Understanding Trust, Transportation, and Accessibility through Ridesharing

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ABSTRACT

Relatively few studies of accessibility and transportation for people with vision impairments have investigated forms of transportation besides public transportation and walking. To develop a more nuanced understanding of this context, we turn to ridesharing, an increasingly used mode of transportation. We interviewed 16 visually-impaired individuals about their active use of ridesharing services like Uber and Lyft. Our findings show that, while people with vision impairments value independence, ridesharing involves building trust across a complex network of stakeholders and technologies. This data is used to start a discussion on how other systems can facilitate trust for people with vision impairments by considering the role of conversation, affordances of system incentives, and increased agency.

1 INTRODUCTION

Relatively few studies of accessibility and transportation for people with vision impairments have investigated forms of transportation beyond public transportation and walking [4, 20, 29, 31, 35, 48]. These papers mostly describe orientation and mobility strategies and technologies that people with vision impairments use to navigate indoor and outdoor environments, and while using bus systems. Yet, the transportation and accessibility landscape for people with vision impairments has evolved over the past few years and relatively few studies have investigated other forms of transportation.

To develop a more nuanced understanding of accessibility and navigation for people with vision impairments, we turn to an increasingly pervasive mode of transportation - real-time ridesharing services. Real-time ridesharing services or more simply, ridesharing services, allow for quick scheduling of a ride on short notice. The most common ridesharing services in the United States are Uber and Lyft. In 2017, the president of the National Federation of the Blind summarized a few of the benefits of ridesharing services for people with vision impairments, saying, "*Companies like Uber and Lyft are empowering blind people to live the lives we want by providing fast, convenient and affordable transportation*" [17]. Access to transportation has been known to provide resources such as improved healthcare and upward social mobility to low-income populations. Yet, prior work describes how disability can be a barrier to accessing these services [18].

To investigate accessibility and transportation in a new context, we conducted interviews with 16 people with vision impairments who actively use ridesharing services like Uber and Lyft and asked them about their experiences. Our findings show how participants leverage multiple sources of assistance across a network of people and technologies to build trust in ridesharing services. We describe examples that show how the driver, strong and weak ties, and augmented reality technologies play important roles. This work makes several contributions to the HCI community including:

(1) A review of trust in online and offline communities for sighted people and people with vision impairments
(2) A study of transportation needs of people with vision impairments in a new context - ridesharing services
(3) Strategies people with vision impairments use to build trust through technology outside of online communities
(4) Strengths and limitations of ridesharing services to support one community of people with disabilities, people with vision impairments

2 RELATED WORK

We discuss relevant literature in the context of trust, transportation, and technology for people with vision impairments.

Transportation and Navigation for People with Vision Impairments

Much research in HCI on people with vision impairments using transportation systems focuses on how they navigate environments using public transportation or walk. Most research on public transportation focuses on buses [4, 14, 23, 32]. This work describes challenges of accessing buses such as finding the bus stop prior to entering the vehicle, entering the bus, and knowing when to disembark a bus [14, 23]. Guentert (2011) has discussed similar challenges with people with vision impairments in trains [28].

Further, a large body of research has explore wayfinding and discussed strategies for improving wayfinding for people with vision impairments while walking [4, 5, 30, 45, 50]. Tools have been built to improve spatial awareness for indoor and outdoor navigation [4, 5, 41]. For example, Paneels et al., (2013) built a tool that can play aloud local landmarks and points of interest. Yet, findings show people are overwhelmed at the amount of information provided. Researchers have developed maps with audio [29, 50] and tactile feedback (see [5] for review) to support blind wayfinding. For example, Fiannaca et al. (2014) developed a head-mounted display that helps people with vision impairments better navigate large, open spaces and experimented with sonification and TTS feedback [22]. There is limited work on how people with vision impairments wayfind and navigate their environments beyond public transportation or walking. We explore how they do so in the context of ridesharing services, comparing and contrasting their experiences in other forms of transportation.

For sighted people, prior work describes how the process of wayfinding is highly social in vehicles where passengers or trusted parties help drivers navigate and reduce uncertainty about their navigation environment [25]. While trustworthiness or dependability is often an attribute assigned to closer ties, it can also be developed over time just as one establishes a relationship [7, 25]. Forlizzi et al's work (2010) highlights how conversations that take place in collaborative transportation experiences are similar to how people use conversation and social experiences in online communities to build trust with and through technology [25].

