Help Facilitates Accessibility: Understanding the Social and Technology-mediated Experiences of People with Visual Impairments in India

by

Vaishnav Kameswaran

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Doctoral Committee:

Associate Professor Sile O'Modhrain, Co-Chair
Professor Tiffany Veinot, Co-Chair
Assistant Professor Robin Brewer
Assistant Professor Anhong Guo
Associate Professor Joyojeet Pal

Vaishnav Kameswaran
vaikam@umich.edu
ORCID iD: 0000-0003-1519-8956

For Appa

Who would have liked me to see this through

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HCI - Human-Computer Interaction

AT - Accessible Technologies

VI - Visual Impairments

PVI - People with Visual Impairments

PwD - People with Disabilities

WHO - World Health Organization

UN - United Nations

UNSDG - United Nations Sustainable Development Goals

UNMDG - United Nations Millenium Development Goals

UNCRPD - United Nations Convention on the Rights of Persons with Disabilities

ABSTRACT

In this dissertation, I conduct a nuanced and in-depth examination of helping-related interactions or assistance provided by a helper to a help-seeker. These interactions have so far received little attention in research at the intersection of Human-Computer Interaction and Accessibility. I uncover the nuances and dynamics of these interactions from the standpoint of one group of people with disabilities: people with visual impairments in India. I reveal, among other things, the motivations driving them, the actors involved, and the outcomes and their impact on helpers and help-seekers.

I conduct my research examination in one Global South context, India. In contrast, much work in Accessibility and HCI research is set in the Global North. In India, like in many Global South contexts, societies are community-driven and value interdependence. Moreover, in India, there is limited structural support for people with disabilities due to resource constraints and historical legacies. In contrast, societies in the Global North value individualism and autonomy. Additionally, there are fundamental structures that support people with disabilities. The limited availability of accessibility support structures and the community-driven nature of everyday interactions suggest that help is likely to be interpreted and valued differently in India to the Global North.

I address critical gaps concerning helping-related interactions in HCI and Accessibility literature. I uncover the motivations underlying helping-related interactions, which have been understudied in accessibility research. I also bring to light the positive outcomes of these interactions, about which we know less due to the inherent focus of the discipline on the costs and negative implications of help-seeking.

My studies also address other knowledge gaps.

1. First, given the unique nature of the Indian context, less is understood about the relationship between independence and help here, given that people likely interpret these constructs differently from other Global North research sites. In Study 1, I address this gap by **studying the relationship between help and independence**. I draw upon a case study of people with visual impairments using *digital payments*.

2. Second, we know little about how cultural constructs, important frames of reference to situate the everyday experiences of people with disabilities in India, shape helping-

related interactions. In Study 2, I address this gap by **using a cultural lens situated in disability studies literature to expand on the motivations and dynamics of helping-related interactions** in the context of *indoor navigation*.

3. Finally, due to the inherent focus on mixed-ability interactions, less is known about the interactions between people with disabilities. In Study 3, I address this gap by **examining the nature and outcomes of interactions between people with visual impairments** in India when they recover from *disruptive software updates*.

I conducted 66 semi-structured interviews with people with visual impairments in India. I complemented my interviews with observations and a video-diary study. In Study 1, I conducted field observations with four participants. In Study 2, I used a video-based diary study with a subset of six participants from the interview study. I analyzed data through inductive and deductive methods. In Study 1, I used the moneywork framework to organize my findings. For Study 3, I used Communities of Practice theory to understand the helping-related interactions of my participants.

I find that helping-related interactions, often mediated by technology, are central to the accomplishment of accessibility in social and cultural contexts. Here, help, rather than impeding independence is critical to its achievement. Indeed, independence is more than self-reliance and has relative and social dimensions. Help is made necessary by the structural inaccessibility in India. Cultural values of compassion and duty also create shared expectations which motivates people with visual impairments to accept the help on offer. Rather interestingly, help, in some cases, is also motivated by the helper. Yet, here too, people with visual impairments seek to use their agency to shape helping-related interactions in ways that allow them to benefit from the interactions. Through help, people build expertise, form networks, and present valued selves. However, the value of helping-related interactions diminishes when helpers provide unsolicited and inappropriate aid.

I make several contributions to HCI and Accessibility research. I contribute to a deeper understanding of help, which is critical to understanding the social organization of activity of people with visual impairments. This is an area of focus for social accessibility research interested in unpacking the situated interactions of people with disabilities. I also expand on the concept of independence which in some contexts entails seeking help. This contests the dominant design for independence paradigm in accessibility research which will give an alternate scope for designers of ATs looking to foster independence (e.g., through enhancing help). I also highlight the unique expertise inherent within communities of people with visual impairments. In doing so, I bring to light novel ways in which HCI and Accessibility researchers and designers can center the needs of people with disabilities.

CHAPTER 1

Introduction

1.1 Cover Statement

This dissertation is a culmination of multiple years of research with people with visual impairments in India that aimed to understand the nature and relevance of helping-related interactions, the assistance provided by a helper to a recipient of help to enable the latter to accomplish a task, in their lives. This work takes a primarily qualitative approach to examine their interactions with technology in the context of digital financial services [132, 134], indoor navigation technologies [129], software updates [128] and their broader lived experiences. Three papers representing this line of research form a part of this dissertation. My dissertation has been informed by my broader research with marginalized communities in both, the Global North and Global South [69, 136, 23, 213, 75, 133, 109, 135, 51, 50, 197, 130, 70, 196, 198, 160].

In this dissertation, I examine the construct and ecosystem of "help" grounded in the experiences of people with visual impairments in a context where there is limited accessibility infrastructure, India. In particular, the present work sheds light on the actors involved in helping-related interactions, the values associated with helping, and its many outcomes. Together, the studies presented in this dissertation demonstrate the centrality of helping-related interactions in the everyday lives of people with visual impairments in India. In particular, the three studies show that:

1. Study 1: Helping-related interactions, in the context of *digital financial services*, are central to the achievement of "independence."

2. Study 2: Helping-related interactions, in the context of *indoor navigation technology design*, are situated and bound up in cultural values. Helping-related interactions are valued by people with visual impairments, but particularly when they exercise agency in shaping these interactions.

3. Study 3: Helping-related interactions that entail people with visual impairments taking on interchanging roles of help-giver and help-seeker to recover from disruptive *software updates* result in the acquisition of technology-related expertise.

These studies extend the accessibility discourse in HCI (Human-Computer Interaction) research by contesting prior framings of the actors involved in, motivations and directionality, and outcomes of helping-related interactions. To do so, I shift view from Global North contexts, the site of much research in HCI and accessibility, to one Global South setting: India. In HCI research situated in the Global North, "independence" is often conflated with self-reliance, which is the ability to accomplish tasks by oneself without help (e.g., [124]). This conflation may be interpreted as a product of a Global North discourse valuing individualism and neo-liberal autonomy [100, 259]. Additionally, HCI research on accessibility situated in the Global North assumes the presence of fundamental societal structures and infrastructures to support peoples' independence. For instance, early work in transportation accessibility in HCI involved the design of mobile interfaces to give deaf-blind users information about bus stops and timings to make bus services more accessible [27, 28]. Yet, this research presupposes the presence of accessible bus stops, buses, and trained bus drivers who understand the needs of people with disabilities, and how to provide accommodations [27, 28]. Furthermore, motivated by the social model of disability [235], such research posits that if these structures are inaccessible, they can be altered or changed sufficiently, including through technology and interventions. This includes research that describes how permanent building installations such as Bluetooth beacons in airports and malls can help people with visual impairments navigate the indoor environments on their own [103, 227].

In contrast to this prevailing discourse, I center my investigations in Indian society which is more community-driven and collectivist than countries in the Global North [270, 100]. In India, norms of independence are not the desired ideal [100, 259, 142]. Rather, Indian society values interdependence [100]. Additionally, in India, the provision of accessible structures including physical infrastructures and technologies, and their ability to change quickly is problematized by historical legacies, poverty, limited resource availability, and indifferent societal attitudes towards disability marked by pity and charity [100, 169]. Shifting the scholarly view to India allows me to contest dominant perspectives and inherent assumptions about helping-related interactions.

1.2 Related Research

1.2.1 Accessibility Research in Human-Computer Interaction

The discipline of Human-Computer Interaction has primarily been concerned with understanding how digital technology can address the needs of human beings [71, 107]. While the "average user" in early HCI studies were those with "normal" physical and mental abilities, this trend changed in the mid-1990s, when people with disabilities became a mainstream user group in HCI research [188], resulting in the emergence of accessibility research as a sub-field within HCI. Traditionally, accessibility research in HCI has had an interventionist approach and has centered the design of novel accessible technologies (AT) for people with disabilities [114, 246]. ATs here, are viewed as a way to address one's impairment. For instance, in an ASSETS 2018 paper, Bonani et al. describe the design and evaluation of robots to assist people with visual impairments with assembling a tangram puzzle, a task which otherwise necessitates sight [43]. Thus, the objective of the technology was to functionally account for their participants' lack of vision by assisting with a game that is otherwise contingent on visual cues to complete. Likewise, computer vision solutions through the years have been designed to assist people with visual impairments with independently identifying objects and images [40], navigating indoor and outdoor environments [103, 26], detecting people in the vicinity for increased awareness [249], and reading printed text [29], tasks which otherwise are stated to require sight to accomplish on one's own.

This interventionist approach, by focusing on "design" and "novelty of artifacts", mostly ignores people's specific needs and their perceptions of technology. The focus on the design of novel technology artifacts in accessibility research is evident in one key statistic. Of the 25 most cited papers in accessibility research in HCI as of 2020, 22 concerned only technology design, while just three studies attempted to understand the perspectives and practices of people with disabilities using technology. This is not to say that technology interventions that account for the impairments of people with disabilities do not have value for them. On the contrary, some of these technologies have had long-lasting impacts on people with disabilities (e.g. Slide Rule which is widely acknowledged to have been instrumental in people with visual impairments being able to use touchscreen phones [137]). More recently, however, accessibility research has turned to the social [101] reporting on user behaviour in 'natural' and 'situated' contexts, in contrast to lab-based studies [101] and begun to include considerations of both functional usability and social situations of use [237].

1.2.2 Accessibility's Turn to the Social

Research that followed the traditional interventionist approach in Accessibility centers the everyday activities of people with disabilities which like with other non-disabled people, are socially organized in real-world public settings. This line of work primarily uses qualitative methods to center and elevate the perspectives of people with disabilities. In doing so, it shifts the scholarly focus to the users of technologies and foregrounds their experiences in the development of ATs. Among the key themes addressed in this research are people with disabilities 1) perceptions of ATs and 2) social interactions surrounding the use of ATs.

Formative work examining peoples with disabilities' perceptions of ATs by Shinohara and Wobbrock [241] found that ATs' forms and functions influence the confidence and self-efficacy of people with disabilities when they are used in social settings. Also, when ATs are inaccessible, and people with disabilities cannot work around these inaccessibilities in social settings, it influences others' perceptions of their abilities [240]. As a result, researchers implore designers of assistive technologies to improve the accessibility of mainstream technologies to not set them apart as "disabled people" in public settings such as theatres and malls [240]. The social acceptability of ATs has been widely studied and is now understood to be important in their adoption in the first place [210, 241, 238]. Other researchers have studied the perceptions of specific characteristics of ATs such as their form and function to unpack how variations in these characteristics might impact their uptake and use (e.g., [202, 210, 218]). Research has also examined people with disabilities' perceptions and use of mainstream non-assistive technologies. These studies attempt to uncover the accessibility limitations of technologies and propose design recommendations to make them more inclusive. This line of work includes research that has examined people's use of collaborative writing tools like Google Docs [65], finance-related apps like Google Pay [132], ridesharing services like Uber [51, 131], and social media [288]. Thus, as opposed to traditional interventionist approaches, where evaluations of AT usability follow iterative design processes, this line of research takes a more bottom-up view of AT design.

Another line of work examines the situated interactions, including those mediated by technology and social dynamics of people with disabilities, including with non-disabled people in varied social contexts such as homes [48], workplace environments [49, 203, 65], public recreation settings [31]. This research highlights how these interactions are often collaborative and involve people working together to achieve a common goal. For instance, Branham and Kane find that the inaccessibility of technologies at home and workplaces such as TV remotes and printers results in people working together to find solutions to inaccessibilities [48, 49]. Others highlight dynamics of these collaborations in the context of tasks like programming [203], writing [65], navigation [280], shopping [286] among others.

These studies also identify the circumstances and factors that result in the breakdown of these collaborative social interactions. For instance, multiple papers have highlighted that the lack of a *common understanding of each other's needs* results in failed interactions between people with mixed abilities. Williams et al. find that sighted guides routinely struggle to assist people with visual impairments with navigation as they do not know when and how to provide feedback about environmental cues [280]. Likewise, Yuan et al. find that the lack of know-how of personal shopping practices [286] results in frustrating shopping experiences for blind people and their shopping partners. Branham and Kane highlight that the same breakdowns strain people's relationships [48, 49]. For instance, they found that blind people felt that seeking help from colleagues in workplace environments affected their professional working relationship [49]. In the event of interaction breakdowns, the onus is often on people with disabilities to mediate and devise mechanisms to recover from them [286, 65, 203]. Subsequently, technology is viewed as a way to reduce their work and better mediate interactions (e.g., [249, 174]). Pandey et. al. find that in the context of programming tasks in workplace environments, people with visual impairments during code reviews with their sighted colleagues often have to do the work of explaining their code, written in particular ways for ease of screen-reader use [203]. Here, the authors highlight how automated formatting of code could reduce the burden of work on people with visual impairments [203].

Many of the above papers focus on collaborative social interactions but not helping-related interactions, which have different dynamics. For instance, while collaboration suggests people involved in the collaborative relationship playing a near-equal part in the accomplishment of a common task, this is not the case with helping-related interactions where the work of providing help falls on the helper for a task defined by the help-seeker. For instance, Vincenzi et al. highlight how navigation is often a collaborative activity where blind people provide instructions and relevant feedback while guides offer physical assistance [271]. Here, both guides and blind people have a part to play in reaching the destination. However, when Kameswaran et al. find that drivers offer riders who are people with visual impairments help in the context of ridesharing with entering/exiting a cab and completing financial transactions [131]. Here, the onus of completing the required task is on the driver and riders only specify what assistance they need in particular. In the next section, I examine how helping-related interactions are addressed in HCI and Accessibility literature.

1.2.3 Helping-related Interactions in Accessibility Research

Interactions that facilitate the seeking and provision of help, the assistance provided by a helper to a recipient of help to enable the latter to accomplish a task, have thus far only received tangential attention in HCI and Accessibility research. When explored, researchers have discussed helping-related interactions in the context of an important goal guiding AT design: independence. As per this design goal, ATs are deemed effective to the extent that they allow people with disabilities to be "self-reliant," with the ability to perform tasks on their own and without help from others. Wobbrock et al., in their seminal work on ability-based design, emphasize this design goal. The authors state that "all accessible computing approaches share the common goal of improving independence for people with disabilities" [283]. Interventionist research in HCI and Accessibility also emphasizes this design goal [40, 201, 206]. For instance, Piper and Hollan suggest that their intervention, an interface to allow deaf people to communicate with their medical providers, is effective because it fosters feelings of independence among deaf people, as they no longer have to rely on interpreters to communicate their needs. Likewise, Bigham et al. suggest that their portable screen reader WebAnywhere is effective because it allows their participants to "independently access the web" or access the web on their own without external help [41]. The emphasis on independence and its interpretation as self-reliance also features tangentially in research that followed accessibility's turn to the social. For instance, Morrison et al., based on participatory workshops with people with visual impairments, highlight the need for future AI solutions to foster social independence which is "the ability to be free from the constraints of social interaction through independent abilities", a definition which is closely related to ideas of self-reliance [174]. This universal interpretation of independence as self-reliance in HCI and Accessibility research is not unsurprising as the geographical context of this research is the Global North, where societies emphasize values of individualism and autonomy [142, 100, 259]. Less is understood about the relationship between independence and help in more community-driven and interdependent societies, a gap that I address in this dissertation (Study 1).

Studies motivated by the design for independence goal emphasize self-reliance as they emphasize that help-seeking has personal and social costs for people with disabilities. For instance, these studies find that people with disabilities may be reluctant to seek help over concerns about resulting feelings of embarrassment, [275, 288] and desires to avoid negative perceptions of their abilities [203, 280, 49]. People may also seek to avoid feelings of being indebted and the resulting need to reciprocate the help received [46]. For instance, Brady et al. found that people with visual impairments use social media less than sighted people to ask questions due to the perceived social costs of asking questions to their social networks

[46]. Specifically, participants were concerned about appearing dependent and about not being able to reciprocate equitably [46]. Overall, this prior research primarily emphasizes the negative aspects of helping-related interactions. Indeed, one might argue that this negative framing of helping-related interactions motivates the "designing for independence" paradigm underlying much accessibility research in HCI by allowing designers and researchers to justify the design of a novel technology artifact. This successful intervention replaces the burdensome help from a non-disabled person with technology, thereby preserving or enhancing people with disabilities' sense of independence. For instance, Bigham et al., in their design VizWiz, a crowdsourcing tool to provide real-time answers to visual questions posed by people with visual impairments, highlight how the decreased independence resulting from people otherwise having to ask sighted people for help with identifying objects motivated the design of their artifact and made people independent [40]. Likewise, the developers of NavCog, an indoor navigation assistant, cite the lack of independence for people with visual impairments, who otherwise have to rely on sighted guides in navigating unfamiliar environments as a motivation for their design [227]. Here, VizWiz and NavCog are framed as vital to people's independence. Help is also a site of innovation wherein technologists can intervene to replace an interaction that is burdensome to the help-seeker with a novel artifact to enable them to accomplish tasks without seeking help.

Recently, some scholars have pushed back against the negative view of helping in accessibility research. Research has shown that help, in some contexts, is valued by people with disabilities. This work challenges universalizing interpretations that help-seeking and -receipt are burdensome interactions for people with disabilities. For instance, Kameswaran et al. [131], in the context of people with visual impairments using ride-sharing services in India, highlight how help from drivers was instrumental to the achievement of accessibility. People expected assistance from drivers to get into the vehicle, reach their destination, and complete financial transactions, all of which contributed to making ride-sharing accessible [131]. This help played a central role in participants achieving a sense of independence from using ride-sharing services. Help can thus be a pathway to feelings of independence rather than an impediment as much prior work in interventionist accessibility research emphasizes. Likewise, Thieme et al. [254], through a video-ethnographic study of people with visual impairments, found that helping-related interactions were central to participants' sensemaking abilities in the context of outdoor exploration. These authors argued that technologies should further support such interactions as they will align with people's existing practices rather than eliminate the same interactions that will disrupt how people accomplish the same tasks. Other research, too, emphasizes the relevance of helping-related interactions to everyday tasks such as completing financial transactions [132] and navigating in public

environments [271].

Another line of work has directly contested the centrality of independence to technology design by proposing "interdependence" as an alternate theoretical orientation to technology design [36]. Interdependence theory posits the mutual dependencies and reliance between all people, thereby challenging the idea that anyone is independent [36]. Interdependence theory underlines the importance of examining people with disabilities' interactions with their environments and other people, and in doing so, recognizes the work of people with disabilities in creating access for themselves [36]. Accordingly, this theory recognizes that helping is central to the lives of both people with disabilities and non-disabled people. Proponents of this theory argue that it is vital not to disregard these helping-related interactions in the pursuit of designing technology for independence. This work points to an emerging understanding of helping-related interactions as valuable to people with disabilities in some contexts.

There is a common thread underlying accessibility research that centers independence as self-reliance and work that points to the possible benefits of help-seeking. Both strands of research do little to examine the dynamics of help-seeking including its underlying motivations and how specific contexts shape how the interaction is interpreted by people with disabilities. This is important as it is likely that help-seeking is not going to be universally interpreted as burdensome, especially in community-driven contexts like India where help and relying on one another is likely to be seen as a routine way of accomplishing everyday tasks. In this dissertation, I address these gaps in the context of people with visual impairments in India navigating indoor environments (Study 2).

Furthermore, despite emerging research pointing to the benefits of help-seeking for people with disabilities, this work is still limited. Furthermore, these benefits are often limited to examinations of the value of help in the accomplishment of shorter-term, episodic tasks which result in momentary access for the help-seeker (e.g., completing a financial transaction [132]). We know little about the potential longer-term positive outcomes of help (e.g. in facilitating technology-related learning), another gap that I address in this dissertation (Study 3).

1.2.4 On Helping-related Interactions

Helping-related interactions, particularly help-seeking, have been studied extensively in several disciplines, including social psychology, communication and media research, and disability studies. Research on this topic has largely investigated the perspectives of non-disabled people, although its conceptual resources may prove fruitful for this dissertation research. In my review of this literature, I noted that research on help has a strong conceptual basis

and fits into five broad themes. These are: 1) understanding what constitutes "help," and defining the concept; 2) categorizing different types of help; 3) examining how actor characteristics, i.e. characteristics of helpers and the people being helped affect helping-related interactions; 4) the motivations, costs, and rewards of help giving and help-seeking; and 5) the perceptions of received help.

1.2.4.1 Understanding what constitutes "help," and defining the concept

Help in fields outside of HCI, including social psychology and communication studies, is understood as a dyadic interaction between a helper and the person help-seeker. Here, the former is often assumed to provide the latter with "assistance to improve a situation or problem" [217]. Help is also "communication about a problem or troublesome event. Here, help is about obtaining support, advice, or assistance in time of distress [98]." Others take a processual view of helping-related interactions and define them as the sum of their constituent parts. For instance, scholars have stated that help-seeking has to be understood in relation to the characteristics of the person being helped and those of the helper, the type of help sought, and the context in which help is sought [281]. Likewise, others have uncovered how help-seeking is composed of three components: 1) definition of a problem for which help is to be sought by the help-seeker; 2) intentional action, which is voluntary and consciously executed by the helper; and 3) interpersonal interaction, which involves communicating the problem to the helper [61]. Among the three antecedents to seeking help are: 1) recognizing the problem, 2) deciding to act, and 3) identifying the source of help [61]. In my dissertation, I use a simplistic definition of help being assistance of a certain kind to improve a situation or problem [217].

1.2.4.2 Categorizing different types of help

Help takes several forms. Researchers have distinguished between practical help, personal help, and material help [85]. Others have distinguished between verbal and physical forms of assistance [255]. A more granular take on categorizing help includes work in which help is interpreted as "social support," which in turn takes several forms, including: 1) instrumental support; 2) emotional support [147]; 3) informational; 4) network; and 5) esteem support [63]. In my dissertation, as I will highlight later, I unpack various forms of help, including physical assistance [255, 147] and informational assistance [85, 255].

1.2.4.3 Motivations for help-giving and help-seeking

Researchers in social psychology and sociology have also examined motivations behind and considerations underlying, giving and seeking help. Prior work in these fields has argued that peoples' desires to help others stem from: a sense of altruism [35]; empathy [66]; a sense of social responsibility [250]; and desires to feel good about themselves [59]. The latter motivation is amplified when people receive positive affirmations about their helping behavior [120, 126]. Research in the same fields has found that people engage in help-seeking to improve a situation [217, 98] or overcome distress or troublesome events [98]. On the other hand, people may be reluctant to seek help, even when they might need it. A refusal to seek help even when needed could be due to resulting feelings of incompetence [245] and threats to self-esteem [230] that may surface in a helping-related interaction. There may also be fears of an inability to reciprocate for the help received [46].

1.2.4.4 Perceptions and outcomes of helping-related interactions

Several studies have examined factors that impact self-perceptions of the value of received help. For instance, research on help-seeking in a workplace finds that people are more satisfied when they receive help from higher-status individuals as they perceive this help to be more constructive [263]. People with disabilities, often portrayed as seekers of assistance, have been the focus of this research examining the perceptions of received help.

Researchers in social psychology and disability studies have found that solicited assistance — when people help people with disabilities in the manner they desire and when they require it is very much appreciated. On a related note, research has found that when help is initiated by familiar helpers and motivated by helpers paying close attention to people's access needs, it is valued [255]. This finding may be related to the fact that people with disabilities are more comfortable receiving help from familiar people who are more likely to be aware of when they need help [255]. Such solicited helping-related interactions can have positive outcomes and are associated with improved quality of life and personal well-being [255]. However, solicited help is less common in the everyday lives of people with disabilities than unsolicited help [255]. Indeed, it is common for well-meaning people to provide assistance when people with disabilities do not need it or want it [47]. Often viewed through the lens of ableism, unwanted help results in the loss of face [97] and self-esteem [230]. It can also produce feelings of incompetence [245] and reinforce stereotypes of them as dependents [15].

1.2.4.5 Helper and help-seeker characteristics

Another body of work focuses on the characteristics of helpers and help-seekers. This research examines: 1) who engages in helping-related interactions; and 2) how individual characteristics affect perceptions of helping-related interactions. For instance, in the context of seeking medical advice from medical professionals for health issues, a large body of research has uncovered associations between demographic factors and how much people seek help. For instance, while examining the characteristics of help-seekers, researchers find that age is a factor that is associated with who seeks help [98, 281]. Specifically, they find that young people are more likely to seek help than older adults [281]. Women are also more likely to seek help than men [98]. Socioeconomic status and race are other demographic factors that impact who seeks help [98, 281] with middle-class people seeking help more often than those with lower or higher perceived social status [98, 281]. White people are also more likely to seek help than people of other races [98].

Likewise, research has also examined helper characteristics. For instance, gender is a demographic that has been found to be associated with who offers assistance [226], and research has suggested that males are more likely to assist people than females, especially with tasks that are physically demanding [226]. About people with disabilities, other factors such as the extent of one's disability [226], the effort required during helping-related interactions [261], and the frequency of help necessitated [221] are considerations related to whether people provide physical assistance. In my dissertation, I pay attention to the specific characteristics of helpers and circumstances that lead people with disabilities to seek help from others.

1.2.5 Uncovering Assumptions Inherent in Help in Accessibility Research

The above five themes which result from the literature review of helping-related interactions in disciplines outside of Human-Computer Interaction and Accessibility provide me a framework to raise questions about some of the inherent assumptions and interpretations of help in Accessibility literature.

1. **Motivations and Directionality:** The review on the motivations of seeking help in broader helping-related interactions literature prompted me to ask: What are the key assumptions regarding the motivations of help-seeking in HCI and Accessibility research? The review of HCI and Accessibility literature suggests that help seems to be motivated by the task-level needs of people with disabilities. This assumption is inherent in the design of computer vision technologies for object recognition. In

research papers describing the design of such technologies, an assumption is made that people with visual impairments have to rely on sighted people for visual assistance with identifying everyday objects [127, 40]. People with visual impairments are not seen to contribute to the object recognition process in any way. Rather, object recognition is seen as solely being facilitated by sighted people [127, 40]. Help is thus a one-way interaction where the work of helping is done solely by the helper.

2. **Perceptions and Outcomes:** The review on the perceptions and outcomes of seeking help in broader helping-related interactions prompted me to ask: What assumptions are made about the outcomes and perceptions of help in HCI and Accessibility research? Help is assumed to be universally burdensome for people with disabilities. Studies find that people with disabilities may be reluctant to seek help over concerns about resulting personal and social costs [275, 288, 280, 203, 49, 46].

3. **Actors:** The literature review on helper and help-seeker characteristics in broader helping-related interactions literature prompted me to ask: Who assumes the roles of helper and help-seeker in interpretations of help in HCI and Accessibility research? The helper in the helping-related interaction is a non-disabled person who is assumed to have the requisite capacity or expertise to assist people with disabilities. In this context, people with disabilities are only passive recipients of help. These assumptions too are inherent in the above example which addresses the design of computer vision technologies for object recognition. Here, an assumption is made that people with visual impairments have to rely on sighted people for visual assistance with identifying everyday objects [127, 40].

Despite the value of the broader literature on helping-related interactions beyond Accessibility and HCI research in helping unpack the many assumptions inherent in helping-related interactions in accessibility research, there are some gaps in this research. Much of this work is also situated in the Global North and is set in non-technological contexts. However, today, technologies are pervasive and have begun to mediate and shape social interactions. Therefore, this dissertation unpacks how technology necessitates, fosters, mediates, enhances, and sometimes impedes helping-related interactions.

1.2.6 Critical Knowledge Gaps in Accessibility and HCI literature

In my dissertation, I move from traditional research settings in the Global North to one context in the Global South, India. Here, like in the rest of the Global South, there are limited physical infrastructures and legal provisions to support the independence of people

with disabilities. This limited support is because of historical legacies, indifferent societal attitudes towards disability, and the lack of resources [100]. Without such accessibility provisions in the environment, and as I argue in my prior work [131], acquisition of help is likely to be necessary to achieving accessibility and resulting participation. Indian society is also more community-driven [100], collectivist [270], and place value on interdependence between people [100]. As a result, I posit that people here may interpret the role of help in their everyday lives differently. For these two reasons, India is an excellent context to investigate helping-related interactions. In this dissertation, I take a qualitative approach and use technology contexts as my settings. Such settings allow me to understand the role of technology in mediating interactions, a central concern for HCI and Accessibility research.

