RQ4). The ***Pictorial Display*** prototype takes a public display approach with an image-forward format. It consists of a wearable screen that broadcasts the messages in a lighthearted pictorial format visible to all surrounding strangers. The ***Vague Directions Flagger*** prototype takes a private display approach with a more specific form of text feedback. It is a smartphone app that runs on the sighted helper’s smartphone, identifying vague directions and descriptions that the sighted person gives (by transcribing their speech) and prompting the sighted person with ways to improve them.

Through a user study with 20 participants (10 mixed pairs of sighted and BLV participants), we uncovered insights about several key design aspects of help supporters (RQ1–RQ4), such as face-to-face requests vs. app-based requests for help (RQ1) and the types of information that help supporters should offer users during help (RQ3). We found that during the connection phase, having app-based help requests reduces social pressure for both BLV and sighted people, making both more willing to join together. BLV people prefer to know their helpers’ level of knowledge and time availability before asking for help. During the collaboration, sighted helpers seek real-time feedback on their performance and encourage help supporters to educate them when needed on the spot, yet hide their mistakes from other sighted people. We conclude our work with design implications for future efforts in technology-mediated mixed-ability help.

2 RELATED WORK

2.1 Collaboration Between BLV and Sighted Individuals

Researchers have investigated how BLV and sighted individuals collaborate for everyday activities across various scenarios such as navigation [25, 51, 52], shopping [56], workplaces [11, 33, 37], classrooms [38], and households [10]. The value of their collaboration extends beyond enabling BLV people to achieve independent living and encompasses fostering their active social integration with society as equal individuals [56], improving cohabitation in shared space [10, 11], and promoting increased mutual understanding [16]. Previous research has revealed that collaboration between sighted and BLV individuals is far from straightforward and is characterized by challenges across three areas: social barriers, misperceptions of abilities and needs, and behavioral and semantic misunderstandings.

Regarding social barriers, BLV individuals express concerns about inconveniencing sighted helpers and subjecting them to social pressure [25], and they often hesitate and feel awkward reaching out to strangers for help. BLV individuals also often lack awareness of other people in their surroundings and are anxious about identifying potential helpers when they need help [9, 46]. To address the difficulty of locating and identifying other people in the environment, several works have explored using computer vision on wearable camera feeds to give BLV people information about nearby people [19, 26, 30, 36, 45]. Most of these works, however, focus on enabling BLV people to recognize people they already know rather than to meet strangers. They also do not investigate or compare with other means of connecting the two parties (such as via an app-based platform).

Regarding the misperceptions of BLV individuals' abilities and needs, sighted strangers often mistakenly categorize BLV individuals under a uniform disability label, leading to unintentional behaviors that do not align with the actual abilities of BLV individuals [46]. This can manifest as actions such as speaking louder, slowing down, or offering unnecessary assistance like transportation when walking is feasible [20, 46]. To address this challenge, BLV-serving organizations have incorporated guidelines on their websites to educate sighted individuals. These guidelines recommend sighted individuals speak normally, talk to BLV people directly [15, 34, 54], and ask if assistance is needed [8, 54]. Despite this, during everyday encounters, many sighted people do not know how to interact with BLV individuals and help them effectively. We hypothesize that this is due to the lack of prior exposure to these guidelines. There is a lack of an in-situ and real-time approach to support sighted people in their interaction with BLV people—a goal of help supporters during the collaboration phase.

Lastly, regarding behavioral and semantic misunderstandings, BLV people prefer verbal descriptions from others that align with their non-visual perception of the environment [25], yet sighted people often describe things in visual ways (e.g., pointing “Over there!”, “It’s just past the blue door.”). Other communication challenges include confusing phrases, omitted information, and vague orientation descriptions [51], prompting researchers to develop guidelines for giving directions to BLV people [27, 31, 40, 42, 43]. Furthermore, there exists a tendency for sighted individuals to frequently misinterpret BLV people’s behavior, often mistaking the act of following an edge with a white cane (to maintain orientation) as running into obstacles [25, 51]. Our two collaboration-phase prototypes explore how assistive technology can address these types of misunderstandings, and users’ attitudes toward assistive technology working in this way.

2.2 BLV People’s Current Practices for Navigating and Sensemaking

BLV people navigate and make sense of their surroundings through a set of unique practices that often involve their non-visual senses, orientation and mobility skills, and cues and guidance from other people [46]. It is important to note that, while BLV people’s process for navigating and sensemaking is different from sighted people’s process, it is equally valid and just as effective.

Thieme et al. [46] describe a representative scenario of a BLV person navigating through an airport that highlights several methods that BLV people employ to navigate successfully. The BLV person first uses a magnifier to read signage. While trying to find the right signage, they spot a person wearing bright yellow clothes, whom they think is a security staff member that they can approach with a question. The BLV person unintentionally frames the question in a confusing way due to their vision, but is still able to successfully gather useful information from the brief conversation. Following that, the BLV person learns more about the airport’s layout by wandering around and reading more signs. Eventually, they find the signage pointing to their departure gate.

The authors identify several opportunities for assistive technology to support BLV people’s current practices: by enabling BLV people to better identify people around them and choose who to interact with, by fostering a shared understanding of other people’s actions, and by considering existing social relationships between them. Through this research-through-design process, our objective is to explore and compare different approaches that represent these opportunities for assistive technology to learn more about what designs work best and what user attitudes and preferences towards such technologies are.

2.3 Assistive Technologies Used by BLV and Sighted Individuals

The Assistive Technology Act of 1998 [48] originally defined assistive technology as tools used to aid individuals with disabilities. Since its enactment, this definition has evolved and expanded due to both theoretical research advancement and assistive technology design progress to include considerations for individuals without disabilities. This evolution marks a significant step forward in human rights that rejected disabilities as a medical condition and embraced a social model of disability [41].

Theoretical frameworks in research have broadened the scope of assistive technology to include individuals without disabilities in multiple facets. The community-based accommodation framework argues that assistive technology should facilitate access not only for individuals with disabilities, but also for those without disabilities to interact with individuals with disabilities [28]. Social accessibility studies the use of assistive technology in the presence of others, shedding light on the issue of social acceptance of such technology [44]. The interdependence framework further solidifies the view that assistive technology, individuals with disabilities, other people in proximity, and the physical environment form a partnership to address accessibility challenges and make the world universally accessible [5, 49]. Our research acts upon the existing theories to design assistive technologies for both BLV and sighted users, in a context involving all the stakeholders: sighted helpers, BLV helpees, the *help supporter* prototypes, and the physical environment.

In the domain of remote sighted assistance, tools like AIRA [1], VizWiz [7], and BeMyEyes [3] leverage crowdsourcing to connect BLV individuals with sighted volunteers or professionals for assistance. However, sighted individuals providing assistance through these systems encounter the challenge of not sharing a common visual perspective with the BLV individuals they are aiding. To address this gap, researchers have introduced tools aimed at aiding

sighted individuals in delivering more accurate navigation guidance to BLV users. This includes creating remote maps of the BLV user's environment, which enables sighted helpers to gain a better understanding of the physical surroundings and nature of tasks faced by BLV individuals [55]. Despite this, when compared to in-person co-located assistance, these remote assistance tools have limitations. They do not facilitate the physical co-presence of sighted individuals and the environment alongside BLV individuals. This absence hinders an interdependent social environment that fosters collaborative interaction and inclusivity. Our present research explores how assistive technology might facilitate face-to-face help and mutual understanding, as well as users' attitudes toward assistive technology working in this way.

3 HELP SUPPORTER PROTOTYPES

We developed four prototypes using a research-through-design process, with two prototypes for the connection phase and two for the collaboration phase.

Over the course of several months, we designed the prototypes through ideation and iteration. Two authors started with an idea of using fun-friendly Bitmoji [47] public messages to bridge the social differences between sighted and BLV people. Following this initial prototype idea, we engaged in extensive brainstorming and internal co-design sessions among four mixed-ability co-authors (three sighted and one low-vision author) and another low-vision lab member (mentioned in acknowledgment) who was on a different project team. During these discussions, the debate between private and public display of messages, as well as information format and level of detail, started to emerge. Our mixed-ability co-designers conducted a series of regular meetings. We created note cards for all the diverse perspectives and considerations from both BLV and sighted team members. Then, we used affinity diagramming to iterate and organize them into groupings. Together, we identified six design attributes that the co-designers unanimously agreed were important but could be designed in different ways. For example, within what radius should a help supporter connect sighted strangers willing to assist, and should the process of requesting help be discreet or be announced more publicly? We formulate these six design attributes in Table 1.

Next, given these six design attributes, the co-design team employed an iterative ideation process to generate a list of more than ten prototype ideas with various combinations of the target design attributes. From this pool, we selected two prototype ideas for each phase of help (the connection phase and collaboration phase) and developed them into full prototypes. Table 2 shows the design attributes for the four final prototypes. Table 3 summarizes the four prototypes and how they fit into the interdependence framework proposed by Bennett et al. [5, 49]; specifically, how the assistive technologies interact not only with disabled people but also sighted people and the environment to foster the shared goal of facilitating access.

Our two *connection phase* prototypes explore different approaches for how BLV and sighted strangers could connect with each other. The first prototype, *Person-Finder Glasses*, fosters face-to-face requests for help. It enables the BLV user to locate potential helpers

nearby so that they can ask for help face-to-face. The second prototype, *Volunteer Platform*, fosters a mobile-app volunteer platform for requesting help, similar to BeMyEyes but for in-person help. In this approach, help seekers are matched on the app with nearby pre-enrolled sighted volunteers, after which the sighted helper walks over to meet the BLV person in person.

Our two *collaboration phase* prototypes explore different ways for the *help supporters* to provide real-time information to the sighted party during the process of helping to improve the assistance they are giving. The *Pictorial Display* prototype explores a public display with a causal and fun-friendly information format. The *Vague Directions Flagger* prototype explores a private display with a formal and detail-specific information format.

Below, we describe each prototype and their implementation in detail.

3.1 Connection Phase Prototype 1: *Person-Finder Glasses*

Person-Finder Glasses are a HoloLens-based tool intended to provide a direct means for BLV individuals to connect face-to-face with potential sighted helpers. Its design is shown in Figure 1, implementation shown in Figure 2.

In public environments, BLV people have difficulties locating other people in their surroundings and are hesitant to reach out for help due to concerns about behaving in a socially awkward manner. For instance, when asking for help and not knowing surrounding strangers' exact locations, BLV people often resort to loudly shouting out to attract others' attention. We designed the *Person-Finder Glasses* to help BLV people locate, approach, and greet nearby strangers. The technique we use is inspired by prior work that leverages facial recognition to help BLV people in social interactions [30, 36]. Through this prototype, we explore how the *help supporters* may connect people directly face-to-face, and what BLV and sighted users' attitudes are toward this approach.