Trust

We continue by describing relevant work from researchers on trust and technology in HCI, specifically challenges in accessibility and transportation.

In Online Communities and Automation. Research has shown how people with vision impairments trust human assistance in social settings and online [51]. However, this can lead to expectations of reciprocity and social burden on those helping [8, 9, 13]. Automation has been described as a method of reducing social burden, yet recent literature suggests there are challenges in people with vision impairments trusting automation.

Research on technology use by people with vision impairments shows that one challenge is the amount of trust they place in automation happening in these communities. Much of this work is about automating captions and alt-text [38, 49]. Findings reveal a model of experience-based trust where alt-text automation is undermined based on negative experiences with the system. Further, findings suggest automation should encourage skepticism as a means for providing a more accurate measurement of trustworthiness. Additionally, while errors do occur with automated systems, prior work shows how people with vision impairments may be more forgiving of certain errors [2].

Prior work shows that sighted people use many visual cues to make inferences about other people, their environment, and trustworthiness [21]. One line of work describes how people build trust with relational and embodied conversational agents [6]. In online communities, sighted people can validate captions of photos by looking at the photo, thus determining a measure of the source's trustworthiness. Abdolrahmani and Kuber (2016) describe strategies people with vision impairments use for assessing the credibility of websites such as the presence of typos or inconsistent information, or the lack of descriptive text [2].

Researchers have described how sighted people and people with vision impairments have different trust building strategies when building trust online [2, 21] and with an agent [40] where blind people are more positively biased and likely to change opinions of an agent based on experience. This work describes the importance people with vision impairments ascribe to using voice as a feature to characterize one's trustworthiness, but with conflicting findings [1, 40]. While research provides no evidence that people with vision impairments and sighted people evaluate social trust differently [40], in another experiment, people with vision impairments rated aspects of trustworthiness based on gender and pitch differently than sighted people [1].

In Transportation. Early work on ridesharing communities reports how people do not trust carpooling with strangers, suggesting these communities use algorithms to learn about social networks and connect known social ties in shared rides [16, 19, 47]. More recent work describes how trust is a major factor affecting adoption of ridesharing services

Table 1: Participant Information - average age = 41.5 years old, 6 = female, varied vision conditions

			List of Participants	
ID	Gender	Age	Vision Condition	Services used
P1	Male	25	Totally blind	Uber
P2	Male	21	Low vision	Uber, Lyft & RITMO
P3	Male	23	Totally blind	Uber and Lyft
P4	Female	45	Blind with LP	Uber and Lyft
P5	Male	65	Totally blind	Uber
P6	Male	61	Totally blind	Uber
P7	Female	25	Totally blind	Uber
P8	Male	61	Blind with LP	Uber and Lyft
P9	Male	52	Totally blind	Lyft
P10	Male	56	Low vision	Lyft
P11	Female	19	Blind with LP	Uber and Lyft
P12	Female	69	Low vision	Uber and Lyft
P13	Female	23	Low vision	Uber and Lyft
P14	Male	49	Low vision	Lyft
P15	Female	25	Blind with LP	Uber and Lyft
P16	Male	45	Totally blind	Uber and Lyft

Note: * LP - Light perception

in low-resource/low-income communities [18, 19]. Designing for trust in low-resource communities could involve increased visibility of ridesharing services and transparency when describing pricing. Dillahunt's work describes how people mostly distrust Uber because of negative experiences with monetary transactions and safety. Similarly, prior work states how blind people are concerned with going to unfamiliar locations in public transportation services or walking [4] because they feel unsafe and don't trust being able to get assistance in these environments. Additionally, recent research show conflicting opinions on trust of autonomous vehicles by people with vision impairments [12]. This work suggests a need for more research on transportation and trust.

Ridesharing in HCI

Past work on ridesharing services has examined both, driver and rider experiences. In the case of the former, research has examined the effects of new technology mediated workplaces on the workforce, the resulting inequities and subsequently, how design can create more equitable workplaces [3, 26, 43]. On the other hand, work examining rider experiences has focused on understanding the benefits of ridesharing and barriers to their use, often by comparing them to other modes of transportation [18, 26, 33, 39]. Here, design has been touted as a means to create a more holistic ridesharing experience. Evidently, the approach to most studies has been to understand ridesharing by focusing on the disparate experiences

of drivers and riders, ignoring aspects of the intersection of their individual experiences and how they play a crucial role in shaping the experience of the other, a finding confirmed by research suggesting that the driver-rider relationship is indeed collaborative [27, 34].