Accessibility research, in its tangential examination of help, has emphasized the negative implications and costs of helping-related interactions (e.g., [275, 288, 280, 203, 49, 46]). Less is understood about the potential positive outcomes of helping-related interactions, which this dissertation uncovers (RQ1 and RQ3). Uncovering these outcomes will provide HCI researchers and designers with an alternate paradigm for technology design, where technologies can foster and enhance help rather than eliminate the interactions. Accessibility research has also thus far failed to directly examine the motivations of helping-related interactions (RQ2). Examining these motivations is essential to understanding the social organization of everyday interaction [72] of people with disabilities, especially in the Global South.

I address other key gaps in Accessibility literature in the three individual studies that form a part of this dissertation.

1. Study 1: Interventionist Accessibility literature frames independence as the desired ideal for people with disabilities, the achievement of which necessitates the elimination of helping-related interactions. This resonates with findings in broader helping-interactions literature, where the loss of independence [47] is cited as a cost of seeking help. However, for reasons outlined previously, in the Indian context, it is likely that people with visual impairments interpret independence and help differently. This prompts questions about the relationship between help and independence in more community-driven and interdependent societies in the Global South [100], which has so far been unanswered in Accessibility research. I address this gap in Study 1 (RQ1) by studying the social interactions that enable people with visual impairments to use *digital payments*, technologies that foster feelings of independence [132].

2. Study 2: In Accessibility research, motivations of help-seeking interactions are understudied. In Study 2 (RQ2), I address this gap by bringing disability studies literature into conversation with Accessibility research in the context of *indoor navigation*. Prior

work has also highlighted how frames of disability based in the Global North are insufficient to understand the lived experiences of people with disabilities in India and underline the need to understand the same through a cultural lens [87, 100]. This cultural lens has evaded examinations of helping-related interactions in the broader literature, another gap I address (RQ2).

3. Study 3: Accessibility research, in its examination of social interactions such as collaborations, has so far primarily focused on interactions between people with mixed abilities (e.g., [203, 48, 49, 65]). We know little about the nature and dynamics of helping-related interactions between people with disabilities. I address this gap in Study 3 (RQ3) by studying interactions between people with visual impairments when they recover from *disruptive software updates*. Studying the outcomes of these interactions, where people with visual impairments benefit from help received from other people with visual impairments will uncover: 1) the positive outcomes of such help on help-seekers; and 2) the unique capabilities and forms of expertise that helpers possess. Fostering and enhancing this expertise can provide critical ways for HCI researchers to center the needs of people with disabilities in research and design processes.

1.2.7 Research Questions

The studies presented in this dissertation address the following three research questions:

1. RQ1: What is the role of helping-related interactions in the achievement of independence for people with visual impairments in India? I answer this research question in Study 1 in the context of digital financial services.

2. RQ2: How are helping-related interactions among people with visual impairments situated within the cultural context of urban India? I answer this research question in Study 2 in the context of indoor navigation and related technologies.

3. RQ3: How do these helping-related interactions between people with visual impairments in India unfold? I answer this research question in Study 3 in the context of software updates.

   (a) RQ3a: Why do these helping-related interactions between people with visual impairments in India occur?

   (b) RQ3b: What are the outcomes of these interactions?

1.2.8 Summary of Chapters

The remaining chapters of this dissertation are organized as follows. In Chapter 2, I present an overview of the methods used to conduct the individual studies. In Chapters 3-5, I present findings from my individual studies. In Chapter 3, I discuss findings from Study 1, where I examine the relationship between help-seeking and independence in the context of digital financial services. In Chapter 4, I discuss findings from Study 2, where I use a cultural frame to situate helping-related interactions in the context of indoor navigation and related technologies. In Chapter 5, I discuss findings from Study 3, where I study the outcomes of helping-related interactions in the context of software updates. In Chapter 6, I discuss my overall findings in relation to prior work and outline the key limitations of this dissertation. In Chapter 7, I present a conclusion.

CHAPTER 2

Methods

2.1 Overview

I used a combination of qualitative methods to answer the three research questions outlined in Chapter 1. For data collection, I used semi-structured interviews as a primary data collection method. In Study 1 and Study 2, I combined interviews with other data sources, including observations and a video-based diary study. I used inductive and deductive methods to analyze the qualitative data. Inductively, I used a combination of pattern coding [225], affective coding [225], and process coding to develop codes and themes from the bottom up. Deductively, I used provisional coding [225] to generate codes from existing theories and frameworks (e.g. theory of Legitimate Peripheral Participation [148] in Study 3) in literature to organize and unpack my data. The University of Michigan's Institutional Review Board (IRB) approved all three studies.

2.1.1 Data Collection

I recruited participants for the three studies through diverse means. For Study 1 and Study 3, I used personal contacts, Access India - an online group for people with disabilities in India and snowball sampling to recruit participants. For Study 2, I worked with vendor organizations that recruited participants from non-profits in major metropolitan cities in India.

2.1.1.1 Interviews

I used semi-structured interviews as a primary data source in all three studies. I selected interviews for their ability to explore technology experiences and issues "in-depth" [146]. In addition, interviews also allow participants to express their thoughts and feelings in their

own words. Semi-structured interviews rely on a set of questions and try to guide the conversation rather loosely around the questions [110]. However, unlike structured interviews, semi-structured interviews give participants more freedom to talk about what is important to them [110]. Such an interview design allows conversations to develop and potentially uncover new topics relevant to the interviewee [110]. In the three studies, I used a combination of narrative questions [222] (e.g., "tell me about the last time you navigated an indoor location"), scenario-based questions [284, 54] (e.g., "imagine your favorite messaging application had a software update that made it impossible for you to use the app. What would you do?") and conceptual questions [222] (e.g., "how do online payment services impact your sense of independence"). Overall, across all three studies, I conducted 66 interviews with 63 people with visual impairments in India. Three participants participated in both Study 1 and Study 3. All interviews lasted between 45-90 minutes. Most interviews (n=63) were conducted in English, and the rest in Hindi (n=3), a regional Indian language spoken by many people in India in which I am fluent. I conducted interviews in person, over Skype/Zoom, and via phone conversations. For Study 1 and Study 3, I continued interviews until I hit data saturation and no new codes and themes emerged from the data [104]. For Study 2, I conducted a pre-determined number of interviews (n=11). This decision was based on prior recommendations that 10-12 interviews are sufficient to reach data saturation [228]. However, I did not reach data saturation for Study 2. I audio-recorded the interviews for which I sought consent before the start of the interviews. Participants were compensated between $8-$10 USD for their time.

2.1.2 Observations and Video-based Diary Study

For Study 1 and Study 2, I used observations and a video-based diary study to complement the semi-structured interviews. With both methods, I aimed to capture the nuanced, moment-to-moment experiences of participants' interactions and experiences. These two data sources attempted to account for the limitations of interviews where data quality can be affected by variance in peoples' attentiveness and ability to recall detail [179].

For Study 1, I conducted observations with a subset of interview participants (n=4) to gather details regarding how they used digital payments and cash to pay for ride-share trips. I sought and received consent to record photographs and videos during the observations. I also took down detailed field notes [73]. Participants were compensated an extra $4 for their time.

For Study 2, I conducted a video-diary study with a subset of six participants (n=6) from the interview study. I recruited a travel buddy to record videos of people with visual

impairments navigating indoor environments. Travel buddies were close companions (family and friends) of participants and regularly accompanied them on trips to indoor environments outside their homes. Participants recorded videos over a two-week period. Through the videos, I captured participants' routines and the repeated strategies that they used to navigate indoor spaces. Overall, I analyzed 22 videos (average duration = 1.5 minutes). I encrypted the videos and stored them in an online repository. Only members of the research team could access this repository. Participants were compensated $150 for their time. The disparity in participant incentives between Study 2 and Studies 1 and 3 can be explained by differing institutional standards which governed how much I paid participants. Study 2 was conducted as part of a research assignment in a technology corporation where participants were set a higher compensation amount for research participation than academic institutions, where I conducted Studies 1 and 3.

2.1.3 Data Analysis

I used both inductive and deductive methods in my three research studies. Inductive methods refer to a ground-up process of generating codes and themes from the data. On the other hand, deductive methods work in a top-down fashion. Here, I start from a theory to create codes [42]. Inductively, I employed a combination of pattern coding [225], affective coding [225], and process coding [225]. I used provisional coding [225] to apply the moneywork framework [205] and theory of legitimate peripheral participation Legitimate Peripheral Participation (LPP) [148] from the literature. In research study 1, I used a two-cycle inductive process to generate codes and themes. I then used a deductive method to organize the previously defined themes under codes I created based on the moneywork framework [205]. In study 2, I used inductive methods to generate codes from the interviews and video-diary study. In Study 3, I followed a process similar to Study 1, although I used Lave and Wenger's theories on Communities of Practice and Legitimate Peripheral Participation (LPP) [148] to create the deductive codes.

2.1.4 Context of Research

According to the World Health Organization (WHO), there are 285 million people with visual impairments (VI), with 80% living in the Global South [194]. As per 2020 estimates, India has over 40 million people with visual impairments which is one of the largest populations of people with VI in the world [83, 158]. People with VI in India are a marginalized group. They struggle with gaining opportunities for social and economic participation [2]. This struggle is due to several factors, including intersections of VI with poverty [100], structural

inaccessibility (e.g., limited access to and inaccessibility of institutions) [87, 100], and the prevailing indifferent societal attitudes towards disability [87]. These are key reasons why the everyday lives of people with VI in India differ from those of many people with disabilities in the Global North, including in countries like the USA. I outline factors affecting the daily lives of people with VI in India below.

2.1.5 Poverty and Structural Inaccessibility in India

Disability in India is correlated with poverty in both rural and urban areas. Many people with disabilities also lack access to resources like healthcare and education [67]. A large number of people with disabilities in India are illiterate and unemployed [191]. Indeed, only 5% of people with disabilities in the country have a college degree [191] while nearly 70% of people with disabilities in India are unemployed [191]. In contrast, in the United States of America, 32% of people with disabilities have a college degree [74], and an estimated 10% are unemployed [189]. Although it is very likely that the limited access to resources and opportunities in education and employment extends to people with VI, I cannot make specific claims about them due to the unavailability of data by the disability/ies which a person has.

Structural inaccessibility is also rampant in India. Prior work has discussed how infrastructures central to the everyday participation of people with VI, such as transportation [244] and financial institutions [140], are inaccessible to people with disabilities. For instance, Singh [244] outlines how public transportation in India is often problematic for people with VI as it is crowded and not timely. Furthermore, institutions that could play a central role in the socioeconomic mobility of people with VI are also inaccessible. This includes educational institutions, which are inaccessible to people VI due to the unavailability of accessible educational material and the inaccessibility of school and college buildings [236]. Likewise, workplaces are inaccessible to people with VI as they rarely have accommodations and flexible workplace policies that are critical for the integration of people with VI [68, 39]. Grech argues that the inaccessibility of such institutions that are key to economic mobility contributes to poverty among people with VI in India [100]. Thus, disability and poverty constitute a mutually reinforcing cycle within the country [100].

Addressing the inaccessibility of physical infrastructures and institutions is a central tenet in the disability studies discourse. This is in part emphasized by the "social model" of disability [235], which calls for the dismantling of all disabling barriers to foster the inclusion of people with disabilities. In Global South contexts, the social model features in development frameworks developed by the United Nations (UN), which is the basis for legal man-

dates/frameworks targeting people with disabilities in many countries such as India. Key UN frameworks include the Charter for the Rights of People With Disabilities [231] (UNCRPD) and United Nations Sustainable Development Goals [186] (UNSDG), which builds on the United Nations Millennium Development Goals (UNMDG) [185]. While UNCRPD is an "international human rights treaty of the United Nations intended to protect the rights and dignity of people with disabilities," [231] the UNSDG is designed to be a "blueprint to achieve a better and more sustainable future for all" [186]. The UNCRPD [231] has been integrated into the Rights of Persons with Disabilities Act (PDA)[190]; this legal framework safeguards the rights of people with disabilities in India (similar to the ADA) and seeks to advance the need for equal rights and participation of people with disabilities [190]. However, importantly, despite such a framework, this law is unimplemented in India. Indeed, scholars have argued that a rights-based approach is a Western approach to disability and question what it even means in a context like India, where a large number of people with disabilities live in poverty and have more immediate needs than individual rights such as food, water, and other resources [91, 100]. Others have stated social change in such contexts is complicated by historical legacies and indifferent societal attitudes towards disability [100]. This lack of implementation of legal protections presents an additional barrier to peoples' everyday inclusion. These limitations are in stark contrast to traditional sites of accessibility research in the Global North, where disability is better understood and where people with VI (like other people with disabilities) have better access to accessible resources [123]. As prior research has highlighted, poverty, structural inaccessibility, and legal protections shape peoples' technology experiences and other life experiences. For instance, legal mandates via accessibility standards enforce accessibility [5] and when unimplemented—which happens to be the case in India—this makes technologies even more inaccessible and unusable for people with visual impairments than is the case in countries in the Global North with legally-enforced accessibility provisions. The lack of enforcement of accessibility standards is a key reason why software updates that are intended to improve people's experiences with software in fact make them unusable for people with visual impairments (Study 3).

2.1.6 Participant Demographics

Participants in the three studies were between 21 and 63 years old (mean = 42.35, median = 42). All of them identified as totally blind. Most participants identified as men (n=39, 61.9%), while the rest identified as women (n=24, 38.1%). A majority of the participants were employed (n=55, 87.30%). The rest were either students or unemployed at the time of the research study (n=8, 12.70%). I conducted my research in metropolitan cities in India due

to ease of access. In particular, participants came from eight metropolitan cities: Bangalore, Lucknow, Chennai, Guwahati, Mumbai, Delhi, Kolkata, and Pune. All participants used screen readers to access technology. Most participants were Android phone users (n=47, 74.60%), and the rest used iPhones (n=16, 25.40%).

2.1.7 Positionality

I am an accessibility and HCI researcher with several years of experience working with people with disabilities in both Global South and North contexts. I identify as male, upper-caste, upper-middle-class, non-disabled, and sighted. I understand that my observations will be filtered through my individual identity.

CHAPTER 3

Study 1: Cash, Digital Payments and Accessibility - A Case Study from India

3.1 Abstract

Despite the growing interest in digitization and money in HCI and CSCW, the use of cash and digital payments by people with disabilities has received scant attention. We present findings from a qualitative study of people with visual impairments' use of cash and digital payments in metropolitan India. Using ride-hailing services as an exemplar, we find that both cash and digital payments were inaccessible to participants. We use Perry and Ferreira's "moneywork" as a theoretical framework to highlight the "added" work necessitated by this inaccessibility; that is, the work done in addition to the interactional work necessary to complete financial transactions. We argue that this "added" work is instrumental in "making" payments accessible. We discuss how ride-hailing platforms mediated collaborations between drivers and riders in relation to payments, while still making "moneywork" essential. We provide recommendations to improve the accessibility of digital payments to facilitate greater economic inclusion.

3.2 Introduction

India has 63 million people with visual impairments (VI) - the world's second largest population of people with VI [204]. People with visual impairments, like people with other disabilities in the country, struggle with social and economic participation [2]. Among factors that contribute to such limited participation are attitudinal barriers [199], inaccessible workplace environments and transportation services [199], and the lack of inclusive financial infrastructures (for e.g. inaccessible currency notes [201, 16]), which make everyday transactions difficult. Removing these barriers is crucial to the wider participation of people with

disabilities and their resulting notions of "financial independence" [278].

India is a cash-driven economy, with a large percentage of the country's workforce falling under the informal sector [89] where cash is the primary mode of economic exchange. Recently, however, there has been a push by the Indian government towards the adoption of digital payments as part of its "Digital India" vision. Digital payments, which include debit/credit cards and mobile wallets (like Paytm and PhonePe), are seen as a means to bring marginalized communities into the fold of the formal financial system. The move is also partly seen to help enhance transparency in the economy [122]. In this context, in late-2016, the Government of India undertook a 'demonetization' exercise, which resulted in certain high-denomination currency notes being banned and taken out of circulation and the introduction of new versions of other notes. Despite these efforts, a majority of transactions in the country are still cash-based [224]. Interestingly, digital payments have taken on the role of augmenting cash practices rather than replacing cash altogether. In fact, recent estimates indicate that a majority of debit card transactions were cash withdrawals from ATMs [229]. This is in contrast to many countries in the Global North where most transactions take place digitally [219, 176].

Prior work in HCI and CSCW has investigated the Indian financial technology landscape by examining the adoption and use of digital money by a range of actors including rickshaw drivers [193, 177], small business owners [197], migrant laborers [181] and rural households [144]. In this study, we extend this line of research to focus on people with visual impairments in metropolitan India. A study of their use of cash and digital payments is particularly relevant because currency notes - including those introduced post-demonetization - are inaccessible to people with visual impairments. In addition to the challenge this posed to their notions of "financial independence"[1], the inaccessibility of currency notes also resulted in online petitions to the Reserve Bank of India (India's central bank) demanding the provision of accessible currency notes [7]. Given the centrality of cash to the everyday lives of people in India, including those with visual impairments, and the increasing prominence of digital payments, we undertook this study to understand their use of cash and digital payments. Here, we draw on data from a larger study examining the ride-hailing practices of people with visual impairments [131]. In [131], Kameswaran et al. reported findings focused on theorizing people with visual impairments' experiences of "independence" resulting from their use of ride-hailing services. In contrast, this study focuses on a detailed analysis of how participants used cash and digital payments in the ride-hailing transactional context and the issues they faced when attempting to do so. An analysis of different payment methods in this context is particularly relevant because, in addition to being one of the first transactional

[1]https://feminisminindia.com/2017/10/12/demonetization-currency-inaccessible-blind/

contexts to introduce mobile based digital payments [178], ride-hailing affords multiple ways for a person to complete a transaction including via cash, credit/debit cards and mobile wallets. Research conducted in this context, thus, permits a direct comparison between the use of different payment modalities in a common transactional situation. Finally, ride-hailing allows us to understand the role of digital platforms in mediating collaborations between the customer-service provider in a service context.

Our study makes three significant contributions to CSCW research. First, to our knowledge, this is one of the first studies to examine the use of cash and digital payments by people with visual impairments. We uncover how cash and digital payments are *inherently inaccessible* to people with visual impairments and, subsequently, use the "moneywork" [205] framework to detail *the work involved in rendering them accessible*. We extend the "moneywork" framework to account for the supplementary, *hidden work* that is necessitated by the inaccessibility of cash and digital payments [205, 177]. Second, we contribute to an emerging strand of research that examines the situated use of everyday technologies by people with disabilities and highlights the social interactions involved in making them accessible [49, 48, 286]. Third, we also discuss the role of platforms like Uber and Ola in mediating rider-driver collaborations in relation to economic exchange and also offer design suggestions on making digital payments more accessible to people with visual impairments.

3.3 Related Work

3.3.1 Money: Meanings, Uses, Practices

Money is an artifact embedded in social relations and practices and has multiple situated meanings and uses [287]. When viewed as a means of payment, the technologies and practices around money are foregrounded and the process of its circulation leads researchers to deal with the question of infrastructures [90]. Previous studies have highlighted some key limitations associated with using cash for the general population including, issues of safety [181], effort involved in transportation and counting [166, 64] and difficulty of obtaining the exact change [145]. Digital financial technologies are often promoted with the promise of overcoming these constraints by making the payments faster and secure [30, 224, 176]. However, this discourse misses out on the technological and human infrastructures that enable digital financial transactions. These infrastructures often remain hidden from the users, just like the regulatory frameworks around them [214, 90]. Recent studies have sought to uncover another crucial aspect that has remained hidden: *the work that goes into making different forms of money "work"* [193, 177]. Perry and Ferreira define "moneywork" as

"the interactional work around the use of money in making financial transactions" [205]. They draw a three-part distinction between (1) pre-transactional, (2) at-transaction and (3) post-transactional work done to successfully complete a financial transaction. A sequential analysis of the activities, actors and artifacts involved in conducting transactions provide insights into how they are accomplished in practice [116]. However, researchers have shown that the work performed around digital money goes beyond transactions themselves [79]. For example, the collaborative work involved in making digital money "usable" and trustworthy for low-literate users has been documented by [193]. Furthermore, researchers have documented the different types of "moneywork" performed by diverse users. For instance, in their study of smart card usage in Japan, Mainwaring, March & Maurer found that it was common for users to run out of balance unexpectedly because they had no way of knowing how much value they had on their cards [157]. Similar findings have been reported in the UK [209]. Insufficient balance on users' smart cards resulted in their not being allowed to enter city buses in London, where cash payments were no longer accepted. Users also could not recharge their smart cards at any place and at any time. Similarly, Airtel Money (a digital wallet service in India) users in India had to go to designated centers to convert cash into electronic value before transacting with it [193]. In this paper, we extend this line of research to examine the "moneywork" that people with visual impairments have to perform in order to *make* cash and digital payments accessible. Paying attention to the work that goes into accomplishing different types of payments will provide insights into the implications of inaccessible technologies and suggestions for designing technologies to assist with relieving "moneywork"-related difficulties amongst people with visual impairments.

3.3.2 Assistive Technology Research

Prior work at the intersection of Accessibility and HCI has primarily focused on the design, development and evaluation of assistive technologies for people with disabilities (for instance [28, 45]). In these studies, assistive technology operates in a functional capacity and serves to offset one's impairment, an approach set in the medical model of disability [52]. However, recently, there has been a growing interest in "social accessibility" - a body of work which examines the *situated* use of assistive and mainstream technologies by people with disabilities, as well as the social concerns of its users (for instance [240, 241, 174]), and it is here that we situate this work. This includes research examining the use of social media by people with visual impairments, which highlights the inaccessibility of these platforms and and the role of design in making them more accessible (for instance [156, 173, 288]). Another line of work in "social accessibility" details the social interactions involved in making artifacts

accessible. For instance, Branham and Kane explain how people with visual impairments work with their partners and co-workers to co-create accessible environments in homes and workplaces [48, 49]. Likewise Yuan et al. highlight how shopping is a collaborative act between people with visual impairments and their sighted shopping counterparts - the success of which is shaped by the latter's knowledge of shopping as a practice and an understanding of the ways to assist people with visual impairments [286]. Finally, Bennett et al. propose an "interdependence" framework for assistive technology design, and argue that an "interdependence" frame foregrounds the work performed by people with disabilities in creating and maintaining accessibility [36]. In this paper, we extend this line of accessibility research to examine the social interactions surrounding the use of cash and digital payments by people with visual impairments and the work done by them to make payments accessible.

3.3.2.1 Digital Technologies, Money and Accessibility

Prior work at the intersection of digital technologies, money and accessibility has centered around the design of technologies to 1) assist people with visual impairments in identifying cash and 2) improve the accessibility of ATMs. The ubiquity of smartphones equipped with cameras has resulted in research examining ways to improve the speed and accuracy of currency note detection (for e.g., [195, 154]). On the other hand, early work examining the accessibility of ATMs focused on enhancing the usability of ATM user-interfaces [159, 159, 62] while more recent work has turned towards building accessible ATM experiences from the ground up, taking into consideration the needs of people with visual impairments [55, 207]. For instance, Pous et al. propose a design which turns a "more accessible" device like a feature phone into a remote control which, then, allows one to withdraw cash in an ATM without a card [207]. Singanamalla et al. adapt this design to make it more relevant for the Indian context [243]. They extend Pous et al.'s design to include smartphones which can be used to pre-authorize cash withdrawals. Finally, Ahmed et al. uncover the privacy challenges that people with visual impairments face in ATMs and detail how making information about people in their vicinity available can improve their sense of security [19].

In contrast, fewer studies have focused on the use of cash and digital payments by people with visual impairments. With regard to digital payments, Kiiti and Mutinda [141] report on the use of M-PESA, a feature phone-based mobile money application, by people with visual impairments in Kenya. M-PESA was 'inaccessible' as participants did not have screen readers on their phones which meant that, in order to to conduct transactions, they had to share sensitive information like PINs with others, resulting in cases of fraud. This problem was exacerbated by the fact that M-PESA was users' main store of value, containing almost all their savings. This study highlights the importance of making digital payments accessible

to people with visual impairments. Furthermore, we note a lack of prior work which compares payment modes in terms of accessibility and work required to facilitate transactions. Hence, we examined the use of cash and digital payments by people with visual impairments in India in a common transactional context - ride-hailing.

3.4 Methods

We draw from a larger qualitative study examining the ride-hailing practices of people with visual impairments in metropolitan India [131]. The study was conducted between June - August 2017. Participants were recruited via Access India - an online list for people with disabilities in India (n=15), personal contacts (n=6), and snowballing (n=9). Interviews were semi-structured and lasted for approximately 60-75 minutes. These included a combination of face-to-face and Skype/phone conversations. Amongst other topics, interviewees were asked about their preferred mode of payment, reasons for their choices, challenges they faced with the payment process, and how they circumvented these challenges. Participants were compensated with a Rs 250 ($4) voucher for their time. Interviews were conducted in English as all participants were familiar with it. Interviews were audio-recorded, for which informed consent was obtained prior to the start of the interview. Interviews were transcribed verbatim by the research team. The interviews gave us rich, in-depth narratives [146] about the use of cash and digital payments by participants. Data pertaining to cash and digital payments was analyzed through a three-cycle coding process which included both, a bottom-up, inductive process for the first two coding cycles, then a deductive process in the third cycle. In the first cycle, we used descriptive codes [225] to identify "topics" about payments and payment modes. In the second cycle, we used "pattern coding" [225] to organize and group the descriptive codes under specific themes. At this stage, we identified eight themes including: (1) reasons for cash usage, (2) challenges with cash usage, (3) advantages of digital payments, (4) disadvantages of digital payments, (6) social implications resulting from the use of digital payments, (7) cash-related workarounds, and (8) digital payments-related workarounds. In the third coding cycle, we grouped data coded under the cash and digital payment workaround themes under three codes based on the "moneywork" framework's [205] distinction between transaction phases i.e. (1) pre-, (2) at- and (3) post- transaction to understand the times in which the workarounds occurred.

In contrast, in the larger study on ride-hailing [131], we focused on a subset of data pertaining to experiences of independence. In [131], we inductively coded for autonomy, control and reciprocity - themes related to independence which were based on prior literature while deductively we grouped data under the different phases of a ride-hailing trip including

- booking, the first 100 meters, cab journey, payment and the last 100 meters. Grouping data under these trip phases allowed us to dig deep into the independence related tensions that emerged during each phase.

3.5 Findings

3.5.1 Cash

3.5.1.1 Preferences and Use

Out of 30 participants, three expressed no strong preference for either, cash or digital payments, whereas three others preferred and used only digital payments. Among the remaining 24, 12 preferred to transact by cash, whereas the other 12 preferred digital payments but had to sometimes use cash for reasons delineated below. The participants who transacted mostly by cash attributed their use to factors such as: their familiarity and widespread preference for physical forms of money in a cash-driven society, lack of trust and difficulties with digital payments, and the immediacy of cash exchange.

Cash is deeply entrenched in India and central to everyday financial practices of people at large, including those with visual impairments, some of whom saw no reason to move to digital payments as they had grown accustomed to using cash over time. Others felt that the shift from cash to digital was simply not "worth it," and that it was too much of a "hassle." Using digital payment apps required becoming familiar with a new user interface. This entailed significant work on their part as it required them to determine the application's compatibility with their phone's screen reader, and, to understand how it interacted with the different screens of the app. This was exacerbated by the limited accessibility of mainstream everyday apps. For instance, unlabelled buttons are inaccessible as they are not called out by screen readers, making it impossible for people with visual impairments to identify the function/task they represent by themselves. As one participant explained,

> Although I have been planning to do a Paytm for a while now, but with just adding more technology and sitting and then having to link it to your bank and all of those things - it's too much for me [...] there are certain - a few accessibility challenges with Paytm as well apparently [...] and I don't want to add to my headache [...] It's just simplest if I know how much I have to pay [...] I keep my money separated in my wallet. I know what I need to deal with, what notes I need to take out and give and things like that. So, it sort of makes it easier. - P37

Whilst some participants saw cash as a "win-win" situation for both the driver and themselves, others felt that using cash was a compromise that they had to make in order to avail a service, in this case avail an Uber or Ola cab. One participant explained his perception of a "win-win" as follows:

> Even the driver is also happy if I give him the cash [...] that day's expenses for him will happen, right? I am thinking from that angle. - P9

The desire to avoid conflict and the need to travel, thus, shaped participants' cash usage. The driver's preference for cash meant that the choice pertaining to a means of payment did not entirely rest with the customer, sometimes putting the two transacting parties' preferences at odds. However, some participants were happy to use cash because they did not trust digital payments and were concerned with the privacy and security of online transactions - which has been highlighted by prior work [243, 118, 19, 18]. P10 noted how his friends with visual impairments had stayed away from Uber and Ola because they associated app-based taxi hailing with digital payments.