Person-Finder Glasses leverage computer vision technology and provide audio feedback to support BLV users in locating nearby strangers without the need for shouting. When wearing the *Person-Finder Glasses*, BLV users receive a continuous auditory cue when the headset detects a nearby stranger in the direction they are facing. This auditory cue guides the BLV user to walk forward toward the detected stranger. As the BLV user approaches the stranger and reaches a distance of approximately two feet, the continuous auditory cue is interrupted by another distinct sound cue, signaling the BLV user to halt their walking and greet the stranger by saying hello. *Person-Finder Glasses* act as a *help supporter* for the BLV user, guiding them to locate and approach a nearby stranger comfortably. This approach aims to eliminate awkward behaviors such as shouting or unintentionally bumping into others, thus improving the experience for connecting BLV users and sighted strangers.

Person-Finder Glasses is implemented using Unity on Microsoft HoloLens (1st gen). The implementation of *Person-Finder Glasses* consists of Microsoft Holographic Face Tracker [50] and audio feedback integrated through Unity and deployed to Microsoft HoloLens (1st gen) head-mounted display. The Holographic face tracking

Table 1: Summary of the six design attributes identified during our internal co-design process. We group these by the two phases of help (the Connection Phase and Collaboration Phase).

Connection Phase		
Discreetness	Environmental Coverage	Decision-Making
To what degree would BLV and Sighted people connect discreetly?	How far aways can BLV and sighted people need to connect? Can they connect from different spaces?	Who has the agency to make decision to connect?

Collaboration Phase		
Privacy	Format / Detail	Information Location
Should the help information be displayed publicly or privately?	What format or level of details should the information contained?	Where should the information be located, on the BLV or sighted person?

Table 2: Summary of how the four prototypes map to the design attributes. We group these by the two phases of help (the Connection Phase and Collaboration Phase).

Connection Phase			
	Discreetness	Environmental Coverage	Decision-Making
Person-Finder Glasses	Low: BLV person walks toward sighted helper	Must be in the same space	BLV person must choose helper randomly (without seeing profile info). Sighted people are put on the spot, making it hard to say no.
Volunteer Platform	High: BLV person sends requests through app	Can be in nearby rooms	BLV person can choose helpers after seeing their profile. Sighted people can accept/decline.

Collaboration Phase			
	Privacy	Format / Detail	Information Location
Pictorial Display	Low: Display is publicly viewable.	Low Detail: Images and short text	On BLV individual
Vague Directions Flagger	High: Display is private on sighted helper's phone	High Detail: transcripts and instructions	On Sighted individual

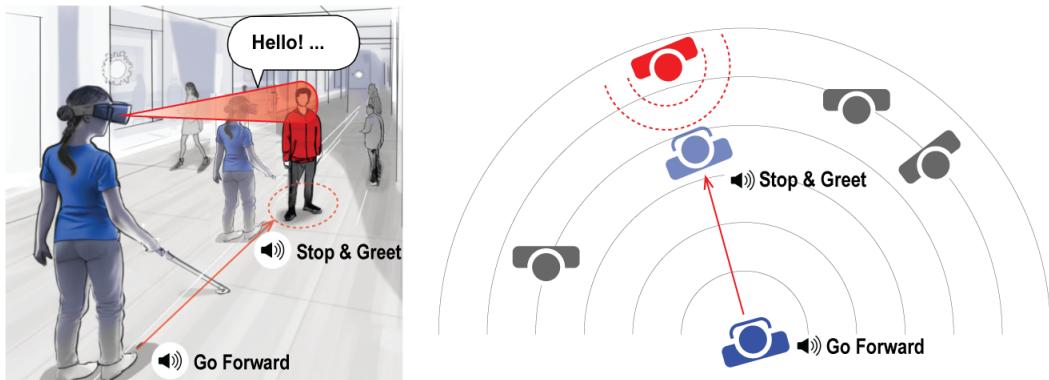


Figure 1: Person-Finder Glasses. Left: A BLV user (in blue) wearing the *Person-Finder Glasses* to locate and greet a nearby stranger (in red) in a public environment. Right: A plan view diagram showing how the *Person-Finder Glasses* support the BLV user (in blue) to detect a nearby stranger (in red) and display auditory cues.

Table 3: Summary of the *Help Supporter* prototypes for the Connection Phase and Collaboration Phase, and how each of the four stakeholders—the *Help Supporter*, the sighted individual, the BLV individual, and the environment—interact to support the collaborative process of help via the interdependence framework [5, 49].

	Prototype	How It Works	Sighted Individual	BLV Individual	Environment
Connection Phase	Person-Finder Glasses	Worn by BLV individuals. Detects nearby people, and guides BLV individuals to them via audio cues.	Goes about their day until BLV helpee approaches and ask for help.	Listens to audio cues to locate potential helpers and make a face-to-face request for assistance.	Cannot have occlusion between system and sighted individuals since the system must see them.
	Volunteer Platform	Facilitate help requests and acceptances between a BLV helpee and potential sighted helpers.	Signals their availability for help, views help requests, accepts a help request, and walks to BLV helpee.	Selects potential helpers from a list on the platform and sends help requests.	People in different rooms/spaces can connect on the platform despite occlusions.
Collaboration Phase	Pictorial Display	Publicly displays pictorial messages on the BLV helpee's chest to help sighted helper give more effective help.	Answers BLV helpee's questions, describes the environment, and views the pictorial display to improve their assistance.	Ask questions and converse with sighted helper to support the collaboration.	Other people in the environment can see the publicly displayed information.
	Vague Directions Flagger	Transcribes voice conversation to text, review directions given by the sighted helper, and flags vague directions that need clarifying.	Answers BLV helpee's questions, describe the environment, and clarify directions flagged as vague by the system.	Same as above.	Only the sighted helper can see the information since it is displayed on their smartphone.



Figure 2: Person-Finder Glasses implementation.
A blind user looks around with the Person-Finder Glasses to find help. When the system detects a face (inset, with an overlay indicating a detection), it plays a continuous spatial audio cue to guide the wearer to the other person.

detects both front and side views of human faces, but it does not detect the back of a human head.

3.2 Connection Phase Prototype 2: Volunteer Platform

Volunteer Platform is a mobile-app-based prototype that provides an indirect means of connecting BLV users and their potential helpers. Unlike the *Person-Finder Glasses*, which helps the BLV person ask for help face-to-face, the *Volunteer Platform* allows the

BLV person to ask for help indirectly via an app. The app matches them with a nearby volunteer, then guides the volunteer to the BLV person's location so the volunteer can help them in person. Figure 3 illustrates the *Volunteer Platform* design, and Figure 4 shows its implementation.

BLV users often hesitate to ask for help, and sighted users often do not know when BLV users need help and whether they should offer help. The design of *Volunteer Platform* provides a means of matching BLV users' help requests with nearby potential helpers' offering to help, thereby mitigating the connection phase's social barriers, including awkwardness, a sense of imposing a burden on others, or fear of making a false assumption that a BLV person needs help when they do not. The technique we use in the *Volunteer Platform* mirrors existing peer-to-peer applications and research for community-centered helping [4].

Both BLV and sighted users use the *Volunteer Platform* mobile app on their respective smartphones. The app starts by prompting the sighted user to provide basic information about themselves and confirm their availability to help while they have the app open. The information about themselves includes their first name, how frequently they are in the area ("Regularly," "Sometimes," or "First Time"), and whether they are a staff member or just a visitor in the area.

BLV users initiate help requests on the app. The help request includes their first name, type of mobility aid, the type of assistance they need ("Physical Guidance," "Directions to a Destination," or "Description of Environment"), and the amount of time they figure they need for the help. Following this, the app generates and displays to the BLV user a list of nearby sighted users who are available to help them.

The BLV user can then choose which helpers from this list they would like to share their help request. The specified sighted users

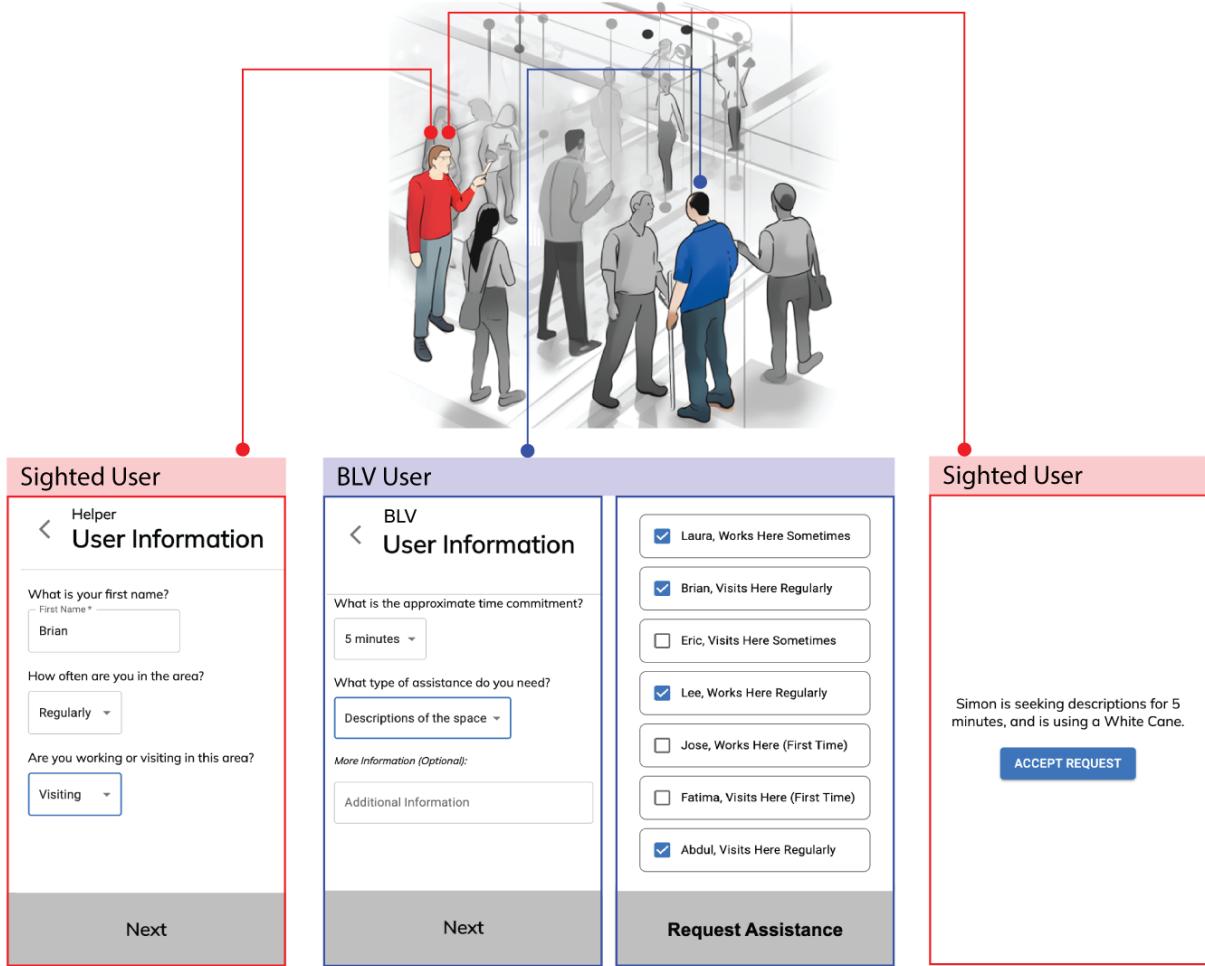


Figure 3: Volunteer Platform. Top: A BLV user (in blue) using the *Volunteer Platform* to connect with one of the nearby helpers (in red). Bottom: Screenshots of the *Volunteer Platform* mobile app. The sighted user (in red) provides basic information about themselves, and the BLV user (in blue) sends help requests to a list of nearby helpers.

receive the help request, and the match is established whenever the first helper accepts the request. The app will then share the BLV person's location with the matched sighted user so they can approach and greet the BLV person in person.

