‘We can go anywhere’: Understanding Independence through a Case Study of Ride-hailing Use by People with Visual Impairments in metropolitan India

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Ride-hailing services have received attention as part of the growing work around the sharing economy, but the focus of these studies has largely been on drivers. In this paper, we examine how ride-hailing is transforming the transportation practices of one group of passengers - people with visual impairments in metropolitan India. Through a qualitative study consisting of interviews and observations, we examined the use and impact of these services on our target population, who otherwise contend with chaotic, unreliable, and largely inaccessible modes of transportation. We found that ride-hailing services positively affects participants’ notions of independence, and we tease out how independence for our participants is not just about ‘doing things alone, without help’ but is also situated, social and relative. Furthermore, we show how accessibility, in the case of ride-hailing in India, is a socio-technical and collaborative achievement, involving interactions between the passenger, the driver, and the technology.

CCS Concepts: • **Human-centered computing → Empirical studies in accessibility**;

Keywords: Accessibility, social accessibility, collaborative accessibility, independence, stigma, social interactions, ridesharing, Uber, Ola, blind users

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1 INTRODUCTION

> *"We have to take sighted assistance; most of the times it was normal travelers who helped us take a taxi and stuff like that. But when this service is available, it is really very, very much freedom [sic] for us because we can do what we want, we can avail anything, we can go anywhere, we don't need to take sighted assistance [...] It unveils a new door, a new world for us - the world of independence, I must say."* - Participant 10 talking about impact of ride-hailing on his sense of independence.

According to the World Health Organization, there are 285 million people with visual impairments in the world including 39 million blind people, over 90% of them living in the Global South [51]. India, with 63 million people with visual impairments, including 8 million blind people, has one of the largest populations of people with visual impairments in the world [37]. Researchers have suggested that people with visual impairments in the Global South struggle with social and economic participation and have cited many reasons for this, including the lack of accessible educational material [48], the lack of access to assistive technology, significant barriers in the workplace [34], and limited access to accessible transportation [42], which fosters independence by enabling access to health, educational, and employment resources [2, 27, 36]. Further, for people with disabilities, transportation has been recognized as an important conduit to increased community participation and, subsequently, inclusion [19, 28, 49].

Although metropolitan India boasts a rich and varied transportation system, including buses, trains, metros, auto rickshaws, and taxis, in general these systems are not accessible to people with visual impairments. Not only are they crowded but there is little in the way of public announcement systems and accessible resources such as maps and schedules. However, recently ride-hailing services like Uber, and its Indian counterpart, Ola, are disrupting the transportation landscape by providing private access to car fleets. Uber has been active in India since 2013 and now operates in 33 cities[1]. Ola cabs, Uber's main competitor in India, has been operational since 2010 and operates in more than 100 cities[2]. Dillahunt et al. examined how ride-hailing services could positively impact low-income individuals in the United States, who benefited from the reliability of the services and social interactions with drivers [13]. Given the importance of transportation for economic and social participation, we investigated how ride-hailing services were being used by people with visual impairments within the wider context of the Indian metropolitan public transportation system. To this end we conducted a two-part qualitative study, consisting of interviews and observations, initially looking at peoples experiences with public transportation overall, then focusing in on ride-hailing services (Ola and Uber), as we uncovered their impact on people's sense of independence.

This paper makes several contributions to CSCW. To our knowledge this is the first study of how ride-hailing services are used by, and by-and-large promote the independence of people with visual impairments. Independence is a core theme underlying accessibility research. As Wobbrock et al. suggested, "all accessible computing approaches share a common goal of improving independence, access, and quality of life for people with disabilities" [52]. As such, the idea of 'independence' is woven into much of the 'HCI and accessibility' research, often as a metric to evaluate the value or effectiveness of an assistive technology or technology intervention designed for people with disabilities. However, in this research independence has been primarily understood as self-reliance, i.e. 'doing things alone, without help'. An artifact is considered to be effective when it allows its intended users to perform specific tasks without, or with greatly reduced-assistance. Independence emerged as a strong theme in our study, being articulated by our participants as a strong driver of their use of ride-hailing services. However, we reveal a more nuanced conception of independence

[1] https://www.uber.com/en-IN/cities/
[2] https://www.olacabs.com/about.html

when it comes to ride-hailing, which extends beyond self-reliance and includes, among other facets, its social nature. Secondly, we reveal how the accessibility of ride-hailing goes beyond the simple functional accessibility of the service's app and requires the driver and passenger to collaborate. Indeed, we found the accessibility of ride-hailing services in India to be a collaborative and socio-technical achievement, involving the driver, passenger, and technology. The degree of success in collaborations between passengers and drivers is the cornerstone to the accessibility of these services, and the source of any feelings of increased independence. This paper therefore contributes to the emerging 'turn to the social' [20, 43] in accessibility research.

2 RELATED WORK

2.1 Ride-hailing services

Most studies on ride-hailing services in HCI and CSCW focus on drivers, extending traditional workplace studies to understand how these new technology-mediated workplaces impact drivers [3, 17, 25, 40]. In comparison, rider experiences are less well understood. In a study in Detroit, Dillahunt et al. found that Uber offers certain benefits to low-income populations, including opportunities for rich social interactions with drivers, but that there are still many barriers to entry resulting from larger social challenges, such as low digital literacy, and from technical limitations of the platform, such as the lack of inclusive payment infrastructures [13]. Gloss et al. found that Uber users were "dismissive of the traditional cab experience" with their preference for Uber resulting from the increased in-ride security and reduced uncertainty during the hailing process [17]. Kameswaran et al. examined how Uber can be a source of social and cultural capital for low-income populations [22]. Meurer et al. studied the transportation habits of older adults including their use of informal ride-shares (taking rides from friends and family) and examined how they navigate the complexities of the driver-rider relationship to reduce their sense of dependence [29]. We extended these studies examining rider perspectives to focus on the use of ride-hailing by people with disabilities, specifically people with visual impairments in India.

2.2 Notions of independence

Notions of independence have been widely discussed in the HCI, CSCW, and accessibility literature, primarily as an outcome or evaluative metric for technology interventions designed for people with disabilities. The most common interpretation of "independence" in these studies is that it relates to self-reliance, or "the ability to do things without ones help or assistance" [41]. Here, technology as a facilitator of independence functions in a substitutive capacity, filling in for people from whom help is sought, thus fostering increased self-reliance. Take the case of navigation, which has long been a challenge for people with visual impairments, who often rely on human assistance to get around. Consequently, there has been an interest in designing assistive technology to foster independent navigation, i.e. enable people with visual impairments to get around with reduced or no help. Examples include technologies that enable people with visual impairments to acquire information about their immediate environment on their own, whether this is indoor landmarks like elevators [6] or bus stop locations and arrival times [4].

Researchers have also attempted to quantify independence, so that the impact of some assistive technology can be measured. For example, technology users might rate their degree of 'independence' on a Likert scale - a representation of the extent to which the artifact allows them to perform a task on their own [35, 38]. However, this research has examined independence almost entirely as self-reliance and has been contested because it gives undue weight to physical capacities while ignoring aspects like autonomy - the ability to independently make decisions.