> They think their money could be stolen etc. So, they always try to avail the cash [...] cash payment [...] even their booking something [...] something from any online shop etc. So, in that regards, as I have said earlier, some of my friends from junior - they did not know direct cash payment is available while booking Ola or Uber, so they were little bit of [...] you know [...] hesitant to book that. - P10

On the other hand, among participants who had used both cash and digital payments, some cited the relative advantages of the former by drawing comparisons with the latter. For instance, some participants voiced concerns about transaction costs associated with digital payments. Cash settles at par and involves no service charges, whereas this is not the case with digital alternatives, whether card- or mobile-based.

> Why should I keep the money in the Paytm guy who doesn't pay me anything at all? No interest, nothing, and he's earning a lot, and for everything, every transaction, he transacts [deducts] 5 percent or 2 percent [...] why should I make a payment to that guy for a digital platform? See, my hard earned cash I have earned it with all my sweat and blood, and I put it into the bank - if he gives me 2 percent or 3 percent interest, it is fine. But if I have put it into Paytm that money, he is not going to give me interest. - P9

Concerns about losing money was a consistent theme with our participants. In India, like much of the Global South, disability is correlated with lower incomes and many people with disabilities receive little formal education and are unemployed [2]. Even those with jobs - like many of our participants - earn significantly less than their able bodied counterparts which likely explains why these concerns surfaced in the first place [2].

Moreover, participants perceived cash-to-digital conversion as a challenge and cumbersome. In India, where cash is the dominant mode of economic exchange already, immediate access to cash for some meant that it was easier to conduct transactions by cash than change it to digital forms of money and then transact with digital money. For instance, P33 reported that a part of his income was earned in cash from his students who paid him for coaching classes. Consequently, it was more convenient for him to circulate cash at-hand as opposed to visiting banks or ATMs to deposit it and then use debit/credit cards. Not only was this perceived as a roundabout way of doing things, but banks and ATMs in India are also mostly inaccessible for people with visual impairments [243], resulting in a preference for cash. Evidently, such a process also necessitated people with visual impairments travel to banks or ATMs in the first place - which can be challenging in metropolitan India, where there is limited accessible infrastructure (for instance - many roads lack sidewalks and public transportation is also inaccessible [131]).

3.5.1.2 Challenges with cash

Notwithstanding these benefits, our participants' accounts indicated that cash was not *inherently* accessible, but rather it had to be rendered "accessible" through work.

3.5.1.2.1 Cash Identification Since neither notes nor coins are easily identifiable through touch, participants found it difficult to distinguish between different denominations.

> Cash is not accessible. I couldn't differentiate Rs. 100, Rs. 500 [...] in this days, RBI had printed coins in accessible mode. Rs. 5 coin will be little more thick, Rs. 10 coin will be less - those things are abolished now, everything looks [feels] the same. Even Rs. 100, Rs. 500 [...] I have to put the note side by side, I have to measure the length. - P12

Although participants relied on the length of notes to distinguish between different denominations, new notes circulating after India's implementation of the demonetization policy introduced new difficulties because the length of the new notes were no longer proportional to the denomination. If given enough time, several participants felt that they could distinguish between denominations, but some reported that it was impossible to identify whether

or not the notes were fake. Only one participant, who was a bank official, pointed to markers embossed on currency notes.

> Thin lines are there, braille lines - Rs. 2000 has seven lines and Rs. 500 has four and Rs. 100 three. - P7

It ought to be noted that, although P7 referred to those markers on the currency notes as "braille lines," there are actually no braille lines on Indian currency notes. These markers are instead used to identify authentic currency notes as opposed to fake ones. None of the other participants were even aware of such markings, and moreover, P7 did not rely on them himself when transacting by cash.

> Those marks you can make out, but I do not depend on that. Truly I do not depend on that thing. Length wise we can make out, we can keep it and measure it. That one option is there. - P7

In transactional contexts, there is often a short time window in which to complete a transaction, which makes locating markers and identifying notes difficult. This brings us to another problem that people with visual impairments encounter with cash - that of obtaining and verifying change.

3.5.1.2.2 Collecting Change As cash identification was difficult through touch, participants were dependent on drivers to assist them with identification and to inform them if the notes handed over to them were too large or small. In fact, some participants also asked the driver to communicate the final price of the trip to them (which could differ from the initial estimate indicated by the app), likely because using a screen reader to move across the user-interface sequentially to read the price of the trip was time-consuming.

> Sometimes I have no record how much money I have and there is no time to check the notes by myself - to take all the notes out and check the size, there is no so much of time for all this - then I take the help of the driver and pay. - P22

Needless to say, participants also expected the driver to hand back the right change as there was little to no time to verify. Sometimes, they had to step out of the cab themselves and seek change from pedestrians or shops in the vicinity. Although these encounters are not unique to people with visual impairments, the effects are magnified for them, and seeking assistance can be particularly difficult in unfamiliar locations.

> But I think 2 months back, recently, we faced the challenge that we gave him Rs. 500 and he was saying that he doesn't have change. So we said that [...] please get a change [...] so he was saying it that time no, you have to get the change [...] so literally we have to just get out of the cab to the shops and we have to collect the change and then we have to give it to the driver. - P30

In relation to collecting change, participants were frustrated by the introduction of large denominations in the post-demonetization period in India. For instance, they questioned the logic of introducing large denominations like Rs. 2000 in the place of Rs. 1000 as it made it harder to obtain change. Furthermore, exigencies such as the need to complete a transaction as soon as possible, as noted above, shaped their preferences. For instance, although some of them knew about and used apps like Moneytell to assist with note identification, they reported that scanning one note after another at the time of transaction was time-consuming and difficult. That they had to repeat the entire process if/when the driver returned change meant that scanner apps were simply impractical for this type of transaction. Participants could neither manually cross-check each note, one at a time, nor use apps to scan them and verify, which meant that they were invariably dependent on drivers.

> I can identify from the sizes of the notes, a little bit I can anyway identify but I don't really sit and cross check. If there are some 5-6 notes being given back to me, I don't really sit and cross check. - P36

Participants expected the driver to act in good faith, and, on most occasions, their trust was not misplaced.

> [...] I did hand a Rs. 500 note to a cabbie instead of a Rs. 100 note and he thought I was asking for change and he told me no change. Then I figured I had given him a Rs. 500 note [...] if I have to take change from them, I have to trust them. - P37

That said, participants neither liked the fact that they had little choice but to trust the driver, nor had they always had positive experiences. Drivers were a mixed bunch and some took advantage of our participants' disability, getting away with the money that was offered in the initial handover.

> I use cash payment as well. Sometimes. Yes. A few drivers [...] they don't give a damn about my vision impairment. Whatever I have given to them, they just accept it and run away. - P29

At a more general level, participants voiced concerns about keeping large amounts of cash with them during a ride as they were concerned about their safety. They were anxious about their money and other belongings being stolen during the course of the ride, by drivers or fellow riders in case of shared rides.

3.5.1.3 Making Cash "Work"

Although our participants saw some practical reasons for using cash, it is clear that they also experienced difficulties with respect to its accessibility for the reasons delineated above. It is, therefore, vital to investigate how our participants rendered cash 'accessible'.

Earlier, we noted that the identification of currency notes was a major challenge for people with visual impairments in transactional contexts that involved time constraints. These factors necessitated that they engage in adequate work in terms of organizing and managing their money. This involved participants using different spaces, such as different pockets or folders in a wallet.

> Right from the beginning - I have this habit of, since I had this vision, I had this note size and keep it in my mind or whatever it is, and before I go home, I have this habit of checking with the people what is the money I am taking. I invariably have this habit of keeping the highest denomination note at the back, like Rs. 2000 at the back, then the Rs. 500 note, and then the Rs. 100 note [...]. - P9

Participants often accomplished this preparatory work with the assistance of family members and friends. The desire to avoid the problem of collecting and verifying change was a key reason that led them to engage in this work.

> I have helpers - my mom used to give me exact cash [...] she would put money in the shirt pocket, I used to pay exactly. But it's not possible when I am in somewhere I have to travel [alone] urgently. - P12

Here, a key technology affordance that assisted participants with this preparatory work was the fare estimate feature on the Uber/Ola application. The information provided beforehand helped them to arrange the cash amount required for the trip, which they segregated and kept aside from the rest of the cash they carried. Although the exact final fare would often vary from the initial estimate, participants using this approach reported that the difference was small and manageable. Another affordance that technology provided in this context was customer support. Participants appreciated the fact that they could now relay

any negative experiences and potentially get reimbursed in case of fraud by drivers. Furthermore, concerns over being defrauded and safety around carrying cash on a more general level resulted in additional work in terms of precautionary measures. One strategy was to limit the amount they kept on person at the time of taking Uber/Ola rides.

3.5.2 Digital Payments

Approximately half of our participants preferred digital payments as they reduced the work involved in using cash. We first address some of the perceived advantages amongst these participants. However, as they noted, using digital payments was not without its challenges, and we delve into the characteristics of credit/debit cards and mobile wallets that made them inaccessible.

3.5.2.1 The Advantages of Digital Payments

3.5.2.1.1 Practical Benefits Participants saw several practical reasons to adopt digital payments like Paytm and Ola Money. Those who preferred digital payments noted that they allowed them to do away with their work at the time of the transaction, especially with respect to the twin problems of currency identification and collecting change. It sped up the payment process whilst also making it more convenient.

The second major reason highlighted was the ease of use. The fare, algorithmically determined by the app, eliminated the need for any haggling with the driver. The immediate deduction of the fare from the embedded mobile wallet upon the completion of a ride meant that there was a reduction in the work involved.

> It's easier to make payment at the end [...] - at the end, once you finish your trip, it will just ask - pay now, pay using Paytm. I just say pay using Paytm and one click of a button and the payment is made. - P2

Additionally, the automatic fare calculation and deduction meant that there was reduced dependence on others such as family members and, most importantly, the driver at the time of transaction. This made some people with visual impairments feel more self-reliant. Digital payments also eliminated the need to seek information from the driver about the actual, final fare for the ride. There were also fewer concerns about being cheated by the driver. This possibility, they said, did not arise in case of digital payments.

> [...] Ola Money or credit card [...] so it automatically gets deducted [...] the amount. So, the driver cannot, you know, cheat [...] otherwise not only cab

> service, I avoid cash transactions. Most of my transactions, I do e-transactions only, wherever possible. - P32

Furthermore, participants reported that they felt more at ease, in general, because they no longer had to carry around large amounts of cash with them during their rides. In addition to practical reasons, there were larger social implications that stemmed from the use of digital payments, which participants highlighted as being key advantages.

3.5.2.1.2 Social Implications Kameswaran et al. note that one of the key advantages that people with visual impairment experienced with app-based ride-hailing services was the increased independence they enabled [131]. People with visual impairments were able to go out and about more, with reduced need for assistance from others, which was not possible previously with other modes of transportation. This enhanced sense of independence was made possible by several affordances of ride-hailing platforms such as the possibility of booking rides via a mobile phone, assistance with navigation through maps, and the offer of digital payments.

The perceived self-reliance that resulted from the use of Paytm contributed to participants' sense of independence, which prior work suggests is a central value that people with disabilities seek from technology interventions [283].

> I need not ask so many peoples help - so independence it has increased and payment issues also, digital cash mode 'it has made us independent [...] whatever amount I want I can recharge into my wallet and pay it easily. I need not worry about the safety of my money [...] So cash wise and traveling wise they have made us independent [...] it has increased our pride, it has increased our prestige before outside world [...] It improved our confidence, it has improved others' confidence. - P12

Here, we also see the role of technology, specifically digital financial services, in enabling people with visual impairments present themselves [95] as competent members of society, through everyday interactions [86] - in this case by being able to handle financial transactions by themselves. With cash, participants were concerned about the potential embarrassment resulting from handing over incorrect cash/denominations to the driver.

> Most of the time, we prefer Paytm or debit card because one - its very easy, and second we may sometimes end up giving more money to the driver or we may even give him less money and it might be bit embarrassing. - P16

Thus, in addition to the practical benefits, we see that digital payments helped participants avoid the social costs which people with visual impairments might incur when using cash.

3.5.2.2 Challenges with Digital Payments

Despite their practical benefits and role in fostering an increased sense of independence, digital payments were not necessarily the default mode of transaction. The choice to adopt and use mobile wallets or cards was neither automatic nor obvious. Below, we highlight some challenges that our participants experienced with using digital payments, pointing to issues related to accessibility, and platform design.

Very few participants used debit/credit cards to pay for their rides and many spoke at length about the inaccessibility of cards in general. There was no way for people with visual impairments to determine card details such as number, expiration date and CVV, all of which are required to authenticate an online payment. Although cards have certain details in a raised, embossed format, participants noted that this was often insufficient. Using cards, therefore, required remembering the card details, a challenge exacerbated when they possessed multiple cards. As this participant explains, cards were made accessible by seeking help from familiar people around.

> P28: That is the I had to like read out the someone like I have to give this card to someone and then..
> Interviewer: So you took help from someone?
> P28: Yeah yeah I took definitely because there is no like there is no any another way for that.
> Interviewer: Every time you have to enter your debit card no. you ask someone to read it out?
> P28: Yeah yeah. I have to take the help of someone, someone's help then I go to [...]
> Interviewer: What about the CVV number? Do you remember it or do you like..
> P28: Most of the time I remembered. Even I remembered my card no. Because like there is no possible that someone like lots of time, many times someone just like you have to find the peoples and then you have to need the help.

Others reported that saving their card details on the apps helped reduce their dependence on others and the need to remember the details. Although helpful, this did not eliminate the work involved altogether because card payments in India are a two-step process. Upon entering the card details, the user receives a One-Time Password (OTP) for authentication.

Whilst Uber and Ola allowed the users to store their card details, step two was still difficult. When people with visual impairments receive an OTP in the form of a text message, they are required to switch apps, listen carefully to the screen reader read out the OTP, remember it, switch back to the browser/payment gateway window, and enter the details correctly to authenticate the payment. Some participants noted that listening to the OTP and going through the process step-by-step was burdensome in crowded, public spaces with a lot of noise and disturbance. Participants were anxious about not being able to hear the OTP correctly or making mistakes while typing it because they had a short time period to complete the transaction. At the same time, the costs of making a mistake were quite high. Three incorrect entries would result in their card being blocked by the bank. This led people with visual impairment to prefer mobile wallets over cards.

A key prerequisite for mobile wallets to be usable was for their primary features and screens to be accessible to screen readers on the participants' smartphones. The fact that Paytm was embedded into the Uber app played an important role in rendering it accessible to screen readers. In contrast to this, unlabeled buttons prevailed in the Ola app, which, in turn, forced participants to resort to cash.

> For Uber, I use Paytm. And Ola, I use cash. While exploring the Uber app, I got the function payment [...] you can link your Paytm a/c with this, ok, so I attached that myself [...] I tried once recharging my Ola Money account with my card, but, again, it's an ally (accessibility) issue. Like, you can't click on Ola Money while using voiceover in iPhone. So, that's why I prefer using cash with Ola. - P27

In this case, it is evident that, although the user preferred digital payments, the poor design of the Ola app, including its m-wallet Ola Money, meant that he had to resort to cash, despite difficulties. At the same time, it is important to note that Paytm itself was *made* accessible by its embedding in the Uber app. Some participants remarked that Paytm was not accessible when used as an independent app in other contexts. This was because it involved steps such as locating the QR code of the service provider and scanning it, which they found impossible to undertake by themselves.

There is considerable work that goes into making m-wallets accessible. Although they allow the user to link bank account or debit/card to the m-wallet account, work needs to done in terms of regularly loading money onto the wallet before using it for a transaction. Recharging a wallet entails the same process as a card payment - confirming the CVV of the card linked to the wallet and then entering the OTP. Again, whilst possible in the fullness of time, many participants noted how recharging it was difficult on-the-go. Often participants

noticed the need to recharge at the time they required an Uber or Ola ride, as rides cannot be initiated without a minimum balance on their wallets. Furthermore, something that made digital payments problematic was that any balance leftover in the wallet could not be transferred back to the user's bank account for free. The user is charged a certain fee for transferring their m-wallet balance. This led to some participants comparing the unused balance in a Paytm/Ola Money wallet to savings in their bank account in terms of how the lack of any return i.e. interest on stored balance in the case of the m-wallet, unlike the bank account, put them at a disadvantage.

Finally, there were privacy concerns about using cards in unfamiliar spaces where participants were uncertain about who was in their immediate vicinity.

> So if there is a way I ask Google to book for me - so it would be very very easier to us and more and more blind person can avail this service. Blind person is frightened to type on the road and some of them also believe that while he is typing credentials or card number, someone can see it. So that is why they try to avail the cash and try to you know. - P10

Screen readers are essential for people with visual impairments to use mobile apps - but in this transactional context, screen readers reading out card numbers aloud, in fact, increased privacy risks necessitating the use of headphones or earphones to minimize these risks. For many, cash was, thus, a more convenient option.

3.6 Discussion

3.6.1 On Moneywork

Perry and Ferriera propose "moneywork" as a framework for understanding the interactional work involved in using cash and digital payments [205]. The framework organizes "moneywork" into three phases: (1) pre-transaction, (2) at-transaction and (3) post-transaction, referring to the activities that people undertake before, during and after transactions. In our study, we found that neither cash or digital payments were inherently accessible to people with visual impairments, and we use the "moneywork" framework to highlight the work that people with visual impairments put in to overcome the challenges resulting from this inaccessibility. We argue that this "added" work - work done on top of the transaction-related activities detailed by Perry and Ferriera [205] (for instance, maintaining and readying payment devices) - is critical to "making" different forms of money accessible for transactions.

3.6.1.1 On Cash

Cash is inaccessible because of the difficulties in distinguishing between currency notes of different denominations, especially with notes introduced post-demonetization, which are not proportional to the length of the notes. Distinguishing between notes was time consuming and almost impossible when there is a limited time window to complete a transaction. Like Perry and Ferriera's participants [205], our participants too organized their activities with the objective of accomplishing the transaction as rapidly and smoothly as possible upon the completion of a ride.

Pre-transaction: As described, two preparatory activities are key in this phase: (1) organizing currency notes and, (2) (in some cases) obtaining help to assist with organizing. The latter involved collaborative work with friends and family and was contingent on obtaining the right help at the right time. Trust, although not stated by our participants likely played an important role in determining whom they sought assistance from, given the potential implications on one's sense of privacy and security. Importantly, our participants didn't report these collaborations as impinging on their sense of independence, likely because of the lack of other ways to work around the challenge of inaccessible notes, which made seeking help a necessity.

These pre-transactional activities constitute "articulation work" - a set of activities that enable financial transactions by making cash accessible. Strauss defined articulation work as "the specifics of putting together tasks, task sequences, task clusters - even aligning larger units such as lines of work and sub-projects in the service of work flow" [251]. This articulation work allowed participants to prepare for a smooth at-transaction cash exchange process through an organized set of tasks. Although Perry and Ferreira introduced digital articulation work [205] which is the work performed to prepare digital devices for a transaction, a unique insight offered by this work is that such articulation work extended to cash as well. Finally, also a part of cash use are concerns over one's personal safety and cash being stolen, resulting in participants limiting the cash they carried with them.

At-transaction: The at-transaction work involved (1) recalling the specific locations of currency notes (organized in the pre-transaction phase) and (2) collecting and verifying change. The first step was made difficult by the time which elapsed between organizing notes and actually spending them, which led to step (2), which, in turn, entailed collaborative work with the driver. Participants expected drivers to assist with the cash exchange process - telling them if they handed incorrect denominations and in handing back the correct change. The limited time window available to complete a transaction resulted in an inevitable dependence on the driver, i.e. participants did not always trust them, but had little choice. Thus, by identifying notes, telling participants about the price of the final trip, and in handing back

change, the drivers too played a part in rendering cash accessible by collaborating with our participants to complete the exchange. Finally, these collaborative acts necessitated that either riders or drivers have the right currency denominations to complete the transaction. If either did not - the onus was on the rider to acquire change in the cumbersome manner described in the results.

Post-transaction: Drivers were a mixed bunch and some participants reported having been cheated by them. Here, customer support - an affordance of Uber and Ola - allowed for post-transactional work and, as a result, participants were able to report complaints (email/message through the app in Uber versus customer support line in Ola). Although the pre-transactional and at-transaction activities with cash likely extend to other transactional contexts, the post-transactional work is unique to technology-mediated platforms (ride-hailing, online delivery, and so on).

3.6.1.2 On Digital Payments

Like cash, digital payments too necessitated work in the pre- and at-transactional stages although the nature of these activities and associated work varied between mobile wallets and credit/debit cards.

Pre-transaction: The pre-transactional activities for mobile wallets and cards included: (1) ensuring there was sufficient balance in the mobile wallet to initiate a trip and (2) seeking help to enter and store card numbers in the app. The first required topping up if there was insufficient balance, which some participants found difficult to do when they needed a ride immediately, since apps typically notify that *after* the process of booking a ride has begun. To work around this, participants switched payment modes - most often to cash to initiate a trip.

Both, debit or credit cards were inaccessible to people with visual impairments (as they were not perceptible by touch) and required collaborative work to overcome the challenges. Although in many cases step (2) was a one-time effort, some of our participants highlighted the work associated with entering card details on other web/mobile apps.

At-transaction: The at-transactional work was significantly reduced with mobile wallets because of automatic deduction. On the other hand, cards necessitated: (1) entering the CVV and confirming a One Time Password - an alphanumerical message sent to a cellphone as part of the two-factor authentication unique to India. Participants highlighted that listening to the OTP was difficult in noisy and crowded environments, which prior research in accessibility categorizes as "situational impairments" - contexts that designers ought to consider while designing accessible technologies [138, 257, 258]. In addition to the process being time-consuming, the cost of entering details incorrectly was also high i.e the risk of sus-

pended bank accounts or blocked cards. It is a combination of the pre- and at-transactional work associated with cards that dissuaded participants from using them altogether - evident by very few participants using them. Further, cash is inaccessible as well - which meant that in the ride-hailing transactional context, more specifically Uber (as Ola and Ola Money were deemed inaccessible), some of our participants found Paytm to be the ideal payment mode. Much like participants in Perry and Ferriera's study [205], the use of digital payments has associated social implications too - like the enhanced sense of independence and reduced likelihood of embarrassment from handing incorrect notes. However, in spite of our participants' preference for mobile payments, we also saw that they often had to account for the drivers' preference (for cash) and this too shaped their use of payment modes - a discussion which is incomplete without understanding the role of the platform in mediating the collaborations between the rider and driver, which we address in the following section.

3.6.1.3 In summary

We agree with Mainwaring et al. that "keeping e-money running smoothly required work from people who use it" [157] and extend the argument to cash use as well. Prior work has examined the challenges with cash including issues of safety, counting and obtaining change [64, 166, 181]. Although we observed these challenges with our participants as well, in many cases, they were magnified - because of the inaccessibility of these payment modes that necessitates "added" work on their part to render them accessible. A large body of work on digital financial technologies has focused on the at-transaction moment i.e. the usability of payments including how they can be made faster and more secure [30, 224, 176]. However, as we show, there is considerable work involved in making payments accessible - at the pre-, at- and post-transactional moments, some of which necessitates collaborative work between people with visual impairments and family, friends and the driver suggesting that payments are actually "embedded within wider socio-technical ecosystems" [193]. In doing so, and examining other work involved in making cash and digital payments accessible, we extend CSCW research that examines the "hidden" work involved in making payments usable [205, 177].

Likewise, a majority of work in accessibility focuses on the design of technologies to assist with functional needs of people with disabilities (for instance [40]). As Thieme et al. argue, these technologies "are often treated in isolation from the wider social contexts in which they occur" [254]. In contrast, we highlight the work done by people with visual impairments, including how social interactions and collaborations are key to *making* payments accessible.

3.6.2 Platform Design and Collaborations

Platforms such as Uber and Ola position themselves at the centre of a controlled, closed ecosystem and mediate not only the interactions between drivers and riders, but also the collaborative work that they perform, including the payment process. One of the major problems with "gig economy" platforms is information asymmetries, resulting from the non-inclusive design of the ecosystem (not just the app) that can that can exacerbate existing tensions [99]. For instance, Kameswaran et al. note how the lack of information about customers' disabilities impedes the driver's ability to assist them [131]. In the context of economic exchange, it is imperative that the two transacting parties are in agreement with respect to the terms and means of exchange. Without probing into why drivers might be reluctant to accept Ola Money or Paytm, merely thinking about the different ways of "persuading" or "enforcing" drivers to accept digital payments will be unhelpful. Previous studies looking at digital money have examined individual users and highlighted individual-level explanatory factors such as literacy levels [168], trust [272] and privacy concerns [273]. Our findings reveal that economic exchange in the case of people with visual impairments entails collaborative work raising questions such as what it means to exercise independence or autonomy (in the context of collaborations).

Furthermore, the workarounds our case illustrates (such as using cash because of driver preferences for the same) echoes the findings by [178], who argue that *it is the very design of the platform* that explains why drivers are reluctant to accept cashless payments. First, the platform design does not allow a rider to change the mode of payment once selected, leaving no scope to negotiate or accommodate driver preferences. Platforms, by design, limit the interaction that customers directly have with workers/service providers; this has been noted as an issue across digital labour platforms, from Uber to Amazon Mechanical Turk [99]. In the ride-hailing context, studies on Uber in the Global North [94] also indicate that cashless payments from the rider are first routed to the platform's account, and, then, transferred to the driver's bank account. This electronic bank transfer process can take anywhere between one day (Ola) to a week (Uber). Consequently, drivers cannot access their digital earnings in real-time or use them to attend to their day-to-day needs, thus explaining their strong preference for cash. Having no stable income, and facing uncertainty about the number of rides they get on any given day [17], they prefer not to accept cashless payments.

The impact of platform design on the "moneywork" done by customers is relevant across gig economy platforms. For instance, recently, DoorDash and InstaCart in the US were found to subsidize delivery workers' earnings with customer tips [2]. Digital payments played

[2]https://www.fastcompany.com/90306499/delivery-workers-tip-us-in-cash-so-companies-have-to-pay-us-more.

a crucial role in enabling them to do this. The platform is, in principle, typically expected to pay either on an hourly basis or per task. Any tip that the customer might provide is an add-on and is generally understood as a token of appreciation for a job well done. However, digital payments, in this ecosystem, enabled platforms to pay lower worker wages. This led to workers requesting the customers to tip in cash so that they could earn their full wages and ensure that there are no deductions made on the tip. This is similar to what drivers expect in the context of Uber and Ola in India, although the reasons might be slightly different [178]. These examples ask us to reflect upon the possibilities that technology enables in terms of exploiting poor labour and wage regulations in emerging markets. They illustrate the larger issue with platforms - their design is inscribed with their own business logic [93] - as opposed to seriously taking into consideration different stakeholders' interests and creating an inclusive, equitable ecosystem - the importance of which has been highlighted by prior work on ride-hailing services [130, 51, 69, 94].

3.6.3 Situating payments in India

In India, much like most countries across the world, cash and digital payments work alongside each other as means of economic exchange. However, unlike many countries in the Global North and like most countries in the Global South - cash is the primary mode of economic exchange [224] and integral to the everyday lives of people, and people with visual impairments are no exception to this. However, cash and digital payments are both inherently inaccessible to people with visual impairments and require additional work on their part to *make* them accessible.

The social model of disability provides an analytical framework to understand the exclusion and subsequent marginalization of people with disabilities [235]. The social model distinguishes between "impairment" and "disability," and whilst the former is defined by the lack of functional ability, disability is understood as the result of structural barriers which excludes people from participation in mainstream social and economic activities [235]. Using the social model as a lens, it is easy to see why the inaccessibility of cash and digital payments is disabling and exclusionary as it makes participation in economic activity - a key aspect of everyday life - difficult. In reality, economic activity is only one facet of everyday life from which people with visual impairments in India are excluded [2]. The lack of accessible transportation, educational institutions and workplace environments also impede mainstream participation - challenges which are compounded by prevailing negative attitudes towards people with disabilities [199].

Notable here is the role of the state in ensuring the accessibility of financial infrastructures

and driving inclusion. In response to the call by people with visual impairments for designing currency notes to be accessible [7], the Reserve Bank of India (the country's central bank) announced the future release of an app to assist with the identification of currency notes[9] - which our research suggests will not necessarily be useful, much like other money scanner apps [195, 154] because of the constraints of real-world transactional contexts where there is a limited time window to complete a transaction. Furthermore, such a measure would exclude those without access to smartphones including a large percentage of people with visual impairments who are low-income, for whom cash is the only means of payment [2]. The efforts by the state here are in contrast to countries in Europe, where currency notes and coins are accessible to people with visual impairments[6].

Likewise, the accessibility of apps and technology is also shaped by accessibility standards and compliance measures (for instance WCAG [108]) which in the Global North are often enforced by state legislation (for instance, ADA in the USA [5]). However, in India - the National Policy on Universal Electronic Accessibility [8] only holds state-owned ICTs accountable to compliance measures and not private players which partly explains why Uber (and Paytm), an international app that conforms to standards in the USA was more accessible than Ola (and Ola Money) which was inaccessible. Thus, here too, we see that there is little help from the state in promoting inclusion. Finally, it is worth noting that the challenges we describe with regard to payments are unique to people with visual impairments, as disability is relational, and disabling social barriers are, in fact, shaped by the nature of one's impairment [235]. For instance, people with motor disabilities, might be disabled by the lack of ramp access to ATM machines, which people with visual impairments are not necessarily constrained by, but are disabled by the limited accessibility of the machines themselves (for instance, by the lack of tactile keys). However, the response of the state and their lack of effort in implementing accessible financial infrastructures is reflective of the larger attitudes towards people with disabilities in the country, who continue to be excluded and marginalized.