We implemented the *Volunteer Platform* as a web app using React JS. We used Ngrok [39] to generate unique, temporary URLs for our study participants.

3.3 Collaboration Phase Prototype 1: Pictorial Display

Pictorial Display is the first of the two prototypes in the collaboration phase which explores how technology can support the process of a sighted person helping a BLV person after the two parties have met. It represents the approach of displaying help information for the sighted helper using a wide variety of information types. It aims to address two common struggles during the collaboration phase:

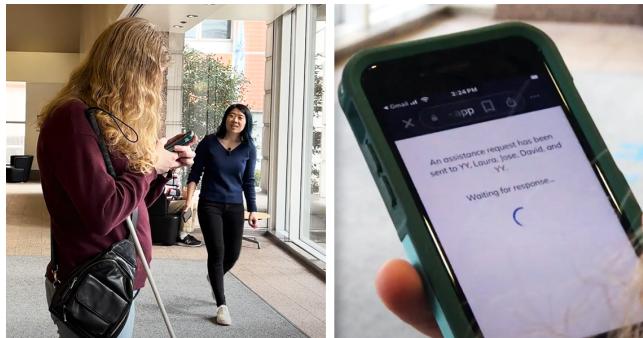
sighted people struggling to follow BLV people's boundaries and communicating directions in a way that does not depend on vision.

Pictorial Display is a wearable public display on the BLV user's chest that displays helpful information in real-time to the sighted helper in a casual, lighthearted tone as shown in Figure 5. We used a smartphone as the wearable display screen. Figure 6 shows its implementation.

The pictorial messages include a set of 20 pre-designed messages (See Appendix B) derived from BLV people's language and social etiquette preferences [8, 15, 34, 54]. Each message consists of a design with Bitmoji avatars [47] and a short text phrase. To facilitate the user study, we generated Bitmoji characters that approximately matched BLV participants' gender and ethnic identities. We use the Wizard-of-Oz method to control which message to display in the context of the participants' conversation during the user study. Specifically, a study confederate accompanied the study and remotely controlled the display in real-time in a manner not noticed by the sighted participant.



(a) Some sighted people are nearby in the background (left) as the BLV user chooses possible helpers on the *Volunteer Platform* (right).



(b) A sighted helper has accepted the request and is now approaching the BLV user (left), and the BLV user is notified via the app that help request has reached the volunteer helpers (right).

Figure 4: Volunteer Platform implementation.

We implemented the *Pictorial Display* in two parts: a web app for the smartphone wearable display and a control dashboard for the study confederate, both implemented in HTML and JavaScript.

3.4 Collaboration Phase Prototype 2: *Vague Directions Flagger*

The *Vague Directions Flagger* is our second help-supporter prototype for the collaboration phase. It is a mobile app on the sighted user's smartphone that reviews the directions and descriptions they give to the BLV person in real-time, flags vague words and phrases, and instructs the sighted person to make corrections, as illustrated in Figure 7 and implemented in Figure 8. In contrast to the *Pictorial Display*, which provides the information publicly and in a pictorial format, *Vague Directions Flagger* provides the information privately on the sighted person's smartphone in a formal, text-only format.

During the collaboration, as the sighted helper verbally gives the BLV helpee directions to their destination or descriptions of the environment, *Vague Directions Flagger* transcribes the sighted helper's speech into text and displays it on the app. Then, the app processes the text and follows the rules in Appendix C to detect words and phrases that constitute vague directions. It will highlight any such words and phrases in a bright yellow color and display

a guideline message (also summarized in Appendix C) to help the sighted user correct or clarify the language.

As an example, the sighted helper might say: "The door is a few steps to your left," and the *Vague Directions Flagger* app would highlight the phrase "a few" on the transcript and display the message "Please revise: provide an exact count or measurement when you can." The sighted helper can then verbally correct themselves by saying, "The door is 10 steps to your left." Finally, when all the flagged words and phrases are resolved by the sighted helper, the *Vague Directions Flagger* confirms that no more vague phrases remain.

We implemented the *Vague Directions Flagger* as a web app using React JS and deployed it through a cloud server. We used Ngrok [39] to generate unique, temporary URLs for each sighted participant. A study confederate manually performed the speech-to-text transcription during the study.

4 METHODS

We performed a qualitative study evaluating the four approaches represented by *help supporters* prototypes. Our user study was conducted in pairs of BLV and sighted participants, in person, on a university campus. Here we describe our participants recruitment, study procedure, and data analysis procedure.

4.1 Participants

We recruited a total of 20 participants: 10 BLV participants and 10 sighted participants. We randomly paired them in mixed-ability pairs for the study sessions. We recruited the BLV participants from a mailing list of individuals who participated in our group's previous studies, through our group's ongoing collaboration with a major blind-serving organization, and snowball sampling [18]. BLV individuals experience a variety of vision conditions. To ensure that we recruited BLV participants who were suitable for our study, we only included participants who answered "yes" to the question "Does your vision affect your ability to navigate unfamiliar places?" on our study sign-up Google Form. Sighted participants were recruited by posting flyers on a university campus. The study was approved by our institution's IRB. Table 4 summarizes the participants' demographics.

4.2 Study Procedure

Our study consists of a three-step procedure: a pre-study interview, experiences using each help supporter prototype, and a post-study interview. Each prototype usage experience typically lasted between 15 to 20 minutes. The entire study, from start to finish, lasted approximately 120 minutes. To facilitate the study, two experimenters worked collaboratively. They conducted the pre-study and post-experience interviews, as well as prototype onboarding concurrently. One experimenter worked with the BLV participant, while the other simultaneously worked with the sighted participant. During the help supporters prototype usage experiences, one experimenter assumed the role of a designated study confederate. This experimenter operated a laptop discreetly, outside of the participants' view, to control the Wizard-of-Oz aspects of the study.

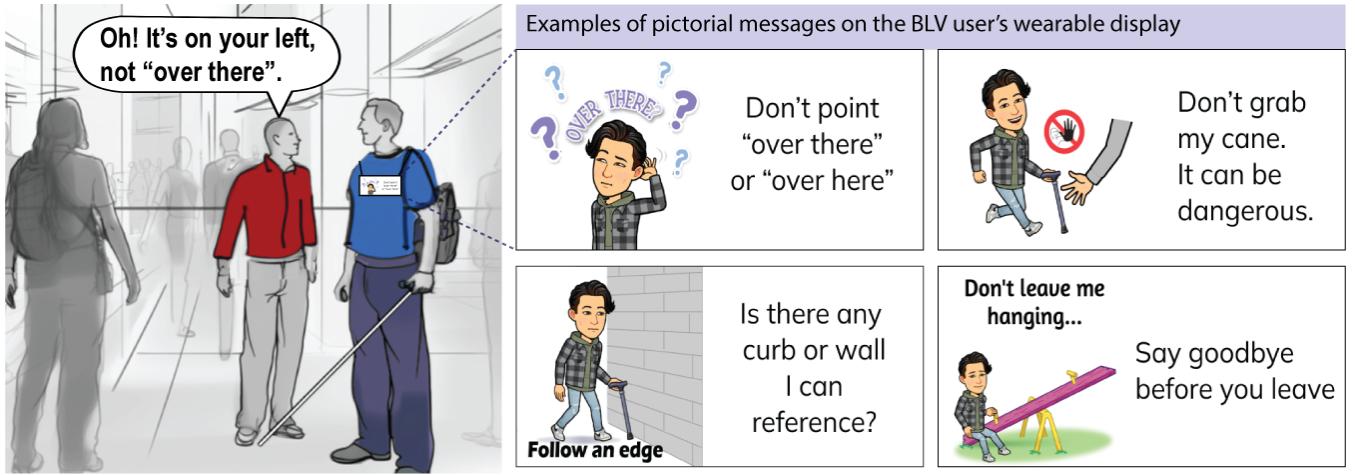


Figure 5: Pictorial Display. Left: A BLV user (in blue) wearing the *Pictorial Display* on their chest receiving help from a sighted user (in red). The sighted user upon seeing the message on the *Pictorial Display* makes a correction of their words. Right: Examples from a set of 20 pictorial messages used in our study.

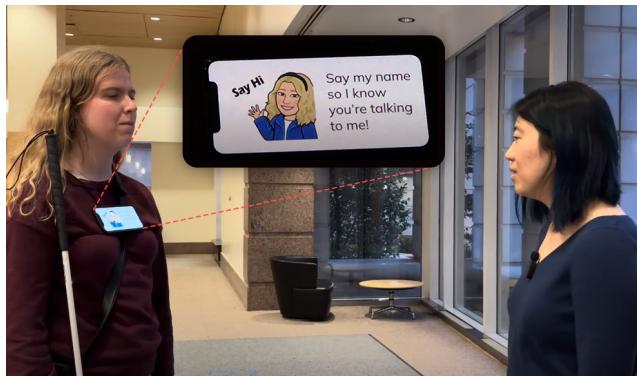


Figure 6: Pictorial Display implementation.

The BLV user's *Pictorial Display*, worn high on their chest, reminds the sighted helper to begin by explicitly mentioning the BLV user's name. Appendix B shows all possible pictorial messages.

4.2.1 Pre-Study Interview. In the pre-study interview, we first collected demographic information from both participants, including age, gender, ethnicity, and level of education. Then, we asked the BLV participant about their recent experiences in seeking help from sighted strangers. During the process, we asked them to recall their frequency of seeking help, comfort levels when requesting help, confidence in communicating their needs, and overall satisfaction with the help they received. We asked the sighted participant whether or not they had past experiences interacting with BLV people. If their answer was yes, we asked about their experiences and how confident they feel about helping BLV people. These questions were designed to enable both sighted and BLV participants to compare and reflect on the differences in their post-study interviews.