2.2.1 Independence beyond 'self-reliance'. In the few studies that looked beyond self-reliance, independence was expressed in terms of autonomy, control, and reciprocity. Autonomy is the freedom to exercise one's choice and in a study of older adults, Hillcoat-Nalletamby found that that the "self-determination in choosing what to do, how and when to do it" is closely associated with independence [21]. In a study of the transportation habits of older adults, Meurer et al. found that the use of informal ride-shares is associated with loss of decisional autonomy, which is the freedom to plan for trips. This is because passengers become contingent on the availability of others, resulting in a loss of independence [29]. Control, defined as "the capacity of people to perform behaviors to influence outcomes in their environment", is also associated with independence [21, 50]. Yang et al. described how users of their technology - an indoor navigation tool for people with visual impairments felt independent, the result of a sense of control they derived from knowing what to do when they were lost [53]. Finally, reciprocity is also linked to independence because it reduces the cost and feelings of dependency [5]. Brady et al. examined the question-asking behavior of people with visual impairments. The authors found that a preference for getting answers from crowdworkers ahead of friends and acquaintances on their social networks was related to a desire for independence. In this case independence was expressed in relationship to reciprocity, with people with visual impairments seeking to avoid unpayable social debts where possible, e.g., asking questions without being able to answer any [7]. Evidently, there is no singular, all-encompassing definition of independence, but given the importance of this concept to accessibility research it is worth exploring further.

2.3 Accessible technology research

Assistive technology has traditionally been developed to play a functional role for people with disabilities. This approach has its roots in the medical model of disability [10], a model that emphasizes one's physical impairments. In the medical model, assistive technology and accessibility are a means to offset physical incapacities and HCI research often adopts a needs-based approach to design and evaluate tools to maintain and expand these capacities. Recently, there has also been a focus on understanding the accessibility limitations of mainstream applications and services that impede their use, with design bridging the gap between inaccessibility and accessibility. This includes work examining use and limitations of social media platforms [26, 31, 55] and public transit services by people with visual impairments [11, 39].

2.3.1 Social Accessibility. Accessibility research might be said to be having its own "turn to the social" [20, 43] in that there is a growing body of research examining either the situated use of assistive technology [12, 45, 56] or the social concerns of its users [7, 32]. Shinohara and Wobbrock found that the form and function of assistive technology influences social interactions by impacting user self-confidence and self-efficacy [46] and implored designers to look beyond the functional value of the technology and design for "social acceptability" [45]. Through a qualitative study of a wearable technology, Zolyomi et al. demonstrated the social dimensions of technology-assisted sight [56]. Morrison et al. [32] conducted workshops with people with visual impairments in India and the United Kingdom around "imagining artificial intelligence". The authors found that most of their participants' concerns were social, from identifying people and their non-verbal behavior, to managing social interactions. Even the more mechanistic applications, such as identifying money, were envisioned in a social context, for example to avoid the embarrassment of giving the wrong offering at a temple. Research examining the collaborative nature of accessibility in different contexts [8, 9, 54] can also be considered to be part of this 'turn to the social'. For instance, Branham et al. found that environments like homes and workplaces pose accessibility challenges for people with visual impairments who then adopt different strategies to circumvent them, including seeking

sighted assistance [8, 9]. The authors concluded that the nature of personal relationships between people with visual impairments and sighted partners/co-workers influences how, when, and how often people seek help.

This work makes it clear that it is important to look beyond simple functionality of accessibility technology to how its use is socially situated and how that use plays out within the everyday actions and interactions of its users. In this paper, we build on this growing body of research, highlighting the social as opposed to wholly practical or functional concerns.

3 METHODS

We conducted this study over two phases: May-June 2016 and June-August 2017. In phase one, we conducted in-person semi-structured interviews with six participants in Bangalore, India, to understand their use of, and experience with, different transportation services including public transportation, auto-rickshaws, and ride-hailing services. These participants (P1 - P6) were recruited through personal contacts (n=2) and snowball sampling (n=4). Interviews lasted 60-75 minutes and were audio-recorded and transcribed verbatim. We also observed three of the interviewees (P1, P2, P4) on four journeys, shadowing one participant on his commute to work by bus (P4) and two others using Uber (P1, P2). For the first ride-hailing trip, we accompanied a participant on a routine journey from home to work (P1); on the other ride-hailing trip, specifically for the research project, we accompanied a participant to a destination chosen by the participant - a coffee shop - and on the subsequent return journey (P2). We used jottings [14] to capture accounts of participants' trips. For the bus journey, our observation began at the participant's home and concluded upon the participant reaching their office. The ride-hailing journeys started at the time when participants used the mobile app to book a cab and concluded when they reached their destination. The research team compiled final notes by elaborating and commenting upon the jottings. We conducted additional unstructured interviews after the observations to understand aspects of the journey that were unclear. These interviews lasted between 15 and 20 minutes. The research team paid trip costs.

In phase two, we conducted semi-structured interviews with 30 participants (P2, P4, P5, P6 and P7 - P32) from eight metropolitan cities in India (Bengaluru, New Delhi, Kolkata, Chennai, Mumbai, Pune, Lucknow, and Guwahati), specifically focusing on ride-hailing experiences. We recruited participants via Access India (n=15), an online listserv discussing accessibility issues and concerns for people with disabilities, personal contacts (n=6) and subsequent snowball sampling (n=9), by which point we had reached data saturation. Four participants (P2, P4, P5, P6) from phase one participated in phase two of the study. Interviews, lasting 60-75 minutes, were a combination of in-person and Skype/phone calls and were conducted in English, which all participants were comfortable and fluent with. Interviews were structured to elicit narrative accounts [24] of participants' experiences with ride-hailing services and challenges with using the services; we used conceptual questions [24] to understand participants' notions of independence in relation to the use of Uber and Ola. We complemented the interviews with four observations of participants (P5, P13, P17, P22) using Uber and Ola in Bengaluru. The participants were different from those observed during phase one.

In total over the two phases, we interviewed 32 individuals, seven of whom we also observed. All participants identified themselves as totally blind. We obtained verbal consent from all participants, with separate consent for photographs and video-recording for the observations. Participants were compensated with a Rs. 250 (approximately $4 U.S.) gift voucher for their time. Interviews gave us in-depth insights into the many aspects of ride-hailing experienced by our participants, including how they used services to get around while navigating the many challenges that surfaced. The data from the observations complemented the interviews, helping us better understand the moment-by-moment experience of ride-hailing.

Figure 1. Local bus service in Chennai (Source: wikicommons - Bernard Gagnon)

Figure 2. Metro train-station in New Delhi (Source: wikicommons - Chandradhar yadav)

We analyzed the interview transcripts and field notes using a combination of inductive and deductive techniques. We used open coding [44] to understand the journey experiences of our participants; we developed provisional codes [44] using literature on independence to understand how ride-hailing services affect perceptions of dependence and independence. Specifically, we coded for aspects of autonomy, control, self-reliance, and reciprocity, all of which are associated with notions of independence.

4 DEMOGRAPHICS AND CONTEXT

Participants were between 24 and 53 years old. In phase one, three participants were male and three female and all resided in Bengaluru, India. Of the 30 participants in phase two, 24 were male and 6 female. We tried to even the gender balance through snowball sampling and by visiting two hostels for blind women in Bengaluru, but very few reported using ride-hailing to get around, which limited their participation. Participants in phase two lived in eight cities: Bengaluru (11), New Delhi (10), Kolkata (2), Chennai (2), Mumbai (2), and one each from Pune, Lucknow, and Guwahati. Most participants had used both Uber and Ola, although six had only used one service (four with Uber and two with Ola). Most participants (n=25) used Android phones (with Talkback, the inbuilt screen reader) and seven used an iPhone (with VoiceOver). The higher number of Android users is in stark contrast to past research in the Global North suggesting people with visual impairments prefer the iPhone [30]. Android phones are relatively more affordable [35], being available over a wide cost spectrum. This difference is important to note because it highlights a core theme running through this research: many of the people with visual impairments in our study were concerned about money. In the Global South, disability is often linked to lower income [1] - there are barriers to finding and keeping a job because of social factors such as prejudice and also infrastructural factors such as lack of accessible transportation and workplaces.