3.6.4 Design Implications

Our study reveals that cash, whilst central to everyday transactions, is inaccessible to people with visual impairments and making them accessible would require considerable change in infrastructures. However, improving the accessibility of digital payments - both in the ride-hailing context and elsewhere - is more feasible and, here, we reflect on three potential solutions - improved screen-reader access, two-factor authentication alternatives, and Unified Payment Interface (UPI). We also briefly discuss how technologies could augment cash

practices.

3.6.4.1 Improved screen-reader access

Our participants noted how the the Ola app (and Ola Money) was inaccessible as it had several unlabelled buttons, which are not picked up by the screen reader making it impossible for them to determine their function. Given that many apps in India don't adhere to accessibility compliance measures like WCAG, labeling buttons would be one of the first steps to improve the overall accessibility of mainstream applications including digital wallets like Ola Money.

3.6.4.2 Two-factor alternatives

Two-factor authentication is intended to provide an extra layer of security for digital transactions. In addition to a PIN/password/CVV, in the Indian context, the user receives an OTP on the mobile number linked to their bank account, which they have to confirm to process a transaction. As we elucidate, this necessitates extra work for people with visual impairments. Although OTPs make transactions more secure, our case illustrates that it can, at the same time, make it more inaccessible for people with visual impairments, thereby creating a security-accessibility trade-off. Whilst one solution could be to embed OTP readers into apps (such as Uber) which could automatically retrieve the OTP from the SMS received, and process it for authentication, this design still entails a trade-off between accessibility and user privacy/security - an important consideration given the concerns people with visual impairments have with online transactions [243, 118, 19, 18]. One way to address this accessibility-security trade-off and simultaneously work for people with visual impairments would be a fingerprint-based biometric authentication. This mechanism would eliminate the need to wait for OTPs and the issues with listening and typing them carefully i.e. 'situational impairments' [138, 257, 258]. Another alternative would be contactless cards[3], which are witnessing increased adoption in the Global North. Contactless cards afford only micro-transactions for security purposes and eliminate the need for authentication as its users only have to wave or flash the card at the point of service (PoS) terminal to complete a transaction. Whilst people with visual impairments might still need assistance in locating the machine, for transactions that occur regularly but are not of a high value, they can be useful in terms of reducing the work associated with card based authentication.

[3]https://www.creditcards.com/credit-card-news/contactless-tap-and-go-cards-us-market.php

3.6.4.3 Unified Payment Interface (UPI)

Unified Payment Interface (UPI) - an interoperable, payment infrastructure that enables users to link their bank accounts directly to a mobile application[4] - launched by the Indian Government - could reduce some of the work associated with cards/wallets for people with visual impairments and simultaneously foster better collaborations like, for instance, between them and the driver. UPI can potentially be a win-win for both riders and drivers in the ride-hailing context (and potentially other transactional contexts) for four important reasons. First, by offering a static-PIN based authentication, it helps people with visual impairment overcome the problems with OTPs by doing away with them altogether. Second, it potentially allows the customer and driver to bypass the platform in the payment process. For instance, the rider can choose "cash" as the payment method at the time of booking and still pay by UPI, provided the driver has a UPI ID. The driver receives a payment confirmation once the transaction is complete. Gig workers have indicated that bypassing the platform is one of the key factors shaping cash preference in the platform economy across contexts[5]. Thirdly, for many of our participants, recharging their mobile wallets entailed work and was hard to accomplish on-the-go. UPI offers a better alternative as it eliminates the need to ensure a minimum balance to initiate rides as the amount is directly debited from one's bank account, facilitated by the app. Finally, UPI levies zero processing/transaction fees, unlike wallets and cards, and, like cash, will settle at par. Although the benefits of UPI are not specific to people with visual impairments, the impact is likely to be magnified because of its ease-of-use and 'accessible' authentication methods which arguably help balance the trade-off between accessibility and security.

3.6.4.4 Technologies to augment cash practices

Although digital payments are on the rise, India, like most countries in the Global South, is still a cash-driven economy [224]. It is, therefore, important to also think about technology augmenting cash practices that go beyond money scanner applications [195, 154]. As we noted earlier, in transactional contexts, they were nearly impossible for people with visual impairments to use. Earlier, we saw how the estimated price feature helped some participants organize cash and prepare for their forthcoming rides. This feature could be useful in other transactional contexts, especially where one has to place a service/goods order in advance to be picked up or delivered at a later time (say, with groceries or restaurants).

[4]https://www.npci.org.in/product-overview/upi-product-overview

[5]https://www.fastcompany.com/90306499/delivery-workers-tip-us-in-cash-so-companies-have-to-pay-us-more

3.7 Limitations and Future Work

There are some limitations to our study. First, our sample of participants consisted of middle/upper-middle class and educated individuals from metropolitan India. This likely explains why they had access to digital payments in the first place. This sample is not reflective of the larger population of people with visual impairments in the country, a majority of whom are low-income with very little formal education [2]. Second, we had a limited number of women (n=6) participate in our study. Although we tried to recruit more women as part of [131], we found it difficult, probably because the primary researcher leading the recruiting efforts was male. Consequently, the small sample did not allow us to establish a relationship between gender and payments. However, given that prior work has established gender differences in financial practices [81], understanding this perspective is an arena for future work. Finally, our analysis of payments primarily stems from the context of ride-hailing. This allowed us to compare different payment modes in a common transactional context and to establish the role of platforms in mediating relationships between the customer (rider) and service providers/worker (driver) in a gig economy context. However, an analysis of other transactional contexts (like online purchases, groceries, restaurants and so on) is absolutely essential because the affordances of digital payments are likely to be different in these contexts. Moreover, it is important to understand situations in which people with visual impairments have to negotiate other non-service relationships. Furthermore, as we show, the affordances of payments vary with transactional contexts which, in turn, dictate the extent of their accessibility (for instance - Paytm, whilst accessible in the case of Uber, was not accessible as a standalone app where the user is required to scan a QR code). This is further complicated by different environmental conditions inducing 'situational impairments' [138, 257, 258]. Thus, improving the accessibility of digital payments in particular necessitates moving out of examining its use in controlled environments and singular contexts to studying its situated use and practices across contexts - which too is a direction for future research.

3.8 Conclusion

In this paper, we presented a qualitative inquiry into the use of cash and digital payments by people with visual impairments in metropolitan India in the ride-hailing context. We found that both cash and digital payments are inaccessible to people with visual impairments and used the "moneywork" framework [205] to highlight the extensive interactional and non-interactional work ('added' work) done by them to overcome the inaccessibility in the pre-,at- and post-transactional phases. We discussed the role of platforms in mediating

collaborations between the customer-service provider in relation to payments, and situated the problem of payment accessibility within the broader situations of people with visual impairments in India. We concluded by providing design recommendations to improve the accessibility of digital payments – a critical concern as we seek to ensure that people with disabilities can participate fully in economic transactions.

CHAPTER 4

Study 2: Expanding Interdependence: Insights about the Help Interactions of People with Visual Impairments in India

4.1 Abstract

A goal of accessible technology (AT) design is often to increase independence, i.e., to enable people with disabilities to accomplish tasks on their own without help. Recent work uses "interdependence" to challenge this view, a framing that recognizes help interactions as critical to addressing the access needs of people with disabilities. However, empirical evidence examining interdependence is limited to the Global North; we address this gap, using interdependence as an analytical frame to understand how people with visual impairments (PVI) in India navigate indoor environments. Using interviews with PVI and their companions and a video-diary study we find that help is a central way of working for PVI to circumvent structural and social inaccess in indoor environments. We uncover two kinds of interdependent help interactions 1) dutiful and 2) compassionate help; both defined by unique actors, interactions, values, and work on the part of people with visual impairments. We discuss how these help interactions are bound up in cultural values of duty and compassion and also highlight the implications the two help interactions have for AT design in the Global South.

4.2 Introduction

Accessibility research in HCI has traditionally been set in the cognitivist paradigm i.e. a task-centered approach to accessible technology (AT) design, where the focus is on enhancing the one-to-one relationship between the user and the technology [107]. Often, the goal of ATs in this paradigm is to make users independent i.e. to allow people with disabilities to be self-reliant and accomplish tasks on their own [283]. More recently, however, accessibility

research has turned to the social [101], examining how AT use is socially situated i.e. located within a web of interactions between people with disabilities and the world around them. A part of this social turn [101] is research contesting the simplistic interpretations of "independence as self-reliance" to guide AT design, interpretations which are disassociated from the wider social context of people with disabilities [151, 36]. For instance, these interpretations devalue "help"; assistance from external actors which play an important role in people with disabilities accomplishing tasks [254] and in the achievement of their independence [131]. Therefore, to re-center help and move away from simplistic interpretations of independence, Bennett et. al. propose interdependence as an alternate frame [36]. Interdependence brings to focus the mutual dependencies between people and the work done by people with disabilities during help interactions [36]. However, evidence showing how interdependence plays out in the everyday lives of people with disabilities is limited. We address this gap by extending interdependence to understand the help interactions of people with visual impairments in India.

India has one of the largest populations of people with visual impairments in the world [194]. The social conditions of people with visual impairments in India differ substantially from people with visual impairments in the Global North; in fact, they are among the most socio-economically disadvantaged groups in the world [2, 100]. Additionally, people with visual impairments in India face several structural barriers, including limited infrastructural support, institutional access [266, 132] and negative societal attitudes [87] which shape their lived experiences and everyday interactions in fundamentally unique ways. So while a majority of work in HCI and Accessibility have centered the experiences of people with disabilities in the Global North, we shift focus to understand the experiences, particularly help interactions, of people with visual impairments in India.

In this paper, we use indoor navigation as a case study to explicate the help interactions of people with visual impairments in India. We conducted interviews and a video-diary study with people with visual impairments and their companions (family members and close friends who most often assisted people with visual impairments). We found that for people with visual impairments, indoor navigation was situated in the social i.e. necessitated interactions with their environment and people inhabiting it, from whom they often sought help to assist with navigation. We draw on the interdependence frame by Bennett et. al. [36] as an analytical lens to understand the particulars of help including; what makes help necessary, the actors involved in help, the interactions and values underlying help, and the work performed by people with visual impairments in the course of the interactions. We found;

- Help is necessitated by structural and social inaccessibility which are pervasive in the

Indian context

- Help took two forms: 1) dutiful help and 2) compassionate help which differ based on actors, interactions, and work performed by people with visual impairments during the course of help interactions
- Help is bound up in cultural values of duty and compassion

We contribute two important extensions to Benett et. al.'s interdependence framework [36]. First, by bringing to light the actors, interactions, and work inherent in dutiful and compassionate help, we unveil the "the different forms of simultaneous assistance" [36] and how they play out in the everyday lives of people with disabilities. Second, we also show that the "mutual dependencies" [36] between people are bound up in cultural values. We also discuss how future ATs might be sensitive to the needs of people with visual impairments in India by supporting both forms of help.

4.3 Related Work

4.3.1 Accessibility Research in HCI

Accessibility research has expanded to encompass not only technical research focused on developing AT's but also to examining the social perceptions of people with disabilities, their situated use, and social interactions surrounding the use of technologies [241, 240, 174]. For instance, research in social accessibility has examined the nature of collaborative interactions between mixed-ability individuals [48, 49, 65, 203] often to understand how technologies might leverage and support these interactions better. Our paper builds on this contribution style, focusing on the social interactions of "help" relating to blind people's navigation in India.

4.3.1.1 Help in HCI and Accessibility

Help has so far only received tangential attention in HCI and Accessibility and has primarily been discussed in relation to a key principle guiding AT design: independence. As per this principle, AT's are effective to the extent that they allow people with disabilities to be self-reliant i.e. perform tasks on their own without help. These studies find that people with disabilities desist from seeking help over concerns about resulting social costs [288, 275] and negative perceptions of their abilities [203, 49, 280] and feelings of needing to reciprocate

help received [46]. Recently, though, research has pushed back against this seemingly one-sided negative view of help. Work has shown that help in certain cases is in fact valued by people with disabilities thereby challenging universal interpretations of independence as self-reliance. For instance, Kameswaran et. al. in the context of people with visual impairments' use of ridesharing services highlight how help from drivers was instrumental in their participants' achievement of independence [131]. Likewise, Thieme et. al. argue for technologies to enhance help interactions which they found were critical to the sensemaking of people with visual impairments [254]. Bennett et. al. take this one step further and to center help and highlight its relevance to people with disabilities, propose *interdependence* as an alternate orientation to independence [36]. Interdependence acknowledges the mutual dependencies between people and our reliance on each other, thereby contesting the idea that anyone is truly independent. Interdependence underlines the importance of examining people with disabilities' interactions with their environment and each other and in doing so recognizes their work in creating access. However, interdependence for the large part remains a theoretical orientation, and evidence for how help interactions and interdependence play out in the everyday lives of people with disabilities is limited (e.g. [271]). We address this gap using the case study of indoor navigation of people with visual impairments in India.

4.3.1.2 Accessibility in the Global South

The World Health Organization estimates that nearly 15% of the world's population is disabled, 80% of whom live in low-resource settings in the Global South [194]. People with disabilities in the Global South often live in poverty and experience stigma and discrimination. Moreover, most people have little or no access to technology [25]. The limited number of Accessibility studies in the Global South have shown that access to AT's boosts opportunities for people with disabilities (e.g. education [200] and employment [199]) while allowing them to circumvent the troubles with inaccessible infrastructures (e.g., transportation [131], education [266]). Others have examined the local technology practices of people with disabilities (e.g. [33, 267]) and outline design considerations to make technologies more situated to align with the practices. However, these studies are few and far between and research has argued for the need for more accessibility and disability research in the Global South [88, 34]; we address this gap by using interdependence to examine help in the context of people with visual impairments in India.

4.3.2 Help Interactions

Help has been studied extensively in psychology, communication, and disability studies where research has examined; 1) categorizations of help 2) how helper-helpee characteristics affect help interactions, and 3) costs and rewards of help.

4.3.2.1 Categorizations of Help

Help is not a singular category and manifests in different forms. Gallagher and Gerstel distinguish between practical (e.g. task assistance), personal (e.g. advice), and material help (e.g. financial help) [85] while Thompson and Cusella in the context of people of disabilities receiving help, distinguish between verbal and physical assistance [255]. Help has been interpreted as social support which takes forms such as instrumental and emotional support. Cutrona and Suhr's social support framework includes other categories of social support including network and esteem support [63]. In this study, we unpack two forms of help interactions and the actors, interactions, cultural values, and work performed by people with visual impairments in the course of the interactions.

4.3.2.2 Actor Characteristics

Another line of work focuses on the *who* in the help relationship and examines the effects of helper-helpee characteristics on helping behavior and perceptions of help. For instance, Thompson and Cuselle distinguish between familiar and unfamiliar helpers and find that people with disabilities are more comfortable with receiving help from familiar people as they are more likely to be aware of when to help [255]. Likewise, demographic differences (e.g. age, gender) affect how people engage in and perceive helping behavior (e.g. [226]). In our study, we unpack how differences in the familiarity of helpers result in different help interactions.

4.3.2.3 Costs and Rewards of Help

Research based on social exchange theory [60] has examined the costs and rewards of providing and receiving help. It has been suggested that people's desire to help others has been attributed to altruism [35], empathy [66], feelings of social responsibility [250] and a desire to feel good about themselves [59]. People with disabilities, often portrayed as recipients of help, are one group in relation to whom this topic has been examined in depth. Ungar states people with disabilities are unlikely to receive help as helpers want to avoid stigmatized individuals [261]. Others argue that people do help people with disabilities but only after making considerations about the severity of one's disability [226], the effort involved [261]

and frequency with which they need to provide help[221]. When help is initiated by familiar helpers who pay close attention to people's access needs, it is valued by people with disabilities [255]. However, such help is uncommon. On the contrary they occasionally receive unwanted help i.e. help when they don't need it [47], which results in the loss of face [97], self-esteem [230] and feelings of incompetence [245, 15]. In this paper, we extend this body of work by highlighting how cultural values motivate help interactions.

4.3.3 Disability, Culture, and India

In India, understanding disability through the lens of either the medical or social models of disability [216] is insufficient to capture the entirety of people's lived experiences. Here, disability requires a foregrounding of cultural/religious constructs which otherwise take a backseat in both models [87, 91, 100]. For instance, Ghai uses "karma" as a frame to understand social attitudes towards disability. "Karma" is the "sum of a person's actions in this and previous states of existence" [87]. Earning "good karma" necessitates the continuous enactment of "good deeds", to ensure that ill deeds do not carry over to ones next birth. Although "karma" has its basis in Hinduism, similar constructs also pervade other religions [87]. We discuss two ways in which karma manifests in attitudes towards disability; 1) duty & 2) compassion.

Duty: Families play a critical role in caring for people with disabilities in India [87]. These familial relationships are guided by dharma, i.e. one's duty to care and address the needs of the family, underlying which is a sense of righteousness and religious responsibility [252]. On the relationship between karma and duty, Anees argues that karma is used to justify the disability of a close family member (i.e. an outcome of ill deeds in a previous life) and the subsequent acts of "looking after" that is deemed necessary to deal with the disability (i.e. to incur good karma) [21, 187]. However, duty is also used to justify family members making decisions and acting on behalf of people with disabilities, thus reinforcing patriarchal attitudes and resulting in their loss of independence and agency [87].

Compassion: Philanthropic or "kindly help" [78, 117] gestures rooted in compassion are central to the disabled experience in India. On a day-to-day basis, this is seen when strangers offer alms to poor disabled people [247] or help people with visual impairments cross roads [150]. The enactment of such acts is perceived as deeds that beget good karma. While in the West there is a tendency to view compassionate acts as acts of generosity, in India they stem from one's religious obligation towards disadvantaged members of society [87]. However, like duty, compassion also results in people being on the receiving end of paternalistic attitudes and being seen as objects of pity (e.g. [91, 112]). Finally, compassion

1a 1b 1c 1d 1e 1f

Fig 1. *(1a)* P4 and his companion walk together. P4 is being held by his shoulder and hand and does not have his cane *(1b)* They climb stairs together, which the companion does not tell P4 about *(1c)* The companion continues to work with P4 to ascend stairs, but provides no verbal cues *(1d)* The companion opens the door for P4 *(1e)* The companion then steps back to guide P4 through the door *(1f)* The companion then puts P4s hand on the ATM machine to signal that they have reached the destination

is often conflated with charity (and the charity model of disability [216]) but while charity is used to denote monetary gestures we use compassion to denote a broader set of non-monetary interactions.

In this paper, we use compassion and duty to understand help interactions. In doing so, we emphasize the need for HCI & CSCW scholars to pay attention to cultural values while understanding disability in India and the Global South.

4.4 Methods

We conducted a qualitative study consisting of 1) semi-structured interviews and 2) a video-diary study to understand the help interactions of people with visual impairments.

4.4.1 Interviews

4.4.1.1 Interviews with people with visual impairments

We conducted 11 semi-structured interviews with people with visual impairments (P0 - Pilot & P1-P10) from across India. To conduct this study we worked with vendor organizations, who recruited participants by contacting non-profits for people with disabilities in three Indian locations - Mumbai, Bengaluru, and Chennai. Participants were sampled based on age, gender, residence location, and prior participation in Orientation and Mobility ("O&M") training; training that equips people with visual impairments with navigation skills including white cane use. All participants identified as totally blind. Interviews were conducted over Google Meet and lasted between 48-90 minutes. In the interviews, we focused on eliciting

narratives [146] of people navigating indoor environments to uncover 1) strategies they used in navigating indoors, 2) challenges they encountered, and 3) how they worked with other people to get around. The interviews were audio-recorded and transcribed verbatim, for which prior consent was sought. The participants were paid the local equivalent of $50 for their time.

4.4.1.2 Interviews with companions

We supplemented the first set of interviews with 5 interviews with companions (C0 - Pilot & C1-C4) of people with visual impairments i.e. people who most often assisted people with visual impairments in navigating indoor environments. Interviews lasted between 25-40 minutes. Companions were asked about 1) how they worked with people with visual impairments, and 2) challenges in working with them. The interviews were audio-recorded and transcribed. The participants were paid the local equivalent of $30 for their time.

4.4.2 Video diary study

We complemented the interviews with a video-diary study of people with visual impairments navigating indoor environments to 1) understand their moment-by-moment experience in a naturalistic setting [223] and 2) capture nuances of interactions that were unsaid in the interviews [211]. A subset of six participants (P0, P1-P4, P6) from the interviews were recruited for this study. To record the videos, we recruited a close friend or family member of the participant, who in addition to recording also offered assistance when necessary. Videos were recorded over a two-week period. We provided three instructions to the pair: 1) To capture videos of journeys to familiar indoor locations alone, to ensure we captured their everyday routines and mitigate potential safety risks 2) To begin and stop recordings at their convenience 3) To assess privacy and safety risks before recording. The videos were encrypted and uploaded to a secure online repository, which only the research team had access to. Overall, we received 32 videos of which we analyzed 22 (total duration = 32 minutes, average duration = 1.5 mins). The remaining videos were not analysed as they focused on outdoor navigation. After the video-diary period, we engaged with people with visual impairments in a debrief session where we asked them about their navigation strategies and specific aspects of their journeys. Interviews lasted between 15-20 minutes and were audio-recorded and transcribed. They were compensated the local equivalent of $150.

4.4.3 Data Analysis

We use the interdependence framework [36] to guide our data analysis. Interdependence calls for an examination of 1) relationship between people with disabilities, their environment, and other actors 2) people with disabilities' work in creating access [36]. We extended this interpretation to four themes: 1) Why is help necessary: To understand the *relationship between people and their environment* and uncover why help is needed (e.g. code: social concerns) 2) Kinds of help: To understand the *simultaneous forms of assistance* and distinguish between them (e.g. code: dutiful) 3) Hidden work of help: To understand the *understated role of people with disabilities in creating access* (e.g. code: collaborating) 4) Difficulties with help: To understand the *tensions in help interactions* (e.g. code: gender dynamics)

Data from the interviews and videos were analyzed through a two-cycle coding process. In the first cycle, we deductively coded [225] data from both sets of interviews under the mentioned four themes. In the second cycle, we categorized the data under the themes inductively [225] into codes and sub-codes. For e.g., we had two codes under (theme 2) kinds of help; dutiful and compassionate help. Both codes had three sub-codes under them; actors, interactions, and values. Overall, we had 12 codes and 6 sub-codes under the 4 themes. For the videos, we generated field notes, which we then analyzed using the themes, codes, and sub-codes we previously generated. The field notes data fit under two codes; interactions (under theme 2)) and inaccessible environments (under theme 1)) and was thereby used to add depth to the interview data. In this paper, we explicate the themes, codes, and sub-codes. Throughout we prioritize the perspective of people with visual impairments while acknowledging the role of companions in the help interactions.

4.4.3.1 Participant Demographics

People with visual impairments in our study were between the ages of 21 and 55 years old (avg age = 37 years). Six participants identified as male and the rest (n=5) identified as female. All participants identified as totally blind. A majority had received O&M training (n=7) and most used the white cane to get around (n=9) as guide dogs are uncommon in India. While we did not gather the socio-economic details of our participants, we note that the non-profits through which we recruited them serve lower and middle-class individuals. Companions were between 31 and 60 years old. Two identified as male and three as female. All companions were close family members of people with visual impairments (C0,C2 - Wives of P1,P5; C1,C3 - Husbands of P0,P6; C4 - Sister-in-law of P10). x

2a 2b 2c 2d 2e 2f

Fig 2. *(2a)* A stranger walks up to P1 and asks him what helps he needs *(2b)* P1 describes to the stranger what help he needs *(2c)* The stranger holds P1 by his cane hand, who as a results struggles to use the cane *(2d)* P1 and the stranger walk together *(2e)* The stranger takes leave of P1 *(2f)* P1 reaches the destination by using his cane to sense the wall

4.5 Findings

We found that help was necessitated by structural and social inaccessibility. We detail two forms of help interactions: 1) dutiful and 2) compassionate help. We also detail the hidden work done by people with visual impairments in the course of help interactions. Finally, we also present the difficulties associated with help.

4.5.1 Help & Navigation: A short introduction

For most people with visual impairments, indoor navigation, like most other activities, was organized around help interactions, i.e. seeking the right help and working with the helper to get around. Many of them, in fact, had grown up being surrounded by people who assisted with a number of their tasks and as a result, were accustomed to help.

> I have always lived with people, with my mom, with my brothers, sisters and now it's my husband. I've always lived with people around me helping. - P6

Interestingly, "seeking help" and "working through help interactions" (e.g. communicating help-related needs, working with others) were key strategies that people with visual impairments learned during Orientation and Mobility training (O&M); training which equips them with mobility (e.g. white cane skills) and life skills to help them lead their lives independently. Over time they perfected these strategies, developing a sense of confidence in working with others.

> We are confident in receiving help because of mobility training - P7

People with visual impairments were appreciative of most help they received, recognizing its value and centrality in the accomplishment of everyday tasks (e.g. indoor navigation). As companion C2 puts it:

> He [Husband] is really thankful always. [He says] 'you are around [hence] I am alive. I'm going to live a life, a respectable life like this'. He's always grateful to me for that. - C2

However, all help was not the same. Help interactions involved several actors, most notably family members and strangers, with who people with visual impairments in our study interacted in different ways. In the following section, we unpack these details, but first, we discuss the factors that necessitated help interactions in the first place.

4.5.2 What makes help necessary

The interdependence frame allowed us to see the material and social worlds within which help interactions were situated and the relationship between them. In this section, we show how inaccessible infrastructures and people with visual impairments' social concerns made help a practical choice for them to address their needs.

4.5.2.1 Inaccessible infrastructures

4.5.2.1.1 Narrow, dynamic environments with non-standard layouts: Narrow, cramped environments were frequent in people with visual impairments' experiences in indoor environments as these spaces were often filled with people and had several misplaced and displaced objects whose placement changed frequently. Such narrow spaces challenged their ability to use the white cane, which plays a key role in their independent navigation (e.g. [280, 103]) as people were concerned about tapping people and knocking over objects with the cane. Help, here, was a safe and definitive way for them to circumvent the troubles of narrow spaces and resulting concerns associated with using a cane.

> For blind people to navigate in small confined spaces is difficult. In India - all indoor environments are relatively small - we have a lot of issues. If we use the cane there - then there are opportunities for people to run into things. There are more people in small spaces... We will run into someone. P4

The lack of implementation of uniform standards/building codes across layouts, which is common in India [262, 125] also made it difficult for them to make navigational decisions. For instance, the size of individual steps in a staircase was often different across indoor

environments, which left people with visual impairments guessing about how high they needed to move their feet and cane. With help, however, people with visual impairments received guidance (e.g. about the height of stairs) while being assured of a safety net (e.g. to prevent them from tripping over stairs).

4.5.2.1.2 Elevators and escalators: While not exclusive to indoor environments, elevators and escalators often featured in people with visual impairments' narratives as being impossible to use on their own.

> In some locations lifts are inaccessible because they need screen touching - we cannot use it... Escalator goes both [ways], so need to ask people which goes upward, which goes downward. - P3

Elevators were inaccessible as it was rare for them to have audio announcements and Braille markings. With escalators, in addition to figuring out the direction, there were added difficulties in judging when to step forward onto the moving stairs. Help again allowed people with visual impairments to use these indoor features, which were imperative to getting to their destination in a safe manner.

4.5.2.1.3 Inaccessible tasks in common indoor environments: Not only were indoor environments inaccessible but in many cases, tasks that people needed to accomplish in these environments were also inaccessible. Here, the goals of indoor navigation were secondary to the inaccessible tasks and in the process of receiving help with the tasks, people with visual impairments also received help in navigating indoors. For instance, tasks in banks and hospitals often involved paperwork, which people were unable to complete by themselves.

> I think there would have been a problem if I had gone [to the hospital] alone... With the counter and forms - I need to ask someone for help. - P2

So it is not just the inaccessibility of indoor environments but is the combination of inaccessible structures (e.g. indoor environment and paperwork processes in banks), that made help interactions necessary.

4.5.2.2 Social concerns

Help was also critical to addressing the social concerns of people when they navigated in many indoor environments. For instance, many of them expressed concerns about running

into other people; an experience common in their previous visits to narrow, crowded spaces, that had resulted in unpleasant run-ins.

> Bank people are familiar [but] other people are customers [...] how do they know I am blind? By chance I dash into them [...] the first thing they ask us, 'hey can't you see?'.. that's insulting. - P5

Also, touching and feeling objects was a strategy that people with visual impairments used to get a sense of their environments. Here, there were concerns about how others who did not know that this was a sensemaking strategy would perceive them.

