A Competencies Framework of Visual Impairments for Enabling Shared Understanding in Design

Submitted 10 January 2023, in partial fulfillment of
the conditions for the award of the degree **PhD Computer Science.**

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Abstract

Existing work in Human Computer Interaction and accessibility research has long sought to investigate the experiences of people with visual impairments in order to address their needs through technology design and integrate their participation into different stages of the design process. Yet challenges remain regarding how disabilities are framed in technology design and the extent of involvement of disabled people within it. Furthermore, accessibility is often considered a specialised job and misunderstandings or assumptions about visually impaired people's experiences and needs occur outside dedicated fields.

This thesis presents an ethnomethodology-informed design critique for supporting awareness and shared understanding of visual impairments and accessibility that centres on their experiences, abilities, and participation in early-stage design. This work is rooted in an in-depth empirical investigation of the interactional competencies that people with visual impairments exhibit through their use of technology, which informs and shapes the concept of a *Competencies Framework of Visual Impairments*. Although past research has established stances for considering the individual abilities of disabled people and other social and relational factors in technology design, by drawing on ethnomethodology and its interest in situated competence this thesis employs an interactional perspective to investigate the practical accomplishments of visually impaired people. Thus, this thesis frames visual impairments in terms of competencies to be considered in the design process, rather than a deficiency or problem to be fixed through technology. Accordingly, this work favours supporting awareness and reflection rather than the design of particular solutions, which are also strongly needed for advancing accessible design at large.

This PhD thesis comprises two main empirical studies branched into three different investigations. The first and second investigations are based on a four-month ethnographic study with visually impaired participants examining their everyday technology practices. The third investigation comprises the design and implementation of a workshop study developed to include people with and without visual impairments in collaborative reflections about technology and accessibility. As such, each investigation informed the ones that followed, revisiting and refining concepts and design materials throughout the thesis. Although ethnomethodology is the overarching approach running through this PhD project, each investigation has a different focus of enquiry:

- The first is focused on analysing participants' technology practices and unearthing

the interactional competencies enabling them.

- The second is focused on analysing technology demonstrations, which were a pervasive phenomenon recorded during fieldwork, and the work of demonstrating as exhibited by visually impaired participants.

- Lastly, the third investigation defines a workshop approach employing video demonstrations and a deck of reflective design cards as building blocks for enabling shared understanding among people with and without visual impairments from different technology backgrounds; that is, users, technologists, designers, and researchers.

Overall, this thesis makes several contributions to audiences within and outside academia, such as the detailed accounts of some of the main technology practices of people with visual impairments and the methodological analysis of demonstrations in empirical Human Computer Interaction and accessibility research. Moreover, the main contribution lies in the conceptualisation of a *Competencies Framework of Visual Impairments* from the empirical analysis of interactional competencies and their practical exhibition through demonstrations, as well as the creation and use of a deck of cards that encapsulates the competencies and external elements involved in the everyday interactional accomplishments of people with visual impairments. All these contributions are lastly brought together in the implementation of the workshop approach that enabled participants to interact with and learn from each other. Thus, this thesis builds upon and advances contemporary strands of work in Human Computer Interaction that call for re-orienting how visual impairments and, overall, disabilities are framed in technology design, and ultimately for re-shaping the design practice itself.

Acknowledgements

First and foremost, my most sincere gratitude to my supervisors Dr Joel Fischer and Dr Stuart Reeves for their continuous and encouraging support throughout my PhD journey. From the very early days, they guided me in navigating research and academia, and through the uncertainty of the pandemic, providing the necessary advice and critique for adapting my work to the unprecedented circumstances whilst giving me the space to develop my own directions. I am very thankful for their mentorship which not only spanned my doctoral research but also my wellbeing and professional development.

I am indebted to the staff, volunteers, and service users of My Sight Notts for generously welcoming me to start my ethnographic research at their premises. Many thanks to Lydia for helping me establish the initial contact with the charity, Angela for offering me options for my research there, Rachael for the sighted guide training and volunteer onboarding, Sarah and Alan for letting me join their social gatherings, and Donna for helping me recruit participants and schedule individual sessions at the facilities. I also thank the groups of visually impaired people that were so kind to share the call for participants for my online study. All my thanks go to the people who took part in the two studies presented in this thesis, for their time, effort, expertise, and enthusiasm.

I thank the National Council of Science and Technology of Mexico (award number 710041), the University of Nottingham, and the School of Computer Science, which collectively have funded my PhD studies. Furthermore, I thank the Mixed Reality Lab and the School of Computer Science for supporting my attendance at academic events and conferences, both online and in person, including travel and accommodation. I am very grateful for the teaching and research opportunities at the School of Computer Science and the Horizon Research Institute, which not only helped me financially but also contributed significantly to strengthening my research skills and deepening my knowledge in relation to the work in this thesis. Likewise, I thank my internal assessors, Dr Andy Crabtree and Dr Michel Valstar, for their valuable feedback and suggestions for improving my work. I also want to thank my thesis examiners, Dr Alex Taylor and Dr Andy Crabtree, for the thought-provoking conversation during my viva and for the constructive recommendations I was provided with to revise this thesis.

Other academic groups and researchers have also been fundamental in helping me develop my thinking around disability and accessibility in HCI. I thank workshops organisers and anonymous reviewers that prompted me to consider different perspectives from which I could approach and frame my research. I am thankful to the members of fempower.tech for organising a range of online activities throughout the pandemic, many of which serendipitously contributed to shape my research. I thank the chairs and participants of the CHI 2021 Doctoral Consortium for their feedback and the ASSETS 2021 conference for the opportunity to be a student volunteer and experience first-hand the work of making an online conference accessible. Thanks to AMC SIGCHI and ACM SIGACCESS, respectively, for funding my registration to these conferences.

I am thankful to several friends and colleagues in the Mixed Reality Lab and Horizon Research Institute. In something akin to an order of appearance in my journey, I want to thank: Juan Pablo Martínez Ávila, Gustavo Berumen Salazar, Carolina Fuentes, Martin Porcheron, Susan Ali, Velvet Spors, Serena Midha, Teresa Castle-Green, Damla Kiliç, Pepita Barnard, Alfie Cameron, Johann Benerradi, Andriana Boudouraki, Edgar Bodiaj, Pablo López Custodio, Cecily Pepper, and Rita Peña.

I also want to thank my family. Gracias de todo corazón familia por el apoyo incondicional y por darme las bases para llegar hasta donde hoy me encuentro, por ayudarme en este proyecto que implicaba irme al otro lado del mundo (las dos veces). A mi papá, Raul Reyes Uribe, por inculcarme el valor de la honestidad y el trabajo. A mi mamá, Carmen Cruz Valadez, por el tiempo, la dedicación y los cuidados. A mi hermana, Dalma, por ser cómplice y compañera. A mi abuelita Evelia, mi tía Maria, y mi tía Bella por prender la veladora y estar siempre al pendiente de mi. A Abraham, Belem, Esme, Montse, Nuria, y demás familia y amistades que me han tenido presente a lo largo de este proyecto.

And last but not least, I am eternally grateful to my partner Adam McGregor. Pursuing this PhD and finishing this thesis has been made possible largely to his material and emotional support. Throughout this journey, he has generously put time and effort to help me accomplish each milestone, from proofreading emails and manuscripts, to supporting the illustration sourcing of my design cards and helping me connect with relevant contacts for recruiting study participants. He has consistently been a light in the difficult times and has continuously taken care of me when I have been at my busiest capacity. For your unconditional love, support, care, and patience, gracias totales.

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Chapter 1

Introduction

There are more than two billion people in the world living with some form of visual impairment (VI) (World Health Organization, 2021), and thus they are one of the main populations of interest in accessible computing research. Possibly due to the visually centred nature of digital systems and the physical world, devising ways to make them accessible for visually impaired people (VIP)[1] has become an important goal, and as such, a great deal of past accessibility work in Human Computer Interaction (HCI) has overwhelmingly concentrated on this user group (Mack et al., 2021). Despite great efforts put into understanding their needs, perspectives, and experiences and into designing and evaluating a range of systems for improving physical and digital accessibility for them, challenges remain regarding how VI are framed in technology design and the extent of involvement of VIP within the design process. Furthermore, HCI research has continuously exhibited VIP as regular or expert users of mainstream[2] and assistive technologies (AT). However, making them accessible, or even knowing about VIP users, is commonly considered a specialist job rather than a general concern of researchers and designers regardless of their domain, leading to a myriad of inaccessible technologies and little awareness of this problem.

This thesis presents an ethnomethodologically-informed design critique for supporting

[1]Throughout this thesis, I use both people-first (i.e. people with visual impairments) and identity-first (i.e. visually impaired people) terminology when referring to disabilities and visual impairments. See section 1.7 for an expanded description of the language and terms herein used.

[2]Technologies designed for the general public as opposed to assistive technologies, which are specifically designed for people with disabilities as target users.

awareness and shared understanding of VI and accessibility in the early stages of technology design that centres on the participation and experiences of VIP. This work is rooted in empirical research investigating VIP's technology practices and competencies enabling them, further providing a critique of how technology design overlooks *current practices* and, consequently, *existing competencies*. The overarching goal of the whole thesis is to sensitise researchers and designers, within and beyond specialised fields, to the experiences of VIP. This work proposes to reframe how VI are conceptualised or even considered in technology design as a way of advancing accessible computing.

The remainder of this chapter continues elaborating on the **research problem and motivation** laid out so far, then stating the **research questions** driving this thesis work. Furthermore, this chapter presents a summary of **contributions** and the audiences or **areas**, within and outside academia, that benefit from, or can find interest in, the work presented in this thesis. Then, an overview of the **thesis structure** is presented, briefly describing the purpose and content of each of the remaining chapters. A list of **publications** related to this thesis is also included, clearly stating my individual contribution to each of them. Lastly, core **language and terms** used throughout the thesis are briefly described and justified to establish a common ground with the reader.

1.1 Problem and Motivation

Great developments in accessible computing have been achieved in the past forty years, from the early considerations of disability in human-interface design (Buxton et al., 1986) to accessibility steadily gaining traction within the HCI community over the years, finally becoming a popular topic in major conferences. In fact, the proportionate growth of accessibility papers at CHI has outpaced the growth of CHI itself in the last five years (Mack et al., 2021). Nevertheless, it is retrospectively recognised that the field had in its beginnings a clear focus on developing individualised solutions through a perspective that considered disability as a problem caused by functional impairments which could be fixed through technological design, employing what is known as the medicalised model of disability (Holloway & Barbareschi, 2021; Wu, 2021; Mankoff et al., 2010). Key turning points have occurred over the years helping to transform and reorient accessibility research in HCI (Holloway & Barbareschi, 2021), for instance by shifting the attention to ability instead of disability in design (Wobbrock et al., 2011), by calling for the bridging with disability studies and disabled lived experiences in designing AT (Mankoff et al., 2010), and by stressing the role of social and relational dynamics in the use of AT and how these should be strongly considered in design (Shinohara & Wobbrock, 2011; Bennett et al., 2018).

However, while accessible computing has advanced, there is still much to do. Contemporary strands of accessibility research in HCI that draw on disability studies, disability activism, and are often led by disabled researchers, continue to challenge the perspectives employed in the design of some current AT and so-called inclusively designed products. These perspectives, despite their intentions, keep framing–or just assuming–disability as a deficit to be corrected through said solutions, which ultimately are not what disabled people want or need (e.g. see Jackson et al., 2022; Williams et al., 2021; Wu, 2021; Spiel et al., 2019) and can lead to harmful and paternalistic narratives about disability (Williams & Gilbert, 2019b; Ymous et al., 2020). Moreover, these new waves in accessibility research are asking the field to move beyond the characterisation of disability as merely functional impairments and encompass societal and cultural aspects in research and design, thus acknowledging and grappling with the complexity of disability (Holloway & Barbareschi, 2021).

In addition, whilst the direct involvement of disabled people in accessibility research is a widespread community norm (e.g. in user, formative, and evaluative studies), some have argued for a more active participation of end users in design. Participatory and co-design methods have been suggested as means of achieving such a goal but have had a relatively low occurrence in the field throughout the years in comparison to other design methods (Mack et al., 2021). Yet, as recent work increasingly moves to adopt participatory, co-design, and community-based approaches for engaging with disabled people in technology design (Baldwin et al., 2019; Meissner et al., 2017; Metatla et al., 2020), there continue to be salient critical discussions within and outside HCI about the extent of said participatory work or the lack thereof (Williams and Gilbert, 2019a; Costanza-Chock, 2020); for instance, concerns about extractive practices, the people who get consulted in the process (e.g. carers, physicians, end-users), and how relevant decisions about the design project are made (e.g. what is the defined problem to be addressed?). Furthermore, design engagements that include people with disabilities often focus on the testing or evaluation stages, reducing their participation to merely giving feedback. While efforts are increasingly made to actively involve them in ideation and prototype creation (Sahib et al., 2013; Metatla et al., 2015; Bennett et al., 2016; Morrison et al., 2017), more work is needed to explore how disabled people can be included and empowered throughout *all* the stages of design (Ladner, 2015).

Within this context, this thesis specifically investigates and engages with VIP in early-stage design. Although past work in accessible computing has investigated VI and designed for them quite extensively, certain gaps and areas of opportunity in the field exist; for instance, ethnographies and case studies have been seldom employed (Mack et al., 2021) and design work is often focused on developing individualised technical fixes or solutions that are unlikely to scale (Holloway & Barbareschi, 2021). Moreover, many issues encountered by VIP when using technology occur because accessibility of mainstream technologies is frequently considered as an ad-hoc matter in both academia and the industry, if ever considered at all (Tigwell et al., 2021). Thus, accessibility should not be an afterthought but it must be incorporated into mainstream technologies, software, and product development to the greatest extent possible (Ladner, 2016; Newell & Gregor 1999).

However, it has been found that professionals in the workforce lack accessibility knowledge and experience; they do not know about disabled users or how to engage with them (Patel et al., 2020); and existing guidelines or standards are often confusing or unsuitable to their practice (Swallow et al., 2014). Therefore, it becomes imperative to communicate the needs and experiences of VIP to those outside dedicated fields in practical and sensible ways, whilst grappling with known and newly identified shortcomings of accessible computing efforts, so that erroneous or even ableist assumptions about VIP are not amplified.

This thesis aims to address and bridge the gaps thus described by presenting an ethnomethodologically-informed design critique for supporting awareness and shared understanding of VI that brings together people with and without VI from different technology backgrounds and levels of familiarity with accessibility and VI topics. To do so, this thesis employs *ethnomethodology* (EM) (Garfinkel, 1967), due to its particular interest in *membership* competence, to conceptualise a *Competencies Framework of Visual Impairments* that is rooted in empirical observations of practical accomplishments of VIP exhibited through using and demonstrating various technologies, and thus offer a lens for technology design that does not frame disability as a deficit but rather positions it in terms of *competencies*. This thesis will exhibit that, although past accessibility work in HCI has extensively investigated VIP and their technology use, little is known about the *interactional work* behind it. Therefore, this work will illustrate that employing an ethnomethodological perspective can benefit and advance efforts in accessible computing. Although this thesis does not follow the route of improving the accessibility of particular technologies through a prototype or system design, the present work identifies and offers opportunities for researchers and designers to adopt a competencies framework to inform their design practice.

1.2 Research Questions

In order to address the gaps so far established, this thesis pursues the following overarching research question:

- **RQ. How can the participation, knowledge, and experiences of VIP be integrated into early stages of technology design?**

To answer this, the work in this thesis is driven by sequential sub-questions.

- **RQa. How do VIP use technology in their everyday lives and what are the interactional competencies they employ?**

  - RQa1. What are the main everyday technology practices of VIP?
  - RQa2. What technologies do they use and for what purposes?

- **RQb. How can the findings from empirical work be used to motivate new practical ways to approach research and design with VIP?**
  - RQb1. What are the composition and social organisation of demonstrations?
  - RQb2. What research and design insights can be obtained through demonstrations?

This thesis starts by enquiring how it is that VIP use technology in the first place by conducting an ethnographic study of the technology practices of VIP. By orienting the investigation towards uncovering what ethnomethodologists call the 'missing what' (described in Chapter 3), this thesis employs a ground-up approach to ascertain what it is that people *actually* do. Then, this thesis moves to identify and develop paths for research based on the outcomes of the empirical work that serve to address RQ. It is through answering RQa and RQb that the conceptualisation of a *Competencies Framework of VI* begins and is refined: firstly by providing detailed accounts of VIP's technology practices and competencies; then by identifying technology demonstrations by participants collected during fieldwork as a source for further analysis revealing they are a fruitful tool for enabling shared understanding between demonstrator-audience; and lastly, by developing a design critique in the form of an online workshop that brings the empirical insights together to answer the main research question.

1.3 Contributions

This thesis makes four original contributions to existing bodies of work from different fields (See 1.4 for a description of such research areas and their relation to the following contributions).

- **A. Providing detailed accounts of everyday technology practices by, and competencies of, VIP:** Adding to past work that has investigated *what* technologies VIP use and *for what purposes*, this thesis unpacks *how* technology activities are conducted in their daily lives. Instead of focusing on identifying access barriers or associated workarounds, this thesis uncovers how VIP practically accomplish ordinary technology practices, in much the same sense that anyone performs mundane or routine actions. Moreover, through conducting this investigation, the interactional and situated **competencies** enabling those technology practices are ascertained.

- **B. Identifying the significance of demonstrations in HCI and providing a methodical examination of empirical demonstrations:** Although a common resource in HCI for showcasing outcomes (i.e., technology demos), frequently featuring empirical HCI research (e.g., in fieldwork, contextual inquiry, home tours) and communities of VIP (e.g. for learning about technology), this thesis addresses demonstrations' lack of methodical examination, establishing their prominence and value for research on VI and HCI more broadly. This thesis unpacks the *work* of demonstrating by VIP and ascertains the core features that make these instances recognisable as 'demonstrations'.

- **C. Informing and implementing a design critique approach for supporting awareness and shared understanding of VI:** Building on contributions A and B, this thesis proposes and executes an online workshop approach that brings together people with and without VI from different technology backgrounds. The material components developed to provoke conversations between participants consist of 1) a deck of reflective design cards defined from empirical insights that encapsulate competencies, tools, activities, relations, and locations involved in technology use by VIP, and 2) video demonstrations collected during fieldwork that, through their methodical examination, are positioned as resources for enabling shared understanding.

- **D. Conceptualising a Competencies Framework of Visual Impairments:** Informed by the empirical work, this thesis develops and offers a framework that, instead of articulating VI as problematic, moves the focus towards highlighting the interactional competencies of VIP and the situational context exhibited when using and demonstrating a range of mainstream and assistive technologies. This work foregrounds the need for collaborative reflection in the design process, so it becomes one that incorporates the participation and knowledge of VIP in design engagements that are not solely focused on producing technology solutions from the outset, and that targets people from different fields within and beyond accessible computing.

1.4 Research Areas

The contributions established above benefit or could be of interest to a range of interrelated areas inside and outside academia. These areas are represented in Figure 1.1 as a Venn diagram that includes the contributions that impact them.

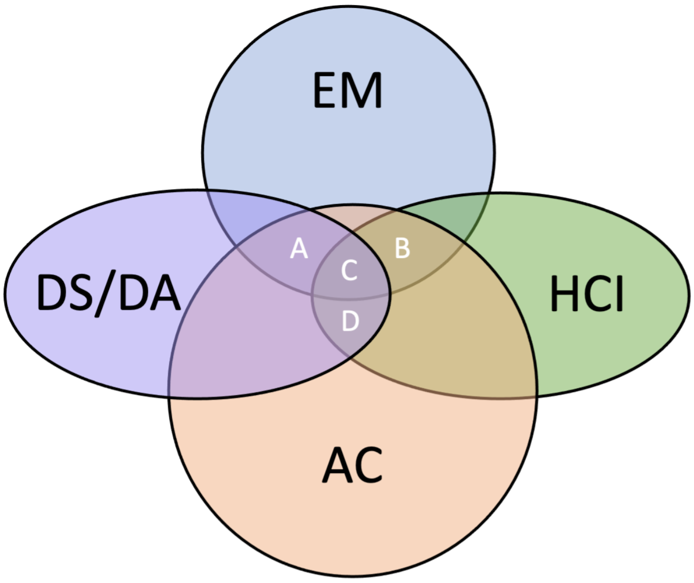


Figure 1.1: Venn diagram showing the relationship between the contributions of this thesis and the research areas they are addressing.

- **Ethnomethodology (EM):** This thesis adopts ethnomethodology as the overarching approach for conducting and analysing the ethnographic investigation with VIP that underpins the design critique. Thus, both the empirical investigations and the way these are employed in informing the remainder of the thesis are relevant to this research area.

- **Accessible Computing (AC)**: Naturally, this thesis adds to the work of scholars and designers investigating and designing for/with VIP and disabled people. Moreover, it contributes to sensitising and awareness work that includes efforts to engage with professionals in the industry and teachers and students of Computer Science and related majors. Therefore, this area comprises accessibility research in HCI and other computing domains.

- **Human-Computer Interaction (HCI):** This thesis also addresses a broader HCI audience. Firstly, those conducting qualitative empirical HCI research that features or could adopt demonstrations as a method for data collection, and secondly, researchers conducting participatory or speculative design endeavours that wish to include collaborative reflections and materials such as reflective cards and video demonstrations in their practice.

- **Disability Studies and Disability Activism (DS/DA):** Lastly, the research in this thesis is rooted in the lived experiences of VIP, and thus aligns with principles of disability studies and disability activism work outside academia. Thus, this thesis is also addressed to scholars, designers and activists interested in bridging disability theory and lived experience with technology design.

1.5 Thesis Structure

Eight chapters comprise the work of this thesis, structured as follows:

- Chapter 2 establishes the theoretical and methodological underpinnings of this thesis. Firstly, it introduces the notion of competence, specifically elaborating on ethnomethodology's concern with **membership competence** and how this concept can be employed to explicate VI. Then, the **nature and use of demonstrations** is surveyed given their occurrence during fieldwork and their presence within communities of VIP. Lastly, approaches employed in **understanding and conducting design for/with VIP** are reviewed.

- Chapter 3 introduces the **methodology** adopted in addressing the research gaps; that is, an ethnomethodologically-informed design critique for supporting accessibility awareness. **Ethnography** is the approach employed for data collection, thus this chapter describes it and its appropriateness for answering the research questions. **Ethnomethodology** is the analytical orientation employed in the fieldwork and analysis, so a brief elaboration of core concepts is also provided.

- Chapter 4 introduces the **ethnographic study conducted with VIP,** initially facilitated by a local charity supporting them. Thus, detailed descriptions of the research immersion, participant recruitment and data collection are provided. Then, this chapter unpacks the everyday technology practices of participants and **unearths the competencies** enabling such practices, also summarising the members' methods found. Lastly, this chapter highlights **demonstrations as a pervasive phenomenon** in the fieldwork data and positions them as a source worthy of further methodical examination.

- Chapter 5 follows the research path established in the previous chapter and analyses a subset of data consisting of technology demonstrations conducted by VIP during the ethnographic study which helped me to make sense of their world. This chapter investigates the **social organisation and composition of demonstrations**, foregrounding demonstrations as a fruitful medium to exhibit competencies and further **enable shared understanding** between a demonstrator with VI and an audience, whilst identifying design areas that can benefit from adopting them. Ethnomethodological findings are also discussed.

- Chapter 6 combines the insights obtained so far and devises and implements a **design critique in the form of an online workshop** where people with and without VI from different technology backgrounds and with different levels of familiarity with the topics collaboratively reflect and discuss accessibility and VIP's experiences using tools developed from the empirical work. These tools consist of a set of **video demonstrations** collected during fieldwork and a deck of **reflective**

design cards representing the competencies of VIP and external tools, activities, relations and situations involved in their use of technology. This chapter further discusses results from implementing such an approach and how the tools enabled participants' interactions and reflections, supporting awareness and shared understanding of VIP's experiences.

- Chapter 7 returns to the research questions established in the introduction and **discusses the contributions** of this thesis, outlining a *Competencies Framework of Visual Impairments* as a resource for engaging with VIP in technology design.
- Chapter 8 concludes this thesis by pointing out the **limitations of this work and the research directions identified** from it.

1.6 List of Publications

This thesis encompasses two main empirical studies branched into three different investigations. For all this work, I was responsible for the research design, data collection, main analysis, and write-up of results. As such, I am the lead author of all the publications (archival and non-archival) that are linked to this thesis. The outcomes of the first study, comprising the first two investigations, have been published in the proceedings of peer-reviewed conferences and a journal in Human Computer Interaction. Moreover, other work in this thesis has been accepted to lightly reviewed venues such as conference workshops and a doctoral consortium, thus helping to shape some of this thesis' contents. The publications produced in relation to this thesis are listed below, indicating the specific empirical chapters that include such work.

Empirical work presented in Chapter 4 has been published or accepted as:

- Gisela Reyes-Cruz, Joel E. Fischer, and Stuart Reeves. 2020. Reframing Disability as Competency: Unpacking Everyday Technology Practices of People with Visual Impairments. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems.* Association for Computing Machinery, New York, NY, USA, 1–13. DOI: `https://doi.org/10.1145/3313831.3376767`

- Gisela Reyes-Cruz, Joel Fischer, and Stuart Reeves (2019). "An ethnographic study of visual impairments for voice user interface design". In: *Workshop on Addressing the Challenges of Situationally-Induced Impairments and Disabilities in Mobile Interaction* at the 2019 CHI Conference on Human Factors in Computing Systems. url: https://arxiv.org/abs/1904.06123

Empirical work presented in Chapter 5 has been published or accepted as:

- Gisela Reyes-Cruz, Joel E. Fischer, and Stuart Reeves. 2022. Demonstrating Interaction: The Case of Assistive Technology. ACM Trans. Comput.-Hum. Interact. 29, 5, Article 48 (October 2022), 37 pages. https://doi.org/10.1145/3514236

- Gisela Reyes-Cruz, Joel Fischer, and Stuart Reeves (2020). "New Approaches to Investigate Disability in HCI". In: *Workshop Nothing About Us Without Us: Investigating the Role of Critical Disability Studies in HCI* at the 2020 CHI Conference on Human Factors in Computing Systems.