India has a rich transportation landscape, with major cities having multiple modes of transportation, including urban mass transit (buses, rail) and auto-rickshaws, three wheelers prevalent in many parts of the country. People with disabilities often receive concessions while using these modes of transportation although this varies by state. Urban mass transit services are often overcrowded and unreliable (Figures 1 and 2)[47]. In terms of accessibility barriers, few bus stops and train stations have public announcement systems, and of course it is first necessary to arrive at the bus stop or train station. All this makes their use challenging for people with disabilities. On demand services are also available, such as the three-wheeled auto-rickshaws, which are often distinctly colored and must to be hailed from the side of the street. Rickshaws are equipped with digital meters. However, in some cities (e.g., Chennai) many drivers prefer to operate on a price negotiated at the start of the journey. Once hailed, often the passenger and driver often negotiate the destination and price and only on conclusion of a successful negotiation will the journey proceed. It is common to have to stop multiple rickshaws before commencing a journey. Local cabs, operating in the same fashion

as auto-rickshaws, are also available in certain parts of the country. Call-in services are available in some cities. On-demand services are more expensive than fixed-route transportation. People also hire drivers to drive cars they own or enter into contractual agreements with a rickshaw driver. In both cases, drivers are paid at the end of a fixed duration of time (for example, a week or a month).

5 UBER AND OLA APPLICATIONS

The Uber and Ola mobile applications are functionally very similar. Both applications allow a user to choose pickup and destination locations, cab type, payment method and rate a driver. While the default pickup location in both cases is set by GPS, they can be edited by the user. The destination address is an auto-complete drop-down list, accessible through the keyboard. At the time of the study, Uber let a user pick between three cab services (Pool, Go, X) while Ola had seven services (Mini, Micro, Prime, Share, SUV, Auto, Outstation). Options to change payment mode and choose the number of seats in a shared cab were also available during booking. Once booked, the passenger is notified of driver and vehicle details, and the vehicle's estimated time of arrival. In addition, Ola sends a four-digit code to the rider, who communicates this code as part of a verbal handshake with the driver, who must enter it to initiate the journey. Uber and Ola are integrated with Google Maps, a visual resource that allows a sighted user to track the location of the cab from the time of confirmation to when the destination is reached. However, this visual resource is inaccessible to both screen readers (TalkBack and VoiceOver). Uber and Ola allowed cash-based or digital wallet payments. Uber was integrated with PayTM, a third-party digital wallet service, whereas Ola uses its own custom wallet, Ola Money. With Uber, passengers can also link their debit and credit cards to their accounts. Card payments in India are two-factor authenticated, requiring one to enter the CVV number and a one-time password (OTP) sent to one's mobile phone to confirm the payment. Both services request passengers to rate a driver after the ride, and this is compulsory in Ola.

6 FINDINGS

6.1 Independence

Interviewees from phase two (n=30) were largely positive about the impact that ride-hailing services had had on their lives. Fifteen interviewees described major changes in their ability to get out and about since they started using ride-hailing. For these participants, a core advantage of ride-hailing services is that they no longer need to rely on sighted people to get around, and this has a big impact on their sense of independence.

> *"One of the pleasures of commutation [sic] is that you don't have to depend on anybody for anything, see that is what - I don't know how familiar you are with people with disabilities - one of the things that checks the right box when it comes to becoming a part of the mainstream is that you would not like to disturb anybody for anything."* P5

Like the classic definition [41], independence here is bound up with self-reliance - doing things for yourself, on your own, without help. In comparison, nine participants were already regularly traveling alone by auto-rickshaw. While these participants were largely happy with ride-hailing, it did not change their lives in such a drastic way. Additionally, two participants had private drivers driving cars they owned, and four participants were non-committal.

To understand the impact of ride-hailing services, it is important to understand what transportation was like before for people with visual impairments in India. Indeed, participants themselves compared ride-hailing with other transportation options, observing that buses, trains, and auto-rickshaws all required them to seek help at multiple junctures, whereas Uber and Ola required help-seeking less often. During an observation of P4 using the local bus service for his regular commute in Bengaluru, we saw people step in on multiple occasions to offer help. First, on the

walk from his house to the bus stop, P4 received two offers of help, which he refused. Afterwards, he reported that although he did not seek help, it was frequently offered and usually he would take it so as to not offend the person offering. Once at the bus stop, the only way to find out whether his bus had arrived was to ask someone. He asked some people nearby and they agreed to let him know, but they were chatting, and their view of the road was blocked, so they did not alert him when his bus arrived. Luckily an acquaintance (who regularly caught the same bus), spotted him and together they made a dash through a maze of people and multiple buses to catch the bus just before it left. Once on the bus, P4 asked people next to him about his current location to determine whether he was close to his destination. Upon reaching his bus stop, he was helped off the bus and across the road to his office by a passerby. It was clear from our observations that it would be almost impossible for people with visual impairments to get on a bus without asking for help because of the chaotic nature of major bus stops, with buses coming from all angles, stopping in any place, without any public announcements. However, asking for help does not necessarily bring the desired results, leaving the passenger at the mercy of strangers. Fortunately, when traveling regularly on the same route, passers-by come to recognize the passenger and often offer help, whether to get to the bus stop or onto the bus. This is one of the reasons why regular journeys, such as commutes, are easier and the interviewees reported being more comfortable making such journeys. Making public transportation accessible without relying on the help of other people would require considerable change in infrastructure and practice.

Similarly, hailing an auto-rickshaw (auto) is often an arduous multi-step task, requiring venturing to main roads, physically signaling for the auto (e.g., waving) and bargaining with rickshaw drivers. This process is often repeated multiple times before agreement is reached and a ride commences. In comparison, participants could use their mobile to conveniently book an Ola or Uber cab and if necessary use the text resources, i.e. the driver's name and contact number on the app, to call the driver and confirm the pickup. P8 contrasted her experience with the auto with that of Uber/Ola.

> *"Walking out, hiring an auto and going away on my own is not something that I am comfortable doing, so that sort of limits me to being dependent on someone else to do it. I would say [I prefer] Uber a little more for these reasons. For being independent and being able to take a cab and go on my own to wherever I want to."* P8

There are practical reasons for desiring independence such as being able to go out when and where one wants, without having to wait for other people. However, there are also strong social elements. Asking for help has social consequences and can cause discomfort, and the interviewees were very sensitive to the irritation they might cause to strangers.

> *"If you frequently demand for help from somebody, that person might get somewhat annoyed. You know, what is this guy always asking for some help. You know, always I have to serve him [...] why he has to bother me again and again?"* P6

The interviewees reported that not having to rely on other people helps them feel more equal and empowered. However, it is interesting to note the **role of the driver**, who is expected to provide help while fitting comfortably within participants' ideas of "without sighted help". For example, P12 discussed the requirement to ask for help when using other transportation and how that compares to ride-hailing.

> *"Even if I [am] walking to my home also (sic) - I have to ask somebody to cross me, cross the road - after crossing the road I can reach my home, I can use my senses and reach the home - if there is a new location I have to ask them to guide [me] to my location. Those things are not required at present - I have overcome those issues due to, because they will drop me exactly wherever I want and most of the drivers are ready to even guide me, they*

> *won't simply run away after dropping me. They used to walk with me up to the door. [...] Due to these cars my independence has increased a lot."* P12

Many participants echoed similar comments, and while it might seem strange that for the cab ride to take place the driver and passenger must successfully locate one another, that is part of (or a small extension of) the driver's job. Thus, this is seen as less burdensome than seeking help from others without this obligation. Clearly, all help is not equal, and P11 even suggested that the role of driver might be even further expanded,

> *"So if somebody has to go for shopping or has to go for a picnic or wants to visit someplace or wants to go and watch some movie [...] so the driver would not only drive but guide as well - like he would park the car [...] take the person along. He may charge extra but in that way it would be beneficial for the visually impaired people. They would be totally independent."* P11

These quotes begin to complicate the idea of independence as simple self-reliance; in practice, it is a more nuanced concept. Another aspect of independence is its **social nature**. It is not just that ride-hailing gives people with visual impairments the confidence to travel - it also gives others the confidence that people with visual impairments can travel safely, and this plays a key element in their ability to engage in independent travel.