In our research, beyond extending work examining the ridesharing experiences of people with vision impairments, we also investigate the centrality of the driver to their experiences and the specific role they play in shaping our participants experiences with ridesharing services. Furthermore, although it is understood that people with vision impairments rely on human assistance to navigate, little is understood about who they take assistance from, the nature/timing of this assistance, and its relevance to the accessibility of transportation services. In our study, we examine the role that strong ties (e.g. family and close friends) and weak ties (e.g. acquaintances and strangers) play in people with vision impairments using services like Uber and Lyft.

3 METHODS

We conducted interviews with people with vision impairments who were active ridesharing users to understand participants experiences with ridesharing services in comparison to other forms of transportation.

Interviews

Interviews were semi-structured and lasted between 60-70 minutes. A majority of the interviews (n=12) were conducted in person while the rest were conducted remotely over phone or Skype. Verbal consent was obtained at the start of the interview. During the interviews participants were asked about their overall experience with ridesharing services, challenges participants faced using ridesharing services, how they navigated these challenges, and perceptions of other forms of transportation (e.g. buses, autonomous vehicles). Additionally, we asked how they used these services to travel to unfamiliar locations due to work that suggests differences in navigating places based on familiarity [5, 30]. Interviews were audio recorded and participants were compensated $20.

Recruitment and Participants

We recruited participants by contacting organizations catering to people with disabilities and vision impairments in the [anonymized] area. Eligible participants were at least 18 years old, had a non-corrective vision impairment (blind or low vision) and had used ridesharing services at-least once in the month prior to when they were contacted. In total, we recruited 16 people (female = 6, average age = 41.5 years old) to participate in the interviews. Participants had varied vision levels including blind, blind with light perception, and low vision (visual acuity of < 20/70). Most participants (n=9)

had used both Uber and Lyft while the rest had used only one of two services.

Analysis

All interviews were transcribed by a professional transcription service, which were then validated by a member of the research team. We used an iterative coding approach to analyze the transcript data. Two researchers began the coding process with a combination of open coding, where we noted any themes common across transcripts, and a priori coding [44], where we used prior literature to inform some of our codes. The same researchers then agreed on a list of axial codes including those for trust, independence, assistance, and accessibility to describe the data. To mitigate coder bias, a sample of the transcripts were coded by two researchers. Coding of the sample was reliable (Cohen's kappa = 0.81, p < 0.05). On reaching this level of agreement, researchers divided the rest of the transcripts and coded them individually.

4 FINDINGS

Our findings provide evidence of a collaborative effort between the driver, strong ties, and weak ties that takes place in ridesharing services for people with vision impairments. In this paper, we use Putnam's notions of strong and weak ties where strong ties are close family members and friends and weak ties refer to acquaintances and colleagues.[42] Further, We highlight trust-building strategies participants use across these sources with and without the use of technology to make ridesharing experiences accessible.

The Role of the Driver

Drivers are critical in the context of entering and exiting a vehicle, providing environmental awareness, and facilitating trust in ride-sharing services.

Entrance and Exit Work. Participants described many positive interactions with ridesharing drivers as they trusted drivers to help them when entering and exiting a vehicle (n = 15). They described how they asked drivers to drop them off at convenient locations that made it easier to find doors. For example, P16 asked his driver if he was "*familiar which way the sidewalks run. I want to make certain that they know I haven't been there before, 'could you please line me up with the door?'*" The lack of a driver, particularly for going to a new location, concerned one participant who said,"*if you go to a new place ...how are you going to...make sure that you're being dropped off in front of the door or how far away is the door or is it to the left or to the right?. (P9)*" Some participants (n = 6) described how their drivers left their vehicles to assist them inside of buildings. For example, P11 described how:

> "*I was going to work a couple weeks ago, and the Uber driver was really, really helpful, and there was a bunch of construction...he tried to walk me around the construction. You know, got out of the car, so that I could get through to go to work.*"

Two participants compared this interaction with other forms of transportation such as buses. One participant said:

> "*The con for me is that I don't think I could do it on my own without serious planning. I have to know on which side of the street the bus stops, when it stops, what are the routes in between. I need to tell the bus driver to make sure that he or she let me know when my stop is approaching. I need to know where it stops on what side of the street when I get off. It's a bit more planning than taking Uber.*" (P3)

This example illustrates how participants may need to trust drivers to help with vehicle entrance and exit work regardless of the form of transportation, but that this may take more effort when not using ridesharing services.