Empirical work presented in Chapter 6 has been published as:

- Gisela Reyes-Cruz, Joel Fischer, and Stuart Reeves. 2022. Supporting Awareness of Visual Impairments and Accessibility Reflections through Video Demos and Design Cards. In Nordic Human-Computer Interaction Conference (NordiCHI '22). Association for Computing Machinery, New York, NY, USA, Article 67, 1–15. https://doi.org/10.1145/3546155.3546697

Lastly, this lightly reviewed publication also includes some of the work in this thesis:

- Gisela Reyes-Cruz. 2021. Designing to Support and Extend the Competencies of People with Visual Impairments. *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems.* Association for Computing Machinery, New York, NY, USA, Article 68, 1–6. DOI: https://doi.org/10.1145/3411763.3443425

1.7 Language and Terms Used

This thesis uses a range of concepts and terms that can be defined and employed in several ways, thus here a brief description of how they are used within this text is provided.

Firstly, disability terminology is often contested and continues to evolve. As such, a variety of conventions and personal preferences exist across groups and geographical regions. For instance, in some countries such as the USA, the convention is to use person-first language (i.e. people with disabilities, people with visual impairments), whereas in countries of Europe identity-first language is preferred (i.e. disabled people, blind people, visually impaired people) (Holloway & Barbareschi, 2021). The former responds to the need to acknowledge people without imposing reductionist views attached to their disability. The latter is a political response to reclaim terms that should not have a negative connotation, and to express that people are 'disabled' by the environment and society rather than a physical or mental impairment. In this thesis a decision was made to employ both person-first and identity-first language to recognise such a diversity of conventions, preferences and advocacy stances (Frauenberger et al., 2016). This decision is inspired by similar positionings from other researchers in HCI addressing the chosen disability language (e.g., see Bennett, 2020; Spiel et al., 2018; Storer & Branham, 2021). Moreover, in this thesis, people without disabilities are generally referred to as 'non-disabled' rather than 'able-bodied', as terms such as the latter inherently imply that disabled people "lack the ability to use their bodies well" (National Center on Disability and Journalism, 2021).

Furthermore, specific VI are referred to in this thesis in terms of how participants described themselves. Given that this PhD research was conducted in the UK, such terms are in the majority 'blind' and 'partially sighted', although some people used the equivalent terminology employed by the National Health Service (NHS) (i.e., severely sight impaired and sight impaired[3], respectively). For clarity purposes, the term 'visually impaired' is used to encompass all the participants, regardless of their specific VI. Lastly, people without VI are sometimes referred to as 'sighted' or 'non-VIP'. The terms 'different visual

[3]NHS website. Blindness and vision loss, Registering as blind or partially sighted, `https://www.nhs.uk/conditions/vision-loss/`

abilities' or 'mixed-visual-abilities' are used to refer to groups comprised of people with and without VI.

Lastly, as previously hinted when outlining the research areas related to the work herein presented, this thesis uses the term 'Accessible Computing' to refer to the umbrella domain dedicated to *"applying computing and information technologies to empower individuals with disabilities and older adults"* (Special Interest Group on Accessible Computing, n.d.). This main domain, however, is comprised of and intersects with several other fields such as medicine, rehabilitation engineering, policy making, and a range of computing areas such as computer vision and machine learning. For that reason, this thesis uses the term 'accessibility research' to specifically refer to work done in HCI investigating disabled people and designing technologies for them.

Chapter 2

Literature Review

This chapter synthesises the theoretical and methodological background that motivates the original research conducted in this thesis, initially shaping the research questions established in 1.2. Four main themes are presented in this chapter:

- The Notion of Competence: This section briefly introduces various perspectives on the concept of competence and, more specifically, elaborates on ethnomethodology's concern with membership competence as a resource for understanding VI.

- Demonstrations and Visual Impairments: In this section, the meaning and relevance of demonstrations in relation to VI are explored, including how they are existing features of VIP communities and accessibility research on VI.

- Visual Impairments in Technology Design: This section presents a brief history of VI in Accessible Computing research, reviewing origins and evolution. Key work sensitising people to VI in design is also reviewed.

- Understanding Visually Impaired People and Their Technology Use: Lastly, this section reviews work researching VI and the state-of-the-art of technology for VIP, highlighting the standard practices and methods employed in the field.

2.1 The Notion of Competence

The previous chapter introduced the problematic framing of VI and other disabilities as deficits to be corrected through technological solutions. This thesis is, then, aligned with contemporary strands in accessibility research that are primarily concerned with moving away from said perspectives. However, in contrast to other efforts in the field, this thesis proposes the notion of competence as a starting point to understand and conduct design with VIP. This section provides a broad overview of competence and an introduction to the notion specifically explored in this thesis (i.e. membership competence).

2.1.1 Perspectives on Competence

The term 'competence' has a variety of meanings, both in everyday and scientific usage. In a broad sense, it can be understood as *"the ability to do something well"* or *"an important skill needed to do a job"* (English Cambridge Dictionary, n.d.(a)); however, further attempts at developing expanded explanations of competence have been heterogeneous, oftentimes confusing or contradictory (Delamare-Le Deist & Winterton, 2005). For instance, competence can be seen as an individually-situated concept i.e. a capability or characteristic possessed by a person; as a socially-situated concept insofar as there is an expected standard to which the person is performing a task; or as an integration of both (Schneider, 2019). The term can be perceived as a binary scale (i.e. competent vs not competent) or as a continuum (i.e. from competence to excellence) (Eraut, 1998). The meanings, uses, and purposes of the notion of competence greatly vary between disciplines, having been developed and applied mostly in educational and professional sectors (Hager & Gonczi, 1996; Short, 1984). The focus has been on assessing and 'teaching' competence in specific domains of practice and across domains; for instance, in preparing people for future occupational performance whilst providing them with skills that can be transferable across particular jobs. Thus, a range of theoretical models and frameworks exist about the concept of competence, referring to a variety of generic and specific skills, knowledge, attitudes and several other related concepts (Weinert, 2001; Schneider, 2019). Where several frameworks and models of competence are concerned with the cognitive and motivational attributes of individuals and their effects on outcomes and performance metrics, practical competence is often 'shrouded in the theoretical' (Delamare-Le Deist & Winterton, 2005). The purpose of this thesis, however, is not to define or assess competence under theoretical attributions, but rather to understand the competence that VIP practically employ for conducting everyday activities, not restricted to specific jobs or domains of practice. Ethnomethodology (Garfinkel, 1967), and its particular interest in membership competence, becomes then a pertinent approach for investigating the lifeworld of VIP. The next section elaborates on such a particular notion.

2.1.2 Membership Competence

Ethnomethodology is an approach of social inquiry that analyses everyday activities from the perspective of the people who are engaged in conducting them. The focus is on unveiling the taken-for-granted and often invisible methods that people (referred to as 'members') use to organise such everyday affairs (Garfinkel, 1967). For EM, competence is not a matter of mental or motivational representation but phenomena that become visible and accounted to others as practical actions i.e. observable-and-reportable, account-able (Garfinkel & Sacks, 1970). Ethnomethodology is not concerned with generic competence nor the competence of a particular individual but the competence involved in being a member of society or a collectivity, comprising all the *"capacities to speak, to know, to understand, to act in ways that are sensible in that society and in the situations in which they find themselves"* (Have, 2005, pp. 36). Therefore, ethnomethodology assumes, from the outset, that members are competent and capable of ordering situated action in and as the *"capability of managing one's everyday affairs without interference"* (Garfinkel, 1967, pp. 57).

Given that ethnomethodology focuses on the visible, accountable, and locally produced methods employed by members in accomplishing their everyday activities, some relevant analyses have shed light on the competencies of people with disabilities, challenging notions that regard them as incapable of participating in social life. For example, Goodwin's work (2004) revealed how Chil, a man with aphasia, competently communicated with others despite only being able to speak three words (i.e. yes, no, and) by coupling them with gestures, gazes, and bodily orientations built upon other people's talk and actions. In a similar vein, Robillard's book (1999) provides an autobiographical account of his experience with paralysis and speech loss in his mid-life, detailing the taken-for-granted methods that he gradually lost, both physical (e.g. the series of movements required to stand up from bed) and socially situated (e.g. orienting one's body and gaze towards others to get their attention). He further describes the new ways he, along with people in his inner circle, developed to communicate and interact with others (e.g. head and lip movements, spelling letters to be interpreted and voiced as words by others). Nonetheless, Robillard also recounts how, more often than not, people excluded him from social participation by dismissing the methods he was able to produce and organise, *"showing how we shut off those who can not follow our pace"* (Have, 2005, pp. 47).

Other analyses of situated members' methods have also exhibited the competence involved in living with a VI. For instance, Garfinkel describes Helen, a woman with congenital night blindness, who configured the arrangement of cookware in her kitchen in just such a way that she may then competently and fluidly produce meals for her partner (Garfinkel & Rawls, 2002). Critically, Helen's careful siting of various pots, pans, and utensils in a specific spatial organisation on her wall is itself an account of the specific situational competencies she developed in response to her visual condition. Due & Lange (2019) examined how blind people walk in urban areas, skillfully using white canes as extended resources that facilitate navigation (e.g. by sweeping from side to side in coordination with legs and feet movement), describing some of the obstacles they encounter and the orderly features involved in object collision and journey repair. In a similar vein, Vincenzi et al. (2021) investigated the collaborative navigation accomplishments of blind people with their sighted guides, and found how the pairs co-constitute common spaces and repair ruptures through talk, bodies and objects as resources when navigating together (e.g. announcing a step or narrow path, bending an arm to indicate change of position). Similarly, Vom Lehn (2010) investigated how VIP experience art with their sighted guides in public galleries; as they employed different ways for encountering artwork (i.e. touching and seeing), *shared* experiences of the pieces were only successful when sighted guides aligned to visually impaired modalities (e.g. touching the exhibits).

Although detailed accounts of the members' methods involved in experiencing the world as a VIP can provide relevant material to be explored in design, ethnomethodological analyses in accessibility research are rather rare (e.g. Ibrahim et al., 2018; Vincenzi et al., 2021). This thesis addresses such a gap and further demonstrates how VI can be thought of in terms of competencies by focusing on understanding what is entailed in *"skilled and competent doing-being-blind-persons"* (Due & Lange, 2019), instead of articulating or assuming them as 'problematic' or less capable of conducting ordinary activities.

2.2 Demonstrations and Visual Impairments

As noted in the Introduction, demonstrations by VIP were a phenomenon captured during the fieldwork of this thesis, serving as a medium to understand the lifeworld of VIP. Demonstrations are a secondary finding and subsequent research direction in this thesis, but also represent an existing feature of VIP's community life and research on VI. This section presents a brief typology of demonstrations, both in everyday and HCI usage. Then, the particular interest in unpacking demonstrations as a resource for investigating VI is elaborated on.

2.2.1 A Typology of Demonstrations

Demonstrations are a common occurrence in everyday life when taken as a broader phenomenon, i.e., *"the act of showing someone how to do something, or how something works"* (English Cambridge Dictionary, n.d.(b)). It can be reasonably assumed that everyone has had to demonstrate how to use an object or perform an activity (e.g. a feature on a smartphone, the way of cleaning a room). Demonstrations can be seen as exhibitions or *"performances of a tasklike activity out of its usual functional context in order to allow someone who is not the performer to obtain a close picture of the doing of the activity"* (Goffman, 1974, pp. 66). Demonstrations are usually conducted by proficient performers and they can be done for learning or evidential purposes. A key characteristic is that two parties are always involved: a demonstrator and an audience or observer; as such, they can be positioned as social interactions (Smith, 2004).

Demonstrations of technology have a long and storied history in HCI research and practice, from Englebart's 'Mother of All Demos' —the first live demonstration of a system showcasing the computer mouse and other items of modern computing—(n.d.) through to tech demos played out on stage during product launches (Barr, 2000). While this 'performative' type of demo has had a significant cultural impact in HCI and several examinations of demos produced by researchers or developers for an intended audience have been conducted (e.g. see Elish, 2010; Johri, 2016), other forms of demonstrations, frequently present in empirical HCI research, have received far less explicit methodological focus. More 'mundane' demonstrations performed by research *participants*—where a participant shows and explains the use of some technology, its functionality, problems encountered, and so on—are not unknown to HCI but routinely feature as ways to understand technology use in home or work settings. For example, demonstrations may appear within ethnographic studies, including in situ interviews and observations (Taylor & Swan, 2005; Ganglbauer et al., 2012; Jain et al., 2013). Beyond more typical ethnographies, contextual inquiry (Beyer & Holtzblatt, 1998) is a potential site for demonstrations to take place, as well as 'home tours' (Taylor et al., 2007) where an investigator visits participants' domestic environments and is shown objects or features of interest within it. As an approach 'home tours' seem most strongly predicated on the social organisation of demonstration as participants surface relevant features of their home life and its relationship to digital technologies. However, demonstrations in empirical research can be seen as a 'means to an end': an alternative to observations of 'naturally occurring' activities, not as a focal point themselves. Often, the researchers' intent is to observe activities that participants would 'normally' carry out, sometimes prompting questions arising from the on-site observation e.g., in contextual inquiry (Beyer & Holtzblatt, 1999), but in practice the phenomena captured takes the form of demonstrations.

However, demonstrating technology, as we commonly experience it, entails much more than just showing an artifact. Taylor (2015) argued that much of what happened to the sides of or behind the scenes in Engelbart's demo might have been obscured by its careful choreography. He urges us to move beyond the notion of the interface or the 'interaction' as discrete or disconnected from the interwoven set of relations happening between user and computer. In a similar vein, Smith (2004) argued that the many hidden layers beneath the demo, if not acknowledged, have the potential to mask HCI issues. Smith hoped that their work examining commercial technology demos could serve as a starting point to enquire about what is actually communicated through other forms of research-based demonstrations, particularly those aimed at supporting our understanding of human activity instead of those intended for public view. In this thesis, I aim to address a component of such a gap that I believe has not been tackled yet.

2.2.2 Demonstrations in Visual Impairment Communities and Research

Video recordings of VIP demonstrating how they perform different activities in their everyday lives (e.g., using various technological devices) have been increasingly gaining attention on social media platforms such as YouTube and TikTok (Wilson, 2020; Lasker, 2020). VIP are thus progressively recognised not only as consumers of media content but also creators (e.g., Seo & Jung, 2017). These demonstrations available online have two main purposes: to serve as informative and instructional material for others within the VI community and to reach out to non-VIP as a type of advocacy and awareness work. Such demonstrations are not confined to video platforms but are a salient feature of community life for VIP, as can be seen in the common activities and services offered by several organisations and charities that support them, often provided by VIP as experts themselves (e.g. Royal National Institute for the Blind, n.d.). Despite the relevance of demonstrations in VI culture, accessibility research has not engaged with them, neither as a topic of study nor as a core resource to analyse VIP's interaction.

Some studies have observed VIP demonstrating activities or objects of daily living as part of other data collection methods such as interviews and observations (Albusays et al., 2017; Bennett et al., 2019; Branham & Kane, 2015a; Williams et al., 2014). For example, Bennett et al. (2019) conducted interviews at participants' own spaces as part of their formative work collecting stories of design work or adaptations done by disabled people, including VIP, in which they could often demonstrate its use. Branham and Kane (2015a) also interviewed blind participants at home, who conducted tours showcasing housewares and demonstrations of some activities. However, demonstrations in these examples are mentioned as a *desired complement*, and not drawn out for focused attention. Notably, Lazar et al.'s chapter on case studies (2017a), where there is a brief form of examination of demonstrations as a methodological tool, used mostly examples of AT investigations to illustrate case studies' nature and best research practices. This might be the case due to the difficulty of recruiting large samples of participants with disabilities and the need for studies in this field to focus in detail on the greatly varied AT uses and users. A few studies where demonstrations have *explicitly featured* in research on VI include Albusays et al.'s (2017) observations of blind programmers demonstrating their coding practices by sharing screen and audio through video call software. The authors noted that explicitly asking participants for demonstrations of positive experiences helped to obtain breadth in the data corpus, which would otherwise have focused only on the negative ones. Likewise, in Shinohara and Tenenberg's case study (2007) a blind person demonstrated and discussed software and non-software artefacts of her daily life, sharing past use instances and feelings about them. Notwithstanding these examples, demonstration-driven or explicit acknowledgement of demonstrations in empirical research of VI is uncommon. Thus, there remains an opportunity for investigating what can be learned about VI through demonstrations conducted by VIP and explore whether demonstrations can support design activities.

2.3 Visual Impairments in Technology Design

This section expands on the overview presented in the Introduction, providing a detailed picture of VI in Accessible Computing, accounting for its origins and contemporary strands of research that are increasingly reorienting the field. Moreover, this section briefly reviews approaches for sensitising designers to the experiences of VIP.

2.3.1 Evolution of Accessible Computing

The development of screen reader software has been groundbreaking for enabling VIP to use computers and mobile phones, providing access to visual elements on the screen through the keyboard or touchscreen with the information being conveyed as audio. Nevertheless, despite these advancements, a major issue of AT is that it continues to 'lag' behind mainstream technology, endlessly having to 'catch up' (Edwards, 2008). Screen readers were originally designed for DOS systems (Han 2022), but when graphical user interfaces began to be adopted and popularised, they had to be re-developed to fit this new form of interaction. Similarly, when mobile phones with touchscreens were introduced, mobile screen reader software had to be devised, implementing new gestural ways for VIP to have access to them (Kane et al., 2008). Making the Internet accessible to VIP has also proved a major challenge. When websites do not have the correct underlying structure, they become inaccessible even when using screen readers. It would seem that a major strand of Accessible Computing over the years has been occupied with 'technical patches' or 'fixes' to make inaccessible websites and apps work for screen readers. If systems were designed accessibly from the outset, no AT or enforcing legislation would be needed (Edwards, 2008). Remarkably, several technology designs originally developed for disabled people have found–or fought–their way into the mainstream (Newell, 2008); for instance, audiobooks and text-to-speech technologies used by VIP. Many argue that putting the needs of disabled people at the forefront pushes innovation (Asakawa, 2021), thus establishing the value of Accessible Computing for other fields in Computer Science, and the need for the creating and strengthening of bridges with them.

Building upon the social model of disability which argues that disability is not defined by personal impairments but by the barriers people face in society (Oliver, 2013), the work of Shinohara (2017) has evidenced the role of social factors in making computing accessible. Shinohara & Wobbrock's (2011) qualitative work investigating AT use (mostly by VIP) in social contexts showed that there is stigma linked to AT, marking users as disabled (something people might want to conceal), but despite feelings of self-consciousness, functional access is sometimes prioritised. In subsequent work, Shinohara & Wobbrock (2016) investigated experiences of VIP and deaf people when using AT in public or social situations, and reactions by non-disabled people when witnessing AT use. They found that when technology or its use fails, it negatively affects social perceptions and interactions (e.g., non-disabled seeing disabled people as not capable of performing ordinary activities), whereas when the technology interaction goes well, self-efficacy and self-confidence manifest, leading to positive social interactions and perceptions. Therefore, the authors highlighted the necessity to make mainstream technology accessible.

Accessibility researchers are now moving beyond the social model of disability, mostly building on Feminist Disability Studies (Garland-Thomson, 2005; Kafer, 2013; Wendell, 2013) and disability justice activism (Piepzna-Samarasinha, 2018); the argument is that solely considering disability as a social construct neglects how stigma falls upon *"particular kinds of bodies, minds and ways of being"* (Kafer, 2013, pp. 6). For instance, researchers are now interrogating independence as the ultimate goal of AT for VIP (e.g. in navigation technologies), and prioritising interdependence and relations with others instead (Bennett et al., 2018; Bennett et al., 2020), and challenging pre-established goals and motivations that do not actually reflect what disabled people want or need, such as smart canes or haptic shoes (Jackson et al., 2022). Other critiques of the social model concerning systems design have emerged; of particular interest to this thesis, Dewsbury et al. (2004) proposed ethnomethodology as an approach to move beyond the shortcomings of the social model; however, their proposition turned out to be less popular as signified by its lack of adoption in the field (as mentioned in 2.1.2). Hence, there is a missed opportunity to employ ethnomethodology as a lens for unpacking situated interactions as experienced by VIP, foregrounding their ways (or methods) of being in the world.

2.3.2 Sensitising to Visual Impairments in Design

Different forms of sensitising work have been extensively implemented in HCI and professional design to help consider a variety of users. Within Accessible Computing design, the purpose has been to ameliorate this disconnection by advocating a deeper development of empathy with disabled users. However, how to proceed in doing so remains a challenge. Traditional empathy-building exercises often include simulation of disability, as exemplified by the University of Cambridge's Inclusive Design toolkit (n.d.) that includes capability loss simulators (e.g., glasses occluding vision to illustrate different VI) and sets of personas representing diverse sets of users in terms of ages, sensorial abilities and personal attitudes (Inclusive Design Toolkit, n.d.). However, simulating activities such as doing tasks while blindfolded have been the subject of severe critiques in disability advocacy within and outside HCI (Bennett & Rosner, 2019; Nario-Redmond, 2017), as they offer a narrow view of the actual experiences of disabled people; yet, they continue to be a common practice in Accessible Computing at large.

Other ways of developing empathy have been sought. User Sensitive Inclusive Design highlights designing for dynamic diversity; that is, recognising that people's abilities change. The approach switches the term 'centred' in UCD to 'sensitive' as *"it suggests that the users are firstly people and that the designer should develop an empathetic relationship with them, rather than treat them as 'subjects' for usability experiments."* (Newell et al., 2011, pp. 237). In spite of the efforts in empathy and relationship-building with disabled people in design, it has been noted that traditional notions of empathy are inherently limited (Bennett & Rosner, 2019; Spiel et al., 2017). Building on the idea that disabled users should be part of the design team during the whole process, from the early stages and not only at the end for evaluating systems (Costanza-Chok, 2020; Ladner, 2015), participatory and co-design work with VIP has increasingly been conducted (Brulé & Bailly, 2016; Metatla et al., 2015; Morrison et al., 2021). But, whilst the ethos of many of these projects is geared towards centring the needs, desires, and wellbeing of disabled people, participatory and co-design work are certainly not a panacea of accessible design; critical tensions exist such as acknowledging and recognising power dynamics and meaningfully engaging with disabled people in ways that are not tokenistic (Williams & Gilbert, 2019a). Thus, there is also a noticeable shift in research developing practices that recognise and respect the tacit knowledge and lived experience of people with disabilities, favouring them over designers' ideas; for instance, in highlighting socio-material adaptations that disabled people commonly create to adapt to inaccessible environments, products, and services, and to express their identity and creativity (Bennett et al., 2019; Jackson, 2018; Profita et al., 2018). However, the notion of 'tacit knowledge' is often vague and remains under-explored.

Two approaches for accessible design are worth highlighting. Possibly the most influential framework in accessibility research, the Ability-Based Design approach (Wobbrock et al., 2011) orients designers to 'what a person can do', moving the burden of adaptation from the user to the system, often using self-adaptive or user-adaptable interfaces to match users' abilities, which are measured, modelled or predicted based on user performance. The Design for Social Accessibility (DSA) approach, (Shinohara et al., 2016, 2018, 2018a, 2020) has been deeply informed by empirical investigations with VIP (as reviewed in 2.3.1) and establishes three tenets: 1) the incorporation of users with and without disabilities in the design activities, 2) the consideration of both functional and social factors in design, and 3) the use of tools for stimulating such consideration. Their overarching objective was to encourage sighted designers and students to learn about VIP and make them engage with users with different VI in one-off workshops and across design courses; their work demonstrated that, in fact, designing for them is not an impossible or difficult task if direct interaction with users and tools is supported. Despite these efforts, more work and tools are needed to further develop this connection between VIP and non-VIP for supporting accessible design.

2.4 Understanding Visually Impaired People and Their Technology Use

The field of Accessible Computing has long studied both the nature of VI, and the design, development, and evaluation of technologies to assist and support VIP in their day-to-day, and improve their quality of life (Bhowmick & Hazarika, 2017; Glinert & York, 2008). Most of the early work on VI was primarily dedicated to building and testing AT for VIP, with a recognisable medical model lens (see 2.3.1). Over time, the field has diversified to encompass other interests and motivations, such as a range of daily activities of VIP, both featuring and excluding technologies (e.g., shopping, recreation and sports, entertainment and creative practices), and various approaches to involve VIP more actively in design (see 2.3.2). In the following, two main topics concerning VIP are reviewed. Firstly, what the abilities of VIP are and how those are investigated. Secondly, what the technologies commonly used by VIP are, how those are used by VIP, and how they are investigated by Accessible Computing researchers.

2.4.1 Investigating Visually Impaired Abilities

Given the relevant work of Wobbrock et al. (2011) calling for centring systems design on ability instead of disability, here I briefly review works investigating VIP's abilities, with the focus on knowing what those abilities are in Accessible Computing and what is already known about them.

Across the literature focused on VI, there is a general consensus that VIP primarily use other senses—particularly touch and hearing—in their daily lives to counteract the lack of full or partial vision. This is signified by the myriad of systems and prototypes designed and evaluated that make use of tactile and auditory modalities to interact with them (Bujacz & Strumiłło, 2016; Pawluk et al., 2015), commonly in an input-output dyadic (i.e., interacting by touch and receiving feedback through audio). This has been largely regarded as designing for VIP's abilities, for instance by Kane et al.'s (2008) project proposing innovative tactile and haptic gestures for VIP to interact with a touchscreen and having different specific information read aloud as a result[1]. However, many of these studies evaluate the usability of systems, and therefore the abilities of VIP, through experimental tasks, measuring performance in terms of accuracy and time taken.

More specifically, it is widely known that, as VIP rely on listening to sounds and speech, their listening skills are 'better' or more developed than those of sighted people. The quintessential example illustrating this is that several screen reader users commonly cus-

[1] This project knowingly inspired the development of VoiceOver for Apple mobile devices (Wobbrock, 2017)

tomise them to speak at a very fast rate (Ladner, 2008). Nevertheless, systematic or in-depth studies of VIP's listening skills in accessibility research have been rarely conducted (Stent et al., 2011; Bragg et al., 2018).