> *"I think I am much more independent in terms of traveling. I think people around me are very comfortable me going by Uber or Ola. It could be my parents or my friends, the fact that they themselves are using it, and I guess they are confident that I will be fine or something like that or I would reach [my destination] safe."* P2

Independence goes beyond what one can and cannot do, it is also about how one appears to 'society', one's perceived competence or face [18]. Technology has a role in leveling the playing field and enabling people with visual impairments to exhibit their competence, in part by demonstrating their independence. Thus, it is not enough that one can do things for oneself, but also that others must recognize this. Being a competent member of society means exhibiting that competence in and through our daily actions and interactions [15]. The interviewees appreciated that technology could help them demonstrate this in the face of ignorance and stigma, as P5 clearly articulated:

> *"You can say that you don't worry about what other people think of you, but when it comes to a person with disability the impression that you create on other people, especially about your disability, largely depends on how sophisticated you are. If I am able to operate my phone on my own, that not only communicates the fact that he is not a dumb fellow but also the fact that he is able to, he is not as bad as I thought, or he is as good as I am or even better. [...] So that impression came only after I started using a smartphone [...] that gave a quantum jump in the confidence level."* P5

Several features of ride-hailing services together afford this extra independence, including booking the cab, the door-to-door service, the cab journey, the flexibility of the services, and the formalization of certain elements of transportation. We address each of these in turn.

6.1.1 Booking the cab. People with visual impairments can book an Ola or Uber using their smartphone app with a screen reader. Booking is a multi-stage process, including choosing the destination, picking the type of cab (e.g., UberPool vs UberGo), choosing the number of seats in the cab ride if a shared ride and confirming the booking. Notifications on the mobile application make it easy for them to determine when their vehicle has arrived. For the most part, both apps are accessible enough that people with visual impairments can book the cab without help. Certainly, Ola and Uber offer improved accessibility compared to the alternative of taking a bus, auto, train or metro, which often require help to get to the right location and help to board the vehicle.

Furthermore, this ability for people with visual impairments to book the cab themselves has an added advantage: not only does it enable them to travel themselves, but they can also use these services to book cabs for others.

> *"So it's a real life changing game - wherever I had to go, I have to go previously I ask my mom [...] just book a taxi for me, take me to the taxi etc. But now if my mom requires I book a taxi for her [...] blind persons are, you know, still considered to be downtrodden so they are not asked to do any service [...] for the betterment of the family [...] but I feel a little bit confident that I am somewhat, a little bit of helping my family in that matter where it was not possible previously."* P10

Being able to book the cab for others thus goes beyond doing things for oneself and enables people with visual impairments to contribute to their families. This is important for increasing self-esteem and status in the family and helps in fighting the stigma of being visually impaired.

6.1.2 Door to door. That the cabs go **door-to-door** is also a major advantage because many of the problems people with visual impairments have in getting around stem from the difficulty of getting to a location where they can find transportation, which means circumventing potholes, a lack of curbs and pavements, stray animals, and crowds, as well as the difficulties of actually hailing an auto-rickshaw or locating the bus.

> *"Well you know [to] take any other transportation whether it is auto-rickshaw, cycle-rickshaw, certainly we have to depend on somebody. [...] So, certainly of course independence is quite interesting - because we don't have to leave our house, go to the main road, talk to the people."* P15

Independence is clearly **relative**; ride-hailing gives people with visual impairments more independence compared to using the bus and auto. This is important to remember later when we examine the problematics of ride-hailing. Ride-hailing does not just reduce the physical difficulties of getting around, but also the emotional stress. Just as with asking for help, there is an element of emotional work that comes into play, particularly with auto-rickshaws, where one may need to bargain with several drivers before coming to a mutual agreement to travel. While this is the same for sighted passengers, the trouble is magnified for people with visual impairments, who cannot so easily flag down the next auto and who may face stigma because of their visual impairment.

6.1.3 The Cab Journey. Once in the cab, participants relied on the voice navigation system on the driver's phone to determine whether they were on the right path. If the driver's voice navigation system was turned off or inaudible, they either requested that the driver turn on/increase the volume or they used Google Maps on their personal phones for navigation. In fact, as we discuss later, ride-hailing apps are just one part of an ecosystem of technology that improves the independence of people with visual impairments, and the use of Google Maps, and indeed smartphones themselves, was often reported alongside Ola/Uber as being a critical component of this process. As P5 elucidated, technology (specifically computers and screen readers) transformed the workplace experience, but there was initially a gap between the experience at work and the experience outside.

> *"So, there was this workplace confidence and outside you are not. So that problem is solved with smartphones - especially with Google Maps and all that. I used to like play around with it, like take an auto and turn on Google Maps and watch where they are going. And those guys were like - they won't have a clue what hit them because I will tell them, you can take a right, why are you going straight. They will be like, how do you know that? [...] So, the thing is that confidence comes from the control you have about your situation."* P5

We can see here that the judicious use of technology in general can help to level the playing field for people with visual impairments. Google Maps enables them, whether in cabs or autos, to assert their competence during the journey. Importantly, it gives passengers an increased sense of control, whether that is just through giving them extra information to enable them to know where they were both in the journey (ETA) and in space, or whether they actually used this to correct or direct the driver, which is one way of exhibiting competence. In addition to Google Maps, participants used applications like BlindSquare and DotWalker to track their location, citing their increased accuracy and availability of additional information like landmarks as reasons for their preference. These resources are used to supplement (not replace) cues like smells, sounds, flyovers, and bridges, which come into play on known routes. Although during the interviews most participants reported using some form of technology to track their location, during the observations we noted that participants also relied on their drivers to communicate details about the journey, including information about their route, their location, and journey time.

6.1.4 Flexibility. Ride-hailing offers considerable flexibility compared to other transportation services because it is on-demand. This enables people to enjoy little freedoms, such as spending a few extra minutes at home in the mornings to catch up on news.

> *"I am quite confident though I get late. If [...] I should listen [to the cricket] highlights one more time. And I have that passion, I do not want to miss and go. By the time I finish that first half it will be 8:45 so if at all I have that confidence, I have Ola, no other worries."* P4

Even where participants had regular arrangements with drivers, all remembered times when they had been stood up without notice and were able to fall back on ride-hailing services. Such services allow people the flexibility to get around when other forms of transportation are unavailable or difficult to access, for example late at night or, as with P4 above, when they simply wanted the luxury of dawdling over cricket news.

Another useful resource coming from the combination of ride-hailing and Google Maps is the Estimated Time of Arrival (ETA), which enables considerably more accurate planning than public transport. While also experienced by sighted passengers, the magnitude of the problem is increased for people with visual impairments, who are more likely to miss their bus and take longer to find an auto. As P19 said,

> *"If I am going for a date - I don't want to disappoint my date by being late for an hour, or if I am going for an interview I don't want to disappoint my future employees by being late by an hour. So I am confident, you know, I can reach [my destination]. That's it - that's a huge boost."* P19

Uber and Ola also made traveling to, and within, unfamiliar locations possible. Many participants reported how they were now able to access transportation in a uniform and consistent manner across geographic contexts, removing the stress of traveling to new locations, whether locally or further afield. Using buses and trains requires a certain amount of local knowledge while the consistent way in which Uber and Ola services operate made them a convenient choice.