> In my friend's house.. I go around *Bindaas* (carefree). I will hold the wall.. I can touch the chair and sofa and go... My friend knows I have a sight problem. In the bank, if I try like this they wouldn't like it. - P0

With touch and feel and white-cane use, people were also concerned with knocking over fragile objects. We noted that these concerns stemmed from a desire to appear competent and fit into a society where there is limited awareness about people with disabilities, who are otherwise viewed as incapable of accomplishing everyday tasks [87, 91]. For people with visual impairments, the costs of hitting someone or knocking over objects are high, resulting in a potential loss of face [95] and driving away people who are otherwise instrumental in helping them; the latter being a key reason why people like P5 took it upon themselves to apologize and be polite while managing unpleasant interactions.

While it is easy to see inaccessible infrastructures and people with visual impairments' social concerns as discrete challenges, it is often a combination which confronts them. Help allowed them to circumvent both and as a result was a more or less de-facto strategy for them to get around indoors.

4.5.3 On the kinds of help

Interdependence allowed us to see the different forms of assistance that people with visual impairments received based on the actors involved, interactions, and values underlying the interactions. We noted two forms of help 1) dutiful help 2) compassionate help. The interdependence frame also lets us see the mutuality in help interactions and in that light, we also explicate the work done by people with visual impairments in the course of help interactions.

4.5.3.1 Dutiful help

Dutiful help referred to help interactions with companions: family members and close friends who assisted people with visual impairments. These help interactions were frequent in people with visual impairments and companions' experiences. Furthermore, not only did people with visual impairments desire to work with companions but companions too sought to assist people with visual impairments as much as possible.

4.5.3.1.1 Interactions in dutiful help To illustrate the interactions underlying dutiful help we use a vignette of P4: P4 walks into an ATM to withdraw money with his companion, who, as P4 noted in his interview *always* accompanies P4 on trips outside his home. P4 is not carrying his white cane (Fig 1a). Rather, his companion and he are coordinating movements and navigating in specific ways. First, P4's companion is holding onto both P4's left palm with his left arm and his right shoulder (Fig 1a). Second, he is providing instructions in a distinctive manner; while he does not inform P4 about the steps leading up to the ATM (Fig 1b), he tells him about the ATM door (Fig 1c) which he opens (Fig 1c). He then steps behind P4 to guide him through it, while keeping the door open (Fig 1d). Upon reaching the ATM machine, P4's companion puts P4s hand on the ATM to signal that they have reached their destination (Fig 1e).

First, like P4, other people with visual impairments too mentioned how with companions, they never used their white cane for navigation. This is indicative of a sense of trust between people with visual impairments and their companions and a key component of their help interactions. The white cane is central to people with visual impairments O&M, providing them with vital information about their environment (e.g. approaching stairs or obstacles). However, when with companions, people with visual impairments expected them to communicate details they would otherwise obtain from the cane while also guiding them to their destination; expectations which for the large part were fulfilled.

> She [companion] tells me orally 'sister, you have to climb the stairs'...Every single time. [companion says] 'the steps are a bit high, so be careful'... When my sister-in-law [companion] is there, I don't see the need for a stick [white cane] at all... She takes proper care of me. - P10

People with visual impairments had very individualized access needs, which companions had grown accustomed to over time and addressed in the specific manner that people desired; a key reason why the trust existed between them. For instance, while P4 needed to be held by the shoulder and his palm others required 1) environment descriptions and 2) instructions and warnings (e.g. of impending obstacles) to be communicated in specific ways. In addition,

companions also understood the capabilities of people with visual impairments and how they made sense of their environment (P4's companion did not provide information about the approaching stairs as he likely understood that P4 could glean the details from their changing pace and posture) thus only providing them with cues that complemented their capabilities.

Finally, we also noticed a certain comfort level inherent in dutiful help interactions i.e. people with visual impairments took more liberties with companions while with strangers they were often forced to accept whatever help was on offer.

> I am more comfortable with my people. Because I can ask them, what is around? [Strangers] They want to finish it [navigation] off fast... [Also] I can't ask them everything and they don't have time for it. P0

Evidently, dutiful help was very much sought by people with visual impairments, for whom working with someone who understood their individualized needs meant fewer concerns (e.g. about safety) and reduced work on their part.

> [With companions] I don't have to pay so much of attention. I can relax...They take enough care of me... I get this confidence, I have somebody else's two eyes... Responsibility on my shoulder decreases a bit. - P1

4.5.3.1.2 Values in dutiful help On the companion's part, they actively sought to be with and address people with visual impairments' needs (beyond navigation) as frequently as possible, a desire that stemmed from a sense of duty.

> This is my duty.. I have accepted her the way she is.. I'm always with her, so then there is a security. - C3

Duty here is used to justify one's active role in help interactions. This sense of duty was accompanied by feelings of responsibility for 1) people with visual impairments' physical safety and 2) managing social interactions, including unpleasant ones, on the behalf of people with visual impairments. As C4 stated:

> She is my responsibility...Somebody should not push her... Somebody shouldn't trouble her unnecessarily [...] and say 'what is it that? Can't you see' that's an insult... I am there always to tell people 'she's not able to see, she's blind'. So I can request people... Then people are more considerate. - C4

Companions were aware of the troubles people faced and by being with them ensured their safety. Companions also managed peoples' social interactions i.e negotiated with others while completing tasks (e.g. paperwork) and also sought accommodations on peoples behalf (e.g. asking strangers to make way so that people could navigate).

When asked about how they felt about their constant participation in dutiful help interactions, one companion noted the emotional and physical labor it entailed. The rest, however, used duty to justify their responsibilities without necessarily feeling a sense of burden. However, when asked about the potential benefits of a novel indoor navigation technology for people with visual impairments, companions were quick to note its benefits for themselves in possibly freeing them up, suggesting that they saw their constant participation in help interactions as laborious.

> Dependency on others would reduce.. he'll not feel the need of somebody else to be around him all the time. I will also feel good about it because he is independent. - C1

4.5.3.1.3 The hidden work in dutiful help

Building familiarity with companions: Working with companions reduced the work that people with visual impairments had to do because companions had grown accustomed to assisting people *in the manner they desired* and understood their needs. However, getting to know and understand each other was a process that took time. Critical to this process was the work of people with visual impairments in walking companions through *how* they needed to be helped.

> In the beginning he [companion] also was a little confused. He thought he should tell me that there is a pothole or we are getting down the stairs. Then he also learned. - P6

People with visual impairments like P6 worked with companions through the familiarization process repeatedly communicating their needs over time to ensure that they received the right help. For instance, P6 did not need information about a pothole or staircases from her companion which he initially was giving her, and over time he learned to communicate only necessary details to her. The process of getting accustomed to each other was not always smooth and people with visual impairments acknowledged that companions initially did make mistakes, which required patient correcting. However, over time, both developed a sense of confidence and trust in each other.

Collaborating with companions: People with visual impairments also performed work in the process of receiving assistance from companions. For instance, in the course of being

helped by companions, people with visual impairments provided directions to reach their indoor destination, having memorized the route from previous visits. These directions varied in detail and included exact turn by turn directions and relevant access points (e.g. lifts, floor to exit on) to more generic instructions (e.g. "take me to the bank counter"). Take the case of P6 and her companion C3.

> [Bank] It is a huge branch... [On the fifth floor] You have to take the third-fourth left... I don't know... She's there with me so I'll take a left. She's giving me directions... She's much more active. I'm just a stick for her but she's the brain behind everything - C3

Thus, these directions played a central role in allowing companions to provide the right help and it is a combination of the directions and physical assistance, that allows both to reach their destination.

Additionally, people with visual impairments engaged in sensemaking (e.g. through sounds, smells), and with companions, they achieved this additionally, by asking guiding questions. Not only did companions pass on all relevant information (without people with visual impairments asking), they also responded to these guiding questions as frequently and in the manner that people with visual impairments desired. These guiding questions are especially salient as people with visual impairments did not use their white cane when with companions.

> [With companions] I prefer to hold their hand... The first time - I always ask them, what is ahead, what is around... They say 'table, people.. machine is on the left or right hand side'.. If there is an obstacle on the way then they tell me 'there is a chair, machine, table or there is a cooler in front - so take care'. - P4

Here, P4 is asking guiding questions to build familiarity with the location. Others while receiving cues in familiar environments (e.g. smells, sounds) triangulated cues with their prior knowledge to determine if they were on the right path, offering suggestions on changing course. Thus, even with the reduced responsibility, people with visual impairments were performing critical work to ensure that the help interactions achieved the desired purpose.

4.5.3.2 Compassionate help

Compassionate help refers to help interactions with strangers who offered help to people with visual impairments. Unlike dutiful help, these interactions were less common in people with visual impairments' experiences, who believed that these interactions were motivated by a sense of compassion.

4.5.3.2.1 Interactions in compassionate help To understand some of the key elements of the interactions underlying compassionate help we use a vignette of P1. P1 is walking towards the entrance of a hospital with his cane in his left hand. As he is entering the hospital, he is stopped in his tracks by a stranger with whom P1 has a brief conversation (Fig 2a and 2b) (in the debrief, P1 stated that he was asked about where he wanted to go in the hospital). Subsequently, the stranger holds P1 by his left palm and guides him inside the hospital. However, P1 appears to struggle to use the cane while being guided (Fig 2c). They walk slowly till a certain point (Fig 2d) after which the stranger seemingly walks away (Fig 2e). P1 then uses his cane to walk along the wall in a straight line towards his destination (Fig 2f).

This vignette highlights some of the key tenets in compassionate help; help is often initiated by the helper, who approaches people with visual impairments to help them. The white cane often served as a social signal for help, prompting strangers to approach people with visual impairments and offer help.

> I feel like people will help, most of the time people help me. I use a cane only when I am travelling alone. It indicates obstacles in my path and others will also understand that I need help. - P2

Compassionate help is episodic; like with P1, where the stranger helped P1 till a certain point before walking away. Unlike companions, people with visual impairments were less trusting of strangers, evidenced by their use of the white cane when being offered physical assistance (like P1). They sought cues from the environment with the cane as they did not trust strangers to give them the same information. As P1 himself noted, strangers were more focused on being protective rather than addressing their navigational needs.

> With any sighted guide [stranger] that person doesn't know much about me... They're more into taking care of me. I start feeling uncomfortable. With my wife [...] that confidence is already there [...] which is not the case with the stranger. [With strangers] I have a plan in my head [...] and that goes for a toss. - P1

Unsurprisingly, strangers were less aware of people with visual impairments' intimate access needs. Moreover, although people with visual impairments often did the work of informing strangers of how they needed to be helped these instructions were rarely followed. However, they accepted whatever help was on offer (P1 took help even though he was incorrectly held by the stranger). P3's acceptance of compassionate help was prompted by considerations about how turning down this help would affect other people with visual impairments who heavily relied on such interactions.

> If I say I don't need help, might be they [strangers] are not going to help others.. I am representing the VI community, so might be they assume that other VI people don't need help, so I never say no to help. - P3

It was also common for people with visual impairments to work with multiple strangers on the same journey. Evidently, compassionate help interactions, unlike dutiful help interactions, are less about trust and comfort and as we shall describe later (Section 4.3.2.3) also necessitated more work on the part of people with visual impairments.

4.5.3.2.2 Values in compassionate help Compassionate help for people with visual impairments was characterized by a sense of certainty i.e. they believed that strangers would always volunteer to help them.

> There's no issue at all... I mean people have awareness.. If they see [...] a visually impaired person [...] they are helpful. There are people who are willing to help so they come personally.. they come with me. - P5

For many people with visual impairments, this compassionate help stemmed from a sense of care. In the face of a society where people with disabilities at large were viewed negatively, compassionate help was counter-evidence; showing people around them in a positive light. As a result, they valued and appreciated the help.

> People [strangers] look after me nicely. It comes from a place of care, we feel happy. There is happiness when anybody helps but when people show me care [...] then I get a sense of happiness. - P9

Others were more balanced in their opinions about compassionate help. Although grateful for how help allowed them to address their needs, they were less appreciative of the values that prompted strangers to help them. They noted that these interactions stemmed from a place of sympathy and pity over people's inability to accomplish tasks on their own and as a result, as with P6, these interactions reinforced her physical impairment.

> [When strangers help] That time we get to know that I am lacking something, that's the reason somebody's trying to help. That is [...] sympathy. People are caring, [but] they also offer their sympathy. - P6

One companion too noted this sense of pity which prompted people to help, specifically in India. He saw this as problematic as it reinforced people with visual impairments' sense of dependency and a barrier to their independence.

> [In India] people help you. People take pity on you in India, a blind person , but in other European countries [...] people don't. [People with disabilities] they don't think the way the Indians think. So, they are on their own... If you keep the person helping the person becomes dependent on you. - C1

4.5.3.2.3 The hidden work in compassionate help

Establishing trustworthiness of strangers: A key element of help interactions with strangers for people with visual impairments involved assessing their trustworthiness i.e. making decisions about whether it was safe to take assistance from them. One strategy we noted was their use of conversation to gauge trustworthiness. People with visual impairments paid close attention to people's actions and words before deciding to take their offer of help.

> Trust is the main thing if you ask... [With strangers] I pay attention to how this person is talking to me... If that person is not talking to me properly then ill be doubtful. - P5

These people with visual impairments also used 'questioning' as a means to gauge strangers' intentions i.e. asking them questions and analysing responses to make a decision. Given the precariousness of women's safety in public spaces in India [139], for women participants, assessing trust was a vital step that preceded help interactions.

Describing help-related needs: In the course of compassionate help interactions people with visual impairments also did the work of 1) describing their needs and 2) providing instructions on how they needed to be helped.

With 1) people with visual impairments noted describing where they needed to go and the kind of assistance they required (e.g. verbal vs physical guidance) while clarifying any questions strangers had. Many people with visual impairments described how these interactions necessitated that they present themselves appropriately [95] while being polite. This was critical to maximizing their likelihood of receiving the right help while not turning strangers away.

> I will ask them [strangers] politely - 'please help us, I want to go here'...We have to be disciplined. We have to present ourselves well... Only based on that do people come to help. - P7

The onus was on people with visual impairments to drive these conversations, and for those who were reserved, concerns over their ability to do so was a barrier to receiving compassionate help. Other troubles while describing needs included misgendering (assuming people's gender by saying "Excuse me, sir") and a lack of knowledge of what language to

describe needs in; a problem salient in India where many languages are spoken in the same city.

Finally, when people with visual impairments sought physical guidance, they noted providing instructions of how they needed to be helped, both during the initial exchange and while they were navigating together. For instance, some described the sighted guide technique to strangers i.e. how they needed to hold them above their elbow to follow them.

> Hold me above the elbow, I will show them... Then it will be comfortable - that's what I tell people. I always tell people - I show and tell them hold me here (above the elbow). I give them instructions... - P9

While strangers did not necessarily follow these instructions, it was nonetheless work done by people with visual impairments to try to ensure they received the right help. Furthermore, the episodic nature of compassionate help meant that people with visual impairments had to perform this work every time they received help from strangers.

Collaborating with strangers: Like with companions, people with visual impairments performed work during the course of compassionate help interactions with strangers. However, the nature of this work was different; while with companions they were less concerned about physical safety and engaged in the triangulation of cues via guiding questions, with strangers they ensured their own safety and made sense of their surroundings by using their white cane.

> I will hold the stick [white cane] in pen style. Even if they [strangers] do not convey information about the environment - I understand what is happening... New people [strangers], they dont know how to guide visually impaired people. They dont know how to tell whats around. Stick is necessary then. - P7

Here, in addition to receiving cues, they were from the environment they were also using their cane to gather relevant cues. However, while they maintained control over how and when they received cues in the case of dutiful interactions by dictating the nature and timing of guiding questions, here, they had to constantly pay attention to information from the cane. Thus, compassionate help necessitated more work on the part of people with visual impairments.

4.5.4 The difficulties with help

Help interactions were not always smooth and did not always yield the desired consequences. In this section, we outline some of the challenges that people with visual impairments had with help.

4.5.4.1 Troubles finding help

Although all people with visual impairments noted how help was readily available, even when they were not with their companions, they occasionally encountered situations people did not step up to help.

> It's not that everybody helps.. I have seen so many people they don't tell you, even if they see the stick in your hand, they will not tell you and also people don't help you. - P10

Many believed certain factors shaped whether they could find help easily. For instance, some believed certain indoor environments were more conducive to help-finding than others, noting how in locations like hospitals strangers were concerned about completing their own tasks and did not help them in comparison to a mall where people had more time to assist. In situations where help was hard to find, people with visual impairments had to do the additional work of finding and asking for help, which required careful listening to audio cues (e.g. voices, footsteps) and approaching people to ask for help. Often this entailed people waiting for longer periods of time and repeatedly asking to be helped.

4.5.4.2 Incorrect and unwanted help

All people with visual impairments had experiences with incorrect and unwanted help. Although they noted that most strangers understood that they had an impairment (after seeing their cane), occasionally they encountered people who did not know that they had a disability and how to communicate with them. Many spoke of strangers who gave directions by pointing their hands or by giving them hard-to-follow instructions.

> [Strangers] They also say go here, go there. I don't know where is here, and where is there [...] They also show with their hand.. that you will not understand obviously right? - P10

Others mentioned how despite providing instructions on how to help, strangers did not follow them. People with visual impairments also noted multiple instances with unwanted help [280] i.e. receiving help even when they did not require it or in an incorrect manner. There were instances when strangers did not ask them if they needed help and began to physically guide them assuming they did, leading to unpleasant interactions. Few others noted how strangers guided them by grabbing their cane and expressed frustration with such interactions.

> People come and hold me tightly and start taking me but don't know where I want to go... Some people come and hold my white cane [...] if they do so, I am going shout because its [white cane] my eyes. - P3

Again, the limited awareness about people with disabilities in India is one explanation for these interactions. Moreover, these instances also put into context why people with visual impairments value interactions with companions.

4.5.4.3 Gender dynamics

Dutiful and compassionate help interactions were complicated by gender dynamics. This was because help interactions to a large degree entailed physical assistance which required people with visual impairments to hold companions and strangers. In India, however, holding someone who is not of the same gender in a public location is frowned upon and considered awkward. Nearly all women in our study noted instances where men offered them assistance but would refuse to hold them, or P6's case, hold her white cane, which was not appreciated by her.

> They catch the stick [..] that I just don't like... It could also be that's a gentleman and they don't want to touch a lady; because I'm a woman. It looks so bad. - P6

In fact with P6, even her companion (C3) spoke about how he felt it to be awkward to be holding his wife in public locations and was concerned about how he would be perceived by people around. These dynamics also meant that there was a preference in the case of women like P2 to seek out only women to help her.

4.6 Discussion

Our paper highlights how help, for people with visual impairments, was made necessary by structural and social inaccessibility. Help took two forms, dutiful and compassionate help; both defined by different actors, interactions, cultural values, and work on the part of people with visual impairments. Finally, we also showed some of the difficulties with help, including with finding help, incorrect/unwanted help, and gender dynamics. In HCI and Accessibility, the focus on 1) designing for independence (e.g. [283]) and 2) discussing the social costs of help (e.g. [288, 275, 203, 49]), results in the portrayal of help as undesirable, burdensome, and a one-way interaction; one which characterizes people with disabilities as passive recipients of help. However, we show that this was far from true and help was central to addressing

the needs of people with visual impairments and was thus appreciated by them. Moreover, it necessitated their invisible work [248] to ensure help addressed their needs. So while we describe our results through the lens of "help," this help necessitated work on the part of people with visual impairments, which aligns with interdependence [36].

4.6.1 On Help

4.6.1.1 On what made help necessary

Help interactions have to be viewed in relation to people's relationship with their environment; after all, disability is relational [192]. Here, the interdependence frame helps us understand the conditions that made help necessary. First, we show the structural inaccessibility is pervasive across indoor environments in India. Not only were indoor environments crowded and narrow, but lifts/escalators and common tasks in indoor environments were also inaccessible. As Grech argues, this structural inaccessibility is a feature of Global South contexts, which he attributes to the limited economic resources and state bureaucracy [100]. Furthermore, while in the Global North, there are legal mandates to make lifts/escalators accessible (e.g. ADA in the USA [5]), such mandates remain unenforced in India [132]. Second, people also reported on social inaccessibility i.e. running into other people and inconveniencing them (and apologizing if they did). Here, people with visual impairments' view that they were the problem stands in contrast to views on disability such as the social model [235] which pushes back against the view that people with disabilities are the problem. Moreover, while other studies associate seeking help with feelings of incompetence [15, 245] and loss of face [95], people with visual impairments saw help as a way to circumvent the same feelings during unpleasant encounters.

4.6.1.2 On the Types and Cultural Elements of Help

Help took two forms; dutiful and compassionate help which were bound up in cultural values. While both involved instrumental (e.g. physical assistance) [255, 63] and informational dimensions [255, 63] (e.g. obstacle info), there were differences in the helpers, interactions, values and work involved.

4.6.1.2.1 On Dutiful Help The role of families in the lives of people with disabilities has been discussed extensively where families are quoted as being sites of oppression that challenge the agency of people with disabilities [233]. We, through our discussion of dutiful help, which most often involved family members, offer a slightly more nuanced take on the relationship between people with disabilities and their families. Companions were *familiar* to

people with visual impairments, which resulted in access intimacy (i.e companions inherently understood peoples access needs) [170], trust, and comfort, and this in turn meant reduced work on the part of people with visual impairments in negotiating help interactions. Discussions on help in the context of people with disabilities often cite how help is forced upon people resulting in the compromise of their sense of autonomy (e.g. [192]). However, here, familiarity with one's access needs and trust meant that people with visual impairments sought and desired to work with companions as much as possible. Traditionally, families assume responsibility for people with disabilities, especially in addressing their unmet needs in the face of structural inaccessibility (e.g. [105]). In our case, we noted this sense of responsibility too, but there was an added dimension; a sense of duty which we argue has its basis in one's religious obligation towards people with disabilities [87, 187]. The sense of duty that guided these help interactions resulted in 1) companions desiring to be with and assist people with disabilities as much as possible (like [187]), and 2) companions justifying the physical and emotional work involved in the help interactions. Dutiful help was thus not just initiated by and driven by people with visual impairments but companions too sought to be with them as much as possible. However, our view on dutiful help is likely limited and in reality, these help interactions could have other negative implications on the lives of people with visual impairments which need to be explored. Nonetheless, in discussing dutiful help, we heed the disability scholar Shakespeare's call for a "balanced account of the contribution of families" in the lives of people with disabilities [233].

4.6.1.2.2 On Compassionate Help India has a strong community spirit, underlying which are practices of helping each other [112], highlighted by strangers who volunteered to assist people with visual impairments when they saw that people needed assistance. Although it has been stated that non-disabled people avoid helping people with disabilities due to fears of stigmatization by association [96, 261] or because they do not know how to help [261] or that people make several considerations before assisting (e.g. [221, 226]), this did not appear to be the case for our participants. Compassionate help was characterized by a sense of certainty i.e. people always stepped forward to help of their own accord. Here, we argue that help is motivated by religious values of compassion towards disadvantaged members of society [87] and a way to beget good karma. Indeed the boundaries between compassion and previously highlighted motivators of help (e.g. altruism [35], desire to feel good about oneself [250]) are blurred. For e.g., Mishra argues that compassionate acts as entirely self-serving which stem simply from a desire to feel good about ones self [171]. However, our argument, like with dutiful help, is that a cultural/religious orientation can put altruistic and self-serving acts in context, providing *one* explanation of why strangers help.

People with visual impairments, unlike with dutiful help interactions were more balanced in their views on compassionate help; while they valued the functional value of the assistance that was provided to them, they were less appreciative of the underlying sentiments of pity and sympathy [91, 112] that motivated these interactions in the first place; the latter being a key reason why the charity outlook [216] towards disability has been criticized by disability scholars [234]. People's appreciation for this help was despite strangers being unfamiliar to them, their needs and ways to help them, which often meant more work on their part during help interactions. This suggests that compassionate help despite its underlying motivation addressed a critical need.

Thus, our study by contributing to emerging work showing interdependence at play but in a Global South setting also extends Bennetts framework [36] by 1) unveiling two forms of help and the differences between them and 2) showing how help is bound up in cultural values. With 1) we confirm prior research that familiarity (of helpers) results in differences in how help is perceived [255]. However, we additionally highlight why this is the case by bringing to light a) the relationship between familiarity and access intimacy/trust and b) the work performed by people with visual impairments in help interactions. With 2), by highlighting the importance of duty and compassion in motivating help we extend studies discussing why people help others. In doing so we too argue for a key consideration of culture while studying disability experiences in India and the Global South [100, 87, 91].

4.6.2 Design Implications

Our findings have important implications for the design of future AT's, including collaborative help-seeking technologies in Global South contexts. While the goal of designing to enable people's independence [283] by liberating them from help might seem like a worthwhile goal, our study shows that help, which is bound up in cultural values, has benefits and is appreciated by people with visual impairments. Therefore, in line with HCI research that calls for designing *within* value systems in the Global South (e.g. [253]), we outline how technologies can foster and enhance help interactions [254].

4.6.2.1 Reduce collective work associated with dutiful help:

Companions play an important role in the lives of people with disabilities in India and disability scholars have long advocated for the examination of the role of companions in shaping experiences of disability [87]. Our analysis reveals how dutiful help interactions (motivated by a sense of duty) were appreciated by people with visual impairments as it meant working with someone who understood their intimate access needs. In this light, we

call for the consideration of companions as key stakeholders in the design of AT's. One way to accomplish this would be to expand the unit of analysis for design from the individual (people with visual impairments) to the collective (people with visual impairments + companions). Thinking about the collective will prompt going beyond questions such as"How can design ease the work done by people with visual impairments" to"How can design alleviate the work done by *both* people with visual impairments and companions?". In the context of indoor navigation, this would mean a reconsideration of key user goals that existing tools seek to address, such as directions (e.g. turn by turn guidance [103]) and safety (e.g. guiding users past obstacles [127]); both of which, as our study suggests, are addressed by the companion. Rather, here, a goal could be "informational assistance", where people with visual impairments could direct guiding questions to the technology (e.g. via voice), questions which they otherwise asked companions. These questions could help them get answers to details about their surroundings (e.g. color of walls, texture of floors); details which are otherwise de-prioritized when safety and directions are goals of systems. Such a feature would empower people with visual impairments while freeing up companions who can then focus on pressing concerns like safety. Thinking beyond navigation, systems to support domestic routines (e.g. [279]), management of finances (e.g. [274]) and relationships (e.g. [48]), and other collaborative activities common to households are avenues for future work. Finally, given that companions too felt the demands of assisting people with visual impairments, crowd and remote-assistance technologies (e.g. [1, 13]) can offset this work but yet provide people with the right assistance.

4.6.2.2 Increase mutuality of compassionate help:

Compassionate help in particular has implications for future deployments of volunteer-based remote-assistance technologies (e.g. Be My Eyes [1]). First, our findings suggest values of compassion might serve as a form of intrinsic motivation [20, 208] for digital volunteers to sign up and regularly assist people with disabilities in the Indian context. This in turn suggests building awareness about apps like Be My Eyes among the larger public could result in the significant adoption of similar technologies. Second, we also make a case for mandatory training for digital volunteers (who currently only receive training on how to use the platform [1]) on signing up. Training should address 1) the underlying sentiments of pity and sympathy which are less appreciated by people with visual impairments through disability etiquette training (e.g.[3]) 2) how to work through help interactions by taking initiative on providing assistance; which will reduce the work done by people with visual impairments in describing how they needed to be helped when working with strangers. Third, while services like Be My Eyes tend to connect people to volunteers based on only availability,

we argue for the inclusion of familiarity and expertise as considerations to connect users to volunteers. Familiarity is key given that people with visual impairments had individualized access needs and here, connecting users to the same volunteers over time, rather than unique volunteers each time like the current platform will help build access intimacy [170]. This will make volunteers aware of common challenges of users and the specific ways in which they needed to be helped to address those problems, while also fostering trust between them. This will also reduce instances of incorrect help from strangers. The inclusion of topical experts as part of the volunteer group could also alleviate the work in help based interactions. CSCW systems research, in particular, has dealt extensively with the problem of 'finding experts' [14] to solve problems, and here, this can be partly addressed through the *creation* of experts via specific training for common problems people use Be My Eyes to assist with, like navigation and tech troubleshooting. For instance, with navigation, sighted volunteers could be trained in providing remote instructions to complement people with disabilities' capabilities and in driving interactions to address their access needs. For technology-related troubleshooting, the expert group could expand to include other people with visual impairments, who likely have a more inherent understanding of accessibility and related issues on technologies. Fourth, we also noted that with strangers, people did work to evaluate their trustworthiness. While this is likely to play out differently online, platforms like Be My Eyes can still play a key role in fostering trust by conveying details like expertise and prior assistance experiences which are established trust-fostering mechanisms (e.g. [242, 113]).

4.7 Study Limitations and Ethical considerations

Our study methods were affected by the COVID-19 pandemic. The videos, a substitute for in-person observations, illustrated key elements of people's interactions and environments they frequented. However, some aspects remained unclear (e.g., conversations between people were difficult to hear) that could have affected our results. Moreover, the presence of a companion, and likely, their participation in videos (i.e. self-presentation [95]) also likely shaped how they approached the study. Our preferred method would have been sustained, in-person observational fieldwork [223], which would have helped us gather deeper insights into people's routines; nonetheless, we obtained valuable insights through the video-diary method. Finally, our study is based on a limited sample of participants from a few Indian cities; revisiting this work with a larger and more diverse sample is an important direction for future work.