However, interacting with the ridesharing driver to enter a vehicle also presented challenges for participants. Popular services like Uber and Lyft provide the license plate, vehicle make and model, and sometimes image of the vehicle to help passengers locate the driver. However, this becomes a challenge for someone with low vision and almost impossible for a person who is blind to use as a resource. To help mitigate this challenge, some participants (n = 6) describe contacting the driver, disclosing their disability, and asking the driver to find them instead of vice versa. For example, P5 said:

> "*Well, sometimes they can't always see where you are. They think you can see them and you tell them you can't. You call the rider and your waiting and they still can't see you. For example, I waited out by my garage before and a guy swore he was at my house. And I said, "You're not at my house 'cause I'm at the garage.' He goes, 'I'm at the garage.' I said, 'No you're not, 'cause I'm right here.' And I even waved the cane around. So he drove around, and he finally saw me.*"

However, this is only available to passengers who know this is a feature as one participant wished ridesharing services had an option to contact the driver. Often, participants described this disability work of communicating with the driver and entering the vehicle as the most challenging part of using ridesharing services. While other work highlights this as a similar challenge in public bus systems for blind and blind-deaf people [4], this challenge was not as prevalent in our study when participants were asked about their use of buses, presumably since stops are fixed, and para-transit services where there is often door-to-door service to enter and exit a vehicle. For example, P1 said, "*They have something*

called a connector, which is door to door. They are good. They were accommodating before I found Uber."

Environmental Awareness. Upon entering a vehicle, participants (n = 12) enjoyed drivers who provided cues about the trip and destination environment. P8 describes a trip in which he was traveling to a new place and the driver provided him with information about nearby landmarks saying:

> "*...in route, she was noting different locations that we were passing, and what was in those locations, and you know, different tourist spots if we were interested and different restaurants that we might want to visit that was in our general area and the route...so I thought it was very accommodating.*"

One participant mentioned how if not provided with these cues, he would ask questions to seek environmental awareness. P2 said:

> "*Well, he doesn't know that I'm unfamiliar with the location, so in that particular instance since I was leaving, it wouldn't be beneficial but let's say that I just arrived and I was taking Uber out, then it would be really useful to get information about the area just like you would in a taxi cab. If I were to take an Uber in that situation, I would probably strike up the conversation anyways. I'd be like, 'Oh, hey, what's around here?'*"

Beyond local landmarks, people would also ask questions about nearby doors and obstacles at their target destination.

Trust-building Strategies. Participants overwhelmingly discussed the "social contract" of taking ridesharing services where conversing with the driver about their lives was both an expectation and benefit of this form of transportation (n = 16). For example, P10 said, "*I think there's an unspoken kind of social contract that plays out in the Lyft. Not always, but ... 'Cause some drivers obviously don't wanna talk, but generally they do.*" Participants discussed enjoyed conversations with drivers. P4 described how her driver "*was extremely helpful, great conversation, all of that. It was like five star all across all services. Wasn't just a ride, it was more like a friendship in a ride.*"

Prior work has also discussed the social capital benefits of using services like Uber and Lyft (e.g. companionship, advice) [33], but participants also seemed to use conversation as a tool to establish trust with the drivers. Being in a vehicle with a friendly driver seemed to make participants comfortable enough to trust drivers to take them to the correct destination. For example, P1 said, "*I do go across some driver [sic] that I may have taken in the past. So, that happens like, 'Hey man, good to see you again.' I feel a bit comfortable because they know me.*" In his interview, P1 described an experience where he needed to take a 3-hour trip at 2:00 a.m. and felt more comfortable doing so with a driver he had encountered before. This trust that was built over multiple rides and conversations that put him at-ease to not only trust this one driver, but other ridesharing drivers.

Similarly, two participants described being more comfortable in rides with drivers they had encountered before and rides where they wanted to keep where they were going private. P9 described how he uses ridesharing services "*When I have to make trips to like the bank to keep my privacy so nobody take me.*" P1 echoed this sentiment when he said:

> "*Let's say I want to go to somewhere that I don't want anybody to know. Not necessarily bad, but I want to go to a beach. Beach, park, a store. I want to buy something as a surprise, a birthday party, whatever. It gives me a freedom to be myself.*"

Here, ridesharing drivers are described as trusted third-parties which, due to not having a connection to the driver, was a benefit. This is similar to why people describe using the Internet to research information they want to keep private, or solicit advice on a topic rather than asking family members and friends.