6.1.5 Formalisation. Ride-hailing services formalize some aspects of the transportation experience, and participants mostly found this beneficial. Specifically, interviewees discussed safety, payment, and recourse. An increased sense of **safety** came from the ability to track the journey, share their trips with other people (in the case of Uber) and use the panic/SOS buttons in case of emergencies. However, one participant reported feeling safer on public transport such as the metro, because it was busy and public, and help was routinely provided by the metro staff.

Two aspects of **payments** were called out by our interviewees as contributing to feelings of independence (1) the automated fare calculation, and (2) digital payments. Firstly, the automatic fare calculation both liberated passengers from bargaining and reduced concerns about cheating.

> *"The saving of the time when we go out and bargain with the driver and [...] these types of things we don't have to do and to save your energy, saves your time, saves your you know, [getting] upset due to the fact that you are not getting any transportation. So [...] it has become quite easy."* P15

This quote clearly elucidates the emotional work involved in taking auto-rickshaws and public transportation. This is recognizable to any transport user in India, and the main motivation for sighted passengers to use OlaAuto was because it removed the fare negotiation [3], but again this challenge is magnified for people with visual impairments.

Secondly, the integration of digital payment systems allowed participants to have additional control over payment. This is because cash transactions are time-consuming and leave people open to cheating, given that different denominations of notes and coins are not easy to tell apart. Furthermore, having cash carries a safety risk. Several participants were worried about using credit cards because they often had to seek help to use them, whereas the digital wallet is relatively more accessible. Nonetheless, many participants continued to use cash (Figure 3), citing a lack of trust in digital payment platforms and driver preference for cash. The different ways in which the participants distinguished between currency notes included using the length of the notes to tell between denominations (only partially reliable because certain denominations are similar in size) and using different portions of their wallet to organize notes, with some taking sighted help to help with this process. Participants described the note identification process as being difficult and time-consuming, with participants having to rely on drivers to verify denominations and hand back the right change.

During the observations we also noted that participants relied on drivers to communicate the cost of the trip to them, even though cost details were available on the app. Because this information is on the app, and the passengers have recourse with the ride-hailing companies, passengers have a reasonable confidence in a fair transaction. Furthermore, there is also a fair amount of trust in the passenger-driver interaction (as illustrated by P9), even if it is tempered by an awareness that not all drivers are trustworthy.

Formalization also gave participants options for **recourse** in the event of a poor experience. Ola had a customer support line and Uber took complaints through the app. Although only a few participants had registered complaints with Ola and Uber, others were comforted by the fact that this option was available. P2 described how he was overcharged on a trip, but after complaining, got his money back. He contrasted this with his feeling of often being cheated by auto-rickshaw drivers and being able to do little about it.

There is a tension in the relationship between the passenger and driver, which is magnified for people with visual impairments. While they are comfortable with the driver providing them assistance to find the cab and arrive at the location, there is also an often-hard-won awareness that not all drivers are trustworthy, and it is much easier to deceive people with visual impairments. Passengers do not have an innate trust in the drivers; they are aware there are both trustworthy and untrustworthy drivers and that it is not always easy to tell them apart. However, some recourse is found in technology - both in the features of the apps themselves (location tracking, payment, etc.), and the ways in which they formalize certain aspects of the service, and through resources such as the competence and confidence instilled by Google Maps. These resources give people with visual impairments more control over their traveling environment.

Figure 3. Cash transaction in Ola cab

Figure 4. Participant (in red) taking sighted help to find cab

6.2 Challenges to independence

We have described the advantages of ride-hailing services and how these afford a level of independence for people with visual impairments in India. However, our observations and participants' descriptions showed a number of challenges to using these services, including: (1) app inaccessibility, (2) finding the cab, (3) choosing and negotiating drop locations, and (4) driver troubles.

6.2.1 App inaccessibility. The apps themselves, while basically usable, are not fully accessible. One inaccessible feature in both apps was the map view, which shows where the car is in relation to the passenger and in which direction it is going. As a result, most participants relied on notifications or sighted help to determine where the car was on the map.

More features were accessible in the Uber app than the Ola app, perhaps because Uber, as a multi-national corporation, might face more pressure to conform to accessibility standards that are prevalent in other countries where it operates. In the Ola app, the buttons were not always well labeled. Interviewees found it difficult to choose among the different types of vehicles, forcing them to rely on sighted help by either handing over their phones to sighted acquaintances (although this means having to turn the screen reader off), or asking acquaintances to book cabs for them on their own phones (enabled by cash payments). The relative accessibility of the Uber app was one of the main reasons for participants preferring it over Ola. In addition, software updates were a concern in both applications because they could herald reduced accessibility without notice. Interviewees either desisted from updating altogether (at the cost of missing out on new features) or sought out information about interface changes from online and offline sources before updating.

6.2.2 Finding the cab. Almost all participants mentioned that the biggest challenge with ride-hailing was identifying the precise location of the vehicle once it had arrived. Ola and Uber display the cab's registration number; however, the only practical way to find the cab is to match this provided number to the cab itself by visually searching for the car with the right number. Although ride-hailing is ostensibly a door-to-door service, in practice many factors intervene, such that the cab could easily be 50-100 meters away (or farther). The cab could also be parked on the other side of the road from the rider, and its orientation is unknown to the participants. Several factors play a part in this happening: (1) GPS accuracy is not always perfect; (2) it is not always easy to establish the correspondence between booking location (when inside an office building, apartment block or college campus) and the best access point for cabs; and, (3) the cab needs to find a safe place to wait for the passenger. For example, during one observation, P5 read out the cab number from the Uber app to his mother who was accompanying him to find the cab. She located the cab less than 20 meters away on an adjacent perpendicular road and asked the cab driver to back up. P5, apparently alerted by the sound of the cab, then moved toward it and only avoided colliding with it because of his mother's intervention. In this case, finding the cab was a joint achievement between P5, his mother, and the driver. Our interviewees frequently **took sighted help** to locate the cab (Figure 4); however, it was not always efficiently achieved. In another observation, P2 sought help from the

security guard in his apartment building to find the cab, after phoning the driver and being told the cab had already arrived. Although the cab was the only car on the road, the guard, did not identify it and spent a few minutes looking. P2 then used the app to call out the cab number, and the guard located the cab and escorted P2 to it.

The same people who helped locate the cab, typically escorted participants to it. They also helped locate the unoccupied seat in the case of shared rides and opened the car door to show passengers in. An alternate strategy to taking sighted help was to **involve the driver** in locating the rider. Typically, participants called the driver from the app, described their location, and gave cues to the drivers that they could use to identify both their location, such as landmarks, and them, e.g., shirt color or white cane. P12 described his experience with both strategies:

> *"Initially, I had no idea how to direct my driver to my office - so I used to talk to my friends, this is the vehicle number, tell me if it comes because driver may not be able to identify me. They will expect me to wave my hands - so I took few people's help initially, then later [...] I saved my location. If I select that then I can pinpoint my driver nowadays. I will stand with my walking stick [and tell him] you can identify me and pick me."* P12

However, it was common for drivers to try to circumvent road challenges like U-turns by asking passengers to cross the road or walk from the narrow side streets to main roads to find the cab. Such requests were frustrating because navigating the roads is arduous and often requires sighted intervention. At this point interviewees typically disclosed their disability to the drivers if they had not already done so.