A substantial strand of work in Accessible Computing is entirely dedicated to understanding navigational techniques employed by VIP (Bhowmick & Hazarika, 2017), from the more traditional ones such as white canes, guide dogs, and sighted guiding (Williams et al., 2013; Vincenzi et al., 2021), to an evolving range of systems aiming to enable independent navigation, such as mobile apps, remote sighted assistance, and smart aids (Csapó et al., 2015; Lee et al., 2020).

The range of VIP's conditions and experiences has been also acknowledged in the past. For instance, research has outlined explicit differences in interaction methods between and within partially sighted people, blind people, and people going through gradual vision loss (Bartlett et al., 2019; Guerreiro et al., 2010; Trewin et al., 2010; Zhao et al., 2018). Oliveira et al. (2011) also highlighted different sensory, cognitive, and motor capability levels among blind participants, which are not always taken into consideration by design. Beyond traditional considerations of audio-tactile and navigational abilities, calls for understanding and designing around the sensory and embodied capabilities and knowledge of VIP have recently been made (Bandukda et al., 2021; Brulé & Bailly, 2018; Metatla et al., 2019; Morrison et al., 2021). Moreover, recent moves towards encompassing disabled people's experiences beyond only functional ability (Frauenberger, 2015; Holloway & Barbareschi, 2021) have broadened the scope of ability considerations, and as such, the literature is increasingly investigating 'social abilities' in terms of situational negotiations (Thieme et al., 2018; Branham & Kane, 2015b), mundane attunements (Bennett et al., 2020), and collaborative creation and maintenance of accessible spaces (Branham & Kane, 2015a).

2.4.2 Investigating Visually Impaired Technologies and Uses

In terms of specific technologies, research has examined VIP's use of desktop computers, mobile devices, and screen readers (Fajardo-Flores, 2017; Kane et al., 2009; Leporini et al., 2012; Szpiro et al., 2016; Wahidin et al., 2018; Ye, 2014). A large and long-standing body of literature has also investigated technologies for outdoor and indoor navigation and wayfinding (Bhowmick & Hazarika, 2017; Guerreiro et al., 2018).

Naturally, accessibility issues of websites and mobile applications have been prominently investigated (Damaceno et al., 2018; Leporini et al., 2012; Tomlinson, 2016). However, many of the challenges identified one or two decades ago still exist (Kuber et al., 2012; Vtyurina et al., 2019). Despite the existence of web and mobile accessibility standards (Web Accessibility Initiative, n.d.), 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 nowadays built-in and/or installed in mainstream mobile phones and personal computers– and other assistive devices such as Braille displays (WebAIM, 2022). Moreover, it has been found that the most common issues encountered by VIP could be relatively easy to address, especially if they were considered from the early stages of design (as stated in 2.3.2). Some of these issues are bad colour contrast, lack of alt-text description for images or other visual content, and overall poor structure (e.g. incorrect use of mark-up language, empty buttons or links) (Mankoff et al., 2005).

Thus, mainstream systems, platforms and software must be accessible so that AT used by VIP remain usable. This becomes particularly evident with emerging technologies that could be, and are framed as, potentially useful for VIP; for example, screen-less devices such as smart speakers. However, due to their dependency on their paired mobile apps (e.g., for logging in, enabling content or granting permissions) and their evolved design incorporating digital screens, 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 (Pradhan et al., 2018). Many other technologies also hold promise for visually impaired users, as accessibility research has explored their early adoption and expert usage of haptic interfaces (Stearns et al., 2016), speech input (Azenkot & Lee, 2013), voice control (Zhong et al., 2014), computer vision (Grayson et al., 2020), mobile crowdsourcing services (Burton et al., 2012) and head-mounted displays (Zolyomi et al., 2017).

It is important to note that several investigations of technology practices are often tied to new prototypes or systems as part of formative work gathering requirements (Brulé et al., 2020). Likewise, the aim of a substantial body of research is towards understanding the purposes, attitudes, perceptions, and feelings that are held by VIP in relation to technologies. In turn, fewer works have aimed to understand current technology or non-technology practices with no intention to inform a specific design project. This strand of literature has responded to the 'turn to the social' (see 2.3.1) in Accessible Computing. These works naturally favour qualitative approaches, such as interviews, diaries, and direct observations. In terms of ethnographic, observational, or *in situ* methods, past accessibility research in HCI examining socio-material practices of VIP has employed a range and mix of methods. Whenever possible, some have conducted a number of their interviews at participants' homes, which consequently allowed them to collect photographic evidence of the various assistive technologies and adaptations employed by participants (e.g., Kane et al., 2009; Shinohara & Wobbrock, 2011). Others have moved to investigate naturally occurring activities *in situ*, such as shopping practices (Yuan et al., 2017), children's classroom and field trip activities (Brulé & Bailly, 2018), or the travelling experiences of Paralympic athletes (Thieme et al., 2018), which inherently have involved ethnographic observations. Nevertheless, the time and effort required to conduct such types of studies have been acknowledged (Yuan et al., 2017), which would serve to explain why these methods are very uncommon within the field (Mack et al., 2021).

On the whole, although locating accessibility issues and obtaining accounts of VIP's perceptions and feelings towards technologies is valuable for identifying design opportunities for their improvement and innovation, more work is still needed to understand the detailed and organised ways in which VIP conduct their technology practices for centering them in future design endeavours.

Chapter 3

Research Approach

This thesis is, in the first instance, preoccupied with uncovering the 'missing interactional what' of *how* VIP conduct their everyday technology practices. To this end, ethnography is the approach adopted for obtaining a bottom-up account of what it is that people *actually* do. Building upon the introduction to ethnomethodology presented in 2.1.2, this chapter establishes *ethnomethodologically-informed ethnography* (Crabtree et al., 2012) as the particular kind of ethnography adopted for the work conducted in this thesis, in the field and afterwards; that is, an ethnomethodological perspective informed and influenced not only the data collection and analysis but also the subsequent design critique for supporting accessibility awareness, conceptualised from the empirical findings. Hence, the relationship between ethnomethodology and design is also discussed in this chapter.

Although the ethnomethodology perspective runs throughout the research, each study chapter in this thesis addresses different specific aims and their focus of inquiry varies. Moreover, the methodological application and analysis of the design critique approach (Chapter 6) significantly differs from the two other chapters. Notwithstanding, each piece of work has informed those that followed, from the initial immersion in the field and participant observation investigating VIP's technology practices and competencies (Chapter 4) to the in-depth analysis of demonstrational work as an emerging phenomenon in such fieldwork (Chapter 5), and the use of those empirical findings for developing and implementing a design critique approach in the form of online workshops (Chapter 6). Furthermore, there are some overlapping methodological techniques across chapters 4 and 5, as both of them analyse and present data collected in the same ethnographic study, making use of video recorded material for unpacking participants' actions and interactions. This chapter elaborates on other key methodological concepts that serve as a background and rationale for the research presented in this thesis. Note that this chapter does not describe the practical details related to the procedure of data collection and analysis; instead, that information can be found within each corresponding study chapter.

3.1 Ethnography

Ethnography has become a widespread approach across several disciplines including system design (Blomberg et al., 2002), which is concerned with obtaining first-hand perspectives of particular social phenomena by getting close to the people who conduct it and understanding how they make sense of it (Brown, 2013). By employing ethnography, a bottom-up approach is taken, without arriving at the setting with prescriptive assumptions or pre-defined concepts of interest (Baszanger & Dodier, 2004), and without taking a problem as given, but rather seeking to "*uncover the world from the point of view of the social actors within it*" (Randall et al., 2007, pp. 56).

Originated in the anthropological traditions and later adapted and transformed by sociological scholarship, contemporary ethnography can take many forms and guises (Baszanger & Dodier, 2004; Harrison, 2014). That is, although research practices under the ethnography label may be similar or shared, they are often grounded in different paradigms or epistemologies. Moreover, the nature and application of ethnography have been sites for disagreement, where some have been more concerned with the methods and procedure and others with the lens through which human activities are observed (Blomberg et al., 2002). Therefore, it is necessary to situate and rationalise the particular kind of ethnography adopted in this thesis, namely ethnomethodologically-informed ethnography (Crabtree et al., 2012). Yet before elaborating on the characteristics of the analytical–ethnomethodological–orientation employed for achieving the purposes of this thesis (later provided in 3.2), it can be useful to briefly review the origins of ethnography and the hereditary key precepts for conducting fieldwork that continue to be at the centre of ethnography in HCI and related fields such as CSCW.

Although somewhat contested (Atkinson & Hammersley, 1998; Harrison, 2014), Bronislaw Malinowski is commonly recognised as the pioneer of ethnography in anthropology, due to his articulation of ethnography as a method of inquiry for understanding and documenting the lifeworld of people living in small-scale non-Western societies (Blomberg et al., 2002) in his book reporting a long-term ethnography in the Trobiand Islands (Malinowski, 1922). Such work entailed Malinowski immersing himself into the community of study and personally observing the natives' everyday practices and social organisation, or '*the imponderabilia of actual life*', as he called it. Malinowski did not seek to become a native, but to "grasp the native's point of view, his relation to life, to realise *his* vision of *his* world" (Malinowski, 1922, pp. 25). Malinowski's work sat in stark contrast to other anthropological works of the time that studied small-scale non-Western societies as part of expeditions that entailed going to the settings, observing the natives, interviewing selected informants, and collecting artefacts and information about the natives, rather than getting immersed, taking the natives' standpoint, and participating in their activities (Button et al., 2015). Harrison states that Malinowski's prescriptive methods for conducting ethnography include:

> *"... long-term residence by a trained researcher, learning the local language rather than relying on interpreters, collecting as much data as possible on as wide a range of activities as possible–from the spectacular and ceremonial to the everyday and mundane–and taking copious fieldnotes, and when possible, partaking in social activities as a 'participant-observer'."* (Harrison, 2014, pp. 241)

To this day, Malinowski's legacy can be reflected in common guidelines for conducting ethnography; that is, researchers should go beyond merely observing and collecting data, and immerse themselves in the setting of study, aiming to see the activities from the natives' or members' point of view. Nonetheless, fieldwork is only one part of ethnography, where analysis–often encompassing an overarching analytical orientation guiding the fieldwork *and* the subsequent data analysis–is the second key component, which has caused the emergence of different styles of ethnography (Crabtree et al., 2012). In this thesis, ethnomethodology is the analytical lens employed and is elaborated on in 3.2. The following section broadly describes how ethnography is carried out.

3.1.1 Conducting Ethnography

Conducting ethnographic research is not dictated by a fixed stepwise process but by the flow of the activity (Blomberg et al., 2002). In a sense, ethnography's flexibility urges researchers to be 'opportunistic' in following activities as they become available (Taylor, 2009). What remains at the centre of ethnography is the need for obtaining that first-hand understanding of participants' lives and a commitment to describing their experiences as they occur (Blomberg et al., 2002).

Although different ways of analysing and reporting ethnographic work exist, there is a consensus about how it should be broadly carried out:

> *"Most researchers agree that the ethnographer's primary job is to shut up and listen, to watch what happens, see what people do, to write it down, tape it, record what documents be recorded, and so on".* (Randall et al., 2021, pp. 195)

Ethnography, then, features various tools and resources that are used depending on the research aims and particularities of the study topic (Chu & Ke, 2017). The main idea is to conduct ethnography in a natural setting where participants live, work, or where they conduct the activities of interest i.e. *in situ*, situated where the action happens (Lazar et al., 2017b). In-depth observation acts as one of the main techniques for achieving this, especially as people often cannot articulate their tacit knowledge through reflective-only methods such as interviews. In that regard, interviews within ethnographic fieldwork are often a tool for gaining an initial understanding of people and their activities and for exploring what could be observed. Therefore, making fieldnotes is a central part of the ethnographic work, for documenting what is being heard and observed and noting down unfolding thoughts and questions that will help in further investigating the topic of interest (Crabtree et al., 2012).

The ethnographer goes to the setting in two capacities: as data gatherer and as observer and participant (Baszanger & Dodier, 2004). The purpose is to gradually assemble an ethnographic record consisting of all the data taken away from the setting (Crabtree et al., 2012). The data collected can take a variety of forms, from notes and diagrams captured in the fieldnotes, to photographical evidence of the settings and physical resources relevant to the tasks investigated. Audio-visual data is also a staple for capturing people's accounts and activities; although it has its limitations, such as only capturing a partial view of the scene, recordings allow for repeated examinations of the work of interest and help to unpack and elucidate on how the work is achieved.

Data analysis is treated as an ongoing process that starts in the field, rather than as an activity occurring only after data collection. As Crabtree et al., (2012) note:

> *"Analysis is not something that comes after fieldwork then, but something that permeates it. It is something that we do from the off, something that occurs as soon as we walk into a setting and start looking at what is going on there. Analysis is inseparably intertwined with going and looking at what people do. It is something that we do as we seek out the accountable character of work not as an afterthought but as something that the work we are looking at is already possessed of as we do the looking. The data we gather – the 'vivid exhibits' we collect – document the accountable character of work and our evolving analysis of it."* (Crabtree et al., 2012, pp. 112-113)

Thus, the data collected act as supporting material for the understanding of the members and their methods that the researcher must grasp through the ethnographic engagements, not as a replacement for the ability to understand what is going on and how it is accomplished (Randall et al., 2007). 'Data' is used to exhibit phenomena of social order, not to act as empirical proofs of this. The data is then used as exemplars of the work observed–or 'vivid exhibits'–that help to elaborate such work and make it visible and available to others.

3.2 Ethnomethodology

As already established, this thesis adopts ethnomethodology (Garfinkel, 1967) as the analytical orientation guiding fieldwork and the subsequent analysis. With roots in sociology, ethnomethodology requires the researcher to practice a particular kind of attention and inquiry, concentrating on membership competence i.e. the members' methods employed in ordering situated action, as explained in the literature review (2.1.2). Thus, the researcher's objective is to uncover the members' methods used to accomplish even the most mundane and ordinary practices. It is worth remarking that by using terms such as 'mundane' and 'ordinary', ethnomethodology means to emphasise that such practices are thoroughly unremarkable to participants but take practical effort to be accomplished. In other words, everything we do takes 'work' (Sacks, 1995), and such work has a processual character i.e., it is sequentially organised (Randall et al., 2007). Unpacking work and thoroughly describing it is achieved by attending to the practical action and practical reasoning that inhabit a setting; that is, the actions and interactions as ordinarily conducted and understood by the particular members of a particular setting at a particular given moment (Garfinkel & Sacks, 1970). '*Interactional work*' is embodied and involves the use of artefacts; therefore, it is observable when members *do* practical action and practical reasoning through *interaction* with other people, a setting, the artefacts, or all of them (Crabtree et al., 2012).

3.2.1 Developing Vulgar Competence

Ethnomethodology suggests that in order to apprehend and understand membership competence, the researcher should develop a deep competence in the members and their methods, by meeting the '*unique adequacy requirement*' (Garfinkel, 1988) in doing fieldwork. Vom Lehn (2014) differentiates between two types of unique adequacy in ethnomethodological studies. In the strong version, the researchers conduct the activities under study themselves and acquire the practical skills and competencies of the professionals, whilst for the weak version the researcher must develop an ordinary or '*vulgar competence*' in the members' work. This thesis adopts the second version of the unique adequacy requirement as participants are treated as experts in the investigation, with the aim to gain the best possible understanding of their membership competence and 'work' as routinely done by them (Rawls, 2008). Vulgar competence *"... points to, at the very least, a certain attention to 'how the job gets done' and what might be necessary, in terms of skilful, or artful, performance in order that this happens."* (Randall & Sharrock, 2011, pp. 2). The implications for the present thesis are that I did not seek to become a 'competent member' (i.e. a VIP), but rather sought to at least be competent enough to recognise and understand the members' methodical practices, to explicate them and make them visible (Crabtree et al., 2012); that is, at the very minimum the researcher must be able to comprehend the practices so as to produce an account that is recognisable and intelligible by competent members. Ethnomethodological research can be seen as formed of two stages, where the researcher first develops membership understanding and uses it to make sense of the ethnographic record, and then conducts a procedural analysis of such knowledge and materials (Have, 2005).

3.2.2 Reflexivity

Significant concerns have been raised regarding the application and evolution of ethnography, especially when studying other cultures or groups that are different from those of the ethnographer (Harrison, 2014). For instance, the researcher being in a position of privilege over the people studied and consequentially shaping the research based on the researcher's personal interests and embodied experiences (Williams & Irani, 2010).

A very common way of attending to such tensions in the social sciences requires the researcher to engage in an ongoing reflective process (often known as 'reflexivity') where the positioning of the self within the fieldwork is deeply considered and the impact of personal assumptions and decisions are embraced as subjective rather than framing the research as completely objective (Taylor, 2009). Lazar et al. (2017b) remark that at the very least an awareness of personal bias should be developed when conducting ethnographic work. In this thesis, I attend to such academic reflexivity by explaining how I came to the position to study the subject and members of interest (in Chapter 4).

However, it has been remarked that academic reflexivity often puts the researchers at the center of the ethnographic work, mostly focusing on their process for gaining access to and knowledge of the people and settings under study, thus neglecting the people and the organisation of their day-to-day activities (Button et al., 2015). Ethnomethodology, then, makes a diferentiation between this type of 'academic reflexivity' and 'incarnate or endogenous reflexivity', which refers to the *"self-explicating, self-organising character of members' actions"* (Czyzewski, 1994, pp.163). This means that members make their actions accountable *in and through* these actions themselves, exhibiting the incarnate or embodied character of how those actions are intelligible to, and interpreted by, the members (Czyzewski, 1994). As Button et al. (2015, pp.97) put it, *"there is a reflexive relationship between what was done and how it was done"*. In other words, members in any setting or activity of everyday life act in certain ways so as to make clear to others what is going on or at least explainable if requested. These actions are intersubjectively recognisable for members (Crabtree et al., 2012), so they are able to understand what is going on or request clarification if needed. Therefore, reflexivity in ethnomethodology is not treated as a research choice or sensibility but a property of human life (Have, 2005), positioning members as skilled analysts of social order; that is, they are not only able to organise their affairs in methodical ways to be recognisable and understood by others, but they are also able to see and understand those organised actions themselves (Button et al., 2015).

3.2.3 Generalisation

Another concern that is often raised in relation to ethnographic studies, which tend to focus on small participant samples and report their findings using a few data excerpts, is that of how the findings generalise to people and settings different to those in the fieldwork. Prior undertakings have addressed this concern from an ethnomethodological perspective, explicating that even the most mundane activity in everyday life encompasses social order i.e., it comprises a sequence of methods or characteristics shared in a culture (Crabtree et al., 2013). For Sacks (1992), this seen-but-unnoticed or taken-for-granted order produces a '*machinery of interaction*' from which some form of generalisation can be drawn out regardless of criteria such as the number of observations or sample size. Crabtree et al. (2013, pp. 8) remark that "*A single case of the machinery of interaction at work on any particular occasion is generalisable because it is a shared cultural resource for arranging the everyday affairs it elaborates*". So, there are countless activities in everyday life that are culturally shared, from taking turns at talking, to walking, driving, cycling, crossing a street, buying products from a shop and so on; the methods used to order and organise those actions and interactions can be cohort independent and setting independent (Button et al., 2015). This means that members' practices are more or less conducted in the same way each time, which indicates that a *shared cultural resource* for organising the activity exists, and it is this *machinery of interaction* that ethnomethodology is interested in revealing. As previously described in 3.2.2, there is an intersubjective property in such everyday activities that *"our culture has provided us with"* and allows for generalisation of findings (Crabtree et al., 2012, pp.167).

3.3 Connecting Fieldwork Insights with Design

Having described the data collection approach adopted for the first study of this thesis and the ethnomethodological orientation running through it, this section explains how the analytical outputs were linked to design. That is, the empirical accounts of participants' competencies and their demonstrational work informed the development of the subsequent workshop study and its design materials (i.e. design cards and video demonstrations) towards supporting reflection on VI, accessibility and technology (presented in Chapter 6). In order to elaborate on the conceptualisation of such a second study, in the following section the relationship of ethnomethodology with design is examined, touching upon some of the traditional pathways employed for informing design through ethnomethodological studies and explaining how this thesis pivots from them. The design and analytical methods used in the workshop study are described in 3.4.

3.3.1 Ethnomethodology's Relationship with Design

This chapter has established the value of ethnomethodology for understanding human action as it occurs in the real world, regularly involving their interaction with technological tools, other resources, the setting, and a range of actors. This strong attention to interactional detail has allowed for the development of a strand of research that has adopted ethnomethodology for informing the design of interactive systems, playing a relevant role in shaping and contributing to work in areas such as HCI, CSCW, and Ubicomp.

For HCI and fields alike, ethnography's[1] value is not *only* in producing the highly detailed descriptions of what has been observed in the field, but in producing a *connection* with design (Button et al., 2015). Nevertheless, although several attempts have been made at developing such a connection, not many have been successful in the long-term (Taylor, 2009), and the ways in which ethnographic findings have been traditionally translated into outputs to be consumed for design purposes have presented challenges for both researchers and designers, thus generating some debate within the community (Rogers, 2012).

The disconnect between the thoroughly descriptive accounts from ethnographic investigations and the demand for concise and prescriptive design strategies to be put in practice led to the wide adoption of '*Implications for design*' as a resource for bridging this gap. That is, from the detailed descriptions of what they observed in the field, ethnographers would draw out some general recommendations to be taken into consideration by designers as a practical and actionable guide. However, some have criticised such practice—and the expectation to insert this at the end of every ethnographic report—deeming it forced, common-sensical, and even diminishing the value of the in-depth ethnographic work produced (Dourish, 2006; Plowman et al., 1995). Dourish (2007) argues that ethnographic investigations do not always need a strict connection to design in the form of design implications, requirements, or guidelines, but rather their value lies in the analytical and conceptual aspects gained through the fieldwork. Crabtree et al. (2012) agree that more concrete ways exist for producing design utility, including requirements specification and

[1] Note that here I switch back to talk about ethnography in general, rather than referring only to ethnomethodologically-informed ethnography, as the troubled attempts at bridging it with design have affected ethnographic studies alike, regardless of the specific approach underpinning them.

modelling, sensitising design, development of scenarios, mockups and prototypes, design evaluation, and assumption testing, and that drawing out implications is only but the start of such translation. Randall et al. (David Randall, Harper, and Rouncefield 2007) state that the outputs of ethnographic work are thus closely linked to the purpose of the investigation, such as maintaining a corpus of ethnographic studies, sensitising design, or aligning and integrating multidisciplinary teams, which can (and should) also be used in conjunction with other methods in systems design. Ultimately, Taylor (2009) argues that beyond the divergence of opinions about how ethnography can or should contribute to design, the value of ethnography lies in *opening up possibilities* for design, allowing for exploring design spaces and further research directions around technology ideas.

More specifically to ethnomethodologically-informed ethnography, Button & Dourish (1996) identified three ways in which ethnomethodology has been—or can be—constructive for technology design: 1) by getting ethnomethodologists closely involved in design projects, acting as direct informants of the phenomena observed in the field from an ethnomethodology lens; 2) by producing written ethnomethodological accounts to be used for informing design, although this approach would require designers to be well-versed with ethnomethodology (and overall, is subject to the aforementioned troubles concerning ethnography); and 3) by developing a more foundational and deeper connection between ethnomethodology and design, at conceptual and theoretical levels, in order to forge the emergence of 'hybrid' approaches, arguably responding to what Garfinkel (1996) envisioned as 'hybrid disciplines'.

However, although the first and second approaches of what they coined as '*technomethodology*' had success in being adopted for system development, the third approach had little uptake and modest advancement in comparison. This latter approach entails grappling with ways of linking the thoroughly detailed and analytic nature of ethnomethodology with the generative character of design, heavily reliant on abstraction and generalisation (Dourish & Button, 1998). Crabtree (2004), for example, proposes in-the-wild deployments of new designs to be treated as breaching experiments for investigating practical action occasioned by them, and from the insights, fleshing out new abstract design concepts for further iterations. Nonetheless, there continues to be an opportunity space to explore new ways of combining "*a softer, more user-friendly version of ethnomethodology with other approaches from various disciplines*" (ibid, 2004, pp. 207).

In a similar vein, others have recently called for combining ethnomethodology, conversation analysis and interaction analysis with design practices, suggesting the potential of embedding video analysis in the design process. However, the challenge remaining is how to make it accessible to people less familiar with these approaches (Pelikan, 2022; Pelikan et al., 2022). Certainly, HCI and related design disciplines could learn from conversation analytical work in language and communication areas, where audio and video data has been central to develop communication training (Stokoe, 2014) and language therapy interventions (Beeke et al., 2014).

3.3.2 Informing a Design Critique for Supporting Awareness and Shared Understanding of Visual Impairments

In this thesis, ethnomethodology is not used as a sensitising device for me as a designer or informant of a particular system, moving away from the ethnomethodologist serving as a proxy for users in the field, which has been a critical turning point in accessibility research. Given that such a discipline entails addressing particular sensibilities arising from conducting research and design with disabled people, Garfinkel's notion of developing a hybrid discipline "*whereby ethnomethodologists would develop the skills to become practitioners within the setting*" (Rouncefield & Tolmie, 2013) becomes, in this case, not only virtually impossible but not recommended and deemed ableist (Nario-Redmond et al., 2017). Thus, developing a hybrid approach in this context would entail shifting the efforts by attending to the continuously evolving processes and practices used in research and design with and for disabled people.

How is ethnomethodology employed, then, to connect to design in this PhD work? Using Button & Dourish's (1996) contribution types, this thesis is positioned in a space spanning the second and third approaches of technomethodology. That is, it initially provides ethnomethodological accounts of the everyday technology practices of VIP (investigation

1, presented in Chapter 4) and demonstrations by VIP in the context of such fieldwork (investigation 2, presented in Chapter 5). Then, this thesis uses those analytical insights to develop an exemplar of a more foundational connection between ethnomethodology's concepts and emerging practices and ethos in accessibility research (as described in Chapter 2), in the form of a design critique workshop approach (investigation 3, presented in Chapter 6). Figure 3.1 presents an overview of the whole thesis and how the analytical and conceptual outputs of each investigation informed the subsequent work.