The videos raised ethical considerations throughout the study, which was conducted in

both public spaces and homes. Concerns over the risk of data breaches and unauthorized access were mitigated by using an encrypted medium to transfer videos and by limiting their access to the research team. One risk of this method is that participants might have inadvertently captured sensitive information while recording videos. Although they were instructed to assess their privacy/safety risks before recording, future work using similar methods might consider additional precautions such as asking participants to review media before researchers could access them.

4.8 Conclusion

We conducted a qualitative study to examine the help interactions of people with visual impairments in India, using a case study of indoor navigation. We found that help was fundamental to their accomplishment of indoor-navigation related tasks. We uncovered 1) the structural and social inaccessibility that made help necessary 2) two types of help: dutiful and compassionate help, each defined by different actors, interactions, cultural values, and work and 3) the difficulties with help. We thereby extend the interdependence frame by Bennett et. al. [36] by uncovering the two forms of help and by showing how help is bound up in cultural values.

CHAPTER 5

Study 3: How People with Visual Impairments in India Experience and Recover from Disruptive Software Updates

5.1 Abstract

Human-Computer Interaction (HCI) research has begun to examine peoples' practices and challenges with software updates. A majority of this work holds that updates are critical for improving technology systems, and thus aims to remove barriers to their installation and use. In this paper, we shift this focus to understanding how installed updates may result in negative experiences for one group of technology users: people with visual impairments. This is because updates often result in the loss of software accessibility, a phenomenon that becomes even more pronounced in areas without strong accessibility law enforcement like India. In order to examine the impact of software updates, we therefore conducted a qualitative study consisting of semi-structured interviews with people with visual impairments in India. Based on 25 interviews with this group, we find that software updates result in the following negative experiences: (1) uncertainty; (2) loss of control; (3) negative emotions; and (4) loss of time and decreased productivity. Together, these experiences made software updates disruptive. However, we also found that participants recovered from update-related disruptions. Using Lave and Wenger's Community of Practice (CoP) theory, we show that visually impaired technology users in India comprised a CoP that had developed software update recovery practices. These were: 1) restoration; 2) situational problem solving; 3) abandonment and switching; and 4) escalation. Thus, accessibility was a social practice achieved by this CoP. Using CoP theory's related concept of Legitimate Peripheral Participation, we show that the CoP involved both experts and novices, but that novices possessed a fluid expertise about specific problems, and performed critical community maintenance actions. We discuss design implications to improve the accessibility of software updates for

people with visual impairments and to better support this CoP's important practices.

5.2 Introduction

People with disabilities are the largest minority group in the world; there are more than 1 billion people with disabilities worldwide [32]. More than a fifth of people with disabilities have visual impairments, resulting in the use of alternate methods for engaging in activities that sighted people would typically perform using their eyes [194]. Technology facilitates some of these activities by extending the capabilities of people with visual impairments thus allowing them to perform tasks that were previously impossible on their own. As a result, many people with visual impairments have incorporated multiple technologies into their everyday activities. For instance, with screen readers, people with visual impairments can use mobile applications to assist with text detection (e.g. SeeingAI [13]), which allows them to read text on paper "independently." Without technology, such activities otherwise necessitate sighted help. When using such technologies, visually impaired people often rely upon highly-individualized software settings.

Given these individualized setups, disruptions in the ability to use technologies that are incorporated into everyday life can have significant consequences for people with visual impairments since they often have no fallback options. Software updates, or upgrades to ostensibly improve mobile and computer applications, may cause technology use disruptions for people with visual impairments. In particular, software updates may be disruptive as they are often accompanied by the loss of software accessibility (e.g. a previously clickable button that is no longer clickable) or the loss of features that make software difficult or in certain cases, even impossible to use with screen readers (e.g. [131, 65]). For example, in her CHI 2021 conference keynote address, Chieko Asakawa, a blind computer scientist, noted how an auto-update to her otherwise important dictionary app, resulted in the loss of an important "register new word" feature, rendering the software useless to her [24]. Such challenges are often magnified by the frequency of software updates, which can happen up to several times a week [264, 277]. While similar issues with software updates for people with visual impairments have been highlighted in passing in other HCI and Accessibility work (e.g.[131, 65]), this highly consequential accessibility problem has received little research attention. In this paper, we address this gap by examining the software update experiences of people with visual impairments in India.

India is an important context for this investigation since there are pervasive technology accessibility challenges [182, 183], and limited infrastructures [88, 131, 132] in the country to support people with visual impairments. The Indian context is also important to study as it

has one of the largest populations with visual impairments in the world. Moreover, the social, economic, cultural, and legal conditions in India are vastly different from the Global North. People with visual impairments (and other people with disabilities) are socio-economically less well-off than people with disabilities in the Global North and have limited access to social and economic resources [2]. Moreover, negative cultural attitudes towards disability result in this population being viewed as "dependents" and "always in need of help" [87]. Finally, there are also differences concerning disability-related law (e.g. between the ADA in the USA [5] and the Rights of Persons with Disabilities Act in India [190]). Such legal frameworks are critical to ensuring access and the fundamental rights of people with disabilities. In India, the Rights of Persons with Disabilities Act remains unimplemented [182, 183], a shortcoming that extends to the enforcement of accessibility standards for technologies. These socio-economic, cultural, and legal factors impact among other things, people's lived experiences, and access to technologies and their use. The greater marginalization of people with visual impairments in India in comparison to people with disabilities in the Global North and the lack of implementation of accessibility standards provides a lens through which the effects of software update disruptions become more common and more apparent as there are fewer fallback options. The Indian context thus offers an opportunity to study this issue in greater depth than may be possible in Western contexts.

To understand the experiences of people with visual impairments with software updates, we conducted a qualitative study consisting of semi-structured interviews with 25 people with visual impairments in India. We found that software updates were "disruptive" to participants because they resulted in uncertainty, loss of control, negative emotions, and reduced productivity. However, despite these disruptions, novice participants who had a limited understanding of technology still found ways to recover from disruptions. They often did so by seeking help from, and interacting with, software update "experts" in a "community of practice" among people with visual impairments. We discuss these novice-expert interactions using Lave and Wenger's theory of Legitimate Peripheral Participation [148], which is linked to communities of practice theory [149]. This theory serves as an analytical frame that helps us understand: 1) the characteristics of experts and novices; 2) the nature of their interactions; and 3) the key "practices" that underline the recovery process that novices come to understand through interactions with experts. In this paper, we make the following contributions to HCI and CSCW literature:

- We present themes for how people with visual impairments in India experience disruptive software updates. We show that updates themselves can be a barrier to software use and in doing so challenge inherent assumptions in the HCI field that software updates typically lead to improvements in user experiences with that software.

- We uncover the practices that are central to people with visual impairments recovering from disruptive software updates. In the process, we show that accessibility is a social practice achieved by a Community of Practice (CoP) comprised of people with visual impairments who use technologies. Our findings regarding this CoP should also provoke CSCW and Accessibility researchers to recognize accessibility as something that can be accomplished through the collective efforts and expertise of people with visual impairments. This conception of accessibility extends the HCI, CSCW, and Accessibility fields beyond a previous emphasis on social accessibility as an achievement between people with mixed abilities.

- We introduce the concept of fluid expertise which highlights the potential of visually impaired technology users who are otherwise novices to become experts in a particular software update problem. When they develop this expertise, fluid experts make important contributions to the CoP by disseminating information about these problems and thus sharing the burden of work with experts. This novel concept extends Lave and Wenger's theory on Legitimate Peripheral Participation [148].

- We characterize accessibility-related recovery practices that warrant additional technological support and provide guidance for practitioners to provide this support.

5.3 Related Work

5.3.1 Software Updates Research in HCI

Software updates have traditionally been understood as "improvements" to existing in-use software in order to extend its functionality (e.g. [163, 165, 264, 265]). More recently, researchers have begun to extend this definition to develop categories of updates based on their function. For instance, Fleischmann and colleagues distinguish between "feature" and "non-feature" updates [82]. While feature updates change the core functionality of the software to which they are applied, non-feature updates correct existing flaws in software (e.g. "bug fixes") [82]. On the other hand, Franzmann and colleagues introduce the idea of "design updates," which are updates that improve software usability [84]. Such improvements may be accomplished through user interface (UI) changes [84].

Retaining a focus on the potentially positive aspects of software updates, HCI researchers have interrogated reasons for users' frequent refusal to install them, or delays in doing so. A lack of understanding of the purpose of updates is a key reason why users avoid them altogether [277]. This lack of understanding is exacerbated by a lack of information about

update-related changes [164]. Users' concerns over the impact of updates on their everyday routines and technology ecosystem also dissuade them from installing updates. For instance, Mathur and colleagues found that people ignore updates because they interrupt the flow of tasks and force context switching [164]. Mathur and colleagues also showed that users may avoid updates because they consider updating software to present a risk of malfunction [163]. Other issues that may concern users are the size of updates, disk space that software takes up after updates, and compatibility of updated software with their current technology setup [163, 165]. In order to address these concerns, HCI researchers have recommended that software designers provide more clarity about update-related changes [77], allow for rollbacks to prior versions [163], expand provided information on system resources required by updates [164, 165], and implement nudges to encourage users to update software as soon as possible [163].

While the aforementioned typologies equate updates with improving the current state of software, this is not always the case. Rather, updates are often disruptive, thus affecting users negatively. Update-related software use disruptions among non-disabled users have been documented by mainstream media. For instance, software updates that removed a new Snapchat UI in 2018 [4] and novel Instagram features in 2022 [10] have received media attention. In these cases, the effects of software updates were so drastic that both companies were forced to revert their features to restore user trust [4, 10]. Despite this, there has so far been limited research focus on how people recover from update-related disruptions. Therefore, extending prior research, we specifically investigate such recovery. This is an important issue that, if better understood, could assist technology providers in their efforts to make handling updates easier.

Another shortcoming in existing research and practice concerning the design of software updates is that this work often takes the sightedness of users for granted [239]. This is problematic since software updates themselves are often inaccessible, and perhaps even more troubling, existing accessibility features are often lost after updates. To address this gap in knowledge, we center the software update-related experiences of one group of disabled users for whom updates may be especially problematic: people with visual impairments in India.

5.3.2 Social Accessibility

Accessibility research in HCI has traditionally concerned the design and evaluation of accessible technologies (AT) to assist people with specific tasks. Here, accessible technologies are meant to play a functional role in maintaining and expanding the capabilities of people with disabilities. For instance, a large body of research has examined the use of computer

vision and crowdsourcing technologies to assist people with visual impairments in identifying objects and text (e.g. [40, 127, 249]). More recently, however, accessibility research has witnessed a turn to the "social" [220, 101], partly by examining the situated use of technologies by people with disabilities, and the roles of social interactions in accomplishing "accessibility." For instance, researchers have suggested that access is often created through social interactions between people with mixed abilities i.e., people with disabilities and other non-disabled people [48, 49, 174, 254]. For instance, Branham and Kane highlight how blind and sighted romantic partners work together to make different parts of their home accessible [48]. Mixed-ability interactions have also been shown to facilitate access in the workplace [49] and other physical spaces [271], in everyday activities like travel [131, 51] and shopping [286], and for specific tasks such as photography [288], writing [65], and computer programming [203].

Building on this research, accessibility scholars increasingly contest the "design for independence" paradigm in accessibility design and research. Specifically, researchers contend that it is not appropriate for accessible technologies to seek to eliminate social interactions in the name of "independence." For instance, Thieme et. al. through a video ethnographic study, found that blind people rely on assistance from people around them to build an understanding of different social contexts [254]. Likewise, Kameswaran et. al. showed that in ride-sharing services, people with visual impairments' independence was actually facilitated socially through help from the driver [131]. Consequently, accessibility researchers increasingly implore technology designers to focus on enhancing rather than eliminating these interactions.

In related work, accessibility researchers have begun to question the worthiness of "independence" as a goal for accessibility research and design practice. Bennett and colleagues advocate for the concept of "interdependence," or the mutual connectedness between people and dependence of people upon one another [36], as an alternative paradigm for accessible technology design. They do this by highlighting how symbiotic relationships between people are in fact commonplace and that no one, whether disabled or not, is truly "independent" [36].

This exciting line of theory and research on social accessibility offers exciting new pathways for the fields. However, the field currently lacks a base of empirical evidence regarding how mutual connectedness between people and dependence of people upon one another may contribute to the achievement of access in the daily lives of people with disabilities (e.g. [271]). Moreover, the field has primarily examined the issue of interdependence in dyadic interactions or small groups (e.g. [48, 49, 174]), but not at the larger scale of a community. We address this gap in prior research by examining how these interactions play out

at a community-wide level using communities of practice theory as an analytical lens for studying recovery from software updates. Furthermore, prior research on social accessibility primarily unpacks interactions between people with disabilities and non-disabled people, or mixed-ability interactions (e.g. [203, 275, 31, 155]). We extend this prior focus by investigating interactions between people with visual impairments in the software update recovery process, and how they may facilitate the accessibility of technologies.

5.4 Theoretical Framework

5.4.1 Legitimate Peripheral Participation in Communities of Practice

"Communities of practice" (CoP) are groups of people who share a concern or a passion for a topic, a craft, and/or a profession [149]. CoP share this concern or passion, as well as two other characteristics: 1) community, or members who work with each other and build relationships to enable learning and achieve community-related goals; and 2) practice, a shared repertoire of resources such as experiences, stories and tools to address recurring problems encountered when pursuing that area of concern or passion [149].

Lave and Wenger's theory of Legitimate Peripheral Participation (LPP) complements CoP theory by providing an explanation of how novices, or newcomers to a CoP, become integrated into it and develop expertise through a process of learning [148]. According to LPP theory, "novices" begin on the periphery of the CoP and gradually move to its center by gaining familiarity with its practices through interactions with "experts." LPP theory centers the social and situated dimensions of learning, emphasizing the importance of context and social interactions between experts and novices in the learning process [148].

HCI and CSCW researchers have used the LPP theory to understand how newcomers become integrated into online communities (e.g. [22, 115, 161, 80]). Antin and Cheshire, for example, highlight how new Wikipedia editors, take up reading an activity that is more content-specific and slowly move towards community-specific editing [22]. Other researchers have used LPP to understand other communities such as graphic designers on Dribbble [161], AirBnB hosts [115], and citizen science project participants [175] among others [80]. Other researchers use LPP to conceptualize how to enhance community building within online communities, as in the example of users of online dating platforms [162].

In this paper, we use LPP theory as an analytical frame to analyze the key practices that people with visual impairments use in order to recover from disruptive software updates. This theory allows us to investigate the potential existence of a CoP of people with visual

impairments who use technologies, characterize the community's practices, and study the respective roles of "experts" and "novices" in this CoP.

5.5 Methods

This qualitative study consisted of semi-structured interviews with people with visual impairments in India, followed by both inductive and deductive analyses using core concepts of LPP theory. The project was approved by our institution's IRB.

5.5.1 Data Collection

Study participants were recruited through several sources. These include: Access India (n=3), an online group for people with visual impairments in India; community organizations for people with disabilities (n=3); personal contacts, including participants from prior qualitative studies conducted by the first author (n=6); and subsequent snowball sampling (n=13). In the initial phase of recruitment, participants were intentionally sampled for representativeness based on age, gender, and familiarity/expertise with technology (novice vs expert) since prior work suggests that factors may be associated with how people experience technology disruptions and recover from them [202, 121, 131, 132]. Furthermore, snowball sampling was used since it would increase the chances of finding visually impaired people who were acquainted with one another, thus increasing the odds of locating a "CoP" as per the study's theoretical framework.

We conducted 25 semi-structured interviews lasting 60-75 minutes with people with visual impairments from across India between Aug 2020 and May 2021. We used Skype, Zoom, or phone calls to conduct interviews. Twenty-two (n=22) interviews were conducted in English, with which the participants were comfortable and fluent. Three interviews were conducted in Hindi, a regional language in India that is also spoken by members of the research team. The interviews followed a guide designed to elicit narrative accounts [146] of: (1) participants': perceptions of software updates; (2) their processes for managing updates; (3) specific challenges and impacts of disruptive updates; and (4) how they recovered from the disruptions. The interviews were transcribed verbatim by the research team. The three interviews in Hindi were translated into English by the members of the research team. Interviews were continued until we reached data saturation [104]; that is, no new codes or themes were emerging from the data. We obtained verbal consent from all participants to audio-record the interviews and compensated participants Rs. 500 (approx $7.00 US) for their time.

5.5.2 Data Analysis

The first author analyzed the interviews as he conducted or co-conducted all interviews and was thus closest to the data [167]. Data were analyzed through three independent coding approaches that included both inductive and deductive coding. First, we used affective coding [225] inductively to identify the specific challenges that disruptive updates posed for participants. Second, we used process coding [225] to identify the practices involved in recovery from disruptive software updates. Finally, we used provisional coding [225] to deductively apply LPP theory to develop codes.

5.5.3 Participant Demographics

Participants were between 24 and 63 years old (mean age = 44.7, median age = 47). Of the 25 participants in the study, 11 identified as male, and 14 identified as female. Participants lived in twelve cities/towns. All participants identified as totally blind and used screen readers to access their computers and mobile phones. Fourteen participants identified as basic or novice users of technology, while 11 identified as experts. Consistent with prior work, most participants (n=16) used Android mobile phones (with Talkback) while a smaller number (n=9) used iPhones (with VoiceOver) [131, 132]. A majority of participants (n=24) in the study were employed.

5.5.4 Positionality

We are disability, accessibility, and HCI researchers with several years of experience working with people with disabilities in both Global South and North contexts. We understand that our observations will be filtered through our individual identities. The first and fourth authors identify as male, upper-caste, non-disabled, and sighted. The second author identifies as female, blind, and coming from a lived experience situated in the Global North. The third author identifies as male and is a member of the community of people with visual impairments in India. The last author is a woman and non-disabled health informatics and HCI researcher from the Global North (Canada and the United States). Her research addresses health and healthcare disparities, including a focus on people with disabilities as a group who experience such disparities.

5.6 Findings

Participants learned about software updates in two ways: (1) changes to software leading them to conclude that an update had occurred; or (2) explicit prompts which asked them to update their software. The first was particularly common among participants since all of them used auto-update features on their software. Indeed, very few had experiences with explicit prompts which required participants to manually update their software. Participants considered manually updating software to be an onerous task given the multitude of software they used and the frequency of updates.

Participants described their experiences with what they saw as both "helpful" and "disruptive" updates, with the latter being the most salient and memorable. Helpful updates fulfilled their intended purpose; that is, they improved the way people could use the software and accomplish tasks. As P1 described, a helpful update did not necessarily need to improve the software experience, but rather, it was helpful when,

> [Software] keeps getting updated, but there is no change. I'm able to use the way I was able to use [before the update]... Everything is the same functionality and same feature... It's normal and you're able to use those stuff. - P1 (Novice)

However, disruptive updates did quite the opposite, reducing participants' abilities to use the software effectively. A number of the participants described them as "sudden" and "drastic." These unexpected updates resulted in large-scale changes, which is what made them disruptive in the first place. Take the case of P9, who routinely faces troubles because of sudden changes to the Text-To-Speech (TTS) software on their mobile phone,

> If we are using Hindi or English (India) version for Google TTS and suddenly there is an update and it becomes silent. This is a persistent problem I have had faced several times... I have to take sighted assistance [to recover from the update]. - P9 (Expert)

Disruptive updates to certain types of software like screen-readers were particularly problematic. Additionally, disruptions to work-related software and ride-sharing apps had pronounced effects. Here, P3 describes the difficulties of coping with regular updates to work-related software.

> [Without technology] probably I cannot even keep my job [...] that's leading me to my financial independence. And gives me a confidence... So I have to like every month Microsoft will be rolling out some new patches and compulsorily I

> have to download them. So whatever changes they are going to do is going to affect me. - P3 (Expert)

Disruptions to mobile payment apps were also very difficult as they are now essential to performing economic transactions in India [58, 144, 197, 268]. Accordingly, disruptions to these apps undermined participants' abilities to participate in the economy and their resulting sense of financial independence [201, 132]. We now highlight what makes such disruptions problematic for people with visual impairments.

5.6.1 Challenging Experiences with Disruptive Updates

5.6.1.1 Uncertainty

The biggest challenge with software updates was the sense of uncertainty it created in people with visual impairments about whether an update would be "helpful" or "disruptive". Participants were left guessing if the update would result in decreased accessibility and removal of previously useful features or actually improve, or at least not disrupt their system. The uncertainty of updates was well described by P7.

> I took the update, and I'm wondering what was happening to it, because it took almost one and a half hours... I completely freaked out, because I didn't know what to expect. It's very difficult to keep up with all of this as somebody who's an average user. It is disturbing and it disrupts, not just work, it disrupts the peace that comes, the familiarity that comes with using one particular update. – P7 (Novice)

As highlighted previously, technology and software often provide the only means for people with visual impairments to accomplish certain tasks. Therefore, participants' concerns stemmed from whether the updates would impede their ability to perform their usual tasks. Some study participants used older software (e.g. P4 with a Windows 8 system) and for them, the process of updating software was itself inaccessible. This meant that they were often uncertain about what was happening during the update process. This uncertainty encompassed: the extent of update completion, information on prompts that indicated changes being implemented at a certain time, and required user actions like clicking buttons or picking options to allow the update process to proceed. Finally, as we will address later in this paper, dealing with disruptions entailed finding the right recovery strategy and here, participants were initially uncertain about which strategy would best address their troubles.

5.6.1.2 Loss of Control

Disruptive updates were often associated with the loss of control over: (1) software and its functioning; and (2) participants' sense of independence. Participants felt that updates were "forced" onto them, and they had little choice but to accept the changes in the newer software versions. However, they did not always want these updates given the possibility of reduced accessibility after their installation. Furthermore, participants also felt that they had no choice in the timing of the updates. Although this was particularly true with people who used auto-update features, even those who manually updated their software discovered that they could only defer updates for a finite length of time. After a certain point, they were forced to update their systems as the software would cease to function without them doing so.

Disruptions also resulted in a loss of control over peoples' sense of independence. Take the case of P2, who was using one version of a web browser with which they were able to use an add-on (called "webism") to solve inaccessible image CAPTCHAs, which are a security mechanism that requires users to enter a code displayed on their screen as an image to proceed. P2 said,

> That webism used to detect [CAPTCHA]. With this 61 [updated version of browser] or whatever, that support [for webism] was removed. So as a result, I am not able to work on the CAPTCHA part, like I'm not able to like, again, it was a dependency on the sighted person. It is not possible to have a sighted person all the time. - P2 (Expert)

Other participants also spoke at length about their discomfort with seeking sighted assistance to address software update-instigated troubles. To seek assistance to cope with changes to the very thing that made them able to do tasks on their own was felt to be counter-productive and hence something that they did not enjoy.

5.6.1.3 Negative Emotions

Updates to software were associated with two negative emotions: fear and frustration. Fear was linked to participants' inability to tell whether an update would be helpful or disruptive. This meant that their uncertainty was almost always accompanied by a sense of fear over forced updates. Specifically, people were anxious about what an update would bring and how it would affect them.

Disruptions were also associated with a great deal of frustration. Participants could not comprehend why new versions of software were inaccessible and had changed for the worse.

In addition, the inaccessibility of the update process, the loss of control from the forced need to cope with the changes, and the possibility of having to seek sighted intervention to deal with disruptions were also sources of frustration. P5's quote exemplifies this frustration.

> IRCTC [Indian Railways] website, they update very frequently - it's like annoying. Whenever they include the update it doesn't support for screen reader users... Right after updating we can't use. I observed they update, if the update is very frequent also we will get annoyed. It has to be I think timely. - P5 (Expert)

5.6.1.4 Loss of Time and Decreased Productivity

Bigger software updates, such as those to operating systems, and updates on older systems, often took a long time and did not always happen in the background. This meant that people could not perform other tasks using the same software—or in some cases other software as well—and had to wait for the update to complete to resume work. Many believed that this affected their work-related productivity. As this participant said,

> The drivers stopped working and I was totally at a loss. It was sort of tense because those days, I had to wait [for help]... I used to do medical transcription. There used to be deadlines. By the end of the day, we had to compulsorily turn in our work. But [because of the update] you will have to call them and cancel your work. – P4 (Expert)

Inevitably, when software updates resulted in UI and workflow changes, people had to relearn interfaces and how to perform tasks that they were able to perform before updates. Relearning interfaces was one of the most time-consuming results of software updates, as it required repeated exploration and memorization. The challenges of re-learning a UI were exacerbated by the lack of information about software-related changes from an accessibility perspective. Although update notes, which accompany updates often highlight changes to software, participants found the language technical and unhelpful for relearning. Despite these challenges, people recovered from disruptions, and in the following section, we describe their recovery practices.

5.6.2 Recovering from Updates in a Community of Practice

5.6.2.1 Visually Impaired Technology Users as a Community of Practice

People with visual impairments in India formed a community that together addressed common issues of accessibility that they all faced, including disruptive software updates. Here,

P7 describes how she leverages expert help from the community to recover from software updates.

> I've been part of the community for many, many years... [For update-related disruptions] I reach out to friends who are very, very tech-savvy. If I'm not able to reach them then I write on these mailing lists. Sometimes WhatsApp groups you get information more instantaneously. A lot of community support...symbiotic existence. - P7 (Novice)

Our participants preferred to seek assistance from community members to seeking help over sighted intermediaries such as family, friends, and colleagues at workplaces. This was because sighted intermediaries did not understand accessibility features and access-related issues, so people with visual impairments often had to do the work of educating them. So, although, people with visual impairments relied on sighted intermediaries for occasional assistance, often with one-time accessibility issues that resulted from update disruptions (e.g. entering CAPTCHAs and entering One-Time Passwords (OTP)), they did not enjoy working with them as they believed it compromised their sense of independence. In contrast, they felt working with community members allowed them to learn how to diagnose issues and use mechanisms to address disruptions. This in time enabled them to work through disruptions on their own. As P13 highlighted,

> I am interested to take help from visually impaired. Because I will get more knowledge. I want to learn. Whatever issue I have, they explain by sending voice clip. [But sighted person] only does the action. [They say] "this time I have clicked, now you continue". [Sighted person is] not telling the solution, he's resolving issues. - P13 (Novice)

5.6.2.1.1 Sites of Interaction As is evident from the above quote, community interactions occurred on a range of mediums; these were critical sites for novices to be able to interact with experts. While novices preferred one-to-one interactions with experts, they also used WhatsApp groups, email chains, online groups/communities, and group meetings in physical spaces to interact with experts. Each of these mediums had their unique set of affordances which people leveraged to their benefit. For instance, one-to-one communication with experts allowed for in-depth synchronous verbal communication, but these opportunities were constrained by the availability of experts. Novices used WhatsApp groups to get "quick fix" solutions to disruptive software updates. These groups allowed for one-to-many interactions in which novices had access to several experts at the same time, which increased

their likelihood of getting fast responses to their queries. In participants' experiences, these groups were active and reliable in that they always got written responses from experts there, often in a very short time. This suggests that communication via these groups was almost synchronous. In addition to allowing novices to reach experts, these groups also allowed novices to observe and learn from discussions between experts and other novices or even between experts. Participants were often part of several of these groups, which were often dedicated to specific technologies (e.g. Apple or Android-related groups) or a certain domain of technologies (e.g. tech for banking). Here, P15 states how he used multiple WhatsApp groups to pose a query,

> If it is a iOS specific group I can put it [question] in there, there's no point in putting Android query there... Like the PDF, when I told you that I created from my Word document [after an update], it was not reading properly. I was clueless. I know a lot of people face difficulty. I created that query. I put that query to two, three groups... in one group, one person kind of gave me a little more clear answer. - P15 (Novice)

Finally, online groups such as Access India allowed for asynchronous communication and let participants learn from public discussions organized by questions or topics. In addition to helping novices find solutions to disruptive updates, these mediums helped people learn about new technologies and software accessibility more broadly.

5.6.2.1.2 Nature of Interactions Within this CoP, interactions were informal. People were often well-acquainted with each other and understood that they could rely upon each other for assistance. Experts whom novices sought for one-to-one help were often their trusted friends whom they had known for many years. Novices, however, rarely personally knew experts with whom they interacted at the aforementioned sites. However, several participants noted that these experts made their contact information available or reached out by themselves to provide assistance and additional clarification if the guidance they provided on digital channels was insufficient.

Interactions within this community were also reciprocal in nature. Although novices lacked technology-related expertise, they had other forms of expertise which they readily shared with other members of the community. For instance, P19, a novice who relied on others in the community for technology help, provided other forms of assistance for people in the community.

