Designing to Support and Extend the Competencies of People with Visual Impairments

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ABSTRACT

This work sits in the fields of Human Computer Interaction and accessibility research dedicated to the study and development of technology used by people who are blind or visually impaired. Increasingly, researchers have stated the need to get away from technological solutions that intend to 'normalize' disabled individuals, towards providing alternative ways that accommodate diverse bodies and minds. To achieve this, scholars and activists call for a shift in the design paradigm in which both the designers' orientation and the design processes centre not only the needs of people with disabilities but also their lived experience and tacit knowledge. Moreover, more mainstream technologies must be built to accommodate them to the best extent possible, instead of leaving the responsibility to specialised assistive technologies. My PhD has been focused on uncovering and highlighting the competencies that people with visual impairments employ in their technology practices and how these are showcased, by closely examining a corpus of ethnographic data, including a comprehensive set of video demonstrations. Furthermore, my research aims to explore how these findings can be used for practical design within and beyond the accessibility and assistive technology fields, resulting in the production of resources that aid the design for supporting and extending such competencies.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in accessibility**; *Accessibility design and evaluation methods.*

KEYWORDS

Visual Impairments, Ethnomethodology, Accessibility, Assistive Technology

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1 CONTEXT AND MOTIVATION

Great efforts in accessibility and assistive technology (AT) research have sought to investigate, document, ease or remove barriers experienced by people with visual impairments. For example, the everyday visual challenges that they face [10] through the development of technologies such as screen readers, crowd-sourcing services or computer vision apps. Nevertheless, some have pointed out that amidst technological improvements, accessibility barriers remain for these users, and much of the challenges identified one or two decades ago still prevail [21, 45]. For example, a fundamental area that continues posing significant accessibility issues for visually impaired people is online and mobile content (i.e. websites and applications). Despite the existence of web and mobile accessibility standards [46], recent reports have found that a large percentage of the most popular websites do not meet many of the basic requirements to be accessible through screen readers –which are built in, or made for, mainstream mobile phones and personal computers– and other assistive devices such as Braille displays [47]. Moreover, most common issues encountered by visually impaired users are relatively easy to address, such as bad colour contrast, lack of alt-text or transcriptions for images or any other visual content and overall poor structure (e.g. incorrect use of mark-up language, empty buttons or links) [26].

Systems, platforms and software must be accessible so that AT remains usable. This becomes particularly evident with emerging screen-less technologies that could be, and are framed as, potentially useful for visually impaired people, such as smart speakers. But, because some of these are highly dependent on their paired mobile apps (e.g. for logging in, enabling content or granting permissions), whenever the apps are inaccessible, or relevant information is only communicated through visual feedback, the proposed value of such technologies for this demographic, is lessened [34]. Many other technologies also hold promises for visually impaired users, as accesibility research has explored their early adoption and expert usage of haptic interfaces [43], speech input [2], voice control [52], computer vision [19], mobile crowdsourcing services [12] and head-mounted displays [53]. This highlights the importance of extending accessibiliy awareness to areas beyond specialised AT.

Research striving to address this gap seeks to understand the reasons behind the lack of accessibility considerations in general technologies and systematically mitigate it, and to develop solutions that directly cope with such existing accessibility issues. For example, including accessibility modules in design or computer science university courses [23, 24, 33] or implementing AI for automatically generating textual descriptions of visual content on social media platforms [9, 18]. Prior work has also investigated the social implications of using AT, outlining structural and societal barriers experienced by visually impaired people and overall, people with disabilities. For example, work has defined many situations in which participants felt self-conscious about their AT use in social or public settings [11, 41]. Furthermore, specialised AT tends to be expensive, pervasive, sometimes automatically marking users as disabled, and carrying associated stigma or prejudices by non-disabled people, as often they consider disabled individuals as less capable of performing ordinary activities [15, 40]. These are some of the reasons behind the high rates of AT abandonment and low adoption. Accessibility then, should not be an afterthought or a lateral consideration, but it must be incorporated into mainstream technologies, software and product development to the extent possible [22, 32].