The work in this thesis, as a whole, presents a design critique of how the competencies of and methods used by VIP are not taken into consideration by mainstream technology design, and even within assistive technology domains they are oftentimes taken for granted or known but unremarked-upon. Moreover, this thesis goes forward to design and implement a workshop study where the design critique is put into practice as a reflective exercise for awareness, for a mix of participants with and without VI who have a diverse technological background (i.e. users, developers, researchers, designers).

The workshop study is informed by firstly investigating the organised ways in which VIP conduct their technology practices, from which I identified and conceptualised the situated competencies enabling those practices. The analytical and conceptual outputs from this first investigation are broadly linked to design by explicitly identifying design domains that can benefit from a deeper consideration of how those competencies are employed interactionally. Additionally, the first investigation allowed me to ascertain a research direction for further examination of demonstration instances which was pursued in the second investigation. Therefore, the analytical outcomes of such work both establish the core features of demonstrations and revisit the competencies of VIP. Through the latter, further design areas and opportunities are identified and refined. Nonetheless, although the ethnomethodological accounts of the first and second investigations helped to point towards design directions to be subsequently followed, this thesis does not explore such a path but instead uses the insights obtained so far in order to bridge ethnomethodology and accessible computing. More specifically this thesis aligns with and is deeply informed by the new waves of accessibility research in HCI (see 2.3).

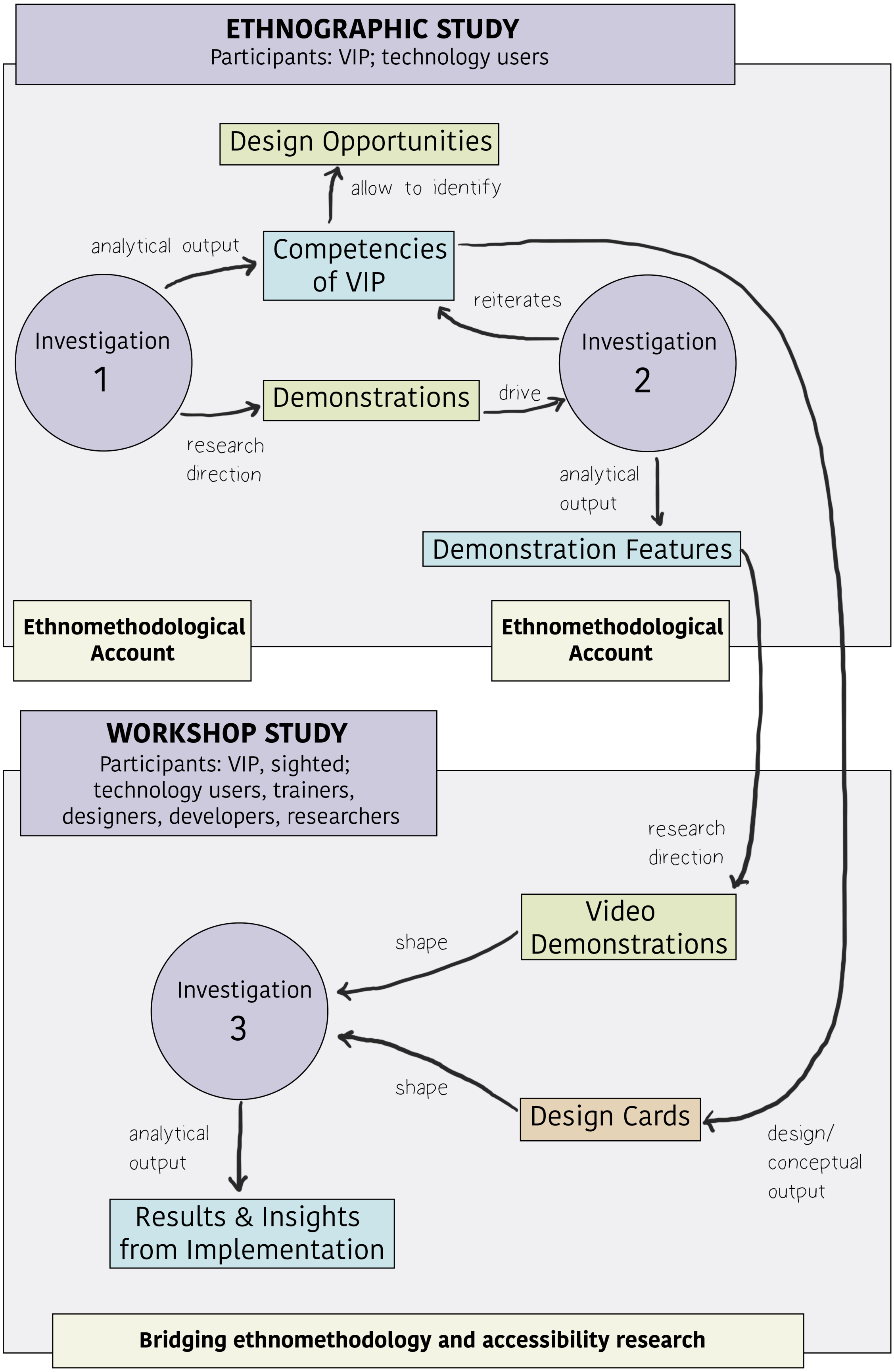


Figure 3.1: Overview of the ethnomethodology-informed design critique presented in this thesis.

That is, the third investigation is both shaped by analytical, conceptual and design material outcomes that were obtained through and developed from the initial ethnomethodological investigations, and by recent critical discussions around disability, technology, and accessibility. Key precepts were taken into account such as the need for VIP to have a central role in the activities whilst making non-VIP directly engage with them, favouring the goal of learning to 'be with' disabled people instead of 'being like' them (Bennett & Rosner, 2019). Moreover, the focus of this workshop study is on the analytical and reflective side of the design process which is often ignored in comparison to ideation, design and testing of prototypes and systems (Ladner, 2015). So, the purpose here is not to produce a design solution addressing problems identified with the technology use or exploring new spaces where technology could be introduced; rather, the main goal is to make use of core concepts from ethnomethodology such as membership competence, situatedness, and members' methods as a basis for design activities that support accessibility awareness and mutual understanding. As Button & Dourish put it:

> *"In other words, the third approach to technomethodology attempts to align system design not so much with the details of specific working practices, as with the details of the means by which such working practices arise and are constituted."* (Button & Dourish, 1996, pp. 24)

The main objective here is to sensitise designers and researchers who are not visually impaired to the practices and experiences of VIP by also centring VIP's participation, diverting from simulation or other empathy-building activities that entail putting themselves in the position of VIP and replacing their direct input by instead foregrounding direct engagement, reflection, and shared understanding.

3.4 Workshop Methods

The two main components shaping the workshop are a deck of design cards and a set of video demonstrations, as shown in Figure 3.1. For the former, design cards are employed as the technique for encapsulating analytical and conceptual outcomes, herein ascertained through the ethnomethodological investigations. The latter are video clips of demonstrations collected during the ethnographic study. As Chapter 5 will show, demonstrations are social encounters whose main purpose is to ensure a mutual understanding of the activity or object displayed. By analysing a subset of demonstrations captured during fieldwork, core features of such phenomena are identified and further used to locate a research direction that makes use of demonstrations for showcasing the competencies and main technology practices of VIP. Consequently, in Chapter 6, video demonstrations and the deck of cards are threaded together in the design critique workshop, serving as analytical tools for participants–with and without VI–to think about and discuss VI, technology design, and accessibility. In the following section, a description of the workshop methods (i.e. design cards and video demos) is provided. Moreover, Reflexive Thematic Analysis (Braun & Clarke, 2022) is introduced as the approach for analysing the workshop data (i.e. audio recordings of workshop sessions). Details about the content of the cards and videos can be found in Chapter 6, as well as the study design, implementation and analysis.

3.4.1 Design Cards

After reviewing different alternatives for encapsulating findings from the empirical work conducted so far, a decision was made to employ design cards as the second material to be used in this study. Their features were considered fitting to the purpose of this study; that is, bringing together people from different characteristics and backgrounds to prompt considerations of VI in technology design.

Design cards are a well-established technique in HCI and design for encoding and communicating concepts and knowledge (Aarts et al., 2020; Wölfel & Merritt 2013). Among their widely varied purposes and uses, a key feature is that they help to level the field between stakeholders from different backgrounds by making concepts accessible to them and by fostering collaborative engagements between them (Wetzel et al., 2017). Moreover, they help to break down design considerations into various layers or factors, often used in HCI for engaging non-designers in the process and helping designers to develop sensitivity and empathy towards the design space (Lucero et al., 2016). Design cards are commonly tailored for the 'fuzzy front-end' of design, which includes pre-design and generative phases (Borum et al., 2014).

However, in the context of disability, some concerns remain as to whether materials such as toolkits, personas, and design cards prevent designers from meeting actual users (Billestrup et al., 2014), and promote the replacement of disabled people rather than their direct participation in the design process (Bennett & Rosner, 2019). Moreover, it has been argued that they can provide reductionist characterisations, misrepresenting them, and reinforcing stereotypes (Edwards, 2020); Cabrero 2016).

Inspired by Shinohara et al.'s method cards (2020) that prompt social scenarios experienced by disabled people, the design cards created for the last study of this PhD thesis encompass other layers in the experiences of VIP that go beyond their functional impairments and include social and situational factors involved in their everyday technology use. Moreover, the central aim of this study is to enable the participation of VIP rather than encouraging their replacement in design activities. Here, the design cards were employed as a reflective tool that shifted the focus away from designing specific solutions towards an awareness exercise that aligns more with critical and participatory work in contemporary strands of Accessible Computing research (as reviewed in 2.3).

In terms of contents, the reflective design cards were created following the process outlined by Golembewski & Selby (2010) consisting of the following steps:

1. Defining the project domain
2. Defining the category suits
3. Defining instance cards within the category suits
4. Creatively engaging with the instance cards
5. Producing the themed cards

The practical application of these steps and the specific content of the deck of cards is described in 6.1.2.

3.4.2 Video Demos

Video demos are a powerful tool to communicate technology use in action, especially to unfamiliar audiences (as established in Chapter 2). While many works have analysed videos available online (Anthony et al., 2013; Blythe & Cairns, 2009; Buie & Blythe, 2013) to better understand user practices and perceptions, and others have analysed the motivational (de Oliveira et al., 2018) and interactional (Tuncer et al., 2020) use of video materials, video demos are an untapped source to explore in design activities. Although they are a staple project output for showcasing prototypes or systems (see 2.2.1), little has been done to explore their methodical character (a gap addressed in Chapter 5) and to understand how they can be used in other stages of research and design. A relevant example of the latter is the work of Shklovski and Grönvall (2020) investigating how people experienced public demonstrations of a system that makes data leakage tangible, by communicating it through electrical muscle stimulation. They argued for the value of public demonstrations as critical design interventions and positioned them as sites for *participatory speculation* (Frauenberger, 2019). Likewise, although the role of film and documentaries in raising awareness of disability (Putnam et al., 2019; Ibrahim et al., 2020) has been explored, and video demos are promoted for teaching accessibility (Petrie & Alistair, 2006; El-Glaly, 2020), little is known about *what* can be learned through them (e.g. the types of reflections they generate).

The work conducted in chapters 4 and 5 will help to establish the background and rationale for using video demos as part of design workshops that centre reflective practices between people with and without VI. The specific content of the video demos used in this workshop study and their selection criteria are described in 6.1.1.

3.4.3 Reflexive Thematic Analysis

Differently from the analysis of the ethnographic data presented in chapters 4 and 5, instead of embodied action and interaction, the main data source of the workshop study was the conversations unfolding between participants and facilitated by myself, akin to focus group engagements. As such, the approach employed for analysing the data was a form of thematic analysis recently referred to as Reflexive Thematic Analysis (RTA) (Braun & Clarke, 2022). RTA was considered appropriate for analysing this dataset as it offers a flexible approach for identifying and interpreting patterns of meaning within it. RTA is useful for conducting the analysis in a more open-ended and exploratory manner at the beginning and allowing for shifting the orientation to the data if needed, especially when there is no initial narrowed focus to approach the data.

RTA follows six analytical phases as defined by Braun & Clarke (2022): 1) data familiarisation, 2) data coding, 3) generating initial themes, 4) developing and reviewing themes, 5) refining, defining, and naming themes, and 6) writing up. This process, however, is not strictly linear but ongoing and recursive due to its reflective nature (Terry et al., 2017). Individual coding and theme development are accepted and common practices in this approach, without the need for a team of researchers to reach a consensus. Authors Braun and Clark (2019) have argued that codes and themes do not 'emerge' from data but are instead conceptualised by the researchers. Therefore, RTA welcomes researcher subjectivity and acknowledges that various analyses from the same dataset are possible, depending on who is conducting it, the analytical decisions throughout, and the underpinning theoretical assumptions. As such, it is important to be conscious and transparent about these factors, or in other words, to engage in a reflexive practice during the analysis. Code and theme development can also vary depending on the orientation to data taken and the type of meaning sought; for instance, the analysis can be inductive (i.e. driven by data content), deductive (i.e. driven by existing concepts), semantic (i.e. meaning at surface level) and latent (i.e. meaning at underlying level). RTA can also align within a continuum of qualitative and theoretical frameworks; for instance, an experiential/contextualist lens where the aim is to explore people's own perspectives and understandings as expressed in the dataset or critical/relativist lens for interrogating meaning and unpacking the realities articulated in the dataset (Braun & Clarke, 2022). These variations in approaching RTA are not necessarily mutually exclusive and therefore urge the researcher to be actively engaged and thoughtful about the analytical decisions taken.

Some recommended practices for ensuring good quality in the thematic analysis include conducting a double round of coding, and checking candidate themes against the coded data and the entire dataset (Clarke & Braun, 2016). Furthermore, the authors warn researchers about the common pitfall of merely reporting topic summaries as themes e.g. reporting all the responses from particular topics asked, and remark that the goal of RTA is to tell a particular story about the data in relation to the research questions and not necessarily to represent the entire dataset. Lastly, although there is no strict answer to the question of how many themes should be developed from using RTA, the general recommendation is between two and six themes (Braun & Clarke, 2022).

Chapter 4

Everyday Technology Practices of Visually Impaired People

This first study chapter presents a four-month ethnographic study that investigated the everyday practices of VIP involving technology. The study was conducted with members of a local charity that supports people with VI and comprised attending group meetings and conducting one-on-one sessions observing technology use at home and a work desk. The study was broad in scope and did not seek to focus on a specific technology or activity, but rather obtain a general perspective of participants' lives. As described in Chapter 3, this work takes an ethnomethodological approach to investigate *how* such technology practices are accomplished, in order to develop detailed accounts of the lifeworld of people with VI that otherwise might remain unnoticed or taken-for-granted. In doing so, this chapter will uncover and conceptualise some of the participants' competencies that enable them to conduct their ordinary activities and ultimately 'get on' in everyday life. The overarching goal of this study is to lay the groundwork for further explorations of how these findings can inform design practices.

4.1 Study Approach

This section describes the process and decisions taken regarding the ethnomethodologically informed ethnographic study conducted with VIP to investigate their everyday technology use. Analysis of the data collected in the study is two-fold: the overall analysis of the ethnographic corpus is presented in this chapter, and a subsequent analysis of a subset of demonstrations data derived from the initial analysis is presented in Chapter 5. Each chapter has a different analytical focus and scope, but as all data was collected in the same fieldwork, the study approach is predominantly described in the present chapter. The following sections describe the research process from initial contact and research immersion to participants recruitment, data collection and analysis.

4.1.1 Research Immersion in a Local Charity Setting

Plenty of third-party charities that support VIP exist in the UK at national[1] and local[2] levels; they were considered potential hubs for recruiting participants, but contact with them had to be established from the ground up. Initial communication was established with staff members of My Sight[3], a local charity established in Nottinghamshire supporting blind and partially sighted people in the area, providing a range of services such as medical information, peer support, equipment advice, IT guidance, and social and well-being activities.

Firstly, interest in conducting research at their premises and with their service users was raised to a known staff member, who arranged an initial meeting held with another person in charge of organising activities and services for the charity in order to discuss the viability of the study. They explained the services they provide and suggested paths of action. They helped me to immerse myself in the community by introducing me to other staff members in charge of facilitating social meetings and by inviting and strongly encouraging me to attend their next training event for sighted volunteers, which I took before starting fieldwork with the charity service users. This was particularly useful to address my lack of knowledge of and experience engaging with VIP.

Following the ethnomethodological differentiation between academic and incarnate reflexivity described in Chapter 3, it may be helpful to provide context of my positionality

[1] https://www.nhs.uk/conditions/vision-loss/
[2] https://www.visionary.org.uk/about-us/
[3] https://www.mysightnotts.org.uk/

as a researcher investigating people with disabilities (Williams & Boyd, 2019), and my knowledge of the subject at the time research immersion took place, since I employed an ethnomethodological perspective requiring the development of 'vulgar competency' in the study topic. I am a non-disabled woman of colour in my thirties from a Latin American country, with a background in computing systems and HCI. My knowledge of accessibility, assistive technologies, and users with VI at the time was basic and I had never engaged or interacted with VIP before. Therefore, I came to the fieldwork with little experience on the subject and carrying with me some common assumptions about VIP (e.g. cane or guide dog users, Braille readers, relying on their hearing sense).

Sight Loss Awareness and Sight Guide Training

The training provided by the charity took place over a whole working day and included two main parts. The first part included a presentation of information about different eye conditions, which were replicated through the use of a few 'simulation spectacles' by the room of attendees. The spectacles were a type of headset that occlude or distort the field of vision to simulate specific conditions; for instance, tunnel vision (e.g. Retinitis Pigmentosa), peripheral vision (e.g. Macular Degeneration), blurred or misty vision (e.g. Cataracts), and spotted vision (e.g. Diabetic Retinopathy). Although a brief activity (i.e. putting the spectacles on and looking around for a few seconds), I was able to learn that VI are not a monolithic experience and this represents differences in embodied experiences and accomplishments (e.g. looking at a certain object might require tilting the head for people who have peripheral vision). Further, recommendations for communicating effectively with VIP were given, covering various areas such as language (e.g. use 'people-first language', do not avoid words like 'see' or 'look'), speech-delivery (e.g. clear but not exaggeratedly loud) and social interaction (e.g. identifying oneself when speaking –not assuming people will recognise voices).

The second part of the training covered guidance and practical instructions on how to guide a blind person when walking. Firstly, we were given basic information and demonstrations on how to do it; that is, the guide positions themselves to the side of the guided person but slightly forward while bending the arm, and the guided person holds the guide by the elbow. The guide should also provide ongoing verbal announcements and instructions while moving together to indicate obstacles and plans of action. Practical exercises were conducted in pairs using blindfolds, alternating between guiding, and being guided. Different indoor and outdoor situations were taught and practised, such as guiding the blindfolded person through narrow spaces, doors, stairs, and crosswalks. I found the exercises somewhat messy, difficult, and nerve-wracking at the beginning. While guiding the other person, I found that giving instructions needed to be quick, concise, and precise, often difficult to achieve in practice. While being guided I found myself bumping into furniture as was sometimes given vague instructions. Being outdoors raised the stakes given the myriad of movable entities and environmental noise. However, we also learned how to use cues in the built environment such as bumps on the floor indicating crosswalks and stairs ahead. Naturally, after practicing, confidence and knowledge of the space and activity increased, but it was clear that sighted guiding requires practice with an actual blind person to develop further skills and experience. Nonetheless, this activity helped me to realise the relevance of the resources employed when vision is impaired such as exploring the floor surface with the feet and moving in concerted collaborative ways with the guide.

Charity Meetings

Subsequently, and after approval by the School of Computer Science's Ethics Committee (Reference CS-2018-R24), I attended 13 group meetings at the charity setting as part of getting immersed into the community and for the recruiting of participants for one-on-one sessions—which will be elaborated on in section 4.1.2. The charity is composed of staff members, volunteers, and service users. These groups are integrated by both sighted people and people with different types of VI (blind and partially sighted). Many service users were older adults (over 50 years old), and staff and volunteers were from a younger demographic (20 to 50 years old).

As aforementioned, I was invited by the facilitators. Due to the meetings occurring on a regular basis, I only had to turn up at the scheduled time whenever possible, without any other pre-arrangement. I attended two types of meetings across the fieldwork duration (January-May 2019): six social meetings and seven 'IT' (i.e. information technology) sessions. The former were informal gatherings held every fortnight where volunteers and service users got together to chat and have a drink, and the latter were drop-in sessions that happened twice a week to provide guidance on technology use, including smartphones, computers, and different types of assistive technology. However, the IT sessions also served as community gatherings for regular attendees, thus the technology guidance was embedded within the social context of the group. The meetings lasted between two and two and a half hours and mostly had regular attendees, with occasional new people showing up.

Initially, the purpose of attending these meetings was to acquire a preliminary understanding of the setting, the people, and their activities, and to build rapport with them. In these meetings people were always sitting around tables or in front of computers, often with many small-group conversations happening at the same time. My approach was to pick a seat and talk to the people around. Initially, I introduced myself to them, but with time people recognised me (i.e., by looking at me or talking to me). The nature of these meetings allowed me to talk to only a few people per session, so as time passed I tried to sit next to new people. Whenever I talked to a new person I explained the purpose of my visit and how I was interested in learning about their technology use. This often provoked conversations around technology among the people around, and some people to show me their personal devices. Further, the staff and volunteers used the opportunity to show me the assistive technology for sale at the charity office, which in turn led to conversations about pricing and preferred devices by attendees. People were very friendly and open to sharing their experiences with me, especially the technology-savvy, although some older adults were reluctant towards using technology and expressed they were unable to contribute to my study. I kept holding conversations with people regardless of this self-selection, as learning about VI in general was productive to my understanding of their membership competence. In many cases I was part of conversations about daily living (e.g. local news), in which technology did not feature. In a sense, I was welcomed as would be any other sighted person who normally attended these meetings, such as volunteers, family members and visitors, although I strove to always make clear the purpose of my attendance, which was reflected by people asking me about my research and its progress. Moreover, I tried to not disrupt people's ongoing activities or conversations to push my own agenda and rather waited to bring up topics when appropriate.

Up to this point, data collection consisted of field notes only, with no personal data. Recording of group meetings was deemed intrusive and ethically complex, and thus not appropriate for the study. After initial meetings, attendees were approached directly and invited to take part in one-on-one sessions, arranged at the participants' preferred times and locations. No specific criteria were defined, except for being VIP. Initial preference was given to people who reported using technology regularly, but the study was not restricted to them, as I also wanted to understand how people manage their everyday activities without technology, and the reasoning behind this (Pal et al., 2017; Miller et al., 2018). As time progressed, I continued to attend the group meetings for the ongoing recruitment process until substantial data was collected. However, these meetings were also used to elicit conversation about themes emerging in individual research sessions, and to expand my understanding of the experiences of attendees. Towards the end of this study, I registered as a volunteer at the charity, helping with one-off activities whenever possible; for instance, giving remote support to a service user on connecting to online meetings during the COVID-19 pandemic. Although not part of this study, such experiences also added to my knowledge of their membership competence, helping to shape the remainder of this thesis.

4.1.2 Participants and Data Collection

In total, I recruited 11 participants for individual sessions: seven men and four women, aged between 28 and 93 years old (mean=52.5, SD=22.3). Table 4.1 presents participants' information. All of them identified as legally blind, but they had different visual conditions and some also described hearing, mobility, or other sensory loss due to age or health conditions. These are reported using participants' own terms for describing themselves. P7 and P10 are married but separate sessions were conducted with them.

Their informed consent was gained prior to data collection following ethical research guidelines, and in addition a situational approach (Munteanu et al., 2015) to consent was sought throughout the study; that is, I aimed to remind and double-check with participants whenever they were being recorded, as well as allowing them to engage and disengage as needed, as per recommendations for conducting user research with people with disabilities (Williams & Gilbert, 2019a). The information sheet and consent form that were given to participants are in Appendix A. These documents were produced and offered to participants in different formats such as large-print and digital versions optimised for screen readers. Nonetheless, most participants preferred that I read aloud the documents to them. Similarly, participants chose their preferred location for the sessions. An inconvenience allowance was provided to participants for each session (£10 per hour). Data was collected using a mixture of field notes, audio, video, and photos, employed as appropriate and as agreed by participants.

Sessions were held with all participants at the charity office and/or their homes on the topic of their everyday activities and technology use—or non-use—within them, and observations were conducted for 10 participants as part of the same or a follow-up session (see column 'Setting/Duration' in Table 4.1). Conversations were audio or video recorded and were devised as a way to gain a general understanding of participants' lives, and for further prompting observations of technology use in action. Participants were asked demographic and visual condition information, occupation and routine everyday activities, home arrangements and assistance networks, and technology use including devices or services, purpose, frequency, and context of use, use cases and their overall experience with them (guiding questions for the sessions are included in Appendix A.3). I then asked participants to observe and video record activities and technologies that came up in our conversations. Those observations comprised mobile, laptop and assistive technology use, home appliances, personal objects, and brief home tours. In addition, three participants were observed in-situ during their shift at the reception desk of the charity where I asked

Table 4.1: Details of participants in ethnographic study, including devices used.