Further, participants described how their prior experiences were useful for building trust needed for future rides. One participant (P13) described being more likely to take any form of transportation if they had a friend with a vision impairment who had had a positive experience. She said, "*If all my disabled friends they use automoto car then I will use it with them. But, if none of them use it I will [say], 'Oh, I'm not the first one who take this risk'*" Additionally, participants attributed being likely to continue using ridesharing services to their own previous positive experiences. While participants were concerned about using other forms of transportation, they seemed trusting of ridesharing services to take them to new places. For example, P2 said:

> "*I don't know anything about the taxi or bus routes. It's a completely new location, so I have no idea how it works, and it's not worth the effort for me to look all that up, and it's potentially unreliable, and I could potentially make a mistake.*"

P4 agreed by saying, "*if it's somewhere new and it's, quite frankly, not in a congested area, I'll take Uber or Lyft.*" Prior work describes the amount of planning and coordination needed to go to a new destination [30]. Based on this work, we asked participants specific questions as to how they use ridesharing services differently when going to an unfamiliar location. Surprisingly, no one reported differences other than searching for the address. This shows how much trust participants place in the drivers and ridesharing services.

Although positive experiences with drivers were described as reasons to continue using ridesharing services, negative

experiences did not seem to deter participants from using them in the future. For example, P4 said:

> "*One of the drivers dropped me off five doors from my house and it was at night and he pulled off...and I didn't know if he dropped me off on the wrong street or if he had dropped me off on the wrong block. I really couldn't tell.*"

P1 had a similar experience where a driver wanted to drop him off on a highway. One strategy to help passenger know if the driver is navigating to the correct destination is to 'follow along' on their phones. Yet, P2 explicitly described not doing this because he trusted not just the driver, but the incentive systems for drivers, saying:

> "*I don't really do it because I usually don't have a real concern with that. Either the place I'm going to ... If I need to go to somewhere quick, it's usually to a place that I know. If I'm going to somewhere new, I usually am not necessarily under that same kind of time constraint. I usually have enough trust in the driver to not intentionally make any turns...I think the way Uber's payment system is set up, it's better to get more rides than to just drive someone around and get the extra cents per mile, but I'm not entirely sure.*" (P2)

Similarly, others like P6 placed trust in drivers because of the affordances inherent in the design of ridesharing services like background checks, saying "*I think there may be more security about the drivers because I know the drivers are screened.*"

Despite the countless incidents where participants described being taken to the wrong destination, only P3 described not trusting drivers to take the most optimal route and using the GPS on his smartphone to confirm the route. However, P3 and other participants are active ridesharing users even after negative driver experiences. This suggests that the benefits of using these services outweigh the costs.

The Role of Strong Ties

Although most participants (n = 12) described using strong ties like close family members and friends as a form of transportation if ridesharing services were unavailable or too expensive, participants also described them as trusted parties used to initiate trips and for help upon arrival to a destination (n = 5).

Ride Initiation. We have already seen how participants describe initiating a ride and finding the driver as one of the most challenging parts of a ridesharing experience. One strategy two participants used was to ask family members to help. One participant, who was older and did not own a smartphone described how she used Lyft by asking family members for assistance. "*That's the only way I can get the*

ride, one of my granddaughters have to text my daughter to do it. Then she'll do it and she'll call that, she'll text what color"(P12). She brings her granddaughter(s) with her during trips to use their cell phones to contact their mother (P12's daughter) to schedule the return visit, since they are too young and without debit/credit cards to have their own Uber accounts. While there are services like GoGoGrandparent, which facilitate initiating trips for people without smartphones, participants seemed to be unaware of them. P12's daughter and granddaughters are acting as a proxy or intermediary, functioning in the same role.

Destination Assistance. A few participants (n = 3) described sharing trips with close family members to help them navigate new or unsafe environments. P5 described how he would ask family or friends to travel with him "*somewhere where I needed someone's eyes to help navigate me to where things were.*" Strong ties' eyes were used to help navigate around obstacles in other environments, and participants similarly described using others' eyes in transportation, more broadly. P13 described how her friend can "*recognize road conditions faster than me. Be with her is less likely for me to miss a stop.*" Here, having a friend accompany P13 on a bus ride helps to strengthen situational awareness.