> If someone is looking for a job, I find out and then let that person know. It's a two-way thing. I seek help, and I, in my own small way return it. Since I am in

> contact with so many people, if someone reaches out to me, like say they have something to be recorded, or they have an exam. I try to find someone... One of my friends was looking for a writer... I could help her. So I was happy about that. - P19 (Novice)

5.6.2.2 Novice and Expert Roles in the Community of Practice

Here, we use LPP theory's [148] concepts of "novices" and "experts," to further characterize roles in the CoP of technology users with visual impairments in India. Novices identified as basic technology users while experts identified as advanced users of technology. To recover from update-related disruptions, novices and experts used different tactics. Novices primarily relied upon experts to assist with recovery. Experts helped novices by: diagnosing what caused update-related issues; providing solutions to recover from these updates; and guiding novices in implementing these solutions.

5.6.2.2.1 Who are the Experts In our sample of 25 interviewees, 11 fell into this expert category. Experts were primarily people with advanced technical competence. This competence meant that they understood how software and technologies worked and their many functions. Some experts also understood the software's underlying code. Additionally, they had enthusiasm about technology: they were passionate about exploring new technologies and "tinkering" with them. Experts also demonstrated resourcefulness in that they used online sources to learn about technology and solutions to technology-related troubles. Finally, experts possessed altruism such that they were typically willing to assist novices with technology problems.

Some experts in our sample built their expertise in technology accessibility-related jobs and worked closely with software on a daily basis. In particular, P2 spoke about he was able to leverage his work experience when helping other visually impaired people.

> I worked as an accessibility tester... When it comes to software update[s] there is something like what is included in the coming update - that will give a brief idea about how it is going to function. People should have some technical knowledge to understand. If you are computer literate, then you'll be able to understand. - P2 (Expert)

Because experts were technology enthusiasts, they spent a lot of their time on software and technology. They frequently looked up news pertaining to the software that they used, staying on top the latest technology trends and looking for ways to build their technology

competence. They were present in online communities about technology, observing discussions and contributing to them. They were passionate explorers, spending time on software and applications, using and testing lesser-known features. Importantly, experts were comfortable in doing these things and were confident that they could recover if something went wrong in the process of exploration. This comfort was reflected in experts' preferences for sorting out issues with updates on their own.

> I love to read about updates. And I explore after... right after downloading... I love to explore them, the new options... Update wise no issues, I can update on my own. I don't ask much questions online [to get help with updates]. Many threads I read online [to overcome disruptions]. - P5 (Expert)

Experts noted that through their ongoing explorations and reading, they often stumbled upon information about future releases of software and the changes that they would bring, especially in terms of accessibility. As a result, they were better prepared to deal with the uncertainty of updates and disruptions than their novice counterparts.

> I keep reading a lot about Apple. So I'm prepared. Last year, when iOS 13 came, there was this guy, he upgraded to iOS 13 and his voice control had been activated. Whatever he spoke, it was being dictated. He was cussing everybody. I knew what it was. So I told him to turn off voice control and he was at peace. - P4 (Expert)

Additionally, experts were able to use the internet to diagnose and find solutions to technology issues—including those with disruptive software updates. This was particularly difficult as information to overcome technology issues was often written from the point of view of sighted people, and there were few sources of information on accessibility in particular. Therefore, experts not only sought accessible solutions, but they also translated existing solutions into a form that could be understood by other people with visual impairments. For instance, a few experts translated mouse-based solutions to keyboard-based commands to make it possible for people with visual impairments to implement a given solution.

Finally, within the community, experts were altruistic and played a central role in helping novices negotiate update-related issues and technical challenges. All novices in our study stated that it was straightforward for them to reach experts and seek assistance from them when they ran into trouble. This suggests that experts were reliable and an "always-available" resource. They were critical in educating novices about practices for recovering from disruptions. Here, P25, a novice explains why she reaches out to experts to recover from disruptive updates.

> For my computer related queries. I have one of my he was one of the students that I guided long back. I call him and I say, now I'm stuck. Now, what am I to do? I'm not that big an expert. [On the other hand] he's very good with technology. He just has a lot of respect and love for me. I also feel very comfortable asking him. - P25 (Novice)

5.6.2.2.2 Who are the Novices Novices primarily sought out experts for help with technology troubles rather than providing that assistance themselves. Novices were users of everyday technologies, and due to their basic technology knowledge, typically used only their most elementary functions. However, through participating in the CoP, they built networks of experts and sighted people upon whom they relied for diagnosing and solving technology issues. As a participant said,

> Now, technology a lot of people have gotten ahead of me, far ahead of me... [to help with technology and updates] I always have a button. I call friends. I call the younger generation. So they helped me out with that... I'm not an explorer, I don't look around for things. I wait for somebody to tell me. - P23 (Novice)

When confronted with an update-related disruption, novices readily reached out to experts for assistance. This was in stark contrast to experts who typically preferred problem-solving on their own. As P15 explained,

> An old friend of mine from last 10 odd years. I know he's good with technology. He's happy to be of help anytime and every time. The few people that I have, I know they are better at certain things in technology. I know they are a call away. - P15 (Novice)

As suggested above, experts were often close friends with novices whom they had known for a long time. These relationships were formed through shared spaces such as schools, workplaces, and participation in disability-focused events. As we highlighted previously, in addition to experts from the community, novices also established or maintained working relationships with sighted people—most often family members. These sighted peers also helped novices negotiate update-related troubles, but they were not preferred as they did not understand accessibility issues in the same way as other visually impaired people did.

However, it is critical to note that novices did not just seek help from experts but did other work that was crucial to other novices in their attempts to recover from disruptive updates. On receiving help from experts and understanding the specific steps they required to recover from disruptions, they became experts in a specific update-related problem. They were then

quick to share these solutions with the larger community, often by responding to specific queries raised in online groups or even sharing problems paired with solutions when not prompted. They also helped other novices in one-on-one settings. We call this role that they performed in sharing recovery strategies as that of "fluid experts." These actions reduced the burden on experts, which in turn helped to sustain expert-novice interactions and thereby the CoP. In addition, novices shared contact details of experts and introduced them to other novices to enable them to build their own network of experts and seek clarification when required. This was critical in expanding the reach of experts within the community. Here, P1, highlights how she shared a solution to an update on Access India, an online group to help others who were encountering the same issue. In doing so, this person who was typically a novice, temporarily occupied a "fluid expert" role,

> Google keyboard got updated. I was typing in a particular way and when it gets updated I have really no idea how to type and send... whole interface changed. I called a tech-savvy friend and he said it might be because of the update. I saw one message on Access India with the same query... Everyone is stuck and confused. I restored it [keyboard] to factory version. I replied on access India that this is how you have to do. - P1 (Novice)

5.6.2.3 Practices Involved in Recovering from Disruptive Updates

In this section, we describe the update recovery practices, or repertoire of resources and experiences [148], that were shared by members of this CoP. Through interactions with a community of experts, novices developed an understanding of these practices and, in time, the expertise to address update disruptions and technology-related issues on their own and to help others with them.

5.6.2.3.1 Restoration Restoration is the practice of creating a working software version by either installing a prior software version ("downgrading") or installing a newer version ("upgrading") instead of the version containing the disruptive software update. Participants described their experiences with restoring system-level software (e.g. operating systems, audio drivers), common mobile phone apps (including pirated versions of some apps that participants used), and Windows software (e.g. browsers). With experts in particular, restoration in the form of downgrading software was in many cases a first-line strategy to recover from disruptions. Here, P8 describes how he uses restoration as a recovery strategy.

> So, after update, there is some issues with that... What we have to do is that for mobile previous version is there with someone... that we have to use... We have

to compromise. Previous version we have to install. - P8 (Expert)

Downgrading was often a very technical task requiring expertise to find older software versions and to execute a series of complex steps to uninstall the current version and install previous versions. Some technologies directly supported downgrading, such as the ability to downgrade to the factory versions for Android applications. However, there was little awareness of this feature—especially among novices. Experts played a critical role in helping novices with the practice of restoration. They located prior working versions, which often took a long time as these versions were not always readily available. They also stored these versions and shared them with novices. In addition, they guided novices through the steps required to downgrade software. Experts also shared summary versions of these downgrading steps via instructions on online communities such as WhatsApp groups and Access India. Here, P2, an expert describes his approach to facilitating restoration.

> Update is not working? You have to go back to previous version, ESR version [of Firefox]. Whenever I download a software, I keep a backup of it... Suddenly [software] gets updates and people will get nervous what to do next. They contact groups like Access India. I shared ESR version. I always use OneDrive, Google Drive... People who use my services will keep my number. They call me up and I just like share. - P2 (Expert)

A less common approach was upgrading software to recover from disruptions. When experts encountered a newer version of software that addressed an existing disruption with it, they played the critical role of conveying this information to novices and the community at large.

However, there were some limitations to restoration. First, participants noted that it was not always possible to downgrade software. In some cases, prior versions were not available and in others, there were system restrictions on downgrades. Others noted how, upon downgrading some software, they were forced to upgrade to the latest version. Second, upgrades did not always address disruptions and sometimes even introduced new accessibility issues.

5.6.2.3.2 Situational Problem Solving This practice involves diagnosing and finding solutions to local accessibility issues. Novice participants primarily learned this practice through one-on-one interactions with experts. Since participants often used and appropriated technologies in highly individualized ways, some update-related disruptions were local in that they were limited to an individual. For example, unlike other participants, P6 used Siri, a

voice assistant on her iPhone to enter text instead of typing. Therefore, P6 and other novices reached out to experts whom they regularly contacted for technology-related assistance and they collaborated to address these local disruptions. It is important to note that in these cases, experts had little understanding of the problem that confronted novices and a vital part of these collaborations was to first diagnose the problem. Often, these were lengthy interactions that involved a lot of trial and error. Take the case of P6, who was experiencing issues using her Amazon Echo mobile app because of an update,

> With the updated version, I'm not able to give commands to Alexa. I checked with a friend... he's an advanced iPhone user... He demonstrated how he's able to speak to Alexa. The steps he demonstrated were simple... He recorded the whole thing in a voice message and sent the message. - P6 (Novice)

As described above, an expert was able to guide P6 in a step-by-step fashion to diagnose issues with her Amazon Echo app and get it working again. Through interactions such as these, novices came to understand common recovery practices such as rebooting technologies, using swipe gestures to activate features, and the aforementioned restoration practices. After this learning, novices tried using these approaches when similar issues cropped up at other times. Take for instance, P24, who highlighted how she routinely dealt with disruptions resulting from updates in her messaging app.

> I will just move my fingers left to right [swipe]. I will get the send button [an accessible UI element]. It has happened so many times... In the beginning stages, somebody who taught me a little bit about iPhone, they have told me [about the swiping strategy]. Some visually impaired person. One of our friend... He keeps helping me. - P24 (Novice)

Although novices preferred one-to-one interactions with experts, and interacted frequently with them, these interactions were constrained by experts' availability. To avoid overtaxing experts, novices were conscious of when they contacted experts and the duration for which they engaged them. When novices could not reach their experts of choice, they reached out to experts on WhatsApp groups and online communities to seek assistance.

5.6.2.3.3 Abandonment and Switching This refers to abandoning the software that was disrupted through an inaccessible update and switching to alternate software with similar capabilities. Among our participants, this included switching between different software programs and also between web and mobile versions of the same program. Experts had an understanding of some of the alternate apps to use in the event of an update from

which recovery was impossible. This was either due to their aforementioned preparation and exploration/trial and error or due to their abilities in finding out about alternatives using the internet. Thus, novices relied on experts for knowledge of these alternate apps and how to use them.

Due to disruptive updates from which they could not recover, study participants had abandoned and switched from multiple types of apps for food delivery, ride-shares, and digital payments. This was possible since all apps in these categories allow their users to accomplish a few key tasks in similar ways. With respect to a food delivery app, Swiggy, P3 related,

> It was some sort of consumer app. And I ended up like going to its rival, which was more accessible. When swiggy became inaccessible, that's something really bad for me. I had to go to zomato... Being on zomato was a better experience. I can open, I can search a restaurant... select address, pay money and track [like Swiggy]. - P3 (Expert)

The switch that P3 made was possible as he was able to accomplish similar tasks such as selecting a restaurant, payment, and tracking his order on both programs. Likewise, other participants spoke about the abandon and switch practice in relation to digital payment applications (e.g. PhonePe, Google Pay, PayTM, BharatPe), all of which are widely used in India [11]. These software applications allow their users to perform tasks such as connecting to an existing bank account, storing virtual money, and paying vendors by going through a sequence of similar steps such as scanning a QR code or entering a phone number to pay a vendor. In some cases, the decision to abandon and switch was temporary and participants returned to abandoned software once they received word from experts that the disruptions had been addressed. However, the lack of availability of alternate versions with all categories of software limited the use of this practice among participants.

5.6.2.3.4 Escalation Escalation refers to the practice of raising awareness about disruptions affecting the visually impaired community with developers, technology companies/organizations, and legal entities. Participants used escalation to address important disruptions to software that were widely used on an everyday basis by people with visual impairments. In most cases, escalation was a last resort and used only after participants' other recovery attempts failed.

Often, the starting point for escalation was individual community members raising issues with disruptions on online communities and WhatsApp groups and gaining consensus about its widespread impact on other community members. CoP members then used these online

communities and groups to rally community members and discuss strategies to escalate disruptions. Here, P10 speaks about how members of the community lobbied Uber after an update had resulted in making the application unusable by people with visual impairments.

> Since Uber was inaccessible, a lot of people followed up with them. That update had come as a result of a lot of persuasion. I did not personally do it. There was no input from my side [for escalation]. [But] we can write email to the developers and follow up with them to make apps accessible. - P10 (Novice)

Experts, on many occasions, led the way in escalating disruptions by finding developer/organization contact information and drafting emails and letters of complaint. For their part, novices observed how experts escalated disruptions and occasionally lent support by signing onto letters. In the process, novices gained an understanding of the practice of escalation. Over time, novices individually began to reach out to developers when they encountered update-related troubles with software.

Less commonly, CoP members escalated disruptions to legal entities. Doing so included initiating litigation to take technology companies that owned applications to court. Evidently, this required legal expertise in the form of awareness of legal processes. The limited availability of such expertise among community members meant that this route they infrequently pursued this tactic.

> For IRCTC, it was 100% accessible earlier but it became merely 10% accessible. Solution was through laws. [Escalation was done through] National Federation for the Blind. The general secretary [of NFB], himself is a senior advocate of the supreme court... Since they had knowledge of the laws [they escalated through courts]. - P8 (Expert)

Escalation had some limitations in terms of its ability to actually solve problems. It was always accompanied by a degree of uncertainty in that people were never certain that developers and legal entities would hear and act on their issues. Indeed, some participants provided examples of cases in which escalation did not address issues with their software. Others noted how escalation, even when successful, took considerable time and effort. It often required people to rally support and reach out to developers multiple times before their issues were addressed.

5.7 Discussion

We found that, for people with visual impairments in India, disruptive software updates resulted in: (1) uncertainty; (2) loss of control; (3) negative emotions; and (4) loss of time and

decreased productivity. However, despite these challenges, people with visual impairments recovered from updates. This recovery often relied upon a larger community of people with visual impairments, who together formed a "community of practice" addressing issues that people with visual impairments in India commonly faced. Using Lave and Wenger's theory of Legitimate Peripheral Participation (LPP) [148], we showed how expert-novice interactions enabled novices to gain familiarity with key update-related recovery practices. In the process of gaining this familiarity, participants also became integral members of the CoP. We found four key practices that people used to recover from updates: (1) restoration; (2) situational problem solving; (3) abandoning and switching; and (4) escalation. We now discuss the implications of these key findings, while comparing and contrasting them to prior HCI research.

5.7.1 Extending Software Updates Research and Practice

5.7.1.1 On Software Updates Research

As mentioned, software updates research in HCI has largely focused on the update experiences of non-disabled users, proposing design recommendations to improve these experiences for such users. We extend this body of work to highlight the experiences of one group of disabled users: people with visual impairments in India.

5.7.1.1.1 Software Updates and Uncertainty People with visual impairments, like non-disabled users, preferred not to update working software [265]. However, this was not necessarily because they viewed updates as unimportant as shown in prior work with non-disabled users [76, 165]. Rather, this user group avoided software updates because of the uncertainty of their impact on the accessibility of software. Furthermore, update notes which could help participants deal with the uncertainty were too technical and difficult to understand, which confirms findings from prior work with non-disabled users [164]. Additionally, participants struggled because software update notes typically failed to address accessibility-related changes in the software, which is a critical issue for people with visual impairments. People with visual impairments also experienced uncertainty during the update process, which was generally inaccessible to screen-readers.

5.7.1.1.2 Software Updates and Loss of Control Findings revealed that updates were also associated with a loss of control such that people felt that updates were forced onto them and they had little choice but to accept them. Although prior work suggests that people organize routines around updating software to maintain control over them [164], our

participants did not. This was likely because several of them, like non-disabled users [77, 163], used auto-update features to manage the many software programs upon which they relied, and their frequent updates. As with non-disabled users, very few participants manually updated apps [77]. Also, like non-disabled users, participants who manually updated apps reported that they ignored or delayed updates as much as possible to maintain control over software [164, 265, 76]. However, as has been highlighted previously, this delay strategy [277, 119] is at odds with companies' requirements for users to update apps early.

5.7.1.1.3 Software Updates, Time, and Productivity For our participants, dealing with disruptive updates resulted in a loss of time and reduced productivity. This was primarily because updates often changed how people with visual impairments used software and required them to relearn interfaces. Although this is also a challenge for sighted users [265], results suggest that this challenge was magnified for people with visual impairments. For example, while someone sighted can be alerted to changes by a quick glance at a screen, people with visual impairments who relied on screen readers had to go through the entire screen, often several times to discover update-related changes. Future research should examine how to better assist people with visual impairments with learning and re-learning interfaces when software updates are inevitable.

5.7.1.2 Design Implications

5.7.1.2.1 Include Accessible Update Notes and UI for Update Processes There are two ways to reduce the uncertainty with updates. First, providing information about accessibility-related changes in update notes along with changes to key workflows and user interfaces in an easy-to-understand manner would likely improve the user experience of updates for people with visual impairments. Second, uncertainty could likely be reduced by ensuring that the update process, including prompts and progress, is accessible to screen readers as well.

5.7.1.2.2 Provide Informative Alerts and Flexible Updates Practically, our results suggest a need to re-think how to provide users more control over updates. For instance, it may be beneficial to alert users to updates [163] by providing them with details about impending updates before they are required, such as a week before the update is mandatory. These alerts could include information about the importance of the update, accessibility-related modifications, and how user interface or workflow changes contained in the update may improve the software update experience. Additionally, people with visual impairments may feel more in control if updates are designed to present them with choices regarding

update-related changes, such as by making some changes necessary and others optional. At the same time, these updates could move them to the ideal software state slowly, and in stages. This would reduce their concerns with the suddenness and drastic nature of updates.

5.7.1.2.3 Include Preemptive Accessibility Checks The above design recommendations concern how to deal with software updates after they already exist. However, this research highlights the importance of the accessibility of software updates being addressed earlier in the process of development, for which technology companies should be held accountable. Here, we echo findings from prior HCI research which highlight how the inclusion of more people with visual impairments in the software design lifecycle including beta-testing efforts could improve the overall accessibility of software [37, 256]. Technology companies could also enforce more rigorous accessibility checks during the application review process (e.g., when apps are added to the Apple App Store or Google Play Store) to ensure that developers design and develop software while centering accessibility.

5.7.1.2.4 Enforce Accessibility Standards Studying update-related disruptions in the Indian context reveals how challenging updates can become without legal protections. In Western contexts, legal regulations (such as the Americans with Disabilities Act in the USA [5]), require that technologies and software comply with accessibility standards (such as WCAG 2.1 [12]). In contrast, while similar legal regulations exist in India, such as the Rights of Persons with Disabilities Act [190]), they are poorly enforced [182, 183, 213]. This is a key reason why updates so often shifted from being accessible to inaccessible. A stronger implementation of the law—one which holds technology companies accountable for the lack of implementation of accessibility standards will improve people's experiences with software and reduce their work in recovering from updates.

5.7.1.2.5 Enhance Community Support Technology companies can also support the community in their recovery practices to improve people with visual impairments' experiences with updates. First, they can enable rollbacks [163] by making available a library of previous versions of software in public locations to reduce the work of searching for these versions and make restoration easier. Second, visual interpreter services (e.g., Be My Eyes [1]) can expand their services to connect people with disabled experts to assist with situational problem-solving when expert availability is an issue. SeeingAI, which connects directly connects users to tech support when they experience issues on the app is one model for how this could be done [13]. Disabled experts can provide accessibility-related support for local issues and set novices on the path to diagnosing and solving software update disruptions on their

own. Finally, technology companies can provide people with visual impairments with more direct lines of communication to developers and testers to escalate accessibility issues. This combined with accessibility-focused tech support can ensure that widespread accessibility issues are addressed quickly and the software needs of people with visual impairments are met in the process.

5.7.2 On Social Accessibility

Accessibility studies in HCI and CSCW that argue for social accessibility as a guiding principle have often examined group dynamics between people with mixed abilities [203, 275, 155, 31]. This research often aims to uncover how technologies might be designed to foster interactions between these groups. In contrast, we highlight the dynamics between people with disabilities in a CoP: people with visual impairments who use technologies in India. This contributes to the emerging body of work that surfaces how this social accessibility plays out in the everyday lives of people with disabilities [36, 271]. Our use of CoP and Legitimate Peripheral Participation [148] as a theoretical framework also allows us to describe the division of work between expert and novice community members, contributing to an understanding of how peoples' specific roles within communities shape their work practices [102, 282]; this is a central area of interest for the CSCW community. Furthermore, by surfacing these work practices which are critical to people with visual impairments in India recovering from update-related disruptions, we challenge common HCI interpretations of access merely being a state of technology [38] and demonstrate how it is in fact the result of continuous and ongoing work done by people with visual impairments to deal with inaccess [38].

In our study, the social accomplishment of accessibility was most often apparent in expert-novice interactions. Although experts addressed some disruptions on their own, novices relied on experts. Novices sought help from experts readily. Indeed, most novices did not even attempt to address issues on their own, approaching experts to find solutions to their problems. So while prior research has suggested that people with disabilities evaluate personal and social costs before seeking help from others [48, 49, 46], novices in our study did not. Rather than seeing help-seeking as burdensome [36, 254] as has often been reflected in prior HCI research that seeks to enhance the independence of people with disabilities through technology interventions (e.g. [283, 40]), novices viewed help from experts as a time-efficient way to find solutions to frequent update related problems.

Expert-novice interactions were informal and often reciprocal when considered through the lens of communities of practice theory. Novices contributed to the community through

their role as fluid experts by sharing solutions with other novices. More importantly, they shared their non-technology-related expertise with others. Experts also relied on the community for help. This suggests that reciprocity between people which involves a mutual give-and-take of expertise forms the basis for the many social interactions within this community. Here, we confirm findings by Pandey et. al. who highlight how help-giving is valued by people with visual impairments [203] and contributes to their enhanced sense of self-esteem and independence. Furthermore, that people were able to reciprocate help received also likely explains why people in the community readily sought help from each other, as the inability to reciprocate has been attributed as a key reason why they desist from seeking sighted help [46].

We contribute an understanding of the broader outcomes of social accessibility between people with visual impairments. As Das et. al. rightly acknowledge, work in HCI and Accessibility often focuses on the role of social interactions in the completion of specific tasks in the short term [65], with some highlighting that this exemplifies "interdependence." For instance, Vincenzi et. al. uncover how people work together to navigate physical spaces outdoors [271]. We too find that accessibility-related interactions have shorter-term outcomes, allowing people to recover from disruptive software updates and use them again, thereby facilitating access to software. However, we also find that these accessibility-related interactions have longer-term outcomes as well. People developed and sustained a community of practice, and coalesced around technology accessibility issues. Furthermore, as some novices acknowledged, they learned over time to implement software update recovery practices on their own. This shift from relying on community members to doing so on their own represented a move towards becoming experts in the CoP. Moreover, although we discuss practices in the context of recovering from software updates, they too have broader significance and applicability in our participants' lives. For instance, our study highlights how people come to understand how to escalate software update issues through interactions with community members. This practice is salient given the relevance of activism and advocacy in bringing about change in the lives of people with disabilities (e.g. [153, 285, 232]). Moreover, escalation is particularly important in a context like India where accessibility issues are pervasive [131, 132, 199, 266], enforcement of legal regulations is weak [182, 183], and confronting these challenges is an everyday reality for people with visual impairments [134]. Likewise, through restoration and situational problem-solving people learnt about mechanisms to recover from update-related issues (e.g. rebooting), which they used to address broader technology problems [121].

5.7.3 On Experts and Novices in Communities of Practice Theory

Our study in particular prompts a rethinking of the role of novices in CoP. In LPP theory, novices often are only understood as newcomers to professions [149], which provides the setting for interactions with experts. However, our study prompts a rethinking of their function in CoP by contributing an understanding of their role as fluid experts. As fluid experts, novices became experts in the problem they were confronted with and shared solutions they learnt with other novices. This work is critical as it likely served to alleviate the burden on experts, which has previously been discussed to be a challenge confronting online communities (e.g. [80]). Furthermore, while novices were basic users of technology they had other forms of expertise and skill which they shared with community members. This highlights how novices were more than simply recipients of expertise and performed active work to build and maintain the CoP which in turn likely contributes to its continued sustenance.

In concepts related to CoP and LPP, experts are understood as people with embodied and acquired mastery of skills, especially in areas of professional practice [148]. In line with this concept, experts in our study were technology and software experts; they understood the intricacies of technology and tinkered with software to further understand it. Thus, we confirm findings by Jain et. al. who find that people with visual impairments in India who identified as technology experts often were able to understand how to appropriate and use technologies in expert ways (e.g. use advanced gestures) [121]. However, experts also demonstrated other qualities not considered by previous LPP theory. Specifically, they demonstrated resourcefulness and altruism. Being able to use online sources to find accessibility-related information was challenging, and experts understood which sources they could leverage and how to do so. Additionally, they were willing to help novices out which likely contributed to their recognition as experts within the CoP [53]. This altruism which formed an integral part of the dynamics between people with visual impairments is reflective of the larger collective cultural values inherent in Indian society [260, 152].

5.7.4 Limitations

Our sample of participants is not representative of the larger population of people with visual impairments in India. Participants were mostly middle-class or upper-middle-class, employed, and literate. However, a majority of people with visual impairments in India lack access to both education and employment opportunities [2]. Future research should recruit from these groups to gain a more complete understanding of the accessibility of software update experiences. Furthermore, a majority of participants lived in urban locations, so

it will be essential to examine the software update experiences of people in rural contexts as well. However, a strength of our recruitment efforts and the resulting sample was the relatively large number of women participants; this stands in contrast with much prior accessibility research in the Global South (e.g. [131, 132]). Accordingly, the present findings represent themes present in both men and women in India.

5.8 Conclusion

We conducted a qualitative study to understand the software update experiences of people with visual impairments in India. Challenging assumptions that installed software updates improve user experiences, we found that disruptive updates were common, and resulted in multiple negative experiences. However, people with visual impairments found ways to recover from these updates, developing and sharing key practices to do so. Using Lave and Wenger's theories of Communities of Practice (CoP [149] and Legitimate Peripheral Participation (LPP) [148]), we complicated previous understandings of expertise as fixed, highlighting the fluidity of expertise around update-related problems facing people with visual impairments. In so doing, we also showed that novices play key roles in maintaining the CoP of visually impaired technology users in India. Furthermore, extending social accessibility work beyond a focus on people with mixed abilities, these interactions between experts and novices, all of whom had visual impairments, were central to the accomplishment of software accessibility. At the same time, novices' involvement in the CoP resulted in long-term learning, where novices developed an understanding of the community's practices for software update recovery, as well as gaining broader knowledge of technology. We describe design implications to improve the accessibility of software updates and better support the community of people with visual impairments in their recovery practices.

CHAPTER 6

Discussion

6.1 Overview

My dissertation contributes to the emerging discussion around helping-related interactions in Accessibility and HCI research. This research shifts HCI investigations from the traditional focus on Global North contexts to India, one Global South context. This shift is significant because, in the Global North, independence is almost universally interpreted as self-reliance which is the ability to accomplish tasks on one's own without help or assistance [52, 215]. However, in India, society is more community-driven [100, 270], and mutual dependence upon one another is not always seen as burdensome. Seeking help is indeed a way of accomplishing everyday tasks. I confirm this finding with people with visual impairments in India. In all three studies, findings revealed that people with visual impairments readily approached others for help. Participants sought help from companions like close family and friends, and strangers for assistance with tasks such as indoor navigation. Most notably, people also sought help from other people with visual impairments to recover from disruptive software updates.

Research conducted in the Global North is also shaped by the background presence of basic accessible societal structures like physical infrastructures and legal provisions that enable accessibility. In India, such structural support is also limited [100]. In my studies, this lack of structural support was very apparent. First, the lack of physical infrastructural support for independence was visible in the indoor environments in Study 2. These urban environments were crowded, cluttered, and did not comply with accessibility standards. Second, the lack of enforcement of legal regulations meant technologies were frequently inaccessible. Studies 1 and 3 showed that digital payments and software updates had repeated breakdowns. In comparison, in the USA, the enforcement of the ADA results in the increased accessibility of technologies for people with visual impairments, making such breakdowns far less likely [5]. I argue that this lack of structural support makes help necessary. People with visual

impairments likely saw help as a straightforward way to account for the limitations and overcome the challenges of limited structural support.