#	G	Age	Conditions	Setting/Duration	IT/AT devices
P1	M	28	Partially sighted (Glaucoma)	Charity office (2 hr)	iPhone, wireless keyboard, magnifying spectacles
P2	M	50	Blind (Diabetic, touch sensitivity loss)	Charity office (1 hr), home (3 hr)	iPhone, iPad
P3	M	32	Partially sighted	Charity office (1 hr)	iPhone, wireless keyboard, Apple watch
P4	M	93	Partially sighted (Cataracts, hearing and mobility loss)	Home (4 hr)	Doro phone, pocket magnifier, lamp magnifier, talking watch
P5	W	28	Blind	Charity office (1 hr), home (3 hr), reception desk (1.5 hr)	iPhone, Windows laptop and desktop computer, electronic Braille notetaker, audio labeller
P6	M	55	Partially sighted	Reception desk (1.5 hr)	Samsung phone, Windows desktop computer, electronic magnifier
P7	M	67	Partially sighted	Home (3 hr)	Samsung phone, radio for the blind, Amazon echo
P8	M	40	Blind (Hearing loss)	Reception desk (1.5 hr)	Doro phone, Windows desktop computer, talking watch
P9	W	80	Partially sighted (Retinitis Pigmentosa, mobility loss)	Home (2 hr)	Doro phone, talking book, desktop magnifier
P10	W	70	Partially sighted (Mobility loss)	Home (2 hr)	iPhone, MacBook, Amazon Fire tablets, Kindle, Amazon Echo
P11	W	35	Partially sighted (Retinitis Pigmentosa)	Home (2 hr)	iPhone, wireless keyboard, Braille typewriter

them to show or explain the tasks they normally carry out in that role.

Participants were prompted to use their devices or explain certain activities in an open-ended way, without asking them to conduct pre-defined tasks, by using questions such as *"Can you show me how you use/do X?"*. Consequently, a large proportion of the video recordings captured took the form of demonstrations. With such a substantial dataset of demonstration instances, they became a subsequent point of interest that are explored in-depth in Chapter 5. However, regardless of the nature of the activities captured (which is also discussed in Chapter 7), the video recording material served to fulfil the original research aim and allowed the investigation of participants' competencies, for which the analytical process described next was followed.

4.1.3 Data Analysis

The ethnographic corpus consists of 5 hours of video recordings, 5 hours of audio material, over 40 photos, and several fieldnote entries from the meetings attended and sessions held. Most video recordings involved the use of mainstream and assistive technologies, but there were also some accounts of practices where technology is not present, for example, the use and adaptation of home appliances and personal objects.

My analytical focus was towards answering the first research question, which was addressed by first attending to two inter-related sub-questions:

- RQa) *How* do VIP use technology in their everyday lives and what are the interactional competencies they employ?
  - RQa.1) What are the main everyday technology practices of VIP?
  - RQa.2) What technologies do they use and for what purposes?

The corpus was analysed employing an ethnomethodological orientation (as described in Chapter 3) employed throughout the ethnographic work, including the research immersion and individual sessions, that allowed me to develop 'vulgar competency' (see 3.2.1) in the setting, the members, their activities, environments, and tools. By doing this, I engaged in an ongoing process of analysis, as described in 3.1.1.

The data corpus was organised and indexed to make sense of what was observed and captured as fieldwork progressed. Data was thoroughly and systematically reviewed, annotated, and catalogued, based on the device or activity captured. No codes were associated with the data, only timestamps and labels for quick identification to facilitate the ongoing analytical process. A summary of high, mid, and low technologies or tools reported by and observed from participants are presented in Table 4.1 (See column 'IT/AT devices'). Moreover, I identified three main sites of practice that feature the use of those mainstream and assistive technologies across the practices of all eleven participants: social relations and communication practices, textual reading practices, and mobility and environment practices, which are described in the following section.

To illustrate and unpack some of these technology practices observed, I make use of video materials supported by audio recordings. In total, I identified 119 episodes, containing 'vivid exhibits' or accounts of isolated activities or technology use instances, ranging from half a minute to several minutes in length. Then, those episodes were examined in fine-grained detail looking at participants' observable-and-reportable actions and interactions; that is, individually and collectively (with the supervision team) re-watching them several times to produce analytical accounts. This process allowed me to narrow the selection down and identify those episodes that best served me to see and recognise what was being done by participants in answering the main research question. Lastly, I transcribed a few relevant video and audio fragments, including conversational turns, device responses, bodily actions and interactions, and so on, that aided the analysis of findings presented in the next section.

4.2 Findings: Unpacking Everyday Practices of Visually Impaired People

Firstly, and before going into further detail, I provide a broad picture of participants' engagements with technology, expanding it from the summary of devices and tools presented in Table 4.1 (See column 'IT/AT devices'). Mobile phones were mentioned as essential for everyday activities by all except P4 and P9 (93 and 80 years old respectively), who own Doro phones—feature mobile phones that have a physical keyboard and were originally designed to be accessible and intuitive for the elderly. P8 mentioned he recently got a Doro phone and was still getting acquainted with it. Participants using iPhone and Samsung smartphones reported using the corresponding voice assistant (i.e. Siri, Google Assistant) and screen reader (i.e. VoiceOver, TalkBack). As mentioned in the introduction of this thesis, such screen readers are software accessibility features built into smartphones and computers that render the on-screen information into sounds and synthesised speech. For five participants, both the voice assistants and screen readers are indispensable for operating their mobile phones, whilst the rest of them enable the screen reader intermittently and use the voice assistant at their convenience. Laptop and desktop computers are mostly used by partially sighted participants and a few who are blind only for specific purposes (e.g. online shopping, work tasks), with accessibility issues frequently encountered. Eight participants reported using mobile voice assistants for what they defined as 'simple tasks': asking the time, date, and battery level, consulting weather forecasts, making calls, composing text messages and emails, playing music, quick and short online queries, opening and closing apps, and enabling or disabling device features such as the screen reader or Bluetooth. Five participants reported conducting these tasks many times a day. The married couple (P7 and P10) are active users of three Amazon Echo devices at home.

Three main sets of practices conducted by the participants with VI in their everyday lives were identified in the data corpus:

- Social Relations and Communication Practices
- Textual Reading Practices
- Mobility and Environment Practices

Technology is featured in these practices to different extents, as participants use different devices, tools, features, and software applications based on their individual VI and preferences, and therefore employ different methods for accomplishing these activities. It is worth remarking that the three main practices presented in this chapter do not represent *all* the practices of participants, but rather they are the most prominent in the data corpus collected. In that regard, the scope of this study is not to be comprehensive in breadth, but depth. Moreover, it is also worth noting that these three practices identified in the data sometimes overlap with each other; for example, some communication practices are closely linked to or dependent on textual reading practices, and similarly, some textual reading practices require participants' mobility practices in order to be conducted. These overlapping areas will be illustrated and highlighted throughout the chapter.

Furthermore, given the nature of the data collected (i.e. at home or the charity office), social and reading practices were more prominent in the corpus in comparison to mobility practices. Consequently, the section describing the third set of practices in this chapter is less thorough and presents shorter data exemplars. The main reason for this outcome can be explained by the commitment to follow the activities that participants deemed relevant to their everyday experience; for example, participants reported not using certain technologies for mobility, such as navigation apps. Although many of them use white canes for moving around, they did not consider these aids as 'technology' in the context of this investigation. Moreover, some of them explicitly asked that their participation only involved indoor/home activities to avoid feeling unsafe or uncomfortable. Thus, this study was guided and constrained by participants' preferences, and examples of technology used for mobility were less comprehensive than those for communication and reading.

As previously described in section 4.1.3, relevant episodes were selected from the data corpus and are presented in this section as data fragments to illustrate exemplars of the participants' practices identified. In this chapter, I present and unpack ten data fragments used for uncovering the competencies exhibited by participants in the course of accomplishing such activities. The first three fragments illustrate different modalities of interacting with mobile phones for supporting social relations and communication with others, the following three fragments illustrate the use of different technologies and methods for reading text originally in print, and the last four fragments illustrate the complexities of, and strategies for, visually impaired mobility. These ten fragments have been selected based on their prominence within the data corpus (i.e. a representative exemplar of a recurrent activity among participants), or contrariwise, on their uniqueness (i.e. a particular technology only used by a few participants). Throughout the selection, organisation, and presentation of these fragments, I attempted to balance out the episodes captured, aiming to give a comprehensive overview of the fieldwork material.

Before introducing the data fragments, each main site of practice is described and contextualised, providing a general description of the activities people regularly conduct, the tools they use, and the purposes they sought to fulfil. The fragments in this chapter are presented using different formats specifically chosen to best communicate the exemplar in question: either as plain text focused on participants' verbal accounts and device verbal and sound responses (e.g. Porcheron et al., 2018), sometimes accompanied by pictures of key moments and relevant contextual information (e.g. Brown & Laurier, 2017), or annotated stills—similar to comic strips—created for conveying and highlighting physical actions and interactions taking place alongside talk (e.g. Laurier, 2016).

The data fragments attend to participants' utterances, device responses in the form of sounds, synthesised speech, and graphic interface changes, bodily actions, spatial elements, and contextual or environmental factors. The transcription notation used in this chapter is described in Appendix B. Participants' names, faces and any other personal information have been anonymised in the data fragments. Throughout the chapter, the fragments are broken down, presented and discussed in segments (e.g. 1a, 1b, 1c and 1d) for clarity and readability purposes, but continuous versions can be found in Appendix C.

4.2.1 Social Relations and Communication Practices

This section will elaborate on some of the most critical of activities: that which revolve around social relations. Here I describe and present examples of how these practices are accomplished through the use of assistive and mainstream technologies. On a day-to-day basis, most participants reported encountering little to no challenge in conducting these activities. Quite prosaically I found that, for participants, phones and computers act as crucial facilitators of social relations and communications practices with family, carers, friends and organisations (e.g. hospital, bank, charities). All participants reported and exhibited proficient methods for making calls, sending text messages or emails, and reading received messages. Herein I will exhibit different modalities of device interaction that participants use depending on their individual visual condition and personal preferences in order to communicate or socialise with other people.

In summary, the communication activities of participants can be roughly divided between smartphone users and non-users. For example, for P4 and P9, such activities consisted of making calls using the landline telephone and the accessible mobile phone. These devices have been acquired specifically to address participants' low vision; thus, they have physical keyboards and large-sized numbers. P4 and P9 have also roughly learned the keyboard and button arrangement of these devices, and, through tactile interactions, they can adequately operate them despite their sight loss due to ageing. For smartphone users, making calls and sending text messages and emails is done through voice assistants, screen readers and the graphic interface.

This section will present and unpack three examples of different types of interaction in which participants demonstrated to me, during the course of the ethnographic fieldwork, some of the smartphone practices that allow them to communicate with others in their day-to-day. These three fragments are exhibits of how VIP compose and/or send text messages using their mobile phones. In the first fragment, a partially sighted participant uses Siri to conduct the activity; in the second fragment, a blind participant uses the iPhone's built-in screen reader (i.e. VoiceOver); and in the third fragment, a partially sighted participant uses the dictation feature:

1. Text Messaging through a Voice Assistant
2. Text Messaging through a Mobile Screen Reader
3. Text Messaging through a Dictation Feature

4.2.1.1 Text Messaging through a Voice Assistant

In this first fragment, P1, who is partially sighted, is being observed at a charity office room while he uses and explains (to me) how and for what purposes he employs a mobile phone in his daily life. After going through some of the common uses of Siri (i.e. Apple's voice assistant) such as asking for the weather or the time, P1 subsequently demonstrated how he uses it for sending text messages. The initial part of the first fragment (Segment 4.1a) is included next in order to contextualise how P1 introduced the practice of messaging others. In this, P1 is sitting at a table, holding his mobile phone in front of him.

```
P1   : one of the most common parts of Siri that a lot of visually impaired and
P1   : blind people do use is ask to message or phone- make phone calls (.) for
P1   : example ((presses home button))
SIRI : (.) ((listening))
```


```
P1   : (1.1) make- send a message to [NAME]
SIRI : (2) what do you want to say? ((beeps))
P1   : so therefore is asking me the message
P1   : ((stops Siri by pressing the home button again))
```

Seg. 4.1a: Introducing Siri for communication practices

In this segment, P1 introduces a pair of communication practices (i.e. messaging and making phone calls) achieved through the use of Siri. Notably, he does not only mention this as a practice he conducts, but he remarks that it is common for VIP in general. Right away, he moves to demonstrate an example, activating Siri by pressing the home button. It is worth highlighting that Siri does not give an auditory indication that it is listening and waiting for instruction. Although P1 is partially sighted and therefore has some residual vision, a brief pause before his utterance can be observed in line 5. This could be attributed to making sure Siri is ready for command and/or preparing to formulate the utterance. While a brief correction takes place in his instruction in line 5, Siri adequately recognises it and asks for the message to be sent. At that point, P1 provides a verbal description of the action that just occurred and stops the voice assistant as he has interrupted the example in course.

Next, in Segment 4.1b, P1 continues this demonstration by immediately re-starting his actions.

```
9  P1   : ((presses home button))
10 SIRI : (.) ((listening))=
11 P1   : =message [NAME]
12 SIRI : (1.5) what do you want to say? ((beeps))=
13 P1   : [ =hello (.) how are you?          ]
14 P1   : [((moves phone closer to his face))]((moves phone away from his face))
```

```
15 SIRI : (2.4) ((beeps)) here's your message (0.5) ready to send it? ((beeps))=
16 P1   : =yes
17 SIRI : (0.6) ((beeps)) okay (.) it's sent ((beeps))
```

Seg. 4.1b: Sending a text message using Siri

P1 has repeated the actions required to activate and instruct Siri to send a message, this time with no pause and no correction before the utterance. Further, he continues conducting the example instead of explaining it. In lines 13-14, he dictates the message to Siri whilst holding his phone slightly closer to his face and moves it away as soon as he finishes speaking. He indicates Siri to send the message after it has asked for confirmation, and then Siri notifies that the action was performed successfully. It is important to note the way in which P1 articulates his message (line 13) by employing a brief pause that might indicate a comma or period, however the message was sent without an auditory confirmation from the assistant. This subject is later touched upon in Segment 4.1d.

Overall, Segment 4.1b exhibits one short and straightforward example of Siri use for text messaging. However, as P1 explains next in Segment 4.1c, other factors are at play in relation to this practice. In the following, he provides more information about it, right after sending the text message.

```
P1   : so I've just messaged a friend in another room and now he would've
P1   : received that message
P1   : it saves me going into my phone if I'm out and about in public
P1   : and again it's a confidence thing
P1   : I don't really like having to hold my phone right to my face
P1   : ((moves phone very close to his face))
```

```
P1   : so when I've got my headphones in
P1   : headphone jack at the bottom ((points at the bottom of the phone))
P1   : I can just make a basic Siri command to send a message
P1   : it's the same again with a phone call
```

Seg. 4.1c: Reasons for using Siri in communication practices

Here, P1 has provided multiple accounts for his preference for using Siri: improved convenience ("it saves me going into my phone") but also "confidence" when he is in public. Although he is partially sighted and can somewhat see the screen's visual interface, he needs to hold the screen very close to his face in order to do so, as demonstrated in line 23. Thus, in P1's account, voice assistant capabilities are to be mastered so as to provide for *social acceptability by others* (Shinohara & Wobbrock, 2016). This is an example of the imposition of particular normative behaviours often experienced by those with disabilities. Moreover, P1 remarks that, for him, an additional item (i.e. headphones) is preferred in conjunction with the mobile phone for giving simple commands to Siri. Presumably, this item would also prevent him from moving the phone closer and away when dictating the message, as seen in Segment 4.1b (line 14). Lastly, he notes that similar reasons and actions apply for making phone calls.

Later on, I prompted P1 to show me how he uses Siri with VoiceOver turned on (i.e.

Apple's built-in screen reader). My request was generated after comments and conversations I witnessed and engaged with at the group meetings with some charity service users in which they discussed how Siri becomes more 'talkative' when VoiceOver is turned on. For Segment 4.1d, P1 has turned VoiceOver on and repeats the example of messaging a contact by using Siri.

```
P1   : ((presses home button))
SIRI : ((beeps)) ((listening))=
P1   : =message [NAME]
SIRI : ((beeps)) (1.1) what do you want to say? ((beeps))=
P1   : =good afternoon (.) how are you?
SIRI : (2.5) ((beeps)) your message to [NAME] says good afternoon how are you?
SIRI : ready to send it? ((beeps))=
P1   : =yes
SIRI : (0.6) ((beeps)) okay (.) it's sent ((beeps))
P1   : the thing is (...) when you do send a message with VoiceOver on
P1   : it will read back the message you've just said (...)
P1   : so I know what's been said or if there's been any grammatical mistakes
```

Seg. 4.1d: Using Siri and VoiceOver together for text messaging

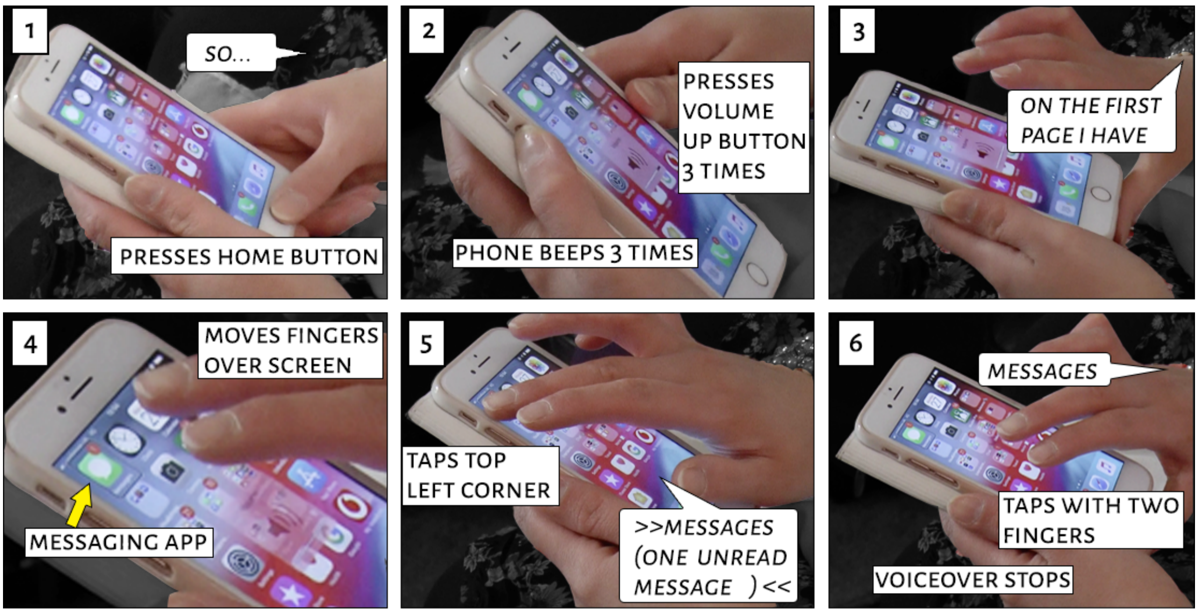
In this last segment, P1 has repeated the same steps performed in Segment 4.1b but now with VoiceOver turned on. Two main differences can be noted: first, Siri beeps right after the home button has been pressed (line 29), and second, Siri reads back the message just dictated by P1 (line 34). Being familiar with using Siri in both modalities (i.e. VoiceOver on and off), he recognises the differences between them, in which the former allows him to listen and review the message before sending it without the need to look at the screen.

Competencies Exhibited. In summary, this fragment illustrated the use of a voice assistant for sending text messages, as done by a partially sighted person. Such a feature is employed to work around the particular VI the participant has and the individual and social experiences resulting from it. To begin with, P1 activates and stops Siri by **pressing the physical button**. The first time he activates Siri (Segment 4.1a) there is a **short pause before his utterance**, but during the following times, **his utterance was seemingly immediate** after pressing a button (Segment 4.1b and Segment 4.1d). Throughout the engagement with Siri, P1 **detects the auditory cues** given by the assistant and as a response he promptly **provides the verbal commands or messages** in a short, structured way, **correcting the verbal instruction** when needed (Segment 4.1a).

Further, the **configuration of features** (Siri and VoiceOver) gives him an added layer of sounds and spoken feedback, providing more reassurance of the message to be sent. Lastly, he explains that his preference for using Siri is based on circumventing the need to **move the phone very close to his face**, an embodied resource he needs to perform to make use of his **residual vision** in text messaging. He reports that such an embodied interaction is an issue, for him, when in public spaces. Thus, the **paired configuration** of using Siri while wearing headphones becomes a way to **blend in public**.

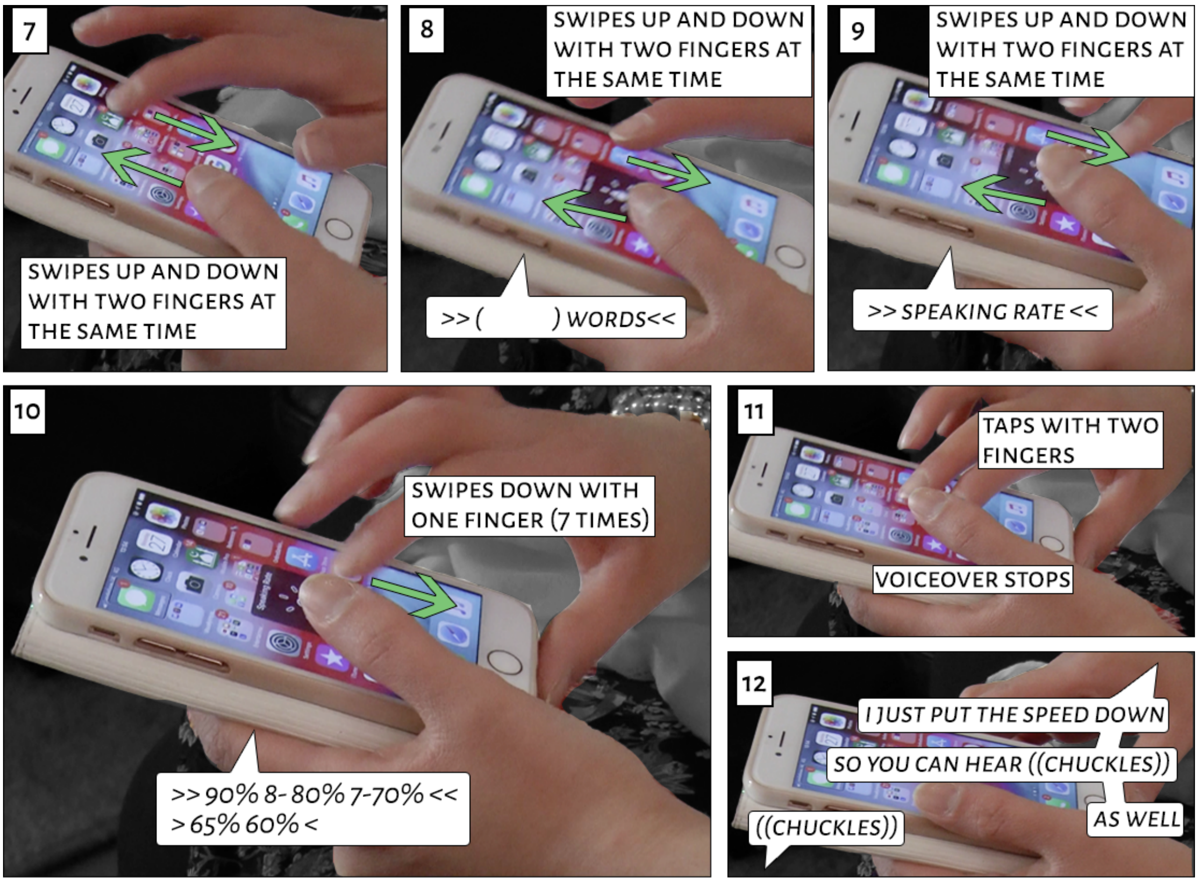
4.2.1.2 Text Messaging through a Mobile Screen Reader

In this second fragment, P5, who is a completely blind participant, shows how she uses the keyboard and the iPhone's built-in screen reader (i.e. VoiceOver) for the composing and sending of text messages. For this fragment, P5 is being observed at her home while she demonstrates and explains various technologies and tools that she uses in her daily life, one of them being her mobile phone. The initial parts of this second fragment show a short but noteworthy event that occurred at the very beginning of P5's demonstration of such a device and its apps, starting with the messaging app. In Segment 4.2a, P5 is holding her iPhone with both hands and prepares to show her apps.



Seg. 4.2a: Preparing to show apps on iPhone

In the segment above, a demonstration of the text messaging app is shown. First, there is a short preparation by pressing the home button to unlock the phone and increasing the volume, and then the first app is tapped after accounting for it ("on the first page I have"). Notably, P5 is not looking for or expecting to find the text messaging app, but rather she directly taps the first app on the first row of the first page of apps, by pressing on the top left corner of the screen. Right after tapping the app icon, VoiceOver starts reading aloud. It is worth remarking that the speed at which VoiceOver is talking is exceptionally fast, making the speech incomprehensible for me, both at the time of the observation and when listening to the recorded material. It is only through listening to the audio several times and slowing its speed down that I was able to understand and transcribe some of the speech communicated by VoiceOver in panel 5. The participant repeats the app name ("messages") and then taps with two fingers in the middle of the screen, which makes VoiceOver stop. Immediately after, Segment 4.2b takes place. Here, P5 adjusts the speech rate of the screen reader, engaging in a set of interactions produced in the span of four seconds.



Seg. 4.2b: Adjusting VoiceOver speaking rate

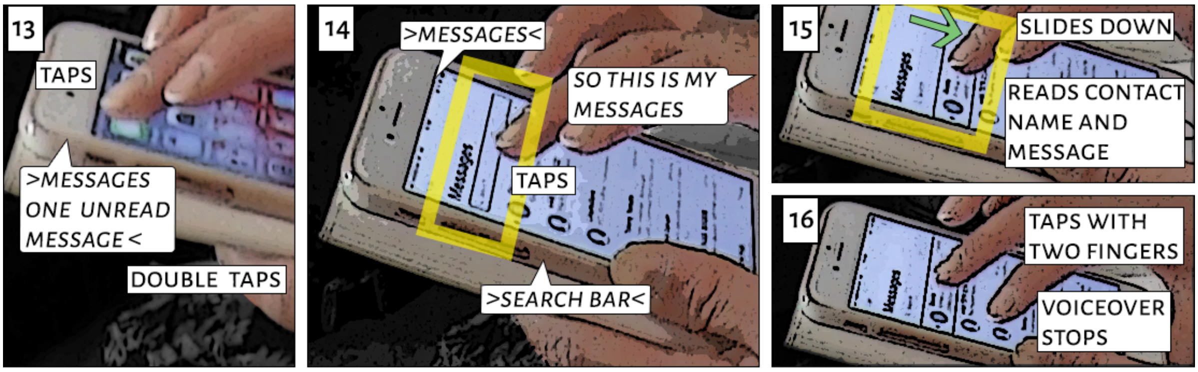
In this segment, P5 performs a series of gestures while VoiceOver reads aloud the element she is interacting with. Again, the synthesised speech is exceedingly fast for me, and only intelligible after careful attention paid to the recording. In panels 7-9, P5 performs the same gesture, swiping up and down with two fingers at the same time. Then, after selecting the option 'Speaking rate', she rapidly performs a simpler gesture, swiping down with one finger, seven times in a row. VoiceOver reads aloud a percentage that decreases each time she repeats the gesture, from 90% to 60%. Notably, P5 performs the gesture so fast that VoiceOver does not finish reading some of those percentages. As this set of interactions take place, the actual VoiceOver pace slows down, making it slightly more intelligible for me. VoiceOver stops 'talking' after the participant taps the screen with two fingers (panel 11). It is then that she accounts for what she has just done ("I just put the speed down"). This segment illustrates a lack of interest by P5 in accounting for her own proficiency adjusting VoiceOver settings, as a display of her taken-for-granted competency that combines complex gestural muscle memory with auditory skills.