> *"I just ask the driver "where have you parked exactly?" I am a blind person [...] I am wearing such and such color of shirt, so you know, can you see me? I ask the driver. When the driver says "Yes, I can spot you" and then he would be able to guide me. Most of the times the drivers have cooperated with me, but there have been some cases where the drivers have been sort of little rude, because first of all if you are traveling in a shared taxi - the driver also has, you know, time issues."* P6

Most noted that disclosing their disability resulted in drivers traveling to them, although in some cases participants reported that drivers were still not accommodating. For instance, P22 explained how drivers were usually more helpful once he revealed his disability but that on one occasion his driver still refused to take a U-turn and he had to take a friend's help to cross the road. For some participants, often those working in colleges or other large grounds where cab drivers were unwilling to venture, this was a major barrier to using ride-hailing. They therefore preferred other forms of transportation. As P28 described:

> *"And mostly the drivers is really not like a sensitive so, if you are like a visually challenged. So when I just ask the pickup [...] just come to my hostel so like they ask me [...] please come to the main gate. [...] So I have to like walk 1 kilometer and then I have to catch this cab thing. So it's horrible."* P28

P11 described how he had to frequently fall back on his students to take him to the college gate to find his cab, and so he returned to using his own car.

> *"For the whole month I am using Ola and Uber, but this serious problem was so much there because from my college I had to depend on my students at least on 6-7 occasions. So, that was very problematic - so from March I again [...] started using my own car."* P11

Although P11 did say that having access to ride-sharing boosted his self-esteem and confidence, the practical problems associated with finding the cab, which are particularly large because he works at a college, meant his private car (with a driver) was more convenient. Not only is ride-hailing not always "door-to-door" enough, it is not always "on-demand" enough.

> *"So, I would love it if I could ditch my car. [...] It is a time away because I'll tell you what happened: I go with Uber to the supermarket okay, I buy my stuff. I can't predict how fast the checkout lines will move, right, and I call the driver and he's waiting there and then the challenge of finding him with all the shopping, so that's a bit of a nuisance."* P14

People with visual impairments are often prepared to pay extra for independence and will stretch their budget to take the transportation that affords the greatest independence. For P11 and P14 it was their private car (with drivers), but as the most expensive option, it was not available to all. For others it was ride-hailing, but if too much help is required to find the cab, the value of ride-hailing is impacted. P11 explicated the role independence plays in transportation choice.

> *"Sometimes if some colleague is going in that direction he will definitely give lift but that basically defeats the whole purpose of taking the cab, because it is the independence it affords. [...] [the] point is that he doesn't have to ask for help from anybody, then it's worth paying money [...] But you have to pay money and then you have to depend on others also, then it's no point."* P11

Finding the cab was the main barrier to independent travel, leading interviewees to speculate about whether a technical solution would help. A few proposed that they would like to indicate disability in the app. Others proposed that the app might support them in locating the car.

> *"For example my Ola app is saying, the Ola which you have booked is 10 feet right from you [...] the cab driver can track me or I can track the car and they can give me proper directions."* P10

While this could be a useful extension of the app, it could be technically difficult to get enough precision and would not solve all the problems because the cab could still be across a busy road, for example. Any solution would likely need to be a collaborative one helping driver and passenger locate each other, and therefore involve both technology and driver sensitization to the needs of passengers who might require extra help. We will return to this in the discussion.

6.2.3 Choosing and negotiating destinations. In addition to finding the cab, another difficulty faced by people with visual impairments is getting to the right drop location. Destination addresses had to be typed in, and while participants saved frequent destinations, many addresses are either unlisted or difficult to identify. Roads in Indian cities frequently share the same names (e.g., 4th Main Road or 6th Cross are common street names) and the list provided by the app does not provide enough detail to distinguish among them.

> *"And, sometimes there are even too many areas with same name. There is Chandra Layout in Vijaynagar and there is another Chandra Layout near Marathalli - so the last time I booked cab to Chandra Layout Vijaynagar, I ended up booking to Chandra Layout Marathalli. And the driver told me this is where you have booked and I don't think you are planning to go there. So I had to get down and book another cab."* P16

P16's experience brings to light another challenge of using ride-hailing: the inability to change a destination address once it has been confirmed, a flexibility one has with auto-rickshaws, where destinations can be changed on-the-fly through negotiation with the driver. In comparison, drivers cannot work around the Uber and Ola workflow.

Lacking access to the visual resource that allows a sighted person to drag a pin on a map to mark a destination address, many participants picked the address of the closest landmark listed in the apps, such as restaurants, ATMs and office buildings. Interviewees identified landmarks through an active information-seeking process in advance of the trip; this involved asking friends and relatives or searching the web. However, the problem with choosing a landmark, is that passengers must then navigate from there to their actual destination. They might ask the driver to take them to the

actual destination, but drivers were not always willing to do so. Some interviewees talked of the importance of being confident and asserting one's right to get to the real destination.

> *"If I am stuck I go in confidently saying "Boss, I have told you this destination get me to this place" it's as simple as that. [...] I will ensure that he drops me at the right point. I will not get down only from the cab - what will he do? For those situations I book UberGo, so that is not a trouble for the driver because if he spends additional minutes with me, that fare is compensated."* P18

This is not something that could easily be done with shared rides, which although cheaper, are more rigid because the concerns of multiple passengers need to be balanced. Another strategy involved participants using the landmark as an exchange or hand-off point, coordinating with people to pick them up, although this reduces the independence afforded by ride-hailing services.

Even where not using a landmark, drivers often parked a few meters away. Passengers sought information from the driver to orient themselves, but this was not always sufficient. For example, in one observation with P5, as the driver passed the destination, he asked "Where exactly do you want to go?" P5 said: "XYZ office building". Driver: "Exactly the XYZ building?". P5: "Yes". The driver brought the vehicle to a screeching halt and remarked "XYZ office building is about 50 meters behind". In reality, it was about 200 meters behind. As he exited the vehicle P5 inquired "Where exactly have you dropped me off?" to which the driver responded, "In front of the complex, the XYZ office is about 100 meters behind". Unfortunately, the road was full of commercial complexes and P5 then asked the first author to escort him to his office building. Other times people in the vicinity noticed the participants needed help and gave them information to orient themselves, warned them about impending dangers, and even escorted them to their destinations. Take the case of P22, who needed a timely intervention to prevent a fall:

> *"I asked [the driver] the landmark and he said everything was fine, so I got down there but it was very far. [...] I thought that there is my home gate, I kept walking there and some people told me that there was a gutter. [...]. Someone stopped me, otherwise I would have fell down in that gutter."* P22

Along with these core themes around independence, a couple of other themes came up in our data around drivers' reactions to disability and accessibility and technology.

6.2.4 Drivers Troubles. Interviewees often rely on the driver to help them achieve a successful ride. However, while some drivers were helpful, overall they were something of a mixed bag. Participants encountered drivers with little education and understanding of disability.

> *"Most of them don't even have basic IQ levels, fundamentally understand that the passenger can't see so he will need additional help."* P14

As discussed, some drivers have even cheated people with visual impairments. Although some interviewees wanted to be able to identify as visually impaired on the app if this would get them additional help, they were aware that because disability is not widely understood in India, this in itself might cause problems. Interviewees suggested that drivers needed to be sensitized through training. One suggested that further automation might be employed to reduce trust concerns, e.g., with notifications from Uber if the driver changes or takes a longer route. Of course, trust can never be fully automated, although putting checks in place could help enhance the perception of it from the passenger side. However, it should not be forgotten that over-formalization can remove human negotiation and judgment and be bad for both passenger and driver [3].

6.2.5 Accessibility and Technology. When discussing independence, Ola and Uber comprise just one type of option in an ecosystem of technology that has positively impacted the lives of people

with visual impairments in India. As mentioned, Google Maps is commonly seen as a boon, not just for directing the cab and instilling confidence in one's location, but also for checking ETAs, giving directions and walking. Wallets and digital payments, in general, as well as online shopping were also cited as having had a big impact in the lives of people with visual impairments. And the smartphone itself has, especially for older participants, noticeably changed their lives.