Strong ties were also used as trusted parties to accomplish a task at the target destination. Shopping was a common activity that needed subjective advice or a "second opinion" (P8). For example, P15 said:

> "*Like if I want to go shopping, and I want someone's opinions, or if it's something I don't want to do alone. If it's a new menu or place and I want someone with me, then I would do that. Or if I just want company.*"

Additionally, more private activities such as going to doctor's appointments or completing a legal form were situations in which people with vision impairments asked family members to accompany them during ridesharing trips. P4 described how her "*preference is when I go to doctor's appointment is to take a close relative or an advocate so most the time that person has sight.*"

Benefit and Burden of Reciprocity. For some participants, "mutual benefit" an expectation to assist either in ridesharing services or providing a means of transportation was expected. Participants described offering homework help, gas money, or introductions to new social connections in exchange for assistance. P1 said:

> "*They never really turn my request down, because again, I do help them in things in return. It's not that they aren't helping me for nothing in return. Sometime money for gas, sometime help with their homework, sometime with a certain connection,*

or they'd like to meet somebody who is coming in town."

While asking trusted parties like family members and close friends for assistance can be beneficial for the person with vision impairments, it can also be burdensome.

Prior work has cited reciprocity as a challenge for people with disabilities and older adults [37]. Similarly, some participants described not being able to provide an 'equal' amount of help. For example, P3 described how "*one of the things that I don't like is I don't mind being driven around, but I always have this feeling that I cannot help the driver as much as they help me.*" This seemed to lead to feeling like a burden to others, which undermines the independence that ridesharing services seem to provide. Participants also considered the negative effects of reciprocity like burden on strong ties in other forms of transportation. For example, P7 said:

> "*you gotta kind of plan ahead of time, lots of times, even if you're gonna have someone take you, because if you don't arrange it ahead of time, they may or may not want to take you. And if you ask too many times, it can be a burden for them.*"

Our data show that while family members and friends may be trusted parties, the expected reciprocity or perceived burden from asking them for help in other forms of transportation could have encouraged participants to use ridesharing more often.

The Role of Weak Ties and Technology

In Planning Trips. Interestingly, participants also described weak ties as an importance source for during their ridesharing experience. Some participants (n = 2) asked strangers nearby about landmarks at their origin destination. They would then give this information to the driver to facilitate finding the ridesharing vehicle. For example, P1 said:

> "*I ask usually the people like, 'What is across from you guys?' Because again, I cannot see. I told the driver, 'Well it's a bluish building, it's right across from McDonald's.' That makes it easier...I try to give the driver a heads up.*"

Similarly, P1 described how he would call ahead to a new destination to receive information to help the driver arrive at the correct address, saying, "*Sometimes they wait for me, sometimes they don't, so I have to call the security, so they can escort me to the right place.*" This shows how riders have to rely on unknown parties, either prior to entering a ridesharing service or arriving at their final destination, to provide information necessary for a successful trip.

During and Post-Trip. After the trip, participants commonly asked for help to find the door to their target destination, but interestingly rarely described asking for help

from other people beyond the driver to assist them with finding the door. P15 said, "*'Okay, where's the front door?' I either have to wait for someone to pass by or just wander around until I found what I needed.*" Lacking the presence of other people concerned participants. For example, P15 said, "If I'm going to a place I haven't been before, I can't ask questions - "Okay, where's the front door?" I either have to wait for someone to pass by or just wander around until I found what I needed." Similarly, P3 highlighted how he would need someone "to help me into the building or find the entrance to the building."

Perhaps consistently finding someone other than the driver was difficult to do post-trip (e.g. in less populated areas) or unsafe to do (e.g. at night). For example, P13 said, "*we play in the night, it's really ideal for me to consider about transportation before I make acquisition that if I choose to go, or not to go. It's not like, 'Okay, I'm go that place.' Then I start thinking what kind of transportation service I'm going to use.*" Along with other data, this quote suggests how participants have a decision-making process for which mode of transportation to use relates to perceptions of safety (related to [10]) and expectations of assistance. Thus, some forms of transportation are more trustworthy than others.

Some participants heavily relied on mobile applications and services for people with vision impairments to navigate to the correct location. With the advancement of GPS technologies, participants described using applications layered on top of common map services like BlindSquare and Around Me for navigation. Interestingly, few participants (n = 3) described using Aira [1], an augmented reality headset technology that connects people with vision impairments to live agents or "visual interpreters" (p16).