4.2.2 Prototype Usage Experiences. For each pair of mixed-ability participants, we asked the BLV participant to seek help and the

sighted participant to be a stranger willing to help. We had participants try a connection phase prototype first, followed by a collaboration phase prototype. This sequence was then repeated with the other connection phase and collaboration phase prototypes. This is to allow participants to experience the entire sequence of help (both phases) together rather than breaking it apart. Participants experienced each phase's prototypes in counterbalanced order. Half of the participants started with the Person-Finder Glasses and then tried the Volunteer Platform, while the other half followed the reverse order. The same counterbalancing was applied to the collaboration phase. We conducted our study in several locations—two academic building lobbies, a student lounge, and a cafe—employing different locations for different pairs of participants as a way of understanding attitudes and behaviors in diverse environments.

Before each prototype experience, two experimenters separately but concurrently gave the two participants individualized onboarding instructions, so that they understood how to use the system from their perspective but were not fully aware of how the system supports the other party. The experimenter working with the BLV participant also helped them put on the HoloLens head-mounted device for the *Person-Finder Glasses* prototype and the wearable display phone screen for the *Pictorial Display* prototype. The experimenters distributed unique URL links for accessing the *Volunteer Platform* and *Vague Directions Flagger* prototypes. Participants used their own smartphones for these two prototypes. BLV participants used the accessibility feature on their smartphones to access the web app as needed.

During the usage experiences for the connection phase prototypes, the two experimenters physically separated the two participants to simulate the process of locating and approaching strangers. We created six pseudo helper profiles with a variety of basic information on the *Volunteer Platform* (see Section 3.2) and instructed the sighted participant to add their information on the platform. We structured this part of the study this way so that BLV participants

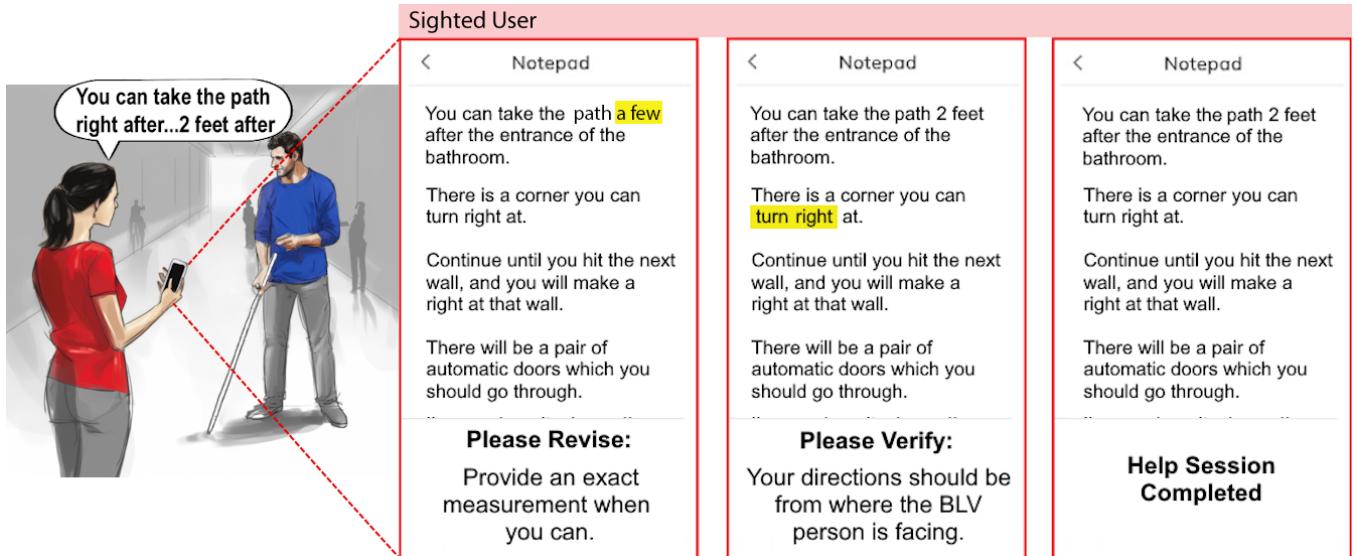


Figure 7: Vague Direction Flagger. Left: A BLV user (in blue) receiving help directions from a sighted user (in red) who has the *Vague Direction Flagger* app on their phone. Upon seeing the direction they are giving is flagged as vague by the app, the sighted user provided more specific information. Right: Screenshots of the *Vague Direction Flagger* showing two examples of flagged vague wording and a notice of help completion following corrections of all the vague directions.

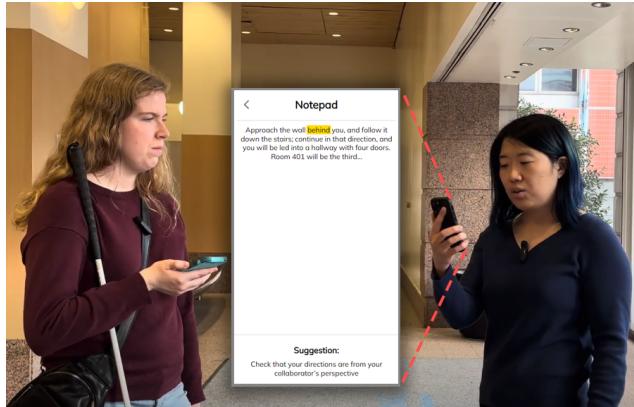


Figure 8: Vague Directions Flagger implementation. As the sighted helper gives instructions, the *Vague Directions Flagger* app on their phone prompts them to check that their directions are oriented from the BLV user's perspective.

could experience the process of selecting the helper from a list of nearby potential helpers.

During the usage experiences for the collaboration phase prototypes, one experimenter accompanied both participants while the other experimenter acted as a study confederate by controlling the Wizard-of-Oz aspects of the study. As described in Sections 3.3 and 3.4, the study confederate remotely controlled which pictorial message to display using the dashboard, and transcribed the sighted participant's speech-to-text through manual typing.

The experimenters took observation notes during the study for later analysis.

4.2.3 Post-Study Interview. After the participants experienced all four prototypes, we conducted post-study interviews with the two participants concurrently in separate rooms. All interviews were recorded with participants' consent and transcribed for analysis.

In the semi-structured interviews, we asked questions including how participants felt about their experiences in the connection phase and the collaboration phase, their preferences for the approaches represented by the help supporter prototypes, the types of information they found useful, additional information they wanted to have, and how their experiences in the study compared to their past experiences getting or giving help. We asked unscripted follow-up questions to dig deeper into insights raised by participants.

4.3 Data Analysis

After transcribing the post-study interviews, two researchers independently sectioned the transcripts into quotes for a bottom-up, open-coding approach to data analysis [12]. We also added the observation notes that we took during the study to the analysis. Next, the researchers worked through multiple rounds of meetings to iterate on the codes, discuss their similarities and differences as part of a comparative analysis [32], and leverage them in an affinity diagramming process [23]. The researchers determined that they reached code saturation when neither researcher could identify new codes or arrive at new interpretations of the existing codes after several rounds of revisiting the quotes.

5 FINDINGS: CONNECTION PHASE

Our research questions related to the connection phase, RQ1 and RQ2, are directed towards understanding the optimal approach for help supporters to bring two strangers together—a sighted individual and a BLV individual—for the purpose of assistance. One option,

Table 4: Self-reported demographic information of our participants who completed the study. B=BLV participant, S=Sighted participant.

Note: "Otherwise visually impaired" serves as a general term that describes having some usable vision and may perceive shapes, light, or movements to some extent. However, as the participants indicated in our sign-up Google Form and pre-study interviews, their vision cannot give them sufficient information about the environment such that they face challenges venturing out in public alone.

Pair ID	Gender	Age Group	Education Level	Ethnicity	Vision Level
P1B	Male	18 to 25	Bachelor's Degree	South Asian	Otherwise visually impaired
P1S	Male	18 to 25	Bachelor's Degree	White	Sighted
P2B	Male	46 to 55	PhD	White	No usable vision
P2S	Female	18 to 25	Bachelor's Degree	South Asian	Sighted
P3B	Male	26 to 35	Bachelor's Degree	East Asian	No usable vision
P3S	Female	26 to 35	Masters Degree	White	Sighted
P4B	Female	36 to 45	High School/Some College	East Asian	Otherwise visually impaired
P4S	Female	26 to 35	Masters Degree	White	Sighted
P5B	Female	26 to 35	Bachelor's Degree	East Asian	Otherwise visually impaired
P5S	Male	18 to 25	High School/Some College	White	Sighted
P6B	Female	26 to 35	High School	East Asian	Otherwise visually impaired
P6S	Female	18 to 25	High School/Some College	White and Asian	Sighted
P7B	Female	26 to 35	Masters Degree	White	Otherwise visually impaired
P7S	Female	18 to 25	Bachelor's Degree	South Asian	Sighted
P8B	Female	18 to 25	High School/Some College	White	Otherwise visually impaired
P8S	Female	18 to 25	Bachelor's Degree	East Asian	Sighted
P9B	Male	46 to 55	Masters Degree	African American	Otherwise visually impaired
P9S	Male	18 to 25	High School/Some College	White	Sighted
P10B	Female	18 to 25	Bachelor's Degree	White	Otherwise visually impaired
P10S	Male	18 to 25	Bachelor's Degree	South Asian	Sighted

represented by *Person-Finder Glasses*, is for the help supporter to empower BLV person with more confidence to approach nearby strangers to ask for help face-to-face. Another option, represented by *Volunteer Platform*, is for the help supporter to facilitate help requests and accepts through an app-based volunteering platform, then enables the two parties to meet in person and initiate their help collaboration. With RQ1, we asked which of these options is better. RQ2 focuses on identifying the types of information that help supporters should facilitate for both BLV and sighted individuals.

We found both BLV and sighted participants preferred the on-platform connection approach. This preference was attributed to the *Volunteer Platform*'s ability to reduce social pressure and cultivate feelings of safety and trust (Section 5.1). Furthermore, we contribute a collection of information types that help supporters should facilitate on the platform (Section 5.2).

The findings are summarized in Table 5 for easy reference.

5.1 RQ1 Findings: Face-to-Face Requests vs. App-Based Volunteering Platform

Recall that the *Person-Finder Glasses* represented the approach of promoting face-to-face requests, while the *Volunteer Platform* represented the approach of using a mobile app platform for facilitating requests and offers for help. Our findings indicate that while both approaches can enhance social acceptance and boost confidence for BLV individuals, the app-based *Volunteer Platform* reduces social pressure even more, not only for the BLV participants but also for sighted individuals. As a result, the on-platform approach emerged as our participants' more preferred option. Additionally, both sighted and BLV participants shared a concern for safety and trust, and we found that on-platform approach plays a greater role in alleviating the concern.