> *"The kind of enormous leapfrogging they are having from 2000's towards independent use of technology has been tremendous. [...] Since the advent of the smartphone, you have a technological solution for everything."* P5

All of these are mainstream technologies enabled by the screen reader. Indeed, it was notable in the interviews that aside from the screen reader, there was little mention of accessibility technologies. As mentioned, as a mainstream technology, ride-hailing enables participants to call cabs for family, as well as giving the family more confidence in participants' use of it because they used it too. Our participants were well aware that they were now dependent on these services for their independence, and although this is always a fragile situation somewhat outside their control (for example, the widespread strikes by drivers impacted participants), they believed that as a mainstream service it was sustainable.

7 DISCUSSION

In the previous section, we examined how ride-hailing services are transforming people's lives by enabling them to get out and about more, at their convenience, to unfamiliar places and even to new cities. In this section, we examine what independence means for our participants regarding transportation and what makes a service such as ride-hailing accessible. We finish with a discussion on ride-hailing in India and discuss possible improvements.

7.1 Independence

Independence in HCI, CSCW, and accessibility research has primarily been understood in its relationship to self-reliance ('doing things alone, without help' [41]) or less frequently, in its relationship to autonomy ('the freedom to exercise decisions' [21]). Both self-reliance and autonomy featured in our interviewees descriptions of how ride-hailing made them more independent. The convenience of booking a cab through a mobile app allowed them to depend less on other people and gave them more freedom to decide when to venture out and where to go. Ola and Uber afforded a new, often greater, level of independence by formalizing the booking and payment of the cab through a smartphone app that is largely accessible. Most participants talked in-the-large about being able to take the cab by themselves, and although the ideal and reality do not quite match, ride-hailing offers a much improved experience when compared to other transportation services. The route tracking, digital payments and recourse features gave the interviewees a sense of control over the ride, which contributed to their sense of independence. However, problems remained around reading the map, and in locating the cab and the destination. As discussed, formalization itself also exacerbates some accessibility problems, for example by impacting people's ability to choose landmarks where exact addresses are hard to specify. The workarounds found in other on-demand transportation systems to overcome these local conditions, such as loose specification and negotiation between driver and passenger, have been largely superseded by Uber and Ola's rigid workflow, particularly in shared rides, causing problems for passengers with visual impairments.

Our research reveals a clear social dimension to independence. Brady et al. [7] touched on the socially situated nature of independence in their study of question-asking behavior of people with visual impairments. In the rather different context of ride-hailing, we too found independence to be a socially situated phenomenon. For example, take P4's articulation of accepting help: although he

was able to walk to the bus stop on his own, he said that he normally would not refuse help for risk of offending the person offering. It is clear that in the real world, independence is a rather more complex phenomenon than can be captured by self-reliance, autonomy, and control. Certainly, with ride-hailing in India independence involves not just what you can do for yourself, but what you can do for others and their confidence in your ability in doing it. Participants talked about how technology in general and ride-hailing specifically, made them more demonstrably equal to sighted people. Independence appears to be socially situated, which is in stark contrast to notions of independence as understood in much of the research at the intersection of HCI and accessibility - which is independence as perceptions of the self, i.e. how independent one feels in performing a specific task using a certain technology artifact [4, 6, 32, 53]. Interestingly Morrison et al. [32] discuss social independence, but they defined it as "the ability to be free from the constraints of social interaction through independent abilities", which while relevant here is rather more closely related to traditional ideas of self-reliance. In this study, independence is not just about how people with visual impairments feel about themselves but also extends to how they feel society sees them. This was crucial for our participants who are living in a society where there is a lack of education around disability and ignorance about what people with different abilities can and cannot do.

Such nuances, can help us think more deeply about the ways in which assistive technologies might impact the lives of people with disabilities: Do they help the user do more things, in this case getting out an about? Of course. But further, do they help the user do things for other people? Or help the user demonstrate to the world that they are a competent member of society [15]? All of these contributed to our users' sense of independence and self-worth and might provide a wider focus for designing and evaluating assistive technology.

Although self-reliance was indeed an important factor in independence, even this has a social element. In this study, interviewees talked about not needing to take sighted help, but this did not include the driver. It is clear, just as with [7] that all help is not equal. Asking for help is social, situated, and has an order to it - in this case a preference for whom you might ask for help. Roughly it would appear to be the driver (or conductor on buses, or other staff on metros), family/friends, and then strangers. The preference to seek help from the driver (and transportation staff) over others is likely explained by ride-hailing being a paid service, allowing riders to seek assistance without the feeling of reduced independence because they see it as part of the driver's job to help. Additionally, in the case of cabs, for a ride to take place the driver and passenger must successfully locate each other. Transportation, whether bus, train, cab or auto-rickshaw ride, is a collaborative achievement between the driver and possibly other staff, and the customer, whether the customer is visually impaired or not. In these situations, it is not that independence requires doing everything alone; rather, independence here is about who needs to be called upon, in what context, and what are the consequences of help-seeking for the various social relationships involved. We can relate this to the notion of "interdependence" found in disability studies. Interdependence highlights aspects of these social relationships by recognizing the mutual connectedness between people and their dependence on one another as a counterpoint to challenge traditional ideas of independence (which highlights self-sufficiency)[16, 41]. Although the interviewees did not characterize their reliance on the driver as interdependent, it is worth considering how this concept relates to their notions of independence. As members of society, we are all interdependent on one another, from the people who provide services and goods, to families, friends, and sometimes strangers. It is the way that these interdependencies play out - with greater or lesser equity - that gives us our sense of independence despite our practical day-to-day interdependence. In our study, our participants' sense of independence in part stemmed from an interdependent relationship with the driver. Certainly, it should not be thought that there were no social consequences of asking help from the driver, it is just as important for the passenger to demonstrate competence in the driver-passenger relationship

as in any other. Hence, interviewees talked about needing confidence to ensure they got to the right destination, of being able to demonstrate mastery of route, avoid cheating, and so on. Of course, demonstrating expertise and competence is part of establishing a collaborative relationship [33]. Unfortunately, in the case of ride-hailing, drivers do not always cooperate because they are not aware of the needs of people with visual impairments or they are not willing or able to adapt to them. Additionally, shared rides, while being more affordable, put extra constraints on the ability of the driver to help, because they must consider the other passengers and there is no leeway in the system for changing the destination or increasing the fare.

Independence is also relative; ride-hailing was not without its problems, however, for many interviewees it was still considerably easier to get around with ride-hailing than with other means of transportation. Interviewees who already used auto-rickshaws frequently, and either had relationships with drivers or were used to hailing autos and traveling alone, said that Uber and Ola had not drastically changed their lives because they were already rather independent. However, ride-hailing services offer certain improvements over the auto: they are a little safer and can be hailed a little more easily, with no bargaining required. This relative dimension also serves as a counterpoint to more deterministic representations of independence that are evident in accessibility work using self-reporting Likert scales to understand the extent of one's independence [35, 38].

Finally, it is important to reflect on independence for whom. People with disabilities in India often have low literacy levels and social stigma and a large percentage (approximately 64%) of adults with a disability in the country, including people with visual impairments, are unemployed and subsequently lack access to a steady income [1]. On the contrary, our sample of interviewees belonged to the middle and upper-middle classes, were educated and employed, and could hence afford to use ride-hailing services. Even so, the cost of ridesharing was a burden for them, hence the preference by some for shared rides like UberPool and OlaShare, despite the disadvantages they conferred. Although research has underlined the potential economic benefits of ride-hailing for riders [17], as mentioned previously most cities in India have access to robust urban mass transit infrastructures, which in spite of being much less accessible are considerably cheaper. This likely explains why in most cases ride-hailing did not entirely replace participants' use of public transportation services. Rather, they used Uber and Ola judiciously alongside buses and trains, especially when they desired the additional flexibility (traveling to and in unfamiliar locations) and, most importantly, greater independence. That interviewees were willing to pay for ride-hailing services even when "it pinches" (P18), shows the value they put on independence. It would be interesting to further investigate any gender imbalance in ride-hailing because we had trouble locating many female participants. This might be because the main researcher was male, but it could also be because there is an underlying difference in access.