Having situated help in the Indian context, using my empirical studies as a basis, I now discuss how my findings extend accessibility and HCI research which deals with the concept of helping. In Study 1, I demonstrated that help is critical in facilitating independence. In Study 2, I showed that helping-related interactions were motivated by cultural values and were more or less valued by people with visual impairments, especially when they exercised agency in shaping the interactions. In Study 3, I uncovered empirical findings demonstrating that help can have longer-term positive outcomes for people with visual impairments. In the Study 3 context, for participants, helping-related interactions resulted in the acquisition of technology-related expertise.

6.1.1 On the Motivations and Directionality of Help

My dissertation contests the inherent assumption in Human-Computer Interaction and Accessibility literature that help is singularly motivated by the needs of the person who requires assistance. The inherent assumption here is that the person experiencing a problem with a task or situation approaches a helper to overcome their troubles [98, 217]. For the most part, this was true with people with visual impairments in India who sought help to overcome accessibility troubles with software updates, digital payments, and navigating indoor environments. However, this was only one part of the story. In Study 2, helping-related interactions were motivated by the helper too. Helpers include strangers and companions (family members and close friends) of people with visual impairments.

What motivated this help? Accessibility research, in its tangential examination of help, has thus far failed to examine these motivations. An examination of these motivations is essential to understanding the social organization of everyday interaction [72]. In Study 2, I address this gap by bringing disability studies literature into conversation with Accessibility research. For both actors, help is motivated by related cultural karmic values of compassion and duty. Prior work has highlighted how frames of disability situated in the Global North are insufficient to understand the lived experiences of people with disabilities in India and underline the need to understand the same through a cultural lens [87, 100]. Such a cultural lens has, for the most part, evaded examinations of helping-related interactions in the broader literature. Compassion and duty are similar to altruism and the desire to feel good about oneself [47, 59]. Yet, while altruism is a wholly selfless act, these cultural motivators are less so. As Ghai explains, through this lens people may help others to influence their fate or destiny [87]. Hence, the opportunity to provide help is equated with the chance to improve

the helper's future state of being. This benefit is in addition to the momentary satisfaction resulting from the provision of the same help [47, 59].

Although compassion and duty are related, they are different. In the context of my study, it seemed as though the underlying duty was a sense of responsibility which was absent with compassion. This responsibility likely explains why companions like family and close friends were concerned about the physical safety of people with visual impairments. Companions also sought to address the needs of people with visual impairments in the manner the latter desired. Moreover, companions worked with people with visual impairments to understand these needs over time. This assistance was in contrast to the interventionist and often momentary compassion-driven help from strangers. This suggests that not all help is the same. Help from companions was motivated by different values and appreciated more by people with visual impairments because it met their needs in the manner they desired. Moreover, as I will explain later in this section, people with visual impairments exercised agency in shaping these helping-related interactions with companions to suit their needs (unlike with strangers) and this is another key reason why help from companions was different from that from strangers.

Help from strangers motivated by values of compassion was prevalent in my participant's experiences. In broader literature on helping-related interactions situated in Global North contexts, this help is often referred to as unwanted or unsolicited help [47] and associated with ableism [184]. In my studies, people with visual impairments accepted and even appreciated this help. This finding contrasts findings from prior work in broader helping-related interactions literature that suggests people with disabilities often reject unwanted help to preserve their sense of autonomy and self-esteem [276].

Why do people with visual impairments accept the help on offer? One key reason is the structural inaccessibility in India because of which people felt they had no other option but to seek help. Thus, they saw receipt of help as the only solution. By contrast, in Global North contexts, infrastructural changes and technological additions can make such environments conducive for navigation on one's own (e.g., through the provision of beacons for landmark identification [103, 227]). However, similar alterations can be challenging in India due to resource constraints [100]. Furthermore, in many Global North contexts, there are legal provisions that enforce accessibility in many contexts (e.g., accessibility standards to make technology accessible) [100]. In the absence of such support in India, they likely saw help as a practical solution to their immediate navigation problems.

A shared understanding of cultural values of compassion [57] could also be a key driver of accepting help from strangers. Prior work has addressed in depth how people with disabilities find meaning in everyday actions (including societal attitudes and social interactions) in

cultural and religious references [87]. People with visual impairments may have viewed help from strangers as an act of care and kindness resulting from concerns for their well-being. In a society in which the needs of people with visual impairments are often overlooked, these acts served as a counterpoint to highlight that people cared for them.

Finally, given that people saw help, whether with companions or strangers, as central to navigating environments, possible concerns over the impact of rejecting help on its future availability could also prompt people to accept unwanted help from strangers (e.g., [276]). Importantly, I found that underlying this unwanted help was the undifferentiated and wholesale assumption that people with visual impairments were in dire need of help [87, 91]. People with visual impairments did not appreciate this underlying sense of pity. However, the above reasons explain why despite this questionable manner of providing help, people with visual impairments were still willing to be forgiving and accept what was on offer.

In contrast to help from strangers, help from companions who were family members or close friends was very often solicited by people with visual impairments. As highlighted previously, this was because help from companions met their needs in the manner they desired. This was one key reason why people with visual impairments sought to be with and work with companions as much as possible. In highlighting these dynamics, I shed some light on the nature of relationships between carers and people with disabilities in India (e.g., [233]). Prior work suggests that these relationships often violate the autonomy of people with visual impairments, who seek to avoid interactions with carers altogether [233]. In contrast, in the limited context of limited context of indoor navigation, I show that carer relationships are indeed valued and appreciated.

Furthermore, it was clear that people with visual impairments exercised agency in shaping the helping-related interaction to suit their needs. They played a critical role in developing a common understanding and interpersonal working relationship with companions like family and close friends over time [286]. Many participants also had highly individual and personalized needs and worked with companions to address them in specific ways (e.g., when to provide instructions). In time, it appears that companions developed "access intimacy" [170], a keen and attuned sense of peoples' access needs. The work of companions to develop "access intimacy" was voluntary and driven by their sense of duty [252] towards people with visual impairments. The underlying feeling of responsibility required companions to care for people with visual impairments by addressing their everyday needs. Indoor navigation, thus, was a collaborative activity [271]. Rather unsurprisingly, people did not have to work to establish "access intimacy" when they sought help from other people with visual impairments. The common ways in which they experienced the world around them, meant other people with visual impairments "simply got" [170] how to offer help.

My findings highlight how the dynamics in the helping-related interaction evolved over time, as people with visual impairments gradually provided fewer instructions and interjected less when companions erred. This evolution suggests help is dynamic and changes over time. Overall, in Study 2, I show how people with visual impairments shape the nature of the help that they receive from companions like family and close friends. This is a key reason why they appreciate assistance from companions. Likewise, in Study 3, I show how over time novices required less technical help from experts as they learned to diagnose software update issues on their own. The finding from Study 2 in particular offers a minor counterpoint to prior work that suggests people with disabilities resist caring relationships as it challenges their agency and independence [233]. Nonetheless, further careful examination is required to understand how these relationships are situated and perceived within the Indian context, where people with disabilities are often infantilized to paint a complete picture of help [87, 88].

6.1.2 On the Outcomes of Help

Research on helping-related interactions in accessibility research has primarily emphasized the negative implications of seeking help to people with disabilities (e.g., [275, 288, 280, 203, 49, 46]). For instance, these studies find that people with disabilities may be reluctant to seek help over concerns about resulting feelings of embarrassment, [275, 288], desires to avoid negative perceptions of their abilities [203, 280, 49] and apprehensions about being indebted to the helper [46]. Fewer studies in HCI and Accessibility focus on the benefits of help-seeking for people with disabilities and how interdependent relationships enable the achievement of access. Positioning help as burdensome allows for the justification of helping as a site for technological innovation. The emphasis on the negative implications of help-seeking is also evident in the broader literature on helping-related interactions (e.g., [245, 230]). In contrast, my dissertation reveals the positive outcomes of help for people with visual impairments in India. These positive outcomes highlight the need to develop a more nuanced understanding of the role of helping-related interactions in the lives of people with visual impairments.

6.1.2.1 Independence

The studies in this dissertation collectively demonstrate that helping is central to the achievement of independence. For instance, in Study 1 I show that digital payments made people independent and allowed them to be self-reliant. My studies also showed that independence is not just about self-reliance. Digital payments were occasionally inaccessible, and here, people with visual impairments sought help from family members and the payee in the transaction at hand to address their troubles. However, this help did not impede their

independence. Instead, help from these sources was expected and seen as critical to getting the technologies up and running again when they became temporarily inaccessible.

Thus, contrary to the widely held view in accessibility research and literature on helping-related interactions that help is a barrier to independence [283, 36], studies in this dissertation show that help in some contexts enables its achievement. In these contexts, independence is not just about self-reliance [52] **but also about being able to shape and affect the helping-related interaction**. It is about who needs to be called upon and in what context. This idea of people being able to decide when to seek help to enable their independence is related to the concept of autonomy in disability studies literature [111], which is about people with disabilities making decisions free from the coercion and influence of others. Thus, an autonomy frame allows autonomy and help to co-exist. This empirical observation holds for Study 1 as well.

However, help-seeking in the pursuit of independence has costs, especially for the different social relationships involved. This finding resonates with prior findings in both accessibility and HCI literature and broader literature on help-seeking [46, 48, 49]. In my case, seeking help with digital payment impinged upon participants' sense of privacy, possibly because finance matters are confidential. Help was made necessary because they saw no other means to address breakdowns.

More recently, accessibility researchers in HCI have engaged with the concept of "interdependence." The concept recognizes the mutual connectedness between people and challenges traditional conceptions of independence [215, 92]. Interdependence as a framework for investigating helping-related interactions raises questions about the mutuality of helping-related interactions and to what extent people with visual impairments saw it as a dependence on others in the context of everyday tasks. People with visual impairments did not characterize their relationships with family members, friends, and strangers who made it possible for them to use digital payments, navigate indoor environments, or recover from disruptive updates as examples of their mutual interdependence. Rather, they saw it as a one-way interaction where they were seeking help from others. Yet, this is likely because my examination was limited to a few technology-mediated contexts.

My research also demonstrates the need to expand on how accessibility research discusses independence. For instance, independence was relative for participants. In Study 1, digital payments were not without their problems. However, for many participants, it was still considerably easier to perform transactions with digital payments than cash. I also noted that the extent of help one required shaped their relative understanding of independence. Participants observed that they needed more help with currency notes (e.g., at every transaction), while there were fewer instances when they needed help with digital payments (e.g.,

during breakdowns). Qualitatively they felt that the work associated with counting notes and handing back change for every transaction was far more than an occasional button click. This relative dimension aligns with studies that attempt to understand the effectiveness of technologies based on their relative impact on one's independence using deterministic ordinal representations of independence captured with self-reporting Likert scales. [201, 206].

Independence also had a social dimension in my studies, particularly about how others viewed people with visual impairments. This is in stark contrast to notions of independence as understood in much of the research at the intersection of HCI and accessibility. In that work, independence is treated as perceptions of the self, which is how independent one feels in performing a specific task using a technology artifact [28, 45, 174]. For instance, Piper et al. and Bigham et al. contend that a major benefit of their respective technology interventions was the resulting sense of independence people felt upon using them [206, 41]. In Studies 1 and 3, I too found independence to be a socially situated phenomenon. However, with digital payments and technology overall, in India, independence involves not just what participants do for themselves, but what they can do for others and their confidence in their abilities to do it. Participants talked about how technology like digital payments and mobile phones made them more demonstrably equal to sighted people. In these studies, 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 [87].

6.1.2.2 Acquisition of Expertise

In Study 3, I find that helping-related interactions between people with visual impairments result in the acquisition of technology expertise. Here, I use literature on peer-to-peer information exchange to situate the interactions that lead to this positive outcome.

Novices often contacted experts within the community of practice to deal with disruptions. Research suggests people seek information from others socially similar or might have more resources than them [106]. In my study, this social similarity stemmed from people's experiences of living with a disability in India. A part of this lived experience entailed understanding technology accessibility. This understanding was fundamental to experts making sense of update-related issues, diagnosing them, and providing solutions. However, sighted people did not understand technology accessibility and were less helpful to novices. Thus, the social similarity defined by disability facilitated information exchange. A common understanding of the disruption caused by the update & technology accessibility, [269] and shared relevance regarding the importance of dealing with update issues were drivers of community

interactions [269].

Literature also suggests one kind of information exchanged between peers is experiential knowledge [44, 180]. In my study, this knowledge took the form of software update recovery practices. Through exchanges with experts, novices understood these practices and gradually became experts. They addressed update-related issues on their own. As a result, they required fewer peer-to-peer exchanges to address their problems. In addition to experiential knowledge, members exchanged resources and artifacts that facilitated recovery (e.g., previous software versions). The value of this experiential knowledge gained through interactions is two-fold: 1) in the shorter term, it had an intended consequence and allowed novices to recover from their update issues; 2) in the longer term, it allowed people to gather technology accessibility expertise, developed through an understanding of update recovery practices. It could be argued that 2) was unintended as novices did not necessarily interact with experts intending to become experts themselves. However, over time, novices implicitly acquired expertise as a matter of course.

6.1.3 On the Actors & Community Dimensions of Help

Given how societies in India are more interdependent placing less value on self-reliance [100] it is also worth commenting on the community dimensions of help and how people with visual impairments worked together to achieve accessibility. In Study 3, I use CoP and LPP theories to show that in the context of disruptive software updates, helping entailed an aggregation of expertise across a community of practice made up of visually impaired technology users. In doing so, I contest prior research that focused primarily on help as a dyadic interaction between two actors, where a helper offers a solution to a problem (e.g., [47, 66]). Moreover, in contrast to assumptions in accessibility research that the helper is offered by someone who is non-disabled, here help *people with visual impairments* was critical in recovering from update-related troubles. The practices of this community encompassed four strategies (e.g., restoration), and used artifacts like prior versions of software) to help people recover from disruptive updates.

Such interactions impacted the larger community rather than just individual help-seekers focused on a specific problem. For example, this was evident when people posted solutions to software update problems in groups. In the context of India, prior research has shown how people in underserved communities during moments of distress and in the absence of state and broader societal support rely on mutual assistance and acts of reciprocity to recover [172, 143]. The community-driven nature of societies in the country [270, 100] means that people are comfortable relying on and supporting one another [100]. I confirm this is true for

people with visual impairments in India. In this context, there is limited state intervention to enforce accessibility, which is common in other Global North contexts [182, 132].

The Indian public has indifferent attitudes towards disability [87], which is likely a key reason why technology providers design inaccessible updates in the first place [256]. People with visual impairments had to undertake the burden of work to address troubles with software updates. In particular, they posted their problems on communities and groups to find solutions. These calls for help created a shared understanding of the problems posed by disruptive updates. There also seemed to be a shared recognition of the relevance of technology without which people cannot accomplish several tasks [138, 48, 49].

Accessibility was also a form of expertise that resided within the community of practice of people with visual impairments in India. People knew others in the community had an understanding of technology accessibility. As a result, they did not have to do the work of describing accessibility to others, which was a problem when they approached sighted people for help [128]. The shared understanding of accessibility meant helpers not only understood the problem but also were able to guide people through solutions in an accessible fashion.

6.1.4 Limitations

My work has some limitations. First, I did not recruit a representative sample of the population of people with visual impairments in India. My participants were mostly middle or upper-middle class, employed, and literate; whereas the majority of Indians with visual impairments are low-income, low-literate, and unemployed [56]. Future research should recruit participants from these groups to paint a more complete picture of helping-related interactions. Further, nearly all participants resided in urban locations. It would be interesting to examine how help manifests in rural Indian contexts, where infrastructures and social dynamics are likely to be different from urban Indian locations (e.g. [212]). A majority of my participants also identified as male and in Studies 1 and 3, I struggled to recruit women participants. It will be important to recruit more women to study in-depth how gender dynamics that prevail in India impact helping-related interactions especially given my preliminary finding in Study 2 that women preferred to seek help from other women. Finally, my results are based on the experiences of a limited number of participants, as is common in qualitative research. Thus, my results likely do not generalize to all people with visual impairments in India. More quantitative studies will be needed to address this gap.

CHAPTER 7

Conclusion

In this dissertation, I use qualitative methods to examine the helping-related interactions of people with visual impairments in India. In doing so, I address gaps in HCI and Accessibility literature where these interactions have been under-explored, including in Global South contexts. My dissertation finds that help is not always an impediment to independence. Rather, in some contexts, help is critical to achieving independence. While examining this relationship between independence and help, I also find that traditional interpretations of independence as self-reliance are narrow. I uncover the relative and social dimensions of independence. For people with visual impairments in India, independence was not just about doing things on one's own, but demonstrating to others that they could. Such nuanced understandings of independence can help us think more deeply about how assistive technologies might impact the lives of people with disabilities: Can these technologies help people with visual impairments do things for others and assist with help-giving [203]? Or enable the user to demonstrate to the world that they are a competent member of society? Answers to these questions might provide a broader focus for designing and evaluating assistive technology.

Help is also culturally situated. Shared cultural expectations underlined by religious values of duty and compassion motivate strangers, family, and close friends to provide help and people with visual impairments to accept the help on offer. Furthermore, help is appreciated and valued so long as people with visual impairments exercise agency in shaping the interactions. By bringing to light the relationship between helping-related interactions and culture, my work also highlights the importance of future research to engage critically with cultural and religious constructs that impact people's lived experiences and social interactions in unique ways, especially in the Global South [100]. This will contribute to more nuanced conversations about the situated interactions of people with disabilities in HCI and Accessibility research. It also contributes to theoretically expanding frameworks like interdependence [36] by bringing to light the values that guide relationships and the subsequent provision of assistance.

Help exchanged between people with visual impairments results in the acquisition of technology-related expertise. In fact, accessibility is a form of expertise that resides within the community of people with visual impairments. Helping-related interactions between community members facilitated the exchange and subsequent dissipation of this expertise among technology novices.

Community-driven exchanges that result in the acquisition of accessibility-related skills and knowledge raise several questions for HCI and Accessibility researchers. For instance, how can technologies be designed to foster and enhance community-driven helping-related interactions for people with visual impairments? Future research has to explore ways to value the accessibility expertise that resides within the community of people with visual impairments. Researchers can explore ways to make explicit these forms of expertise to build robust communities, an area of interest to the CSCW community in particular. Likewise, socio-technical researchers and designers can examine processes via which people acquire these forms of expertise and design technologies that can better support these processes. How can future research center this expertise in research and design processes?

Yet, despite this in-depth research, my conclusions are based on limited technology contexts and moment-to-moment accounts of help. Taking a longitudinal view of help that traverses multiple contexts can better situate the concept. This trajectory is an area for future research.

APPENDIX A

Study 1: Interview and Observation Protocol

** Study 1 relied on a subset of the below interview and observation protocols which were part of a broader study which examined the use of ride-hailing services by people with visual impairments in India

A.1 Interview Protocol

1. Tell me a little bit about yourself
2. What modes of transportation do you use?
3. What circumstances prompt you to use Uber and Ola?
   (a) What modes of transportation did you use before Uber and Ola?
   (b) What do you use Uber and Ola for and why?
4. Can you recall the first time you used Uber and Ola. Can you take me through that process?
   (a) How long back?
   (b) What challenges did you experience?
   (c) How did you overcome the challenges
5. What aspect (feature of the service) do you think has taken you most time to learn/get accustomed to?
   (a) How did you deal with this then and now?
6. Tell me about your experiences using Uber and Ola
   (a) What do you like about it and what dont you like about it?

7. Can you describe (in as much detail as possible) about how you get from one place to another using an Uber or Ola cab?
8. What are the most significant challenges you have experienced while using these services? How do you circumvent these challenges?
9. Can you tell me about any negative experiences you have had using these services? How did you handle these situations?
10. Can you tell me about your experience using the mobile application? What are the challenges you face while using it?
11. How would you describe your degree of independence with Uber and Ola? Can you compare and contrast it with other forms of transportation?
12. What would enhance your sense of independence using services?
13. How has Uber and Ola changed your life?

A.2 Observation Protocol

1. What kind of exchanges took place between rider and driver?
2. What sort of assistance did you provide during the ride?
3. Describe participants' use of technology pre, during and post ride
4. What kind of challenges did participants experience during the ride? How did they circumvent the challenges
5. Describe participants' experiences with payment platforms during the ride (at the time of payment)

APPENDIX B

Study 2: Interview and Diary Study Protocol

B.1 Interview & Diary Study Protocol for People with Visual Impairments

1. Can you tell me about your experience with Orientation and Mobility training?
   (a) What were you taught about dealing with crowded indoor environments?
   (b) What were you taught about seeking help in indoor environments?
   (c) What were you taught about going out with sighted guides?
   (d) What were you taught about troubleshooting (for e.g. when you were lost)?
2. Can you recall a recent instance when you got around your office, a shopping complex, a mall, a library or a hospital (or any other indoor environment)?
   (a) Tell me more about the trip
   (b) How did you prepare for it? Is this generally how you prepare for a trip? How does your preparation change if it is (another less/more familiar location based on first response)? How does your preparation help with the journey?
   (c) Did you go with someone else? Who did you go with? Why did you go with this person? How do you feel about being accompanied by this person - does it affect your sense of independence?
   (d) Were there any challenges with this experience? What were they?
   (e) What are landmarks for you as in relation to indoor environments?
3. What challenges do you face while navigating indoors?
   (a) What kind of obstacles make it difficult for you to navigate indoors? Do you consider people to be obstacles in any way? Why or why not?

(b) What are some challenges that are unique to navigating indoors in comparison to navigating outdoors?

4. Has there been a time recently when you were oriented to an indoor environment?

   (a) If yes, can you tell me about it?

   (b) Who helped orient you? What information did they provide? What were the challenges in orienting to this indoor environment?

5. Has there been a time when you oriented someone else to an indoor environment? If yes, can you tell me about it?

6. Have you used any technologies to help you navigate indoors?

   (a) Can you tell me your experiences with these technologies?

   (b) What did you like about them?

   (c) What are some of the challenges you experienced with these technologies?

7. If you were to imagine a technology that could make it easier for you to navigate indoor environments - what would that look like?

   (a) What are three features you would like in the technology? Which would be the most important of these features and which would be least important?

   (b) Are there any features you would NOT like in the technology? List them.

8. What does it feel like using your mobile phone around others?

   (a) Does it feel different when you use your mobile phone around friends and family vs strangers/people you are less familiar with?

   (b) What does it feel like to use your phone in public spaces?

9. Do you take sighted assistants when navigating indoor environments like offices etc? If yes, can you tell me about the last time you took a sighted assistant while navigating an indoor environment?

   (a) Whose help did you take? Do you often work with this person to navigate indoors?

   (b) If yes, what would you do if this person is not around?

   (c) How do you feel working with others to work through indoor environments?

(d) How do you think the people you work with feel about the assistance they give you in navigating indoor environments?

10. How do people you work with help you navigate indoors?

    (a) Do you hold on to their arm?

    (b) What kind of information do they provide you?

    (c) Do they describe the surrounding environment? Can you give me an example

    (d) Do they indicate any approaching obstacles? Can you give me an example

    (e) Do they provide any physical hints in addition to verbal instructions? Can you give me an example

11. What did O and M training teach you about working with others?

    (a) Can you tell me about the respective roles when working with sighted guides?

    (b) What are the challenges in working with others/sighted guides in navigating indoors?

12. Do you think about how others perceive you when you navigate with other people? How do you think they perceive you?

13. How do you feel about your sense of independence when working with others to navigate indoors?

14. How do you feel about your sense of privacy while working with others to navigate indoors?

15. Let us say you were to go to a crowded shopping complex to shop for a shirt. The shopping complex has several stores next to each other and you want to visit one that you have not visited previously. In general, what would you do to navigate the shopping complex?

16. Let us say you were going to a bank (that you visit twice a month) to open an account by filling out forms. In general, what would you do to navigate and accomplish the task in the bank?

17. Let us say you were going to your workplace desk, which is on the second floor of a building. You visit this location everyday - tell me what you would do to get to your location. In general, what would you do to navigate your office? What would you do to get to an infrequently visited conference room in the same building?

18. Let us say you were going to a friend's house, which you visit a few times every month. What would you do to navigate your friend's house?

19. You said in the Banking scenario you did X but in the Shopping Complex scenario you would do Y? Why the different approach? (Example question: modify based on scenario responses) ? What are the different obstacles that you would encounter (repeat for scenarios)?

B.2 Interview & Diary Study Protocol for Companions of People with Visual Impairments

1. Can you tell me about the last time you accompanied someone with visual impairments in an indoor setting?

   (a) Who did you accompany? How often do you accompany them?

   (b) How did you plan for this trip? Do you try to find information about the indoor layout of the building beforehand? What other information do you try to find about the indoor location?

2. What are specific tasks you perform while navigating with someone with visual impairments?

   (a) What are the challenges, if any, of guiding someone with visual impairments in an indoor environment? What are the specific challenges in guiding people indoors versus guiding them outdoors?

   (b) What could help address those challenges? What could make it easier to work together with people with visual impairments on indoor navigation trips?

   (c) Why do you think (the person you accompany) needs while navigating in such environments?

   (d) How do you think other people perceive you and the person you are assisting when you help them navigate?

3. What other tasks do you help with? How does navigating in indoor environments compare to these other tasks?

   (a) What are the challenges of navigating in indoor environments that are different from these other tasks?

(b) How do you feel about helping with these tasks and navigation related tasks? What are your concerns? Do you like it - if so, why?

(c) How do you think people you support think about the support you give them?

(d) What are some of the everyday activities the people you accompany help you with? How do you feel about this help that they give you?

4. Imagine this - there is an app on a smartphone to help people with visual impairments navigate indoor environments like office buildings, hospitals, shopping complexes, banks and libraries on their own i.e. without a sighted guide. This app will use video from a phone camera to deliver turn by turn directions to enable its users to get to their intended location. The app will use Artificial Intelligence to deliver instructions. To use this app, users must wear the phone around their neck and use an earphone in at least one of their ears.

   (a) How would you feel about the person you accompany using this technology?

   (b) How do you think the people you accompany will feel about using this technology?

   (c) How would you feel about other people with visual impairments using this technology to navigate indoor environments?

   (d) What concerns would you have in people using such a technology? What do you think their challenges would be in using such a technology?

5. If you were to imagine a technology that could make it easier for you to help someone with visual impairments navigate indoor environments - what would that look like?

   (a) What features would you find most useful in the technology?

   (b) What features would be least useful in the technology?

APPENDIX C

Study 3: Interview Protocol

1. Tell me a little bit about yourself. What technologies do you use?
2. Tell me about your experience with software updates
   (a) How do you learn about software updates?
   (b) When was the last time someone gave you information about a software update? Can you tell me more about this.
   (c) Have you got information that was wrong? Can you say more about this.
   (d) What triggers you to update an app on your phone?
   (e) What would prompt you to update an app? What would prompt you to resist updating an app?
3. Tell me about the last time you experienced a good software update
   (a) What made it a good update?
   (b) Did you know in advance that it would be a good update? How so?
4. Tell me about the last time you experienced a bad software update
   (a) What made it a bad software update?
   (b) How did you deal with it?
   (c) Generally, is this the way you deal with bad software updates? What do you do in other cases?
   (d) Were you able to recover from this software update? How did you do that?
   (e) How did you feel about this experience?
5. Can you tell me an especially memorable bad software update

(a) What made it a bad software update?

(b) How did you deal with it?

(c) Generally, is this the way you deal with bad software updates? What do you do in other cases?

(d) Were you able to recover from this software update? How did you do that?

(e) How did you feel about this experience?

6. Has anyone helped you with a software update? If yes, tell me about the last time someone helped you with a software update

   (a) Who did you seek help from? Why did you choose this route? How often do you think you need help when dealing with updates?

   (b) How frequently do you take this route to dealing with updates?

   (c) (If only one time) Tell me about who/where you seek help from otherwise and why you choose that particular route?

   (d) Tell me about a memorable experience when you received help from someone else with an update

   (e) Tell me about the last time you received sighted help from someone with an update

7. Have you helped someone with a software update? Tell me about the last time you helped someone with a software update

   (a) Who did you help?

   (b) How often do you provide help for others to help with negotiating updates? How do you generally help people?

8. Imagine you went to log in to Facebook and you could no longer find the box to post an update - how would you respond to this?

   (a) Is anything like this ever happened? Tell me about it - what did you actually do in such a situation?

9. Some people say that technologies help people with visual impairments become more independent and do things on their own more. Can you tell us about any technologies that helped you do things on your own?

   (a) What did it help you with? How did it help?

(b) What impact did it have on you?

(c) Did you feel like it impacted your sense of independence? How so?

10. Have you ever had an app on your phone or other device have a software update that took away your ability to do something on your own?

    (a) Tell me about it.

    (b) How did you discover this was a problem? How did you deal with it? What impact did it have on you?

    (c) Was this feature ever replaced? Tell me about the last time this happened.

11. Is there anything you would want to tell us about your experience with software updates that we have not asked you about?

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