> "*When I order Uber or Lyft, I can order it through my visual interpreter, and then the visual interpreter knows the name and the car, and they know what the car looks like. So now when the car pulls up, the Uber car, Lyft car, pulls up, because the visual interpreter can see what's in front of me, they can tell me, 'Yes, that's the car. Walk straight ahead, a little to your left is the back door.'...It limits the third party assistance that I would otherwise require.*" (P16)

P16 described using AIRA to resolve the ride initiation challenge described above. Similarly, P7 used AIRA in place of asking a family member for assistance:

> "*I think I called my husband and told him that I was coming. But then it was my phone was tied up because I was using my phone with the Aira... I had her stay on till we got to the library so she could assist me from the car to the door...I'm not*

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[1]http://aira.io

supposed to fall, so that's why I had her assist me. And it was good 'cause I just walked up the ramp and stuff."

AIRA helped P7 with finding her target destination and with obstacle navigation. Technologies like AIRA are increasingly being adopted. Similar to systems like VizWiz [8], see observe how participants are receiving help virtually through a trusted strange, but this help is no longer visible while navigating.

Perceptions of Trust. Beyond ridesharing, prior work has suggested how the future of accessible transportation for people with vision impairments goes beyond ridesharing services to the use of autonomous vehicles. Yet, this same work describes how people may have concerns about how to trust a vehicle, particularly one without a driver [12]. Similarly, several participants (n = 5) were concerned about trusting an autonomous vehicle in an emergency and if it would behave correctly. For example, P8 asked, "Will autonomous vehicles see that vehicle coming off the curb and be able to stop in time?" Similarly, P12 questioned:

> "*How would I know the car is going to stay in between the lines so I won't run over? How would I know the camera all the way around? You can tell me the camera is all the way around the car but how do I know it's working? How do I know it's function? Suppose one of the cameras broke, how would I know that?*"

Other participants like P3 were concerned about "*the route that it takes, knowing that it's an accurate route.*" Each of these participants question how they can determine if the vehicle is performing said functions with presumably no way to verify these actions. Additionally, depending on the level of autonomy, riders in an autonomous vehicle may be called upon to recover from an emergency or vehicle malfunction. Similar to operating existing vehicles, this is one of the biggest challenges cited for why people with vision impairments should not be allowed to be the sole rider in an autonomous vehicle. In ridesharing services, we see how participants often discussed the importance of the driver as a source of help. P5 touches on the need for human assistance when he said, "*I guess if something malfunctions, then I'm gonna have to trust somebody.*" Yet, P15 said, "*I don't trust the vehicles, but I also don't trust my vision.*" It seems like trust-related concerns using an autonomous vehicles may be more closely related to not having sighted assistance. Perhaps similar forms of remote assistance used in ridesharing services like Aira could also be used in autonomous vehicles.

Trust has also been described as "trust work", a relational process where trust can be built over time. Two participants

related trust in autonomous vehicles to elevators and elevator operators. They discussed how everyone, regardless of ability, has to manage this trust work process with any new technology, saying:

> "*There's gonna be a initial uncomfortability with the whole autonomous part because you can think back to elevators. Elevators were initially pulled by hand or whatever, and then when it became autonomous people were really scared to use them. In that transition period, people would prefer to take one step or an automatic or whatever, so that would probably be a bit of a fear.*" (P2)

We find that our participants value the independence and convenience afforded while using ridesharing services, but also rely on assistance in these services from different sources including the driver, weak ties, and strong ties. We also find evidence that technology beyond mobile map applications that are collaborative and include sighted, remote assistance from a human like AIRA are also trusted services that can be leveraged in current and future forms of transportation for people with vision impairments

5 DISCUSSION

Our study provides evidence of conflicting research on trust work for people with vision impairments using automated services, specifically who they trust and how that trust is built over time. Below we describe more about how our findings relate to prior literature on trust work, showing new ways that interpersonal trust is built and maintained.

Supporting Beyond Experience-Based Trust

Although prior work has described how experience-based trust takes place for sighted people and people with vision impairments interacting with agents [6, 7, 15, 24], we observed how experience-based trust was not indicative of future use and trust for people with vision impairments in the same ways when using ridesharing services. Specifically, participants' negative experiences such as a driver dropping them off at the wrong location did impact perceived trustworthiness of that particular driver. However, participants continued to use ridesharing services suggesting that trust in one part of the system can be weakened, but not affect use of, trust, and perceptions towards the broader system of ridesharing services as participants remained positive about and continued using such services. We suspect this happened because the benefits of using ridesharing services, particularly increased independence and no longer feeling the need to reciprocate favors for close social ties, outweighed the costs of negative interactions with drivers.