2 RELATED WORK

Overall, more work is still needed on improving the experiences lived by people with visual impairments encountering inaccessibility both in physical and digital spaces. However, such endeavours also come with challenges. Despite the enormous support that many technologies provide to disabled people, oftentimes some solutions are still rooted in ableist assumptions. Increasingly, researchers –especially those who are disabled themselves– ask the community for a shift in framing the work that targets disabled users, getting away from a medicalised model that formulates disability as a problem or burden [51] or that defines research goals and motivations upon pre-established assumptions, for example, that the ultimate goal of technology for visually impaired people is to help them become fully independent and substitute different forms of human support [4]. Thus, my PhD aims to explore how to directly include the experiences of visually impaired people in technological design.

Previous work has addressed the need to sensitise, educate and orient design practitioners, researchers and students in order to inform their professional practice so that systems are optimised for people with disabilities, or to the very least, do not exclude them. For example, in AT research, the ability-based design framework [49] has been a fundamental baseline of substantial technological development. It comprises seven principles that orient designers to "what a person can do", moving the burden of adaptation from the user to the system, building solutions that adapt to individuals' functional abilities. However, this framework does not comprise other personal (e.g. attitudes) and external elements (e.g. social situation) that also play an important role in the adoption and use of AT. Beyond AT research, and especially for professional web development, guidelines and standards have been established to help practitioners comply with accessible requirements [46]. Yet, lack of awareness and low prioritisation of accessibility in real-world projects is still common [33].

Critiques of empathy exercises as a resource for design in professional and academic settings have been outlined [6], as research has shown that they reinforce prejudice, misconceptions and represent disability as something inherently negative, for example in replacing the input and participation of visually impaired participants by instead conducting blindfolded activities. A relevant example addressing this issue is the Design for Social Accessibility (DSA) approach in which a series of user-centred workshops have been conducted with mixed-visual abilities participants (i.e. visually impaired and sighted) and facilitated by design practitioners [38]. They further developed and iterated design method cards that allowed stakeholders to generate accessible designs that incorporate social factors [39, 42].

AT research across the last few decades has established that people with disabilities must be included in the design process of technology solutions, not only for testing or evaluating them but from early stages where ideation happens and relevant decisions are made (e.g. what is the defined problem to be addressed?). As a response, participatory design and co-design approaches have been naturally adopted in AT research involving people with visual impairments [7, 29, 31, 37]. However, participatory design has not been exempted of critique, as concerns about extractive practices with marginalised groups have been raised and questions about who is consulted in the process remain (e.g. carers, physicians or end-users) [16, 48]. Thus, there is a noticeable shift in research employing methods that recognise, respect and centre the lived experience and knowledge of people with disabilities. For example, *biographical prototypes* [5], in which participants' under-recognised design work was featured and elevated through design material that mirrored adaptations of their own creation in their daily lives. More recently, autoethnographies by disabled researchers in which they narrate their own experiences (e.g. while travelling, life in academia) have been providing insights for technology design through personal stories [20, 50]. Further, some research has explored the collaborative practices of visually impaired makers and do-it-yourself (DIY) communities [8, 27], while other work has employed co-design approaches centring the collaborative practices of sighted and visually impaired stakeholders in specific settings or organisations, for example, designing resources for children in schools [28, 30], and for outrigger paddling in a public environment [3].

3 RESEARCH QUESTIONS AND APPROACH

My PhD aims to bridge and expand the previous work herein outlined, exploring how the knowledge, expertise, abilities and needs of people with visual impairments can be effectively and respectfully communicated to researchers and designers within and beyond the AT field. Further, my work aims to address some of the experiences of inaccessibility in the everyday lives of this demographic; many of which are a result of misconceptions, unfamiliarity and unawareness from those who make design decisions.

Instead of directly investigating the challenges, issues and barriers experienced by people with visual impairments – many of which are heavily documented in the literature – my PhD seeks to uncover the specific methods they use in their everyday activities with and around technology, moving the focus away from a negative framing. Adding to work that propose people with visual impairments as potential power or expert users of assistive and mainstream technologies [1, 32, 44], my work addresses the following research questions:

- RQ1. What are the everyday technology practices of people with visual impairments and what are the competencies enabling them?
- RQ2. How are these competencies being showcased? How can they be investigated, ascertained and communicated?