5.1.1 The Volunteer Platform reduced social pressures for both parties. Our findings indicate that both the direct in-person and on-platform approaches facilitated by help supporters significantly enhance BLV individuals' social acceptance behaviors and effectively mitigate feelings of embarrassment. However, it is noteworthy that we also found that only the on-platform approach alleviated sighted individuals' feelings of social pressure.

BLV participants expressed that using *Person-Finder Glasses* to ask for help in person had a transformative impact on their social behavior. Previously, they often found themselves resorting to desperate and awkward shouting when seeking help, resulting in discomfort. Their study experience with *Person-Finder Glasses* provided them newfound confidence when reaching out for assistance, enabling them to adopt more socially acceptable and composed behaviors, as stated by P7B:

"I think having a way to know with confidence that someone is there and then being able to approach them it's very comfortable. I don't like how it makes me feel when I'm shouting in the street because other people might think that maybe I wasn't all there." - P7B

Some participants shared valuable insights on how *Person-Finder Glasses* played a role in validating their non-visual senses, effectively averting them from embarrassment and bolstering their self-assurance. BLV participant P3B shared with us that, although he has very good echolocation skills and can hear free-standing entities in space, he often found himself in embarrassing situations asking a nonperson object for help:

"It gets embarrassing sometimes [...] I hear a couple of things because when I make noise when I talk [...] I shout, 'Hey, where am I going?' And it turns out what I'm shouting at is a garbage can. And then a person

Table 5: Summary of our findings, which correspond to Sections 5.1–5.2 for the Connection Phase and Sections 6.1–6.2 for the Collaboration Phase.

	Research Questions	Findings
Connection Phase	RQ1 Face-to-Face Requests vs. App-Based Volunteering Platform	F1 The Volunteer Platform reduced social pressures for both parties.
		F2 Both parties expect the <i>help support</i> to establish safe matches.
	RQ2 Information Types Needed for Connection	F3 BLV people want their helpers to be BLV-friendly and, sometimes, female.
		F4 Both parties want to connect with people located nearby who have time.
		F5 BLV people want help from people knowledgeable about how to help.
		F6 Both parties want to understand each other's intention toward help.
Collaboration Phase	RQ3 Information Types Needed for Collaboration	F7 Sighted helpers want to know the precise corrections they need to make.
		F8 Sighted helpers want visual examples of help support guidelines.
		F9 Sighted helpers want to empathize with BLV people's experience.
		F10 Sighted helpers want to know how well they are performing.
	RQ4 Location of Information	F11 Sighted helpers want to maintain eye contact even with a supplemental display.
		F12 Sighted helpers want to see the environment even with a supplemental display.
		F13 Sighted helpers want to keep their mistakes private.

standing to my left will be like, "Oh, the street is over here". And I think to myself, "Yeah, okay, I'm just gonna ignore the fact I was talking to a garbage can." - P3B

Regarding the *Volunteer Platform*, we found that the on-platform connection approach was able to lower social pressure for not only the BLV people asking for help but also for the sighted people who were navigating the decision on whether they should accept the help request. We found that the on-platform approach effectively reduces social pressure for BLV individuals when seeking help, thereby increasing their likelihood to ask for assistance. In the absence of the *Volunteer Platform*, BLV people tended to resort to seeking help only when they were frustrated and in dire need. The on-platform approach has led to BLV participants feeling more at ease and comfortable when requesting assistance. A contributing factor to reducing social pressure is that engaging on the *Volunteer Platform* enables sighted strangers to silently decline assistance requests. This mechanism fosters an environment where BLV individuals perceive themselves as being less of a burden to others, further promoting a sense of ease and confidence in seeking help.

As participant P8B reflected:

"If they [sighted strangers] don't have time, if they have somewhere to be, they don't have to say no to you. They can just not accept your requests on the app, and you wouldn't even know about this. I think it makes it less awkward for them probably. So I'd feel better." - P8B

5.1.2 Both parties expect the help supporter to establish safe matches.
We found that both BLV and sighted participants shared concerns regarding trust and safety. Despite the newfound capability of BLV participants to locate nearby individuals, our study revealed that some participants had hesitations in seeking help due to their inherent difficulty in placing trust in strangers.

"I felt uncomfortable reaching out for help because...you also don't know anything about the person you're approaching. It can be a scary world in [a big city]." - P10B

In order to mitigate trust and safety concerns, BLV users expressed the need for additional information about other individuals in their environment. Sighted people often rely on visual cues to establish a sense of trust with strangers before initiating contact. In contrast, BLV individuals, due to their lack of visual perception, seek alternative information sources to bridge this gap. This finding is consistent with prior research that highlights BLV individuals' interest in discerning whether a stranger is carrying a weapon to avoid potentially unsafe situations [9].

Our sighted participants also had safety concerns. They expressed a similar unease and emphasized the importance of *help supporters* serving as a safety filter through mechanisms such as verification or moderation, in addition to merely serving as a connector to BLV people who need help:

"Some people, like myself, might not be willing to reach out to any non-background-checked stranger, especially at night. Since neither the BLV people nor the sighted helper knows each other, both might be otherwise uncertain if they can trust the other person. But this problem is eliminated when each of us does the verification on the app." - P2S

5.2 RQ2 Findings: Information Types Needed for Connection

RQ2 aims to identify the information that help supporters should give the two parties about each other to help them decide if they

want to connect. We identify four types of information that AT facilitators should offer the two parties: identity, availability, knowledge level, and intention.

5.2.1 Identity: BLV people want their helpers to be BLV-friendly and, sometimes, female. The *Volunteer Platform* probe exchanges members' first names. Our findings revealed that, while participants welcomed the use of first names, they also expressed a desire for additional identity-related information based on their interpretations using the platform. We found that community identity and gender identity information hold particular significance.

Our findings highlighted the value participants attributed to the concept of being a member of a BLV-friendly community. During the evaluation of *Volunteer Platform*, participants recognized their presence on the mobile platform as indicative of a community affiliation. BLV participants elucidated that the sighted individuals' presence on the platforms conveyed a message of BLV friendliness. The information of sighted people's willingness to sign up for volunteer on the mobile platform had a positive impact on developing a sense of social community. The value of forming a community is echoed by the success of the remote assistance platform BeMyEyes [3].

"[...] if they're on the app, maybe they've already done this before [...] It's an easier interaction to have when [it's] already agreed through the app that the person wants to try and help you." – P8B

Sighted participants echoed the sense of community, stating that being on the platform validated them as receptive helpers to BLV individuals.

"[Sighted] users register for [the Volunteer Platform] because they're open to helping BLV people. But if [the BLV person is just] approaching any stranger, there's no guarantee that the stranger would be receptive to help. So if both the BLV helpee and the sighted helper are on the [platform], I feel like that this would help the visually impaired person already know that they are a receptive person to ask." – P9S

Additionally, we found that several female BLV participants indicated a preference for seeking help from sighted individuals of the same gender. In our study, even though explicit gender information was not provided, some BLV participants managed to deduce gender information from the first names presented on *Volunteer Platform* platform. For instance, a BLV participant, who identified as a female, stated:

"I liked the [platform] because the fact that you can see the [helpers'] names is nice. Because [that makes it easier] if I want to ask a woman for help." – P8B

5.2.2 Availability: Both parties want to connect with nearby people who have time. The second type of information that we identified as valuable is availability, which encompasses both temporal and spatial availability. A significant factor contributing to social barriers in seeking assistance is the misaligned expectations between BLV and sighted individuals. Our study reveals the availability information needed by both parties.

We found that the exchange of time availability information could effectively avert uncomfortable situations and enhance communication between BLV and sighted individuals. It helps to align BLV helpees' estimated time for completing a task with the sighted helpers' free time they can allocate.

Participant P10S described how availability informed them to make decisions:

"It lets me know what type of tasks the BLV needs help with, as well as how long of a time commitment the task requires. This helps me judge whether I'm able to help with the task or not." – P10S

Moreover, some participants pointed out that relying solely on self-reported estimated time often led to inaccuracies. There is a need for a more effective approach to provide specific details about the tasks at hand, which could lead to a better alignment of time expectations.

Besides temporal availability, we found that spatial availability information gave our BLV participants a sense of confidence and support. It assures them that assistance is available nearby and that the helper is coming for them. BLV participants found it more reassuring compared to their past experience of asking for help with uncertainty:

"Knowing the helper's name and that help is on the way, is a huge confidence boost already. Versus if I'm by myself without this app, I'm just calling out to any person-shaped objects. Like, it could be a chair, a pillar, or a garbage can instead." – P3B

5.2.3 Knowledge Level: BLV people want help from people knowledgeable about how to help. The third type of information that we identified as important during the connection phase is the background knowledge of potential sighted helpers, which has two facets: knowledge regarding the specific task for which assistance is requested, and knowledge concerning the unique needs of the BLV helpee.

We found that knowledge of the tasks requiring assistance communicates the mutual understanding of both parties' familiarity with the particular task. This includes gauging the extent of a sighted helper's knowledge regarding the task and the additional information that a BLV individual is seeking in order to accomplish the task.

Within the context of navigation tasks, both sighted and BLV participants emphasized the significance of comprehending their partner's familiarity with the surroundings.

"I picked a sighted helper who worked in our location, because these people are more familiar with the environment. If I picked someone who was a first-time visitor, they would be as lost as I am. But if I asked a person familiar with the environment, they can easily tell me where to go." – P6B

Sighted individuals also seek to understand the extent of a BLV person's familiarity with the location. This knowledge allows them to customize the level of detail in their descriptions accordingly.

Another background knowledge is the unique needs and preferences of BLV individuals. With this information, sighted helpers

can better understand the nature of assistance needed by BLV individuals and how to help them. BLV individuals experience a diverse range of visual conditions spanning from complete blindness to low vision and encompasses difficulties such as light sensitivity, depth perception, and field of vision limitations. Initiating an exchange of knowledge regarding the needs and preferences of both parties in advance serves as a crucial step. It allows both the BLV individual and the sighted helper for an assessment of the potential effectiveness of collaboration, ensuring a more informed approach to tackling the task together.

"I think it would be helpful for [BLV users] to also provide their level of visual impairment, since different people have different levels of impairment. Also, some people like me may have other physical impairments as well, that require additional other assistance." – P9B

Sighted participants stated that having knowledge about BLV individuals' functional needs would assist in sidestepping potential awkward situations. This knowledge could prevent the inadvertent provision of excessive unwanted assistance or, conversely, the unintentional withholding of adequate support to the BLV individual.