Facilitating Trust Work for People with Vision Impairments

Below we discuss the ways in which people with vision impairments conducted trust work in ridesharing services. Our data supports prior work on grounding through conversation for trust elicitation and extends relationships between trust and safety, yet provides new perspectives on how system affordances and increased agency affect trust formation.

Conversation as Grounding. Prior work describes how "small talk" or simple, courteous conversations in dyadic interactions is part of trust work [6, 7]. Small talk helps people to build a "like-mindedness" that facilitates trust elicitation. In our study, we show how riders and drivers participate in this trust work through "small talk" and how negative experiences with ridesharing are closely associated with negative conversation experiences with a driver. Prior work discusses the importance of conversation for building social capital with sighted people in ridesharing services [18]. As such, designers and developers of ridesharing services could scaffold better opportunities for conversation, which could simultaneously build social capital and trust for people with vision impairments and sighted people.

Building Trust through Safety. Additionally, prior work suggests there may be a relationship between trust, safety, and independence for people with vision impairments [4]. Our data show how some participants described safety as a primary factor for supporting transportation decision-making and trust like deciding on a mode of transportation and time of day to take said transportation based on whether someone would be able to help them at their target destination. Dillahunt and Malone show how decreased perceived safety are associated with decreases in trust in different applications the sharing economy [19]. We urge researchers to study this relationship further in the context of ridesharing services and emerging forms of transportation (e.g. autonomous vehicles), and other emerging technologies (e.g. digital assistants). Remote-assistance technologies like Aira could be used to help people with vision impairments report unsafe situations, or could initiate communicating safety information to people entering or exiting a form of transportation.

Incentivized Trust-Building. Similar to prior work on blind and deaf-blind bus passengers [4], we see that drivers play an important role in the ridesharing transportation experience. However, in buses, Azenkot's participants described mostly negative experiences with bus drivers not communicating stop information, likely due to the bus policies indicating how passengers should minimize interactions with bus drivers. However, our findings show that ridesharing passengers leveraged assistance from the driver as much as possible.

This is likely due to the inherent service-based design of ridesharing services where communication with the driver is expected from the driver. Perhaps, popular ridesharing services like Uber and Lyft can even encourage conversation and interaction with passengers to support rating systems where passengers are making judgments about how to review drivers based on courtesy shown during the trip, and vice versa. We encourage developers, designers, and researchers to consider incentive mechanisms that could help people with vision impairments build trust with systems.

Agency in Trust Formation. Our data also show the new ways that interpersonal trust is formed through co-located (through drivers) and remote assistance (through technology). Prior work describes how their participants with vision impairments in India rely on their own smartphones and audio from driver's GPS systems to ensure their trips were on the right route because they did not have 'innate trust' in drivers and to feel more in control of their trips [34]. A few of our participants were aware of a remote-assistance technology, Aira, used to help blind people navigate their environments. For those who used Aira, they described it as being a highly trustworthy service because of prior positive experiences and it being more reliable than co-located humans. Aira is an example of how people with vision impairments have more control of creating their own trustworthy experiences through technology in ridesharing services than they might while using public transportation or while walking, where having access to people who can help is less readily available. Brewer and Kameswaran's work describes how control and agency are important factors people with vision impairments consider when assessing potential of other forms of transportation, specifically autonomous vehicles[11]. Also, prior work with older adults introduces 'designing for agency' in online communities [36], but our work suggests there may be ways to design for agency outside of online communities through services like Aira.

Limitations

While this paper provides rich contextual data on the experiences of people with vision impairments using ridesharing services, we recognize that our study was limited to a specific context - people with vision impairments living in one city in the U.S. Vision impairments describes a range of vision conditions including blind and low vision. Although previous research highlights how blind people in India use ridesharing services [34] and differences in how blind and low vision people use technology [46], our data is a first look into ridesharing services across a range of vision impairments. Additionally, this data represent the experiences of people who have recently used Uber or Lyft. We would like to better understand the perceptions of non-users in

the future work, as this could also provide useful insight on perceptions of trust in transportation.

6 CONCLUSION

We conducted interviews with people with vision impairments on how they use ridesharing services, contributing a new perspective of transportation use and navigation to the HCI community beyond public transportation and walking. Our findings show the ways in which blind and low vision people perceive these systems as trustworthy through interactions with the driver, strong ties, weak ties, and technology. This data is used to start a discussion on how other systems can facilitate trust for people with vision impairments by considering the role of conversation, affordances of system incentives, and increased agency.

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