- RQ3. How can these findings support technology design involving both visually impaired and sighted stakeholders?

To answer these questions, I adopt in the first instance, an ethnomethodological approach [17]. Originated in the sociology traditions and widely implemented in HCI to inform the design of interactive systems, ethnomethodology requires the researcher to practice a particular kind of attention and inquiry for understanding the activities of people, concentrating on common-sense reasoning in everyday life. The focus is on articulating the organisation of social actions, by considering the people of the group studied as competent members, capable of producing and engaging in the social order. Thus, the researcher objective is to uncover the methods used by members of the group to accomplish practical action and practical reasoning in their ordinary activities. That is, instead of coming to the setting with pre-assumptions of the actions or behaviour of people, ethnomethodology-informed research allows a bottom-up approach to ascertain what it is that people *actually* do. This approach can provide valuable outcomes for emerging accessibility research. Instead of articulating visual impairments as problematic, the main goal of my research is to uncover and highlight how participants practically accomplish their ordinary activities, in much the same sense that anyone performs mundane or routine actions that can be later supported or leveraged by technology design.

My research comprises two main studies branched in three stages, below described. The first and second stages are based on an empirical study with visually impaired participants investigating their everyday technology practices. The first stage is focused on understanding participants' practices and unearthing the competencies enabling them. The second stage is focused on analysing technology demonstrations, a pervasive phenomenon captured during fieldwork. Lastly, the third stage will comprise a workshop study shaped by the findings obtained so far, resulting in the production of design materials for co-design activities with visually impaired participants.

4 WORK TO DATE AND CONTRIBUTIONS

I conducted an in-depth ethnographic study for four months with visually impaired participants, and through conducting it and analysing the data collected, I have made progress answering RQ1 and RQ2. The study comprised research immersion at group meetings facilitated by a charity that supports people with visual impairments, one-on-one interviews with 11 participants recruited there, and observation of their technology use at home and the charity office. Data was collected using a mix of field notes, photos, audio and video recordings. Analysis of the data collected in this study was two-fold (stages one and two).

4.1 Stage One: Uncovering the competencies of people with visual impairments (Completed)

Data gathered in fieldwork was assembled in an ethnographic record [13] consisting of the ordinary or mundane practices participants conduct in their everyday lives (note the use of the term 'mundane' as to emphasise that such practices are thoroughly unremarkable to participants). Three main sets of technology practices were found: social relations and communication, textual reading and mobility. Most of these practices involved mainstream and assistive technologies to different extents, but there were also a few accounts of practices where technology is not present. Naturally, access barriers and challenges experienced by participants were documented, confirming findings already outlined in previous research. Nevertheless, the main objective of this research was to uncover participants' competence in performing their ordinary activities, that is, how they manage to accomplish activities regardless of the issues encountered.

Drawing on an ethnomethodological orientation, examples of how different activities are accomplished were unpacked, by analysing detailed fragments of video and audio data. For example, composing and sending text messages using a mobile phone in different ways and using various aids to read printed text. By analysing these fragments in detail, moment by moment, sets of competencies were outlined, comprising functional, social and adaptation levels. For example, screen reader users listening to fast-paced synthesised speech, participants varying methods for adapting their technologies to social situations and their specific configurations in physical or digital spaces that work for their own needs. These findings have been published in a CHI'20 paper which I led as the first author [35]. This piece of work contributes to areas of knowledge in HCI and accessibility research, demonstrating the practical application of ethnomethodology as an approach for investigating visual impairments, and overall the discussion that such approach can provide relevant outcomes for investigating disability [14]. Moreover, we introduced the concept of competencies and outlined several examples emerging from empirical evidence.