"It would be great for [help supporters] to provide some details about how severe the BLV person's visual impairment is, so that I know how much help to give. This way, you're not patronizing the BLV person; if they are able to get up and move around on their own, then you know that they don't need my help for that, but I can assist with reading something far away or pointing them in the direction of something. So to sum up, I guess it would help me assess how much help they need." – P4S

5.2.4 Intention: Both parties want to understand each other's intention toward help. The fourth type of information that we identified is information on people's intentions. Our findings indicate that it is essential for not only BLV people to gauge sighted people's willingness to offer help, but also for sighted people to understand the intentions of BLV individuals—whether they intend to seek help from others or to independently tackle the task without assistance.

In the context of asking for help, participant P1B reflected on their experience and how the *Volunteer Platform* clarified both parties' intentions:

"Reaching out to a stranger for help is difficult because you worry that you'll get a negative reaction from them. You might overwhelm or overstep their boundaries. The purpose of [help supporters] is clear: both parties know what they're in for. This means that you can cut the hesitation around asking the people on the [Volunteer Platform] for help. –P1B

Conversely, in the context of unwanted help, BLV participants valued the implicit information conveyed through *help supporters*. It could facilitate communicating their preference for not receiving help unless specifically requested, demonstrating that they are discerning about seeking assistance on their own terms.

"I dislike it when sighted people offer unsolicited help, such as just giving you directions or giving you help without you asking for it. Use of [Person-Finder Glasses] allows me to effectively convey to others that, if I desire

help, I'm capable of reaching out, but otherwise, I'm fine." –P1B

We found that this insight is shared by sighted participants, who valued knowing that the BLV individuals have ability to request assistance via *help supporters* enabled them to avoid unintentionally condescending the BLV individuals.

"[BLV people]'s use of the help [supporter] makes me much more confident in going up to them and offering assistance, because I know they have specifically requested and need help. Whereas without a help [supporter], sometimes it's a guessing game of whether the BLV actually needs assistance or not. Sometimes it's more uncomfortable to go up to [a BLV person] in that way [to offer unsolicited help]. As such, I think the help [supporter] improves my confidence in going up to someone, knowing that they specifically requested help." –P5S

6 FINDINGS: COLLABORATION PHASE

Here we report our findings for the research questions related to the collaboration phase, which were to uncover the specific types of information that help supporters should provide (RQ3, corresponding to Section 6.1) during the collaboration and where that information should be situated (RQ4, corresponding to Section 6.2). In Appendix A, we also report findings on how help supporters' advocacy for BLV users affected their own feelings of autonomy.

As we described in Section 3, we designed our collaboration phase prototypes to display just-in-time information to the sighted helper to support them in following best practices. They advocated on behalf of the BLV person but did not display information to the BLV person. As a result, our findings for these two research questions come mainly from sighted participants. The findings are summarized in Table 5 for easy reference.

6.1 RQ3 Findings: Information Types Needed for Collaboration

RQ3 is centered on determining the types of information that help supporters should provide to sighted helpers during the collaboration phase. By conducting usage experiences on both the *Pictorial Display* and *Vague Directions Flagger*, our study observed and interviewed participants to discern their preferences around their usage engaging with 20 pictorial messages (see Supplementary Material) and six distinct categories of highlighted transcripts flaggers (see Appendix C). We found that sighted participants elaborated on how the information types contributed to their enhancement of collaboration with BLV participants. The findings of our study emphasize the significant benefits of these four information types in improving collaboration: specific corrections, illustrations, empathy-building information, and validation.

6.1.1 Specific Corrections: Sighted helpers want to know the precise corrections they need to make. Our findings indicate that sighted participants valued correction information provided by help supporters. In the user study, sighted participants initially gave information that may exhibit vagueness or lack of specificity. *Vague Directions Flagger* reviews the transcripts and subsequently prompts

the sighted participants to enhance and elaborate on the information initially provided, thereby augmenting it with more useful details to BLV helpees.

We found that sighted participants liked the highlighting of specific words and phrases in their conversational transcripts. They particularly valued the messages that asked for specific corrections from them. The correction requests help to enrich information and streamline the process of making modifications.

"I think having the suggestions in relation to a specific highlighted area of the directions that needed improvement was more beneficial for me in identifying specifically where I could improve and where my words might have been unclear." -P5S

The type of messages asking for specific details are particularly favored by sighted participants.

"One example of a hint that was really helpful for both [Pictorial Display] and [Vague Directions Flagger] was the hint about being specific with numbers. So instead of saying "a few steps," we were reminded to say, for instance, "three steps" when specifying distance." -P9S

We found that the corrective messages by help supporters have an effect on sighted participants' approach in providing descriptions. Initially, sighted participants tend to use brief, simplistic vocabulary. After seeing messages from help supporters, they started to speak with more comprehensive descriptions with detailed directions, distances, slope degrees, surface types, etc. This shift in behavior demonstrates a substantial improvement in their help performance.

"For the first direction, I gave a one-word instruction like 'straight' or 'left', while for the second direction, I actually said a few more details, like "There's a 30-degree ramp". [Vague Directions Flagger] requires the instructions to be very specific, so that the BLV user does not get in trouble or fall. I like how the app gives you guidance about which parts [of your directions] need to be more specific." - P8S

6.1.2 Illustrations: Sighted helpers want visual examples of help support guidelines. In order to address the research question on the types of information that help supporters should provide, we explored two different formats: formal text format and informal illustration format. Our prototype *Pictorial Display* featured an illustration information format, wherein each simple suggestive phrase was complemented by a fun-friendly Bitmoji picture. We found that sighted participants preferred this pictorial format and revealed two insights for their preference: first, due to its role as a visual exemplar, and second, as a source of engaging and affable humor.

Sighted participants perceived the Bitmoji pictures as visual examples of the suggestions made by *help supporters*. The visual examples made it more straightforward and expeditious for the sighted helpers to understand how to adopt the suggestions.

"The pictures [on Pictorial Display] gave me examples. For instance, when it said "include reference points", the display had a cartoon of a guy hitting a wall. This gave me the idea: I can think of curves such as the walls [as

reference points]. Thus, I think it's more helpful to have these pictures alongside the hints." -P9S

Furthermore, we found that the pictorial information served as a catalyst for humor during the collaboration phase, fostering an enjoyable and amicable atmosphere between sighted helpers and BLV helpees.

During our study, two experiment facilitators observed and noted instances of lighthearted humorous interactions stemming from the use of pictorial information format.

We observed at one instance, when the wearable screen in *Pictorial Display* displayed a confused Bitmoji character with the text "Over There" above its head, the sighted participant reacted with a sudden realization prompting them to exclaim "Oh! Not over there!". This prompted laughter from the BLV participant, who responded with: "That's a good one! I can't see you pointing!". Their shared amusement effectively dissolved the momentary sense of embarrassment the sighted participant had felt for their error.

Upon being introduced to the pictorial information format by researchers, BLV participants P1B and P7B expressed their endorsement of the design.

"The Bitmojis are cool. I think a lot of people will be in favor of that idea... whatever is more engaging is probably going to work best for me." -P7B

6.1.3 Empathy-Building Information: Sighted helpers want to empathize with BLV people's experience in order to give better help. The third type of information emerged from participants' insights is empathy-building information¹, serving as a means to the practical benefits of giving better help to the BLV participants. We found that the information provided by help supporters has a positive impact on helping sighted participants to better understand how BLV participants perceive the environments with non-visual senses. As a result, sighted helpers improved their performance during the collaboration phase.

We found that sighted helpers who did not have prior experience interacting with BLV individuals often lack awareness of visual concepts that need to be communicated verbally and often overlook the need to communicate them. Our findings revealed that the messages provided by help supporters serve as empathy information, acting as reminders for sighted helpers to view things from the BLV helpee's perspective.

Sighted participants reported that, after a few messages from the help supporters, they developed a greater sense of empathy toward their BLV partners' non-visual sensory experience. They were able to adopt a more supportive mindset. This effect is particularly pronounced for sighted participants who had past experience interacting with BLV individuals, even if such experiences occurred some time ago.

"I have [...] experience helping [...] my friend in [home city]. [...] So it was really helpful and nice to just remind myself. It makes you appreciate what other people are

¹It is essential to acknowledge the complexities of empathy in disability contexts [6]. Our primary goal is to facilitate effective help for BLV individuals. Thus, our focus is on the practical benefits of building empathy to serve the purpose of giving better help. We recognize this step towards empathy as a valuable, yet not central, aspect of our approach to help support.

going through and appreciate that other people are navigating the world in a totally different way. And that we can still help each other despite our sensory differences.”
- P4S

Furthermore, we found that empathy information from *help supporters* reshaped sighted participants' thought processes during collaboration with their BLV partners, amplifying the empathy mindset into an educational dimension. Participant P9S described how one message taught them to shift their thinking to the BLV individual's perspective:

“I also really liked one of the other hints from the [Pictorial Display], where it said: ‘Are there any reference points that I can use?’ That hint really changed my thinking. Because I was totally thinking ‘Just walk straight and then to the left.’, but the hint made me think, ‘Okay, what can the BLV user use as a way to tell if he’s going straight?’ And this made [giving the description] more challenging, but it also made it more useful.” -P9S

6.1.4 Validation: Sighted helpers want to know how well they are performing. The fourth type of information emerged from participants' experience is validation. We found that sighted participants frequently sought a sense of reassurance and validation from *help supporters*. They interpreted cues from *help supporters* as indicators of their performance. For instance, the absence of vague direction flags or the transition from one pictorial image to another was often interpreted as positive validation.

Participant P6S described how they elicited feelings of achievement by connecting the appearance and disappearance of pictorial messages and the perception of accomplishing subtasks during the collaboration:

“[Pictorial Display] offered me a bit more reassurance. That’s because it almost felt like when each image showed up and then went away, it was like some sort of task or mini-challenge that I was trying to tackle. Yeah, which was kind of strange, but like, somewhat gratifying.” - P6S

Participant P9S provided their interpretation that the lack of highlights on *Vague Directions Flagger* was a positive validation of their performance:

“In [Vague Directions Flagger], it was nice when the yellow highlighting showed up since it functioned as showing that okay, with no highlights, that means you’re using good language, and you don’t need to be corrected.”
-P9S

While validation information is generally well-received by sighted participants, we also found that their positive effects can diminish and even become annoying once sighted helpers gain confidence in how to help BLV people well:

As participant P1S expressed:

“When I was giving directions and using the words ‘left’, ‘right’, etc., every single time [help supporters] would tell me to make sure that I was thinking from the perspective of the BLV person. This feedback got annoying quickly...”
-P1S

6.2 RQ4 Findings: Location of Information

RQ4 is about identifying where help supporters should situate the information it provides during the collaboration phase. We evaluated two approaches represented by our prototypes. The *Pictorial Display* positioned the information on the chest of the BLV helpee, making the information publicly displayed. The *Vague Directions Flagger* involved situating the information on the personal smartphone of the sighted helper, thereby ensuring the information is privately displayed. Through interviews and observations, we found that sighted participants valued maintaining eye contact with their BLV partners (Section 6.2.1). At times, when a sighted helper needs to assess the surroundings in order to convey the information to BLV helpee, they also expressed a preference for the information to be located near the environment (Section 6.2.2). Moreover, we found that maintaining the privacy of sighted participants' mistakes during their conversations is an important consideration (Section 6.2.3).