The VoiceOver setting that P5 opens and modifies in Segment 4.2b is called 'rotor' and through it, users can change the VoiceOver volume or speaking rate, as well as directly move between items or locate them on screen. Although the rotor is a convenient and powerful tool, its main gesture has been reported as hard to understand, learn, and use (Ernst et al., 2017; Rodrigues et al., 2020; Buzzi et al., 2017). Support documentation indicates: *"To use the rotor, rotate two fingers on your iOS or iPadOS device's screen as if you're turning a dial. VoiceOver will say the first rotor option. Keep rotating your fingers to hear more options. Lift your fingers to choose an option*".[4] What can be observed in Segment 4.2b is that P5 performs the rotor gesture in a very different manner than that instructed by Apple's user manual. Firstly, P5 uses two hands instead of one (i.e. left thumb and right index), then she does not perform a rotating gesture, but rather swipes up and down using both fingers at the same time. Such an adapted configuration allows her to manipulate the rotor settings quite proficiently, fulfilling the undertaking in a matter of four seconds.

[4]About the VoiceOver rotor on iPhone, iPad and iPod touch `https://support.apple.com/en-gb/HT204783`

Furthermore, this segment surfaces the critical role of what is known as 'access conflict' and 'conflict negotiation' (e.g. Hofmann et al., 2020). In this case, P5 is working to accommodate for me, as an audience or investigator, by slowing the VoiceOver speed down so as to render it intelligible for a non-user or non-expert listener. Of course, the broader phenomenon of access conflicts and their negotiation is a routine part of everyday life for people with disabilities, and frequently negatively so, as they are experiences sometimes described as structural disadvantages due to the prioritisation of non-disabled needs. Thus, Segment 4.2b throws into relief some interactional features for managing a case of access conflict and its interpersonal organisation. For instance, the participant explains what she has just done but does not explain how the action was accomplished or how she assessed and decided that it was needed, nor is she responding to an explicit request as I did not ask her to change the VoiceOver configuration. This suggests that such management of access conflict is not being done only for me at that moment, implying that she is used to adjusting herself to reach a shared level of understanding with others who are not blind and/or do not use VoiceOver at fast speaking rates. There is a quick exchange between me and the participant at the end of the segment in which we both chuckle, suggesting acknowledgement of the conflict of different auditory abilities and the accommodation needed as just performed by the participant.

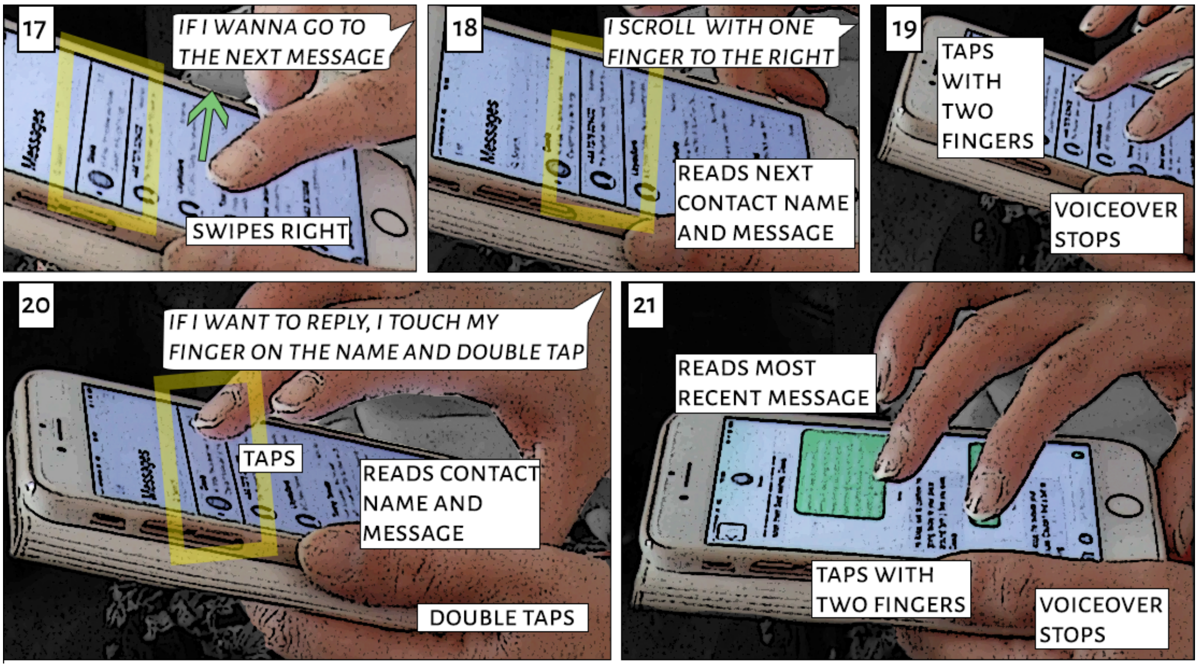
Afterwards, P5 continued showing how she uses the messaging app. The remainder segments present exemplars of the main interactions conducted by P5 in the course of her demonstration, herein simplified for brevity. In Segment 4.2c, she opens the app; in Segment 4.2d, she navigates her conversations; and in Segment 4.2e, she types and sends a short text message.



Seg. 4.2c: Opening messaging app

In this segment, P5 taps on the top left corner of the screen, as previously done in Segment 4.2a (panel 5). Again, VoiceOver reads the name of the app pressed and the notification of one message not read. Its speaking rate is still faster than regular speech, but after the adjustment performed in Segment 4.2a, the speech is much more intelligible for inexperienced listeners. Once the messaging app has been located and selected, P5 double taps to open it. This last gesture is performed indiscriminately, that is, without particularly touching the Messaging app. In panel 14, the app interface appears as VoiceOver reads the first heading ("Messages"). P5 explains "This is my messages" while tapping somewhere on the screen, touching the bottom of an item, which is read by VoiceOver ("Search bar"). From there, P5 slightly slides down her finger and reaches the first conversation in the list; VoiceOver reads the contact name and starts reading the latest message from such a conversation selected (panel 15). Lastly, P5 taps with two fingers in the middle of the screen, stopping VoiceOver from reading the full message (panel 16).

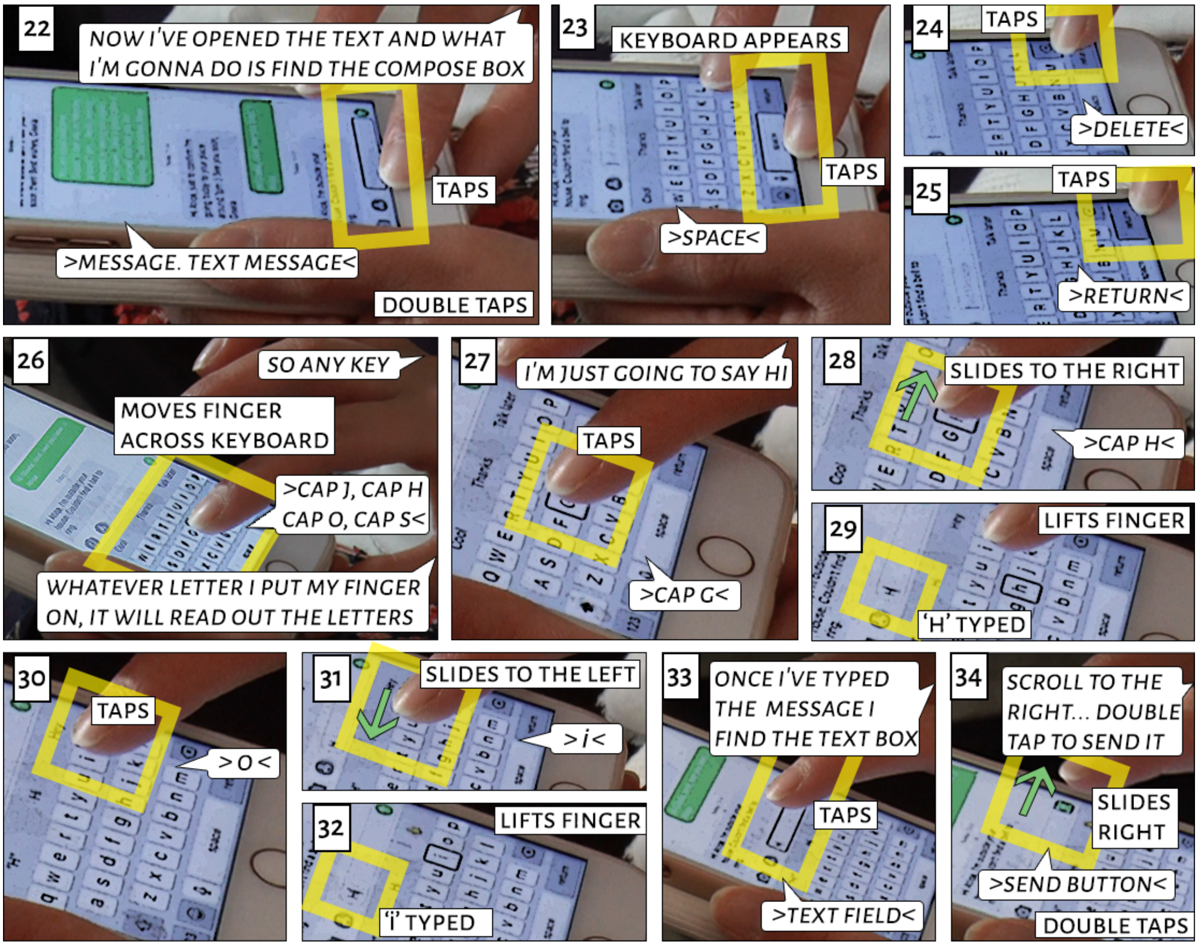
In the next segment (4.1d), P5 further explains how she navigates between and within those conversations on the main interface of the messaging app.



Seg. 4.2d: Navigating conversations in messaging app

First, this segment illustrates that swiping with one finger to the right moves the VoiceOver cursor to the next conversation in the list (panel 17). As soon as the gesture is performed, VoiceOver reads the next contact's name and message (panel 18). Second, P5 shows that by tapping on an item ("I touch my finger on the name") and then double tapping indiscriminately on screen (panel 20), the full conversation opens. As soon as this happens, VoiceOver reads the most recent message in the conversation (panel 21). Therefore, it can be inferred from segments 4.2c and 4.2d that to interact with simple onscreen elements when VoiceOver is enabled one has to tap or touch an item to select it, having the item name or description read aloud in turn, and double tap anywhere on the screen to open it, having the new screen content immediately read aloud as well. Remarkably, after each set of interactions, P5 performs a two-finger tap to stop VoiceOver from reading aloud the corresponding information (panels 19 and 21). Similarly, she has performed this gesture throughout the fragment, in panel 6 (Segment 4.2a), panel 11 (Segment 4.2b) and panel 16 (Segment 4.2c) as a constant, almost automatic method of hers in reaction to VoiceOver's output that further allows her to intersperse verbal accounts without VoiceOver interrupting or overlapping her own talk. More interestingly is the fact that P5 did not account for such a gesture (i.e. two-finger tap) until I mentioned it later on in the observational session, which suggests that it has become a highly ordinary and unremarkable action in her daily use of the mobile phone.

Lastly, Segment 4.2e illustrates how P5 uses the keyboard for typing and sending a text message. In this segment, the continuous performance of the two-finger tap to stop VoiceOver reading aloud has not been included for brevity, as the actions performed next are abundant and complex. Below I unpack these interactions in detail.



Seg. 4.2e: Typing and sending a text message

This segment continues exhibiting the core mechanics of VoiceOver, i.e. typing or touching an element to have it highlighted and read aloud, and then double tapping anywhere on the screen to open it or select it. First in panel 22, she explains that after opening the text the next step is to find the compose box for which she taps directly on the bottom of the screen, barely hitting the edge of it, but just enough to touch the compose box. This shows that she knows the location of such an element on the user interface and also that she has a rough awareness of its location on the physical device. Right after tapping the compose box, VoiceOver reads "Message. Text message.", and then P5 double taps elsewhere on the screen. Such a gesture causes the display of the keyboard (panel 23). P5 taps again on the bottom of the screen, seemingly identical to what she did in panel 22, but this time she locates the space bar on the keyboard, to which Voiceover reads "Space". Immediately after that, she slightly moves her finger up and right, tapping on the backspace key (VoiceOver reads "Delete"), and then down tapping the enter key (VoiceOver reads "Return"). These four panels (22-25) exhibit how she opens the keyboard and locates herself once it is displayed.

Next, in panel 26, she continues explaining that VoiceOver reads whatever letter she touches on the keyboard, while moving her finger randomly across it to demonstrate it. Notably, VoiceOver reads the word "Caps" before each letter to indicate that the caps keyboard is displayed. Then, in panel 27 she moves to type a short message (i.e. "Hi"). For this, she taps directly in the middle of the screen touching the letter 'G', and next she slightly slides to the right, hitting letter 'H' (panel 28). Once the letter is read aloud, she lifts her finger which causes the letter to appear as typed on the compose box (panel 29). After releasing the capital 'H' letter, she immediately taps slightly up and right, touching letter 'o' (panel 30). Note that after typing the first letter the keyboard has changed to show all lower-case letters and thus, VoiceOver only reads "o". Right after that, she slightly slides to the left touching the letter 'i' (panel 31) and by lifting her finger the letter is typed on the compose box (panel 32). This sequence of panels (27-32) shows how P5 is almost precise in directly locating the two keys she is looking for i.e. 'H' and 'i'. She knows the former is in the middle of the screen and the latter above to the right. Once hitting the nearby keys, she knows in which direction to move her finger so as to locate them i.e. right (panel 28) and left (panel 31). Although this is a very short and common word, this segment exhibits P5's knowledge of the keyboard arrangement, which is of course supported by VoiceOver reading aloud the letters pressed but is mainly driven by a combination of P5's memory and spatial awareness.

Finally, in panel 33, she explains that to send the text she needs to find the text box in which her message has been typed, which is located above the keyboard. For this, she taps in the middle of the screen (VoiceOver reads "Text field"). Then, in panel 34, she slides to the right to locate the Send button and double taps to send the message. In these two closing panels, she shows again a precise knowledge of the elements on the user interface coupled with an awareness of their location on the screen.

Competencies Exhibited. To recap, this fragment has shown how a smartphone is used by a blind person to read and compose text messages. First and foremost, the screen reader feature is essential to make the device accessible to the participant and therefore she relies on **listening to VoiceOver's output** as she **physically interacts with the screen and other buttons.** As this mode of interaction is P5's main method to use her mobile phone, and, as this fragment has evidenced, she is an expert user, she prefers a **fast speaking-rate configuration** for VoiceOver in order to perform her actions more quickly i.e. not having to wait for a normal-paced voice. This in turn demonstrates that she can **recognise and understand very fast synthesised speech** (Segment 4.2a). In this fragment, the discrepancy of listening skills between participant and researcher is determined as an issue by P5 herself, as she immediately performs a series of combined gestures to decrease the speech rate for me (Segment 4.2b). By doing this, she **manages the access conflict** encountered and in the course of doing so, showcases her proficient use of VoiceOver, **performing complex gestures in a very short time.** Moreover, P5 **continuously used the shortcut** to stop VoiceOver (i.e. two-finger tap), which allowed her to continue with the demonstration without having the phone speaking in the background. Further, throughout the fragment P5 displays knowledge of the screen layout (Segment 4.2d and Segment 4.2e), **roughly remembering the structure of each page** which helps her to **locate specific elements on the screen.** This was done by **directly tapping** on an area where the item needed was expected to be found, then **exploring the screen** until finding the element, of course **guided by VoiceOver** reading aloud whatever had been touched.

4.2.1.3 Text Messaging through a Dictation Feature

In this third and last fragment illustrating social relations and communication practices, P6, who is partially sighted, shows another modality for sending text messages and explains why this is his preferred choice. In this fragment, P6 is being observed at the reception desk of the charity office where he regularly volunteers. After going through the tasks that he normally carries out during his shift, I enquired about other uses of technology in his everyday life. When prompted about voice-activated technologies he said he did not use any of them at the moment but mentioned the dictation feature for sending text messages as a related topic. P6 subsequently demonstrated how he performs such a practice. In the initial part of this fragment (Segment 4.3a), P6 has pulled his Samsung smartphone out and before opening the text messaging app, he contextualises the accessibility settings he needs to conduct the task.

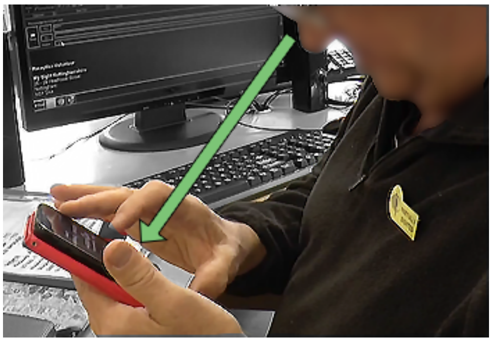
```
1 P6  : my settings have gone a bit weird ((opens settings))
2 P6  : just trying to find the accessibility setting because again ((scrolls))
3 P6  : there is already built in the phone these various options you can have
4 P6  : one which is what they call colour inversion
5 P6  : ((enables colour conversion setting))
```


```
6 P6  : so it does that the same as the computer and I can cope with that better
7 P6  : cause when it's a light screen I do struggle with the contrast
8 P6  : so I need it darker and then I should be able to find what I'm looking for
```

Seg. 4.3a: Contextualising colour inversion feature on the smartphone

The segment above shows that before engaging with the activity (i.e. dictating a text message), P6 opens the setting options on the phone and searches for the accessibility feature that inverts the colours on the screen. That is, the background colour turns black, and the font turns white (Line 5). He mentions that something has happened to the settings ("have gone a bit weird" in line 1), suggesting that the standard option for him is the colour inversion enabled. Further, he uses the computer screen in the background to illustrate his argument ("it does that the same as the computer" in line 6). At this point, he had already gone through some tasks at the reception desk that require the use of the desktop computer, for which he prefers a high contrast on the screen to better support his VI. In this segment, he merely reiterates the issue and how he addresses it ("I do struggle with the contrast... I need it darker" in lines 7-8). Further, although P6 does not make a mention of it, the phone is also set to display large-sized font. This, along with the colour inversion, is one of the various accessibility settings available on the smartphone, just as P6 has pointed out in line 3. It is by employing these accessibility features that P6 can move on to open the messaging app and find a conversation, shown next in Segment 4.3b.

```
9  P6    : ((opens messages and scrolls through conversations))
```



```
10 P6    : okay so I just tap on there ((taps on name)) ((conversation opens))
```


Seg. 4.3b: Opening a conversation

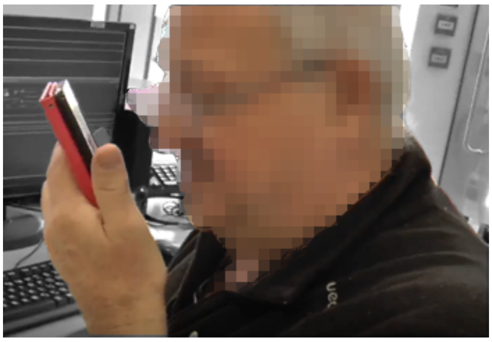
This brief segment shows that once the accessibility settings are set up, P6 can easily open the app and scroll through the conversations, while holding the phone at a distance.

Then he finds the intended contact name and by tapping on it, opens the individual conversation. Next, in Segment 4.3c, he moves on to dictate and send the message.

```
11 P6    : and then tap on type your message and then
12 P6    : instead of typing it it's got the voice key there ((taps on text box))

13 P6    : ((keyboard is displayed)) ((taps voice key))
```


```
14 PHONE : ((beeps))
15 P6    : and just go
16 P6    : ((phone close to face)) ((dictates message)) ((moves phone back away))
```




```
17 P6    : and it comes up so I don't have to type it
18 P6    : and then all you have to do is that key there to send it ((presses key))
```

```
19 PHONE : ((sends message))
20 P6    : and it's gone (.) so much simpler
```

Seg. 4.3c: Dictating and sending a text message

This segment showcases the steps carried out by P6 to dictate a short text message. Once the conversation is displayed, in lines 11-13 he taps on two interface items: firstly, on the text box that in turn displays the keyboard on the screen, and secondly, on the microphone icon located within the keyboard. Again, interaction with the graphic user interface appears to be seamless once it is configured in a specific manner through the accessibility features. After hitting the dictation key, the phone beeps; this acts as a cue for P6 to start dictating. In line 16, he moves the phone close to his face and then speaks aloud the message to be sent. As soon as he finishes, he moves the phone back away. Finally, he sends the text that has been recognised by the phone and is being displayed on the screen (line 18) by tapping on the send button. Interestingly, after the message has been sent, he states that this mode of interaction is "so much simpler". To end this sequence (Segment 4.3d), he continues explaining his preference for dictation over manually typing.

```
21 P6  : I mean that would take me-
22 P6  : even that little message would take me you know three times as long
23 P6  : trying to find the keys and everything so that is
24 P6  : that is really helpful
25 P6  : especially like if outside is (.) is a bright sunny day
26 P6  : I've got no chance of finding the keys
27 P6  : so to be able to actually speak the text is marvellous
```

Seg. 4.3d: Explaining preference for message dictation

In this last segment, after P6 has demonstrated how he uses dictation for the sending of a text message, he adds more context about his preference for such a modality. Firstly, he points out that typing the same message he just dictated would take a considerably longer time. This could be attributed to the size of the keys on the screen; although the large-sized font option has been set up on the phone, the keyboard is unaffected by such a change given that it is a heavily populated element on the user interface. Despite the fact the colour inversion setting has affected the keyboard, this is not sufficient for P6 to easily operate it, as with the rest of the interface (e.g. scrolling through his conversations). Thus, the task of typing various words becomes difficult and time-consuming for him ("trying to find the keys and everything"). Furthermore, P6 mentions being additionally constrained by sunlight when outdoors, making the task virtually unmanageable ("I've got no chance of finding the keys"), which makes the dictation option his best chance to accomplish the practice of texting others.

Competencies Exhibited. In summary, this fragment has shown how a partially sighted person uses the dictation feature to send a text message. Such a feature is employed to ease the task for the participant, but firstly, specific **vision accessibility configurations** need to be enabled to support his particular VI. These are comprised of **large-sized font and colour inversion**, which coupled together make the elements on the screen available to P6 (Segment 4.3a). By employing this combination of accessibility features, P5 is able to **visually find and operate the user interface elements** (e.g. opening the messaging app, searching for and opening a specific conversation) in a seamless manner (Segment 4.3b). However, issues arise as one of the accessibility settings (i.e. large font) cannot take effect on the on-screen keyboard, thus necessitating the dictation feature as a workaround that makes the task simpler and quicker. Despite the keyboard not being entirely accessible or easy to discern to P6, he **recalls the location and look of the items** that allow him to dictate and send the message (i.e. microphone icon and send button), as he directly taps on them when they are needed to continue with the task (Segment 4.3c). Moreover, he employs a combination of auditory, verbal, and embodied resources for the message dictation, that is, **right after the auditory cue** from the phone he **moves the device very close to his face**, then he **verbally formulates the message**, and when finished, he **moves the device away**, back to the initial position. Lastly, P6 points out that other situational conditions such as sunlight can additionally affect his capability of performing a task that is already difficult and time-consuming under ideal conditions (Segment 4.3d). Thus, employing the dictation feature becomes a way to **adapt to the environment**.

4.2.1.4 Summary and Relation with Next Practices

By unpacking these instances of social relations communication and practices, three different modalities of interaction have been illustrated: using a voice assistant, a screen reader, and a dictation feature. Notably, these ways of performing the task (i.e. sending a text message) are similarly applicable to, or have a close relationship with, other practices that require typing or composing messages such as in e-mail, instant messaging and social media apps. Moreover, voice assistants are employed in a similar way for making phone calls, as P1 pointed out in Segment 4.1c.

Across the data presented, there is a contrast between participants here that is interesting. P1, who is partially sighted, prefers to use voice interaction, while P5, who is blind, prefers to engage with the user interface through the screen reader. Meanwhile, P6, who is partially sighted, employs a combination of touchscreen and voice dictation. Thus, participants make use of the modalities that better suit their own VI, but also their concrete competencies and specific conditions or experiences. For example, P5's proficiency with the screen reader makes her feel more confident and fast at typing the message, as opposed to composing it by voice. Conversely, the effort and time required for P1 and P6 to manually type using their residual vision, makes them prefer voice interaction. Moreover, the fact that P6 requires visual accessibility features enabled for operating his smartphone and P1 does not, speaks of the varying levels of such residual vision between people who are considered or categorised (legally and personally) as partially sighted. The competencies exhibited in and ascertained from these fragments will be summarised and discussed in (subsection 4.3.1).