4.2 Stage Two: In-depth exploration of technology demonstrations (Ongoing)

Further analysis of the video data collected in the ethnographic study led to focus on a pervasive phenomenon captured in this investigation: technology demonstrations, in this case, when the demonstrator is visually impaired, and the observer is sighted. The analysis was conducted employing an ethnomethodological approach (with elements of conversation analysis [36]). Albeit a ubiquitous but unremarked and sometimes disregarded phenomenon in HCI research, the attention turned to the interactional work of demonstrating assistive and mainstream technologies. In other words, what is involved in demonstrating, how a demonstration is organised, and furthermore, how demonstrations are connected to the competencies outlined in stage one. Therefore, this analysis generated two main discussion points: 1) demonstrations are part of substantial HCI research but not necessarily acknowledged as an intended or desired method for capturing human activity, and 2) demonstrations are fruitful for enabling demonstrators to showcase some of their competencies, explicitly rendering them for the observer.

This work is described in a paper currently under revisions, in which I am the lead author. We further argue that demonstrations are effective in providing accounts of real-world activities, as they show specific configurations created to fit their needs (e.g. bodily, object customisation), repair of participants' troublesome or uncertain interactions, routine methods such as resetting their actions after failed attempts, or repeatedly verifying their actions to make sure they were correct. Thus, the contribution of this piece of work would be adding to longstanding methodological discussions in HCI about capturing 'naturalistic' or 'realistic' data and provides a detailed examination of a method in the toolset of researchers that has been long employed but perhaps overlooked in HCI. This work further contributes to current approaches and the broader conversation regarding research in a global pandemic, showcasing the use of video demonstrations as a viable and rich data source.

5 FUTURE WORK AND CONTRIBUTIONS

Future work will comprise the exploration of competencies and demonstrations as resources for designing with and for visually impaired people, aiming to reach researchers, practitioners or students within and beyond the field of AT research, moving on to answer RQ3. This stage of work is currently under planning. The exact structure of the workshops and the final form of the design materials are yet to be detailed. Given the current pandemic circumstances, this research will be conducted online.

5.1 Stage Three: Design workshops for supporting and extending competencies (Under planning)

Building on the results obtained in stages one and two, the last stage of my research will comprise a set of design workshops involving the participation of people with mixed visual abilities, drawing on critical participatory design and co-design approaches. I strive to include participants with visual impairments in all workshops to obtain their perspective and direct feedback. Likewise, I aim to target researchers, designers or students conducting work within and beyond accessibility research. The workshops will initially have an open-ended structure for which I will develop an initial version of design material informed by findings of stage one and two. Thus, the workshops and resources will incorporate the concepts and examples of competencies and demonstrations to prompt discussions and facilitate design activities. The design material will be inspired and informed by other examples of design cards [39], critical collections [5], and projects driven by disabled communities (e.g. Critical Axis project [25], that collects and analyses disability representation in media). Such design material will be refined through the workshops. The concept and variety of competencies will be presented to and validated by, participants with visual impairments, whilst also being presented to sighted participants, prompting discussions about how these are or could be taken into consideration in their professional practice. Furthermore, a set of specific demonstrations will be incorporated in the workshops schedule, so that participants conduct them to showcase various competencies. Video demonstrations previously collected or readily available online are also considered as material for the workshops. The main goal would be to focus on positive or neutral experiences, rather than negative ones, in which visually impaired people exhibit their competence, proficiency and expertise. The expected contribution of this future work is to advance knowledge in participatory design and co-design with visually impaired participants, that could be extended to work involving other disability or marginalised groups. Ultimately, my work will contribute to this design space with the development and evaluation of the design material created for and through the workshops.

6 ACADEMIC STATUS

I am in my third and final year as a PhD student in Computer Science at the University of Nottingham, supervised by Dr. Joel Fischer and Dr. Stuart Reeves. I expect to conduct the future work planned, above described, in the first two quarters of 2021. By the time the Doctoral Consortium takes place, I will be wrapping up data collection. Feedback at this point would be considerably helpful as I move on to the last part of analysis and ultimately, dissertation writing. My projected completion is in the last quarter of 2021. Eventually, I aim to continue and grow a career as HCI researcher.

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