6.2.1 Sighted helpers want to maintain eye contact even with a supplemental display. We found that sighted participants valued eye contact with BLV participants. Participants provided feedback on the location of both *Pictorial Display* and *Vague Directions Flagger* in the context of maintaining eye contact. For *Pictorial Display*, some participants preferred the location of the display closer to the eyes, such as on a necklace or forehead, in order to maintain eye contact. In contrast, for the private display *Vague Directions Flagger*, some participants expressed feeling uncomfortable checking their phone during a conversation.

P9S preferred *Pictorial Display*'s location on the BLV individual, allowing sighted helpers to maintain eye contact with BLV helpees while engaging in conversation. Sighted participants believed that eye contact is important, even though due to BLV individual's situation, it might not be reciprocated in the traditional sense.

“I also appreciated that the [Pictorial Display] was on him [BLV helpee], so that you know, I could look at him and still talk to him at the same time, because I feel like I’ve been told that it’s good practice to look at the person, even if they can’t necessarily [see] you.” - P9S

6.2.2 Sighted helpers want to see the environment even with a supplemental display. Besides positioning the display close to BLV people's eyes, our findings revealed that sighted participants also want the information to be situated close to the environment. This arrangement enables them to learn the surrounding environment and give accurate descriptions to the BLV helpees.

We observed that face-to-face helping has a dynamic nature. Sighted participants' attention transitions fluidly. There are instances when a sighted helper's focus shifts away from eye contact with BLV individuals, and towards gaining a better look at the environment to facilitate a more accurate description. This phenomenon is particularly prevalent when the sighted helper is unfamiliar with the environment they are describing. They would momentarily break eye contact with the BLV helpee, and direct it towards the environment. As a result, these sighted participants preferred the information to be superimposed onto the environment instead.

P4S described the challenge they faced when shifting their view:

“Describing the area and then looking at this little screen, so it’s a bit kind of discombobulated.” - P4S

P3S recounted an instance when their physical positions with their BLV partner changed and the information located on the BLV partner’s chest became occluded.

“There’s one situation as well, where he was walking next to me. He was holding my elbow or we were walking down the stairs, where I couldn’t see the [Pictorial Display] screen. You couldn’t see the screen, so you couldn’t really get the feedback.” -P3S

In a dynamic environment, we found that some sighted participants preferred a static location of the display on their personal smartphones. The yellow highlights on *Vague Directions Flagger* attract shifting attention and support glancing.

“I thought even just seeing the little highlighted yellow words from the periphery of my eye—that alone effectively served as a reminder to describe directions in a way that is going to be as clean as possible for the BLV user.” -P4S

6.2.3 Sighted helpers want to keep their mistakes private. Our findings showed that it is important to consider privacy when determining the location of information in the collaboration phase. When we asked sighted participants about their preferences for public versus private displays, they conveyed that it is important to keep their conversation with BLV helpees private, especially their mistakes. It emerged that some sighted participants experience self-consciousness and embarrassment when they make mistakes and need corrections from *help supporters*. To make them more comfortable in the collaboration phase, they preferred to receive suggestive information discreetly on their personal smartphone device.

“I guess the first one [Vague Directions Flagger] felt more personal, because other people can’t see the corrections that are being made to me. I guess it would maybe depend on the person you know, maybe some people wouldn’t want their mistakes to be on a screen [Pictorial Display].” - P4S

7 DISCUSSION

Our study revealed many insights about how assistive technology can support face-to-face help between BLV and sighted strangers. In this section, we interpret those findings to pose design implications for help supporters and our community’s other research efforts around interdependence and collaborative accessibility. The design implications and the findings from which they are derived are summarized in Table 6.

7.1 How Should Assistive Technology Support Co-located Help Between BLV and Sighted Strangers?

Our first two design implications (D1 and D2 in Table 6) relate to how facilitating co-located help between BLV and sighted strangers.

7.1.1 Encourage choice and mutual understanding around asking for help and deciding whether to help. In our study, we discovered common themes among both BLV and sighted participants, including

the experience of social pressures, concerns about burdening the other party, and a shared desire to establish and navigate boundaries within the co-located help context. *Volunteer Platform* stood out as a preferred approach that reduces social pressures for both parties, largely owing to its ability to establish common ground and mutual understanding between them. Connecting through an online platform before meeting in person provides the opportunity to communicate needs and expectations and establish mutual boundaries. Prior research made headways in understanding how social platforms facilitated able people to connect online before shifting their interactions off the platforms and eventually meeting in person [24]. Future research should investigate approaches that intersect both online and in-person social platforms, especially for mixed-ability populations, and explore designs that encourage choice and mutual understanding around asking for help and deciding whether to help.

7.1.2 Build a safe community by balancing transparency and privacy.

When it comes to meeting strangers for help, our findings both align with and augment existing research. Prior works found that BLV people are worried about personal safety in public and are hesitant to identify whom they ask for help from [9, 46]. We discovered that sighted people share the same safety concerns. Synthesizing perspectives from both BLV and sighted participants, our design implication points to the importance of building a safe and welcoming community for all. The assistive technology itself can help establish that community through its platform. The community should not only make sure that both parties feel safe to connect by facilitating mutual transparency of their identities but also create a non-judgmental and private space where sighted people can make and correct their mistakes. We suggest that future work continue to explore the designs of in-person community-building technology by balancing transparency and privacy.

7.2 How Could Assistive Technology Facilitate Education for Sighted People?

Our remaining design implications (D3–D6) offer insights into how the accessibility community can shift the burden of education from BLV people (learning how collaborate with sighted people) to sighted people as well (learning how to collaborate with BLV people). By developing educational assistive technology for the many who would benefit from it, our community can further reframe assistive technology as not just being helpful for BLV people but rather for everyone.

7.2.1 Adapt effective instructions to sighted helpers for accurate and empathetic help support. Due to the in-situ and real-time nature of help, sighted helpers have limited time for immediate reactions to the help supporter’s instructions, as observed in our study. Sighted helpers preferred help supporters to give them precise feedback on words and phrases requiring corrections. Moreover, it is naturally easier for the sighted helpers to perform better without the need for repeated instructions when help supporters’ instructions enabled them to empathize with BLV helpees’ experience. Future help supporter designs should adapt effective instructions to sighted helpers that empower them to make instantaneous improvements. Some prior work has used AI in learning technologies to tailor learning

Table 6: Summary of our design implications along with the finding(s) from which each is derived. The findings are summarized in Table 5, and the design implications are elaborated in the Discussion.

Design Implications		Supporting Findings
D1	Encourage choice and mutual understanding around asking for help and deciding whether to help.	F1, F4, F6
D2	Build a safe community by balancing transparency and privacy.	F2, F3, F13
D3	Adapt effective instructions to sighted helpers for accurate and empathetic help support.	F5, F7, F9
D4	Give sighted helpers real-time feedback and validation about their performance.	F10
D5	Give sighted people visual examples of instructions when possible.	F8
D6	Locate instructions for sighted helpers in a way that facilitates both eye contact and studying the environment.	F11, F12

content to meet students' level of understanding in real-time [35]. Further research is needed, however, to explore the at-scale generation of instructions in real-time mixed-ability scenarios.

7.2.2 Give sighted helpers real-time feedback and validation about their performance. In our study, even though our prototypes did not explicitly include a validation feedback feature, it was emergent that sighted participants often sought reassurance from help supporters to gauge their performance and gain confidence (see Section 6.1.4). Previous work has found that in a human-to-human context, helpers of people with disabilities benefit from feedback and validation; these findings can be translated to help supporters, highlighting the universal value of feedback in supportive interactions [2]. Additionally, since the way people interact with feedback changes depending on their stage of learning, it is imperative that the feedback itself evolves accordingly, ensuring its continued effectiveness and relevance [21]. This highlights the need for personalization might be considered to match with sighted helpers' level of confidence and need for assurance.

7.2.3 Give sighted helpers visual examples of instructions when possible. In the *Pictorial Display*, sighted participants valued how easily they could look at the visual examples demonstrated by the Bitmoji characters and understand the right way to help (e.g. offering an elbow for guidance, following an edge to walk straight). Future help supporter designs can explore diverse ways of displaying visual examples to sighted helpers. For example, drawing upon previous research that employed AR to provide manufacturing workers with 3D instructions [22], sighted helpers might benefit from holographic visual demonstrations. These demonstrations could guide them on how to interact behaviorally with BLV people, encouraging actions that are helpful and avoiding actions that might startle or put them at risk.

7.2.4 Locate instructions for sighted helpers in a way that facilitates both eye contact and studying the environment. We found that face-to-face help requires sighted helpers to navigate their visual attention between various people and places. In our study, sighted helpers wanted to maintain eye contact with BLV helpees and keep

the environment in their sight in order to give accurate descriptions, all while simultaneously ensuring they are catching instructions provided by the help supporter. Future help supporter designs should consider locating instructions for sighted helpers in a manner that aligns with the dynamic nature of their attention. This could involve leveraging eye-tracking and AR technologies to display the instructions always within the sight helper's field of view. Furthermore, drawing from prior work in designing multimodal feedback for multitasking [29], future designs could incorporate multimodal feedback mechanisms to provide sighted helpers with multiple streams of information through the appropriate modality and guide their attention toward the relevant people or places.

7.3 Demonstrating the Interdependence Framework in Mixed-Ability Scenarios

The concept of help supporters and its two constituent phases allowed us to demonstrate and explore how assistive technology can respect the interdependence framework proposed by Bennett et al. [5] rather than attempting to "bridge a perceived gap between disabled bodies and environments designed for non-disabled people" [5]. The interdependence framework (Figure 9(A)) argues that the goal of making the world accessible is not one that assistive technology should by itself bridge for a disabled person, but rather is a shared goal that people with disabilities, technology, surrounding people, and environmental infrastructure collaborate towards achieving. The framework thus suggested exciting new designs for assistive technologies that interact not only with disabled people but also with the environment and other people around them. Our research-through-design process for help supporters allowed us to test different interdependence configurations and discover users' attitudes and behaviors toward them.