Before moving on to the next section that describes, illustrates, and unpacks textual reading, it is worth remarking that many of the social relations and communication practices, such as the data fragments previously presented, are of course intertwined with and somewhat dependent on reading practices. Therefore, this section has elucidated some of the methods participants employ to read in digital contexts; for example, adjusting the size of the font and the colours of the background and font. Moreover, it has become evident that, for some VIP, reading becomes an auditory experience, in this case enabled by a smartphone and its built-in screen reader. The next section builds upon and expands on these methods and will show other ways of reading as experienced by the participants in their daily life.

4.2.2 Textual Reading Practices

The prevalence of textual information in the world is one of the core challenges that recurrently emerged from this study. While these activities tend to be supported by a range of established and mature forms of assistive technologies –some of which will be illustrated in this section– the route to self-determination and the development of competence are hindered in various ways. Once again, participants needed to develop competencies in the form of sets of practices based around 'reading'; practices that worked with the nature of their particular VI. This posed far more challenges than just that of managing social relationships and communication practices.

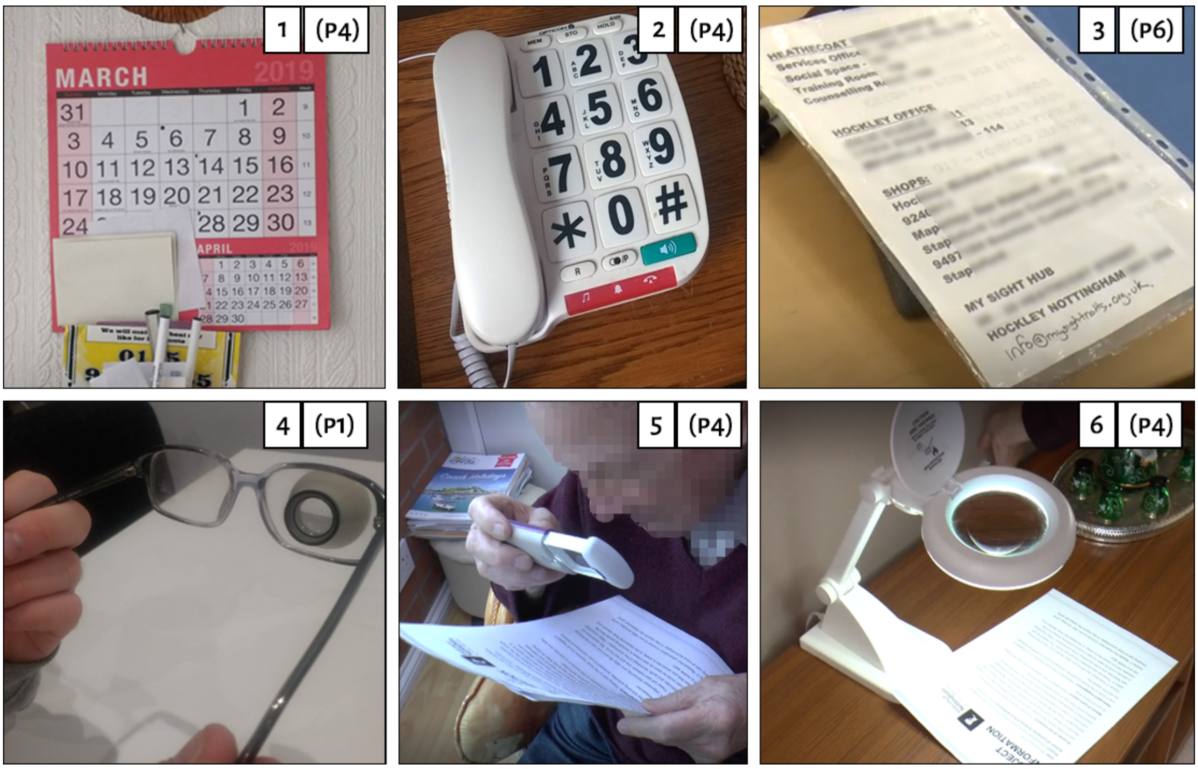
As aforementioned, screen readers on mobile phones and computers were considered as essential to read digital and online content, for both blind and partially sighted participants. However, reading information in the physical world still proves to be one of the most challenging activities in their day-to-day lives, no matter their sight condition. Participants reported struggling to read documents received by mail (e.g. statements, letters, leaflets), handwriting, street signs, food menus and labels on products (e.g. food, toiletries). Regarding such products, participants expressed they wished to know specific details about them (e.g. ingredients, presentation, colours), not just identification. Moreover, participants reported struggling to read the information on digital screens that do not have accessibility features; for example, P6 had to stop working in a supermarket after several years when they introduced touch screens, and four participants pointed out complications in reading text on home appliances (e.g. digital displays). Here technology introduces retrograde steps that break established competencies.

This section will give an overview of the tools and methods employed by participants to read text, thus working around some of the aforementioned issues. In the following, three data fragments will be unpacked; they show different types of devices or mediums available for VIP to support their daily activities that require or involve reading information. Continuing from the first three fragments presented in the previous section, the fourth fragment presents a compilation of some of these technologies or devices captured across the participant sample. The fifth fragment presents a partially sighted participant using a portable electronic magnifier that visually adjusts printed text. Lastly, the sixth fragment presents a blind participant using an Optical Character Recognition (OCR) app that detects printed text and translates it into audio.

4. Reading through Large-print, Braille, and Other Dedicated Devices
5. Reading a Printed Form through a Portable Electronic Magnifier
6. Reading a Tin Label through an Optical Character Recognition App

4.2.2.1 Reading through Large-print, Braille, and Other Dedicated Devices

For this fourth fragment, rather than analysing a specific instance, I present a compilation of ‘vivid exhibits’ encountered in the fieldwork. These are evidence of the variety of low and high technologies and mediums that participants have acquired or adopted for accessing information originally in printed text. Firstly, Segment 4.4a shows examples in which VIP are supported through large-font and magnifiers.



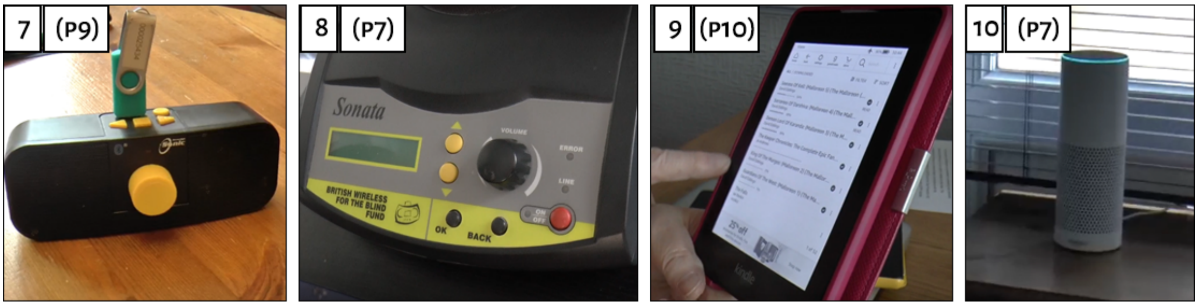
Seg. 4.4a: Large-font and magnifiers for aiding textual reading

The first three images in this segment show the relevance of large-font[5] in print and physical devices for people who are partially sighted. The wall calendar and the landline telephone are items that P4 has acquired at the charity office, where they offer a variety of aids for people with different VI. In a similar vein, the printed sheet used by P6 contains contact details of the charity office staff members, and it has been specifically produced in that format for the partially sighted volunteers working at the reception desk. When partially sighted participants have access to information in large-font, reading it can be supported.

However, it can be noted that large-print is only ever encountered as a special access need, where devices and print are specifically produced to aid VIP. Thus, partially sighted participants have to work around the prevalence of smaller fonts in the physical world. For this, a range of lenses and magnifiers are employed. In the above segment, three different examples can be observed: specialised spectacles, a portable magnifier, and a desk magnifier. Although these are helpful to support participants' individual VI, they also pose challenges. For example, P1 stated how he prefers not to use the spectacles in public due to confidence reasons—similarly to the preferences he described in Segment 4.1c, and sometimes prefers to ask others for help; he stated *"like reading labels in the supermarket, I'd get a friend to, I'd just use their eyes if that makes sense"*. Likewise, P4 explained that he uses the portable magnifier to read product labels when doing grocery shopping, but he prefers to get direct support from staff at the shops in order to make the activity easier and quicker. Similarly, people that own desk magnifiers mentioned that often they prefer to get someone to read their mail aloud to them for reasons of convenience.

The examples shown in Segment 4.4a illustrate instances of short or medium length information. However, accessing longer pieces of information such as books, newspapers or magazines is approached in a different way. Next, Segment 4.4b provides a brief compilation of devices used for book consumption by VIP.

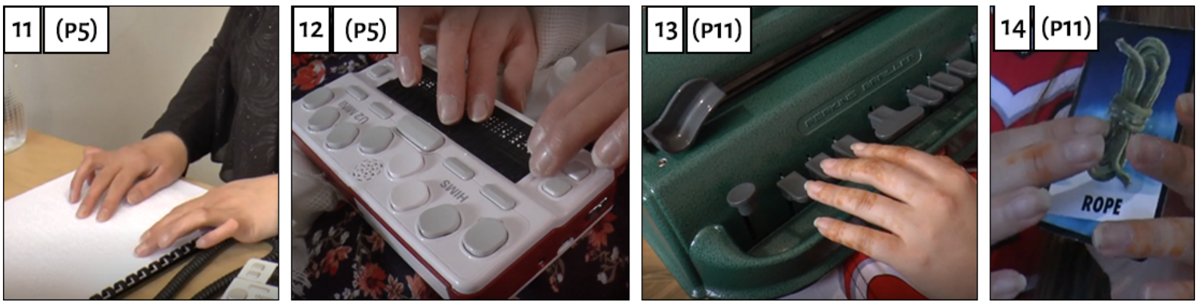
[5] Large-font is also known as large-print or large-type. It refers to the formatting of text in a larger font than commonly used, where regular-print is 10 or 12 points and large-print 16 or 18 points. https://www.rnib.org.uk/information-everyday-living-reading/large-and-giant-print



Seg. 4.4b: Book reading resources and devices

In this segment, four different devices used by the participants for accessing and consuming books are shown. Perhaps not surprisingly, three of them provide the information as audio. The first example is a service provided by the RNIB called 'Talking books'[6] in which a range of books are provided as audio in a variety of formats such as on USB sticks. The next example is a specialised internet audio player for blind people[7] that provides a range of content, including audiobooks. It can be noted that the design of these devices is simplistic, with only a few buttons to operate them. Lastly, two devices that could be categorised under mainstream devices are exemplified: an Amazon Kindle and an Amazon Echo. The former is an e-reader that allows users to adjust a range of reading options such as font size and screen light, and the second is a smart speaker that, among other content, offers audiobooks. In a similar way to these examples, other services also provide news or magazines in audio format.

To close this fragment, Segment 4.4c presents some examples of Braille used by participants.



Seg. 4.4c: Reading and typing Braille

Only three participants (i.e. P5, P8, P11) in this study reported reading Braille. Similarly

[6] https://www.rnib.org.uk/talking-books-service

[7] https://blind.org.uk/get-support/our-radios/sonata-plus/

to large-print, information in Braille format is considered a special access need and thus it can be obtained through specialised organisations or under specific requests. For example, the staff at the charity office generate and provide the address book for blind volunteers working at the reception desk, as shown in the first example of this segment. P5 also owns an electronic Braille notetaker; using this she can type in messages and store them and organise and read them through the refreshable Braille display. It is worth noting that this notetaker also provides the output as audio, which P5 has adjusted to speak at a fast rate—similarly to the preferences described in Segment 4.2a. On the other hand, P11 owns a manual Braille typewriter that she uses to create labels for objects at home so she can read the information on them and/or recognise them; for example, to read the text in board games items, such as cards.

Competencies Exhibited. Although this fragment has not unpacked a specific instance of a participant's interactional competencies, I have provided a compilation of 'vivid exhibits' of participants' reading practices that can help to identify or surface some of the competencies already observed in the previous fragments. In summary, this fragment surfaces the use of **residual vision** (Segment 4.4a), **audio listening** (Segment 4.4b), and **tactility** (Segment 4.4c) by participants for accessing information originally in print. Of course, accomplishing these reading practices depends on other factors such as **individual knowledge** (e.g. for reading Braille) and external resources. For the latter, a particular **configuration of devices** that meet participant's needs, and the provision of **information in the corresponding format**, are necessary. Moreover, these devices, resources and knowledge are created or provided by specific organisations, thus a **network of relations and support** can be surfaced as well. Nevertheless, although these methods are useful for supporting reading, in practice often participants favour **requesting assistance** from others for convenience or confidence purposes. The next fragment provides an example of such occurrences.

4.2.2.2 Reading a Printed Form through a Portable Electronic Magnifier

Next, in the fifth fragment, P6 explains his use of a portable electronic magnifier, a personal device he normally carries with him. This data fragment was captured during an observational session at the reception desk of the charity office, where P6 volunteers. This topic was brought up when I asked him if there were any other devices that he uses for conducting the tasks at the reception, after he explained his main activities and tools there, such as the reception phone and desktop computer. For Segment 4.5a, P6 took the portable electronic magnifier out of his backpack and started explaining its use.

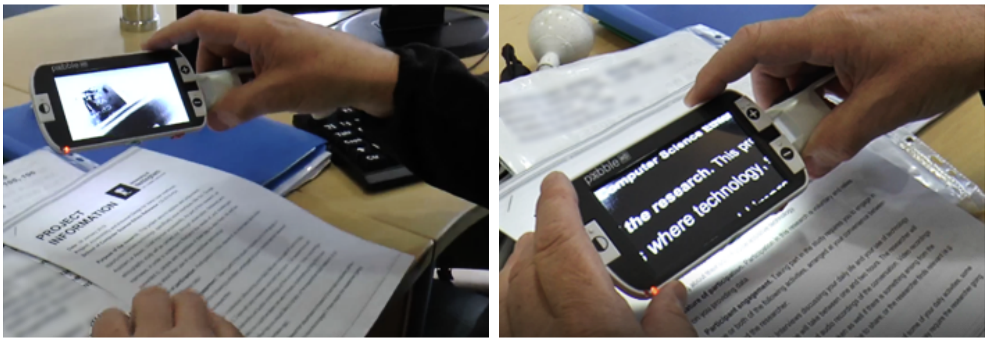
```
1 P6  : I have a hand-held electronic magnifier
2 P6  : which if I had got the time
3 P6  : ((turns device on))
```


```
4 P6  : to go through like the consent form that we've just filled in
5 P6  : I could've probably done it eventually
6 P6  : but it would've took me a considerable amount of time
7 P6  : you know but I use this to help me do things
```

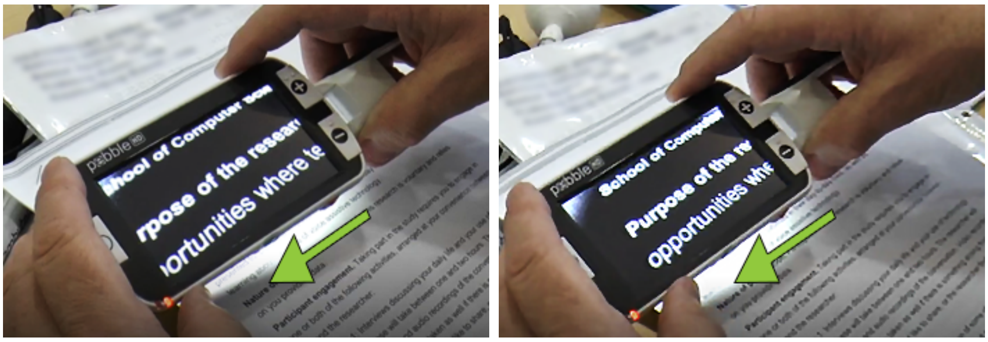
Seg. 4.5a: Portable electronic magnifier for reading print

In this segment, P6 refers to the informed consent procedure he had just gone through for taking part in the research. The information was available to participants in different formats (e.g. digital, print) so they could choose their preferred one. P6, as the majority of participants, chose to have the information read aloud by me. In line 5, P6 acknowledges that he is able to read the document using the magnifier; however, he chose not to to save time. This example resembles the accounts of other participants who expressed a preference for requesting assistance when reading the mail or product labels while shopping. Nevertheless, he states that he uses this electronic magnifier to ‘do things’, presumably when the assistance of others is not available or wanted. To showcase his device, P6 took a sheet of paper from a folder on the desk; this paper was the project information sheet I handed to him, which I previously read aloud during the consent procedure. Segment 4.5b shows P6's demonstration of the electronic magnifier.

```
8  P6  : ((aligns sheet on the desk)) ((holds device over sheet with two hands))
```



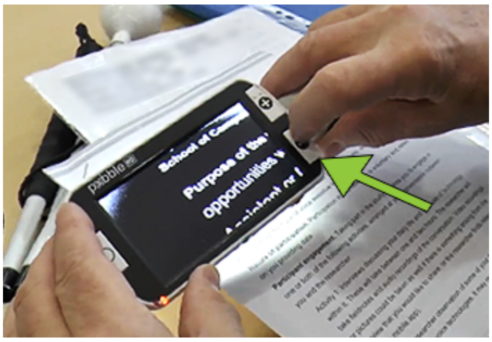

```
9  P6  : so like I say it would've- I would've done this eventually
10 P6  : but it would take considerable time
11 P6  : ((slides device to the left))
```



Seg. 4.5b: Framing portable electronic magnifier over printed sheet

Firstly, P6 puts the sheet on the desk and aligns it in front of him. It can be observed in line 8 that the device has initialised and displays a high contrast version of the area being pointed at. Once the paper has been aligned, P6 holds the device over it and steadies it by using both hands (line 8); once the text is clear and detected, P6 slides the device to the left of the sheet, following the printed line until reaching the beginning of the sentence (line 11). With this, P6 surfaces the bodily work of framing the device over the print and following the sentences back and forth. Further, he reiterates that this action is 'doable' but time-consuming. Right after this, in Segment 4.5c, P6 continues to show how the font can be adjusted in the device.

```
P6  : and this has got an increase
P6  : you can increase it or decrease it
P6  : ((presses (-) button two times)) ((font decreases size))
```



```
P6  : I prefer white writing on a black background (...)
P6  : and like I said depending on how big the print is you can actually
P6  : ((presses (+) button multiple times)) ((font increases size))
```

```
P6  : bring it up really large
P6  : so the only trouble with that is it does take a bit of time
P6  : but otherwise that helps me enormously
P6  : not just on here but everywhere
```

Seg. 4.5c: Adjusting font size on portable electronic magnifier

In this segment, P6 demonstrates that by pressing on the buttons located at the right side of the magnifier he can increase or decrease the size of the font displayed on the screen. The simplicity of such a device lets him directly locate the buttons with ease, first pressing the bottom one for decreasing the font size, and later on, the top button for increasing it. He further explains that such adjustments will depend on the size of the print that needs to be read (line 16), and although it can be made quite large this will extend the time taken to accomplish the task (line 19). Interestingly, he remarks that despite the trouble, the device offers ‘enormous’ support at the reception desk and elsewhere. Moreover, in this segment P6 accounts for the device configuration of white text on a black background (line 15), similar to what he explained in Segment 4.3a, which helps him in reading the text more easily.

Competencies Exhibited. This fragment has shown how a partially sighted person uses a portable electronic magnifier for reading printed text. Yet again, the fragment shows the need for **specific accessibility configurations** that support the participant's particular VI, which are comprised of **colour inversion** and the possibility of **adjusting the font size** as needed (Segment 4.5c). Once these configurations are set, P6 is able to use the device for reading the printed text, which is done by **aligning the paper**, then **framing and steadying the device** over it, and lastly **sliding the device following the sentences** (Segment 4.5b), back and forth, and up and down as needed. Of course, the bodily and reading work herein exhibited is enabled by P6's **residual vision**, guiding him through aligning, framing, steadying and sliding. Further, by the way he **directly locates the buttons** to adjust the font size and maps them with their corresponding action, it can be inferred that the participant has acquired some **proficiency in using this device** and/or the symbols on the buttons are large enough for him to **visually recognise** them. Moreover, this fragment showcases two key support arrangements needed for reading as a person with VI: 1) the acquisition and adaptation of assistive devices into a daily routine, such as **regularly carrying them**, and 2) the **assistance from others** when the reading tasks are time-consuming (Segment 4.5a). Notably, the time taken for accomplishing the task became a key issue reiterated throughout the fragment, making time-sensitive activities less feasible when using devices such as the electronic magnifier. The next fragment presents a workaround to this issue devised by a blind participant.

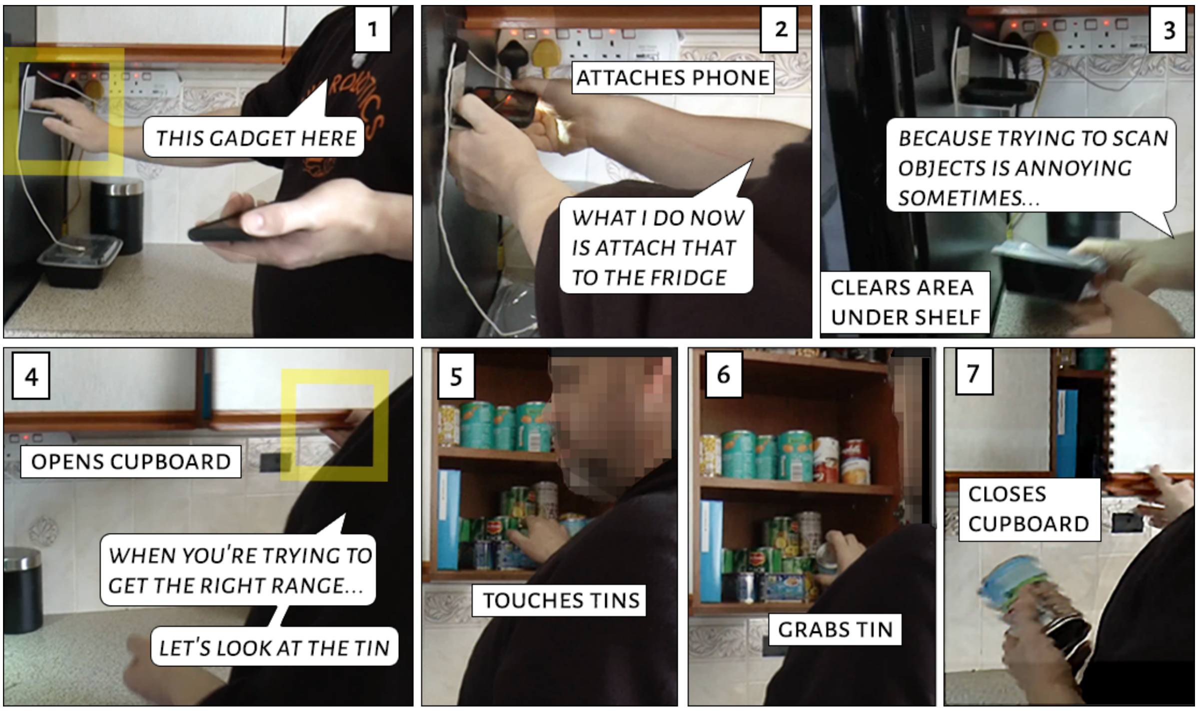
4.2.2.3 Reading a Tin Label through an Optical Character Recognition App

In the sixth fragment, P2, who is completely blind, uses an OCR app on his smartphone, which is one of the core reading practices employed by eight participants in the study. Five participants use Seeing AI[8] and three participants use KNFB reader[9]; they all indicated

[8] https://www.microsoft.com/en-us/ai/seeing-ai

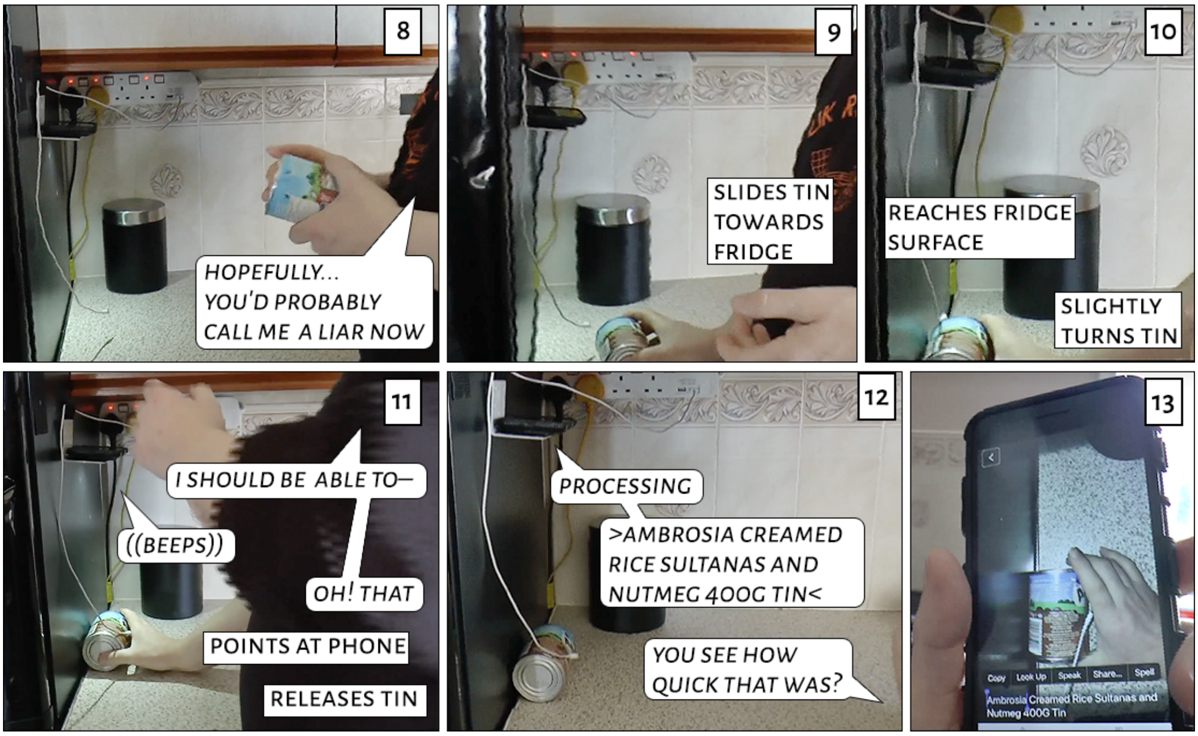
[9] https://knfbreader.com/

using them on a daily basis. Both apps work broadly in a similar way: the user takes a picture of the document or text, the phone processes the picture, and it then reads the text aloud. In this fragment, P2 shows two ways of using Seeing AI, one in conjunction with an adaptation of his own to make the task easier and straightforward, and the second without such an adaptation. In this data piece, P2 is at his home, specifically in the kitchen. In this fragment, he firstly scans a tin label using a 'Velcro station', one of the several homemade adaptations that he has installed around his house, where he lives on his own. In Segment 4.6a, P2 explains that this specific station is a metal shelf attached to the side of the fridge, on which he can place his mobile phone, horizontally, with the back camera facing down. The shelf and the back of the smartphone have the two ends of a Velcro patch, so the phone can be temporarily attached to the shelf for scanning documents or other printed text, as shown in the following. Before the first segment takes place, P2 has opened the Seeing AI app and has selected the 'product mode', thus the camera is ready to scan (i.e. to take a picture of a barcode).