7.2 On Accessibility

The accessibility of ride-hailing services is a collaborative and socio-technical achievement, between the driver, passenger, and technology. The technologies themselves were largely accessible, in that interviewees could use them with a screen reader. Various textual resources made available useful information like ETA and notifications about the arrival of the cab. However, inaccessible features included the map, unlabeled buttons, and software updates. However, accessibility is not only about the technology, it is about the service provided. While technology is integral to it and a major enabler of access, if passengers can't find the cab easily or struggle to get to a useful destination, the accessibility of the app becomes irrelevant. Accessibility is achieved through the interplay of the social and technical, it is not inherent in the technology alone. This is in contrast to the "functional accessibility" [45], inherent in many HCI studies, and we would argue that this is likely to be a feature of all accessible technologies, because they are never used in isolation. People with visual

impairments, like everyone else, are operating in the world, which is full of other people, animals, obstacles, and unexpected happenings. A cab ride is a collaborative achievement anywhere in the world [23] for anyone (except perhaps with driver-less cars, but even these operate in the social world). Its achievement depends on the interplay between driver, passenger, and in the case of ride-hailing, technology. Despite the many advantages of ride-hailing services and their positive impact on perceptions of independence, ride-hailing was not without its challenges for people with visual impairments in India. To overcome these challenges, participants had to work with drivers and others. In contrast to collaborations between people with visual impairments and sighted partners/co-workers in homes and workplaces, where assistance was carefully sought and weighted so as to not affect relationships [8, 9], in ride-hailing, as a paid service, participants expected the driver to assist them. However, drivers were largely unfamiliar to riders (although a few reported encountering the same driver on occasion) and receiving assistance from the driver often meant disclosing their disability and needs, which they were not always comfortable with. This is likely different from such exchanges in homes and workplaces, where people grow familiar with one another and their needs over time. Where help was not forthcoming from the driver, participants often had to fall back on the kindness of strangers, helpfulness of acquaintances, and availability of colleagues, friends, and family. While needs are often understood by familiar people, it can be challenging to communicate needs and elicit help from strangers.

Finally ride-hailing is just one in an ecosystem of mainstream technologies transforming the lives of (at least middle-class) people with visual impairments in India. It is important therefore to make all technologies accessible because mainstream technologies can almost incidentally[3] provide great leaps for the independence of people with visual impairments. Of course, in the Global North the accessibility of technology is a legal matter, but it is often neglected in parts of the Global South. Furthermore, even for the Global South, it is important to remember that the accessibility of the technology is only one part of the puzzle; any services such apps provide access to must also be accessible, which can spill over into social rather than technical concerns. In this case, the accessibility of ride-hailing was tied to the vagaries of the drivers, not all of whom were helpful. The unhelpfulness is likely the result of the stigma associated with disability, which results in perceptions that people with disabilities are a liability, as well as a lack of understanding of their needs. Accessibility here is rather ad hoc, and we would suggest that Ola and Uber take on responsibility for providing an accessible service rather than leaving it to the individual drivers.

7.3 Understanding ride-hailing in India

This is one of only a few studies of ride-hailing outside the Global North. Whereas Ahmed et al. [3], like the majority of ride-hailing studies focused on drivers, in that case the auto-rickshaw drivers of OlaAuto in Bangalore, India, in this study we examined the passengers' experience. As such, we bring to light two sets of findings that we believe are of wide interest: first, the experience of ride-hailing for passengers in India and, second, that of passengers with visual impairments in India. We examine each of these in turn.

Few studies have examined passengers' experiences of ride-hailing, and those that have have been in the United States [13, 17, 22]. There are certainly similarities between the U.S. and India, for example similar motivations for using ride-hailing apps, such as greater convenience than public transit or hailing a cab in the street. However, a core motivation in the U.S. was price: compared to traditional taxis ride-hailing services were much cheaper, nonetheless money remained a concern, although pitched more as not being too extravagant [17]. In India, ride-hailing is certainly not a cheap option, compared to more traditional forms of transport, and like in Dillahunt's study [13], a

[3]Incidentally, since neither Ola and Uber were designed with this aim in mind, nor do much to promote it

concern with price permeates the ride-hailing discourse for Indian passengers, as evidenced by the popularity of shared rides. In fact, the affordability of urban mass transit services in addition to their regularity are crucial in countering some of the challenges associated with their use. In the U.S., too, there was concern with not being "ripped off" during the ride, which was mitigated by the use of Google Maps by passengers during the ride, plus app features like the receipt, which included the route map [17]. An interesting difference between the U.S. and India is that drivers in the U.S. have been depicted by passengers as being just "like me", this did not come up at all in our study, perhaps because the demographics of drivers is rather different in the two countries. In India driving a ride-hailing cab is a full-time job, with most drivers working 12-14 hour days, the same spread of part-time and hobby drivers found in the U.S. is not present. Further ride-hailing passengers in India are typically middle-class because of the relative expense of ride-hailing and the requirement to own a smartphone, whereas drivers often come from the working classes, with many coming in from the villages. Two other factors differentiate ride-hailing in India from the Global North: the formalization of the service through the app and the problem of addresses. Unlike the Global North, many of India's rich transportation services are informal (including many of the buses). From the drivers' perspective, working on Uber or Ola keeps them in the informal marketplace (while removing some of their freedom and agency [3]; however, for the passengers, the app formalizes a number of features of the service, one of the most important being the price, and this both reduces the emotional work of bargaining and gives the passenger a greater sense of fairness [3], which is particularly important given the price-consciousness of many passengers. Secondly, addresses can be highly problematic in India, many are poorly specified or hard to distinguish from multiple similar options. The traditional route around this is to specify landmarks (and even Internet-based grocery delivery services such as Big Basket enable this); however, this is not enabled in Ola or Uber. This means that choosing an address on a ride-hailing app can be rather problematic. The formalization of the app further confounds this by removing the negotiation between driver and passenger, making working around wrongly chosen addresses almost impossible.

For passengers with visual impairments in India, many of the same advantages and disadvantages are magnified. For example, the convenience of ride-hailing over other forms of transportation is enhanced because the others are so much more inaccessible and require so much more help to take. Hailing a cab away from the main streets in San Francisco might be difficult [17], hailing an auto-rickshaw as a sighted passenger might be time-consuming and effortful, but the number of obstacles that must be negotiated by a passenger with visual impairment is many times worse because even just getting to the main street can be fraught with hazards. So although ride-hailing services offer an improvement over other forms of transportation, much can be done to improve ride-hailing, including: (1) driver training and sensitization to enable drivers to better understand and accommodate the needs of passengers with disabilities; (2) ride-hailing company policies to help people with disabilities, for example enabling drivers to go up to 200 meters beyond the specified destination to accommodate them, even in shared rides; (3) more sensitive and better documented software updates; and (4) ways to make information from the map available.

8 CONCLUSION

In this paper we present a qualitative investigation into ride-hailing use by people with visual impairments in metropolitan India. We found that ride-hailing offers people with visual impairments several benefits over modes of transportation like buses and auto-rickshaws, making daily travel more convenient than before. We studied the notions of independence resulting from people with visual impairments' use of ride-hailing and found that independence is social, relative, and situated, thus contributing to a broader understanding of the concept. Finally, we also gained understanding of how interactions between people with visual impairments and drivers makes it possible for

people to use Uber and Ola, leading us to conclude that accessibility in the case of ride-hailing is a socio-technical and collaborative achievement.

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