Figure 9(B) illustrates the interdependence relations that we explore in the connection phase. Recall that, in the connection phase, the goal is to connect a BLV person and sighted person together to start collaborating—that is, to form the dotted edge at the bottom of Figure 9(B). An assistive technology that aims to do this plays as a central liaison between the BLV person, each surrounding sighted person, and the environment—for example, using its knowledge of the environment to remove sighted people that are far away from

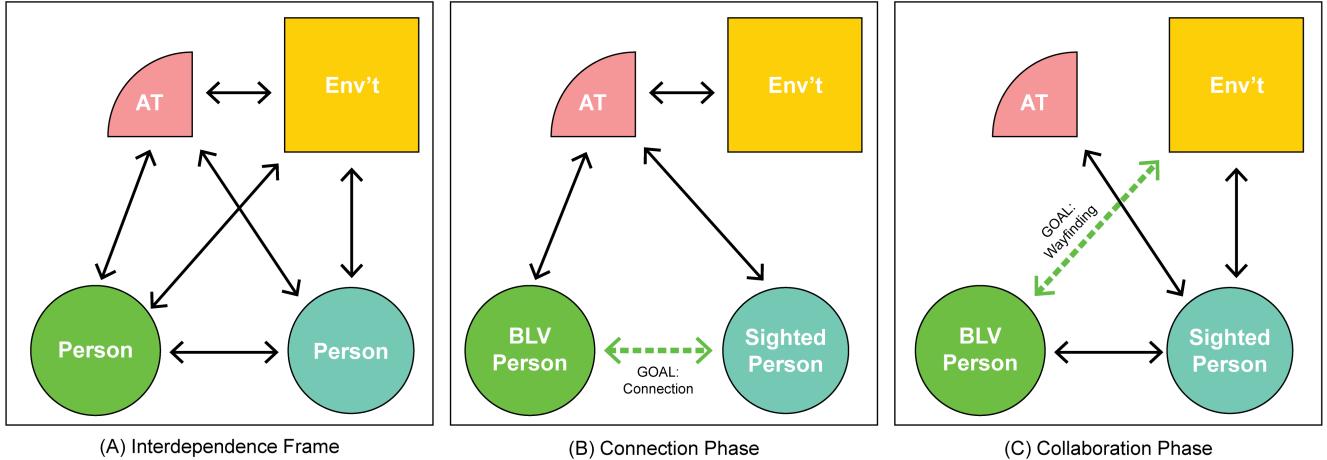


Figure 9: An illustration of how our approaches demonstrate and explore the interdependence framework. (A) shows a reproduction of the original interdependence framework [5]; (B) shows, in the Connection Phase, assistive technology interacts with both BLV and sighted strangers to meet for help; (C) shows, in the Collaboration Phase, assistive technology provides the sighted helper with instructions such that they can best convey information about the environment to the BLV person.

consideration. Both connection phase prototypes follow this model but in very different ways, with the Person-Finder Glasses being situated very close to the BLV person and the Volunteer Platform being a more equidistant liaison. Our findings from these prototypes (F1–F6 in Table 5) reveal the implications of this arrangement.

Figure 9 (C) illustrates the interdependence relations that we explore in the collaboration phase. Recall that the goal for the collaboration phase is to give BLV people the information needed to find their way in the environment—that is, to form the dotted edge in Figure 9 (C). Now, it is the sighted person that acts as a liaison between the BLV person and the environment, but because sighted people often struggle to provide effective help for BLV people, the assistive technology works to not only advocate for the BLV person’s needs, but also educate the sighted person on how to properly interact with and convey information to the BLV person. Both the Pictorial Display and Vague Directions Flagger follow this model but in very different ways. Our findings suggested that BLV people prefer knowledgeable helpers and find that this role for assistive technology alleviates their burden to explain themselves (Finding F5), while sighted people find real-time feedback (Design Implication D4) and visual examples along with instructions (D5) served them well.

7.4 Integrating with BLV People’s Current Practices

Recall from Section 2.2 that BLV people navigate and make sense of their surroundings using a unique set of current practices. In Thieme et al.’s review of BLV people’s current practices [46], the authors identify opportunities for assistive technology to enable BLV people to better locate others around them and choose whom to interact with, foster a shared understanding of other people’s actions, and consider existing social relationships. Our findings around users’ attitudes and preferences for assistive technology

respond to these visions, filling in some of the social gaps that the scenario illustrates.

Finding F1, for example, reveals that the design of a volunteer platform connecting BLV individuals and sighted strangers reduces social pressure for both parties when compared to BLV people approaching sighted individuals directly for help. Nevertheless, making a request through a volunteer platform might require more and effort than approaching a stranger directly. Additionally, BLV people who are comfortable with approaching others using current practices may choose to do so, and assistive technology should not hinder BLV people’s autonomy in choosing how they navigate socially.

Regarding the collaboration phase, we found that sighted people would like to learn more about BLV people’s experiences and processes (Finding F9) and their own current performance in giving help (Finding F10). The burden of both tasks usually falls to the BLV person, who may be at times excited to offer feedback but under other circumstances prefer not to do so, this could depend on the situation and their amount of free time. Our findings underscore the importance of supporting the social connections that BLV people wish to establish within their navigational process, which means that the approaches that we explored for the collaboration phase (Pictorial Display and Vague Directions Flagger) should only be used in cases where the BLV person does not want to do all of the advocacy and education for sighted people themselves. In Appendix A, we show that the collaboration phase prototypes may take conversational agency away from BLV individuals. Future work should explore collaboration phase designs that let the BLV person determine when the assistive technology should remain inactive and when it should intervene to facilitate the education of the sighted person.

8 LIMITATIONS

Our research is limited in that participants only had a single encounter with the prototypes in designated study environments. While we were able to draw meaningful insights from their experiences, a field deployment with a longitudinal study would have allowed us to conduct observations of usage in a more diverse range of physical environments and use cases, and gain an understanding of how people would engage with the prototypes over time. This would shed light on how a mixed-ability help-based community forms and evolves, as well as how the information needed from the help supporters might change over time. Additionally, our participants only included people who live in a major city in the United States, and our sighted participants only included university students. Their preferences might not be representative of the BLV and sighted communities at large. University students may be more receptive to the help supporters' instructions than the average public. Future studies with helper populations from other education backgrounds may uncover additional design implications on their preferences for the formats of instructions. Furthermore, we only studied four help supporter prototypes. While we selected designs that covered very different points in the design space for both the connection and collaboration phases, there could exist other types of approaches we did not explore and experiment with.

9 CONCLUSION

In this research, we explored the design space of assistive technology to support face-to-face help between BLV and sighted strangers. We proposed diverse approaches toward assistive technology serve as *help supporters*, which collaborates with both parties throughout the help process. We evaluated four approaches spanning two phases: the connection phase (finding someone to help) and the collaboration phase (facilitating help after finding someone). These approaches are represented by design prototypes: *Person-Finder Glasses* and *Volunteer Platform* for the connection phase, *Pictorial Display* and *Vague Descriptions Flagger* for the collaboration phase. Our findings from a 20-participant mixed-ability study reveal how the help supporters can best facilitate connection, which types of information they should present during both phases, how the display should be situated with the environment, and more. Our design implications reveal future directions for assistive technology that fosters mixed-ability help and for shifting the burden of education toward sighted people.

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A ADDITIONAL FINDINGS: HOW HELP SUPPORTERS AFFECT BLV USERS' FEELINGS OF AUTONOMY

While both the *Pictorial Display* and *Vague Directions Flagger* supported the sighted helpers in giving effective help, they also have an effect of advocating for the BLV person. This presents a risk of burying the BLV person's own voice and autonomy in the process of help. Both BLV and sighted participants raised several such concerns, with the general consensus that, if implemented poorly, collaboration systems may take conversational agency away from BLV individuals:

"In general, overall, I think I prefer asking clarifying questions myself rather than having the system ask them." -P5B

"The best feedback I can think of would be [from] the BLV person themselves. For instance, when they say, "Can you explain more?" or when they ask follow-up questions." -P3S

Participants also shared a concern that using help supporters too much could feel insensitive to the BLV person if the help supporter became the primary guide for enforcing social etiquette and effective instructions.

"[The helper] reading the Pictorial Display or the Vague Directions Flagger while I'm talking to them [...] felt a little bit strange. It's a little like, 'Oh, they have to read the instruction manual for how to interact with a person like you.'" - P8B

However, participants also mentioned the value and importance of having collaboration systems, as well as vital reminders they provide to sighted helpers:

"Maybe there's a cliff behind me, and I don't know it. So, the help supporter is really important, because it can remind the sighted person, "The BLV needs to know this." But you have to be careful to make sure that it is telling the essential things, and leaving other things up to the BLV individual to say." -P2B

These sentiments reveal a design tension between nudging sighted helpers toward giving better directions and maintaining organic communication between the BLV and sighted individuals. In the balancing act that help supporters must navigate between the two extremes, one BLV participant highlighted the importance of preserving BLV individuals' opportunity to speak up and advocate for themselves:

"One of the huge problems in the blind community is that blind people oftentimes won't express their needs...I think there's a balance that has to be achieved here. You want to give the sighted world information it needs [to help BLV people] without taking advocacy away from the blind person. [...] With the corrections that the collaboration systems automatically give to the sighted helper, those may take away some of the BLV individual's agency." -P2B

One way of achieving this balance may be for the help supporter to let the BLV person control whether they would like to lead the

sighted person's guidance or let the help supporter do the heavy lifting.

B MESSAGES USED FOR THE PICTORIAL DISPLAY PROTOTYPE

The set of 20 pictorial display messages are designed by the authors using Bitmoji [47] as a source of the avatars.



Say my name
so I know
you're talking
to me!

Please do not
pet my
guide dog.

Don't grab
my cane.
It can be
dangerous.

Do you have
1 minute to
help me?

I need
some help for
5 minutes

Do you have
10 minutes
to help?



I can figure this out.
Please don't help me

I'M EXPLORING THE AREA!



Could you explain a bit about our surroundings?



Can you explain what's interesting around us?



Could you help me find my destination?



Don't point "over there" or "over here"



Provide an **exact count** if you can



Describe directions from where I'm facing



Is there any curb or wall I can reference?



Can we go over that one more time?



Could you explain that a little more?



Let me hold your elbow, so I can follow you



Let me know if we're near stairs or an incline.



If there's a step or a drop, let me know!

Say goodbye before you leave

C RULES OF VAGUE DIRECTIONS FLAGGER

If: The sighted helper's speech contains any of these words and phrases	Then: Highlight and display the following guideline message
Some, a few, a bit, a couple, all, several	Provide an exact count or measurement when you can.
There, here, end, between, close to, near, over there	Use reference points and exact language when describing position.
Maybe, kinda, don't know, unsure, not sure	Provide accurate details if you can, or let VIP know that you don't have the information.
Left, right, ahead, behind, in front, next to	Check that your directions are from where BLV person is facing.
Red, blue, orange, gray, white, black, yellow, green, pink, purple, brown	Use non-color descriptors.
Straight	Is there an edge or wall they can reference as they move towards this point?