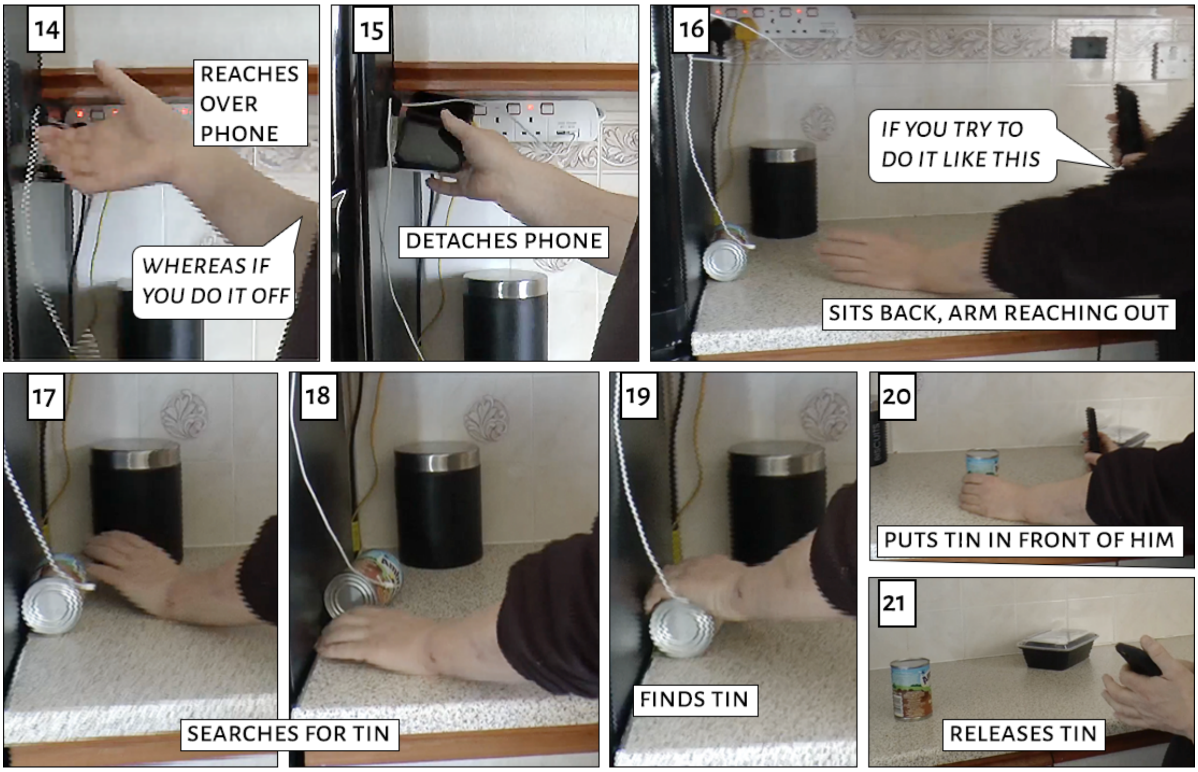
Seg. 4.6a: Attaching phone to shelf and getting a tin from the cupboard

In this initial segment, P2 has shown how he makes use of the shelf already installed on the fridge surface (panel 1) by attaching his mobile phone to it, horizontally, with the back camera facing down (panel 2). He then explains the reasoning behind this homemade adaptation, that is, avoiding the annoyances in “trying to get the right range” when scanning objects, thus suggesting that the shelf enables the phone to always be at a pre-set distance that is ‘right’ for scanning. Further, P2 has shown that the practice of using the shelf to scan requires a clear area underneath the phone, and obviously, an item to be scanned. This segment illustrates how P2 explores the surrounding surfaces such as the counter under the shelf (panel 3) and the tins inside the cupboard (panel 5-6) and shows P2’s overall good awareness of some items and their location, for example, the shelf itself (panel 1) and the cupboard door (panel 4). Next (Segment 4.6b), P2 scans the tin.



Seg. 4.6b: Scanning tin label using shelf

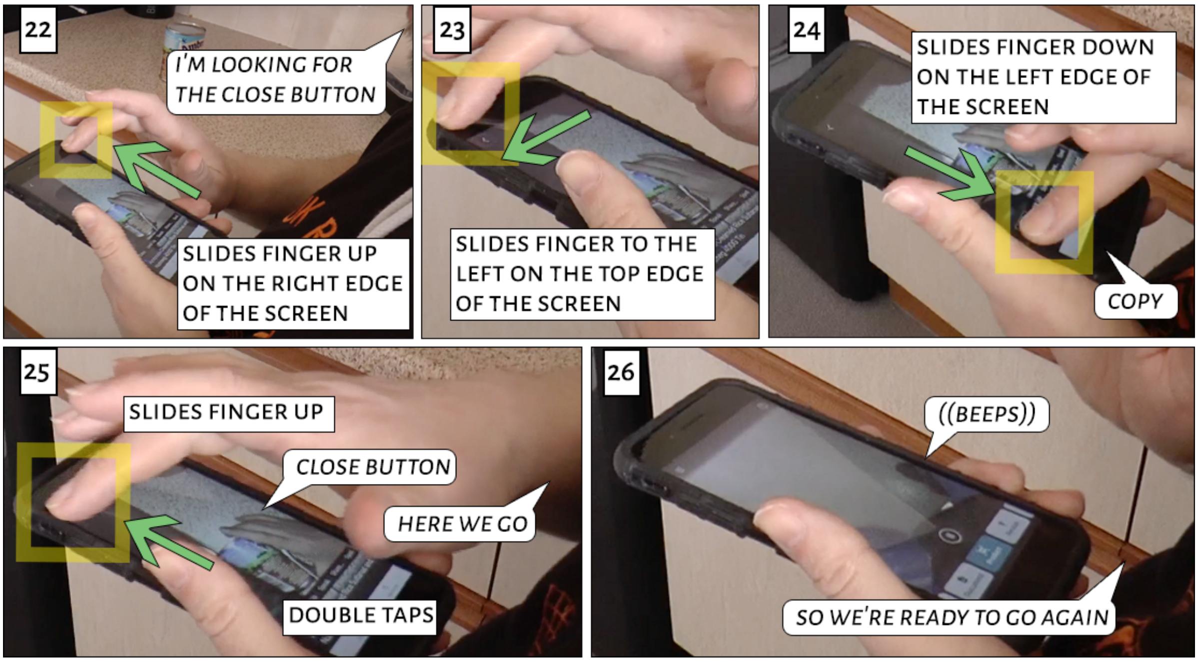
In this segment, P2 seamlessly scans the tin, by first adjusting the hold of the tin in his hand (panel 8) so that it can be placed lying sideways on the counter and slid towards the area in the range of the phone’s camera (panel 9), which is indicated by the tin hitting the fridge surface (panel 10). Then, P2 starts turning the tin so that the barcode on the tin label looks upwards, in the direction of the phone (panel 10). Almost immediately, the phone beeps and takes the picture, then processes the product detected and reads aloud its description (panels 11-12). The image in panel 13, where P2 shows the photo taken by the app, was captured moments later when he was preparing to scan in the second modality i.e. without using the shelf (just before Segment 4.6d took place), but I have included it here to illustrate the outcome of the scanning process shown in panels 8-12. Notably, P2 has remarked that this mode of scanning is more straightforward than scanning the product by holding the phone with a hand, and as such he provides interesting remarks throughout. Firstly, he sets a scene to manage expectations ("Hopefully... you'd call me a liar now" in panel 8), but as he progresses in the task, he gets interrupted by the phone's beep indicating success in scanning ("I should be able to– oh! that" in panel 11). Lastly, he points out the simplicity of the activity just accomplished ("You see how quick that was?" in panel 12). Thus, after succeeding in showcasing the first modality, P2 prepares to demonstrate the second modality, which can be seen in the following two segments (Segment 4.6c) and (Segment 4.6d).



Seg. 4.6c: Detaching phone from shelf and finding tin on counter

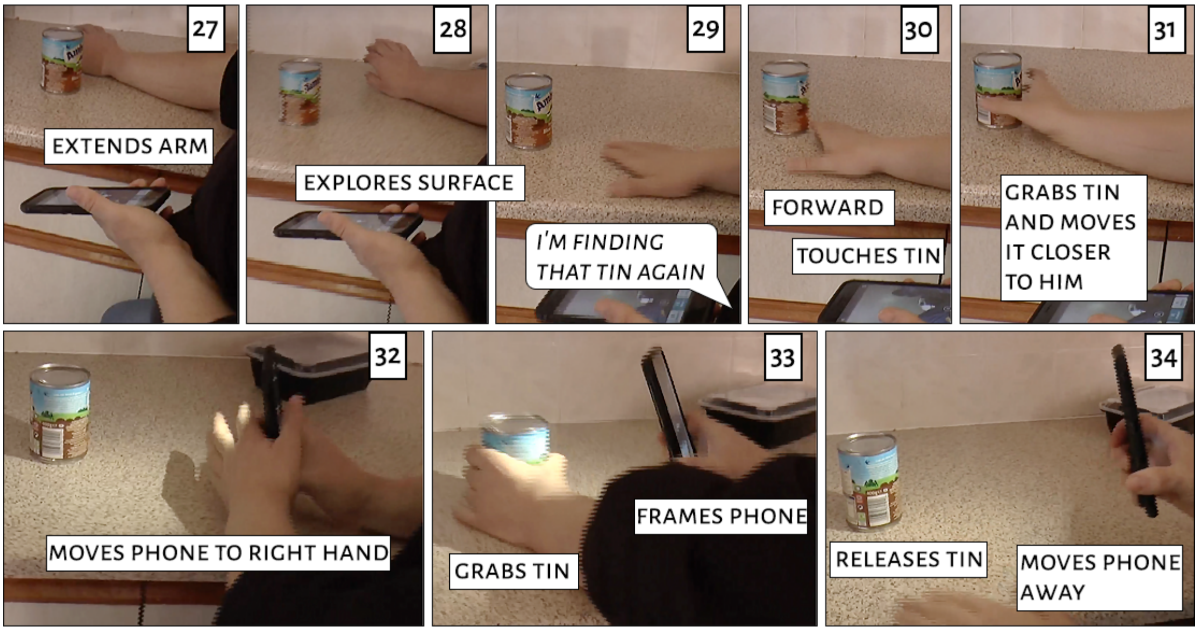
Although this segment shows how P2 gets ready to scan the tin without using the shelf, it also serves to illustrate the closure of the first modality displayed in Segment 4.6b. That is, after scanning the product, the phone is detached, and the tin is located and moved away from under the shelf. Again, overall good awareness of the items and their location can be observed, when reaching out to the shelf (panel 14) and the tin (panel 16). However, the segment also illustrates that although such awareness is present, P2 is not always precise in his moves; he slightly misses the shelf the first time he tries to grab his phone (panel 14) and when he first attempts to get the tin (panel 16-17). Thus, he must reorient his hand towards the objects by exploring around those initial reference points established in support of his spatial awareness. That is, when the back of P2's hand hits the phone and shelf rather than grabbing them (panel 14), P2 obtains a new point of reference that helps him to slightly move his hand under the shelf and then detach the mobile phone (panel 15).

Likewise, as P2 has not found the tin after extending his arm forward (panels 16-17), he continues to explore the counter surface to his left and right, until hitting the tin (panel 18) and then grabs it (panel 19). At last, P2 moves the tin closer to him and places it vertically on the counter, getting ready to scan it again but this time without using the shelf. However, he releases it and fully engages with his mobile phone. As previously mentioned, before Segment 4.6d took place, I asked P2 to show me the phone screen to see the picture taken by the app (panel 13). This conversation occurred between Segment 4.6c and Segment 4.6d and has been omitted for brevity. In the following segment, P2 gets the app ready for scanning the tin again.



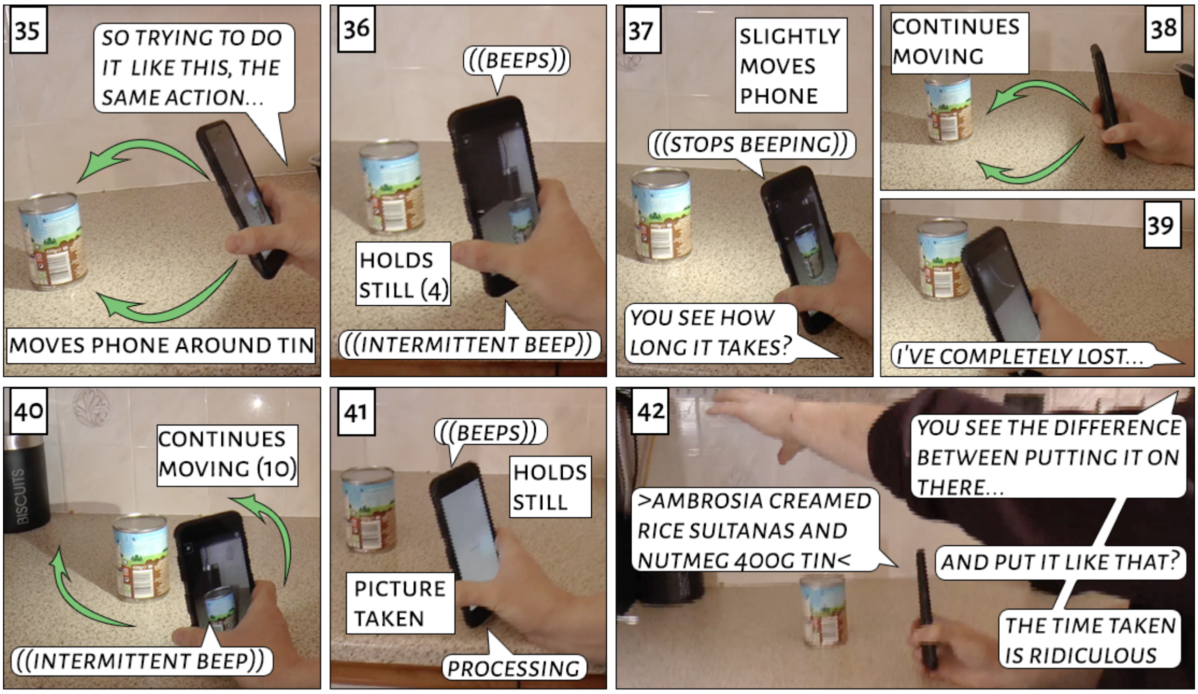
Seg. 4.6d: Preparing app to scan again

This segment continues showing the transition between scanning two times using the OCR app. Once the first scan has been successfully completed, a photograph is taken and a short description of the product appears on the screen (as shown in Segment 4.6b, panel 13). Therefore, in order to prepare the camera to scan again, P2 has to 'close' the picture or essentially, 'go back' to the previous screen. It is worth reminding the reader that P2 is completely blind, and thus, he uses VoiceOver to have the information and elements on the screen read aloud to him. Moreover, the settings are enabled in such a way that when items are selected, a specific sound is produced, which is different from the sound provided when the user touches screen areas where there are no particular interactable items or information that can be read aloud. This segment illustrates the exploration process undertaken by P2 to find the 'close button'. Presumably, he knows this is located somewhere on the edge of the screen, or at least expects it to be there. P2 starts by sliding his finger from the bottom right corner to the top right one (panel 22), then, he slides it to the top left (panel 23), and lastly, to the left bottom corner (panel 24). Throughout this whole exploration of the three sides of the screen, a continuous sound communicating no items or information found is provided by VoiceOver. Notably, P2 misses the 'close button' which is located on the top left corner of the screen (panel 23), by sliding his finger slightly above and to the side of it. However, when he reaches the left bottom, he encounters the 'copy button' (panel 24), which he arguably uses as an indicator for sliding his finger upwards again. On this occasion, P2 encounters the intended button, which is read aloud by VoiceOver (panel 25) and double taps to interact with it and go back to the camera page (panel 26). Then, as he stated, the app is ready to go again. In Segment 4.6e, P2 finds the tin that was left on the counter and frames the phone in preparation to scan it.



Seg. 4.6e: Finding tin and framing phone in front of it

Similarly to the exploration process undertaken to find the tin in Segment 4.6c, this segment shows how P2 first extends his arm forward (panel 27), and when the tin is not found, he moves the arm around exploring the counter surface (panels 28-29) until touching it (panel 30). This serves again as a reference point so that he can confidently grab it and move it closer to him (panel 31). Nevertheless, he has to release it for a second in order to move the phone to his right hand (panel 32), which presumably is the preferred or more natural bodily configuration for scanning an item in this specific moment (i.e. while sitting in front of the kitchen counter, slightly facing the fridge to his left). Right after switching hands, he grabs the tin, promptly locating it and aligns the phone in front of it (panel 33). Lastly, he releases the tin and starts moving the phone away, towards him, while keeping the direction straight. Next, in the last part of this fragment (Segment 4.6f), P2 fully engages with the scanning process while holding the phone with one hand.



Seg. 4.6f: Scanning tin without using shelf

Overall, this last segment illustrates how this second mode of scanning turns out to be more cumbersome than scanning using the shelf, essentially proving P2's reasoning for such an adaptation. Firstly, after the phone and tin have been initially aligned (as shown in Segment 4.6e), P2 starts moving the phone around the tin, both to the right and left trying to find the barcode (panel 35). The app produces a beep as a cue to which P2 reacts by holding the phone still. However, after a few seconds of intermittent beeping with no results produced, P2 slightly moves the phone to the side causing the sound to stop (panels 36-37). Then he starts over, producing the circular movement around the tin (line 38), however, the initial point of reference has been lost and thus the camera moves out of the range of the tin (panel 39). P2 realises this is the case, by not hearing any beeping sound anymore and accounts for it ("I've completely lost…"). P2 continues repeating the movement around the phone for approximately ten more seconds guided by the intermittent beeping (panel 40) until the initial cue sound is heard again and the action in response is repeated i.e. holding the phone still (panel 41). On this occasion, however, the picture is immediately taken, and the phone indicates that the information is being processed. It is then that the same information about the product is read aloud (panel 42). Throughout this fragment, P2 has provided commentary about the difficult and time-consuming nature of this second way of scanning, which incidentally is the intended interaction modality of OCR apps, even for completely blind people. P2 demonstrates that even when having audio feedback guiding the scanning process, the time and effort taken are considerably different than those experienced when using the shelf.

Competencies Exhibited. In summary, this fragment has shown a blind person using an OCR app to recognise a tin and read its description by producing it as audio. Primarily, the fragment repeatedly demonstrates the **spatial awareness** possessed by the participant that allows him to have a **rough understanding of the space** around him and the **approximate location of objects.** Such awareness enables him to **move around in specific directions** and reach out to **interact with such objects**. Moreover, whenever the spatial awareness is not precise enough and the objects cannot be located on the first attempt, P2 uses the **initial point as a reference** to start exploring the area, through **bodily movement** (e.g. orienting himself, extending and waving around his arms) and **surface exploration** (e.g. sliding hand all over the counter, touching tins) until finding a new point of reference to continue exploring, and finally, getting to the target object. This method for finding items is to some extent applicable to P2's interaction with the mobile phone with VoiceOver enabled (Segment 4.6d), as a good spatial awareness of the screen is showcased, along with the exploration process up to finding new points of reference and the target item. Both the engagement with the app on screen and the scanning modalities are aided by **auditory feedback, or the lack thereof,** from the mobile phone in the form of sounds and spoken words that act as a cue for P2 to **reorient his exploration** underway. Further, this fragment shows the configuration work of P2 as he has installed 'Velcro stations' across his house. He has found that scanning an object by holding the phone with a hand (Segment 4.6f), as a sighted or partially sighted person would do, poses alignment challenges that he cannot easily repair or that turn out to be cumbersome and time-consuming. In consequence, he has **adapted the space (i.e. installed a shelf) and modality of use of the app** to make the process easier and straightforward for him

(Segment 4.6b). Once again, the time taken to achieve the task is reported as relevant, as the first method was very smooth and quick, whereas the second method took over ten seconds and provided more uncertainty. The **scanning processes**, in both modalities (i.e. with and without the shelf), require specific steps. The former is comprised of **holding and aligning the tin** in a horizontal direction under the shelf, then **turning it** until obtaining a successful result from the app. The latter requires a more **complex framing work** that requires **moving the phone around the tin** using the auditory feedback as a **cue to hold it still** when the barcode is in range of the camera.

4.2.2.4 Summary and Relation with Next Practices

Together the instances presented in this section provide important insights into how participants conduct reading practices in their daily life. Fragments 4-6 have illustrated a variety of tools, methods and configurations employed by participants to accomplish their reading tasks. A range of low and high technologies have been shown, from magnifier glasses to AI-powered mobile apps. These, of course, vary depending on everyone's particular VI and preferences to meet their needs; so, partially sighted participants use tools that leverage their residual vision, and participants who are completely blind or whose vision is severely reduced use tools that convert the printed text into audio. Moreover, whenever the pieces of information are long enough such as books or magazines, the auditory alternative is sought by the participants regardless of their specific VI. Across the reading instances captured, participants heavily stated the effort and time required for using the tools; although they enable VIP to access printed information, seamlessness or fluidity in such practices are not the norms. Thus, participants commonly prefer to request assistance from other people to read the information aloud to them, or on the other hand, they have to devise ways to reappropriate or adapt the technologies to ease the interactions whenever asking others for support is not available or desired. The competencies exhibited in and ascertained from these fragments will be summarised and discussed in (subsection 4.3.1).

As previously mentioned in this chapter, the three main practices identified in the data are often intertwined with and dependent on each other. In a similar way to how reading is involved in social and communication practices, some forms of mobility and environment practices have been illustrated throughout the unpacking of the reading instances. For example, participants' bodily work and spatial awareness, required to use a portable magnifier and an OCR app to read, have been exhibited. The next and last section builds upon these methods and further presents other examples of mobility and environment practices encountered during the fieldwork.

4.2.3 Mobility and Environment Practices

Participants presented different levels of mobility independence depending on their visual and motor condition, personal confidence, and familiarity with the environment. These practices also pose significant challenges for people with VI, especially those who are blind or severely sight impaired. However, there is a marked difference between participants' experiences at known places such as their home and the charity office, in comparison with their experience outdoors or at less familiar places. As previously described, this fieldwork was limited in scope by following the technology uses of participants in their everyday lives. No instances of outdoor mobility were captured as the data collection was constrained to the spaces and activities that participants deemed relevant to illustrate their routines (i.e. no technology is used for navigating outdoors, other than white canes and sighted guiding) and that they were comfortable involving in the study (i.e. not using navigation apps outdoors that make them feel unsafe or uncomfortable). Thus, this last section is more descriptive and less detailed than those elaborating on social communication and reading practices, but it provides a glimpse of how participants accomplish some of their mobility and environment practices.

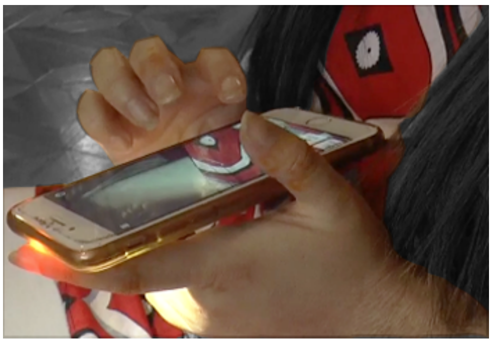
This section will give an overview of some of the tools and techniques employed by participants to move around inside their homes, to get to places, and to work around the challenges of going out. Moreover, because it was a strong concern of many participants, it will present an overview of their reasoning behind not using technology to navigate outdoors, as well as a glance at how they manage their mobility without it. In the following, four short data fragments are unpacked, continuing from the six fragments previously presented. The seventh fragment shows a compilation of some of the arrangements employed by participants to support their mobility at home. The eighth fragment shows a participant using an OCR app for detecting colours. The ninth fragment presents an example of a digital platform used for enabling going outdoors. Lastly, the tenth fragment gives an overview of participants' non-use of technology for outdoor navigation.

7. Detecting Colours through an Optical Character Recognition App
8. Moving Inside the Home through Specific Space Arrangements
9. Booking a Taxi through a Mobile App
10. Taking the Dog for a Walk without Technological Aid

4.2.3.1 Detecting Colours through an Optical Character Recognition App

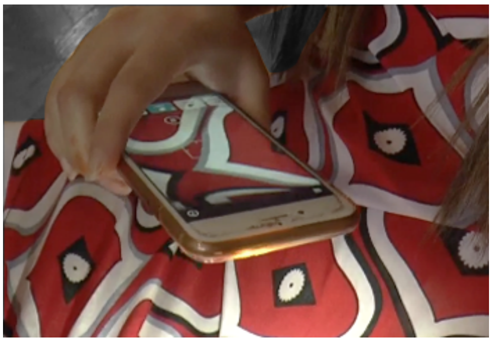
The seventh fragment presents an example of a participant using an OCR app for detecting the environment. In this case, P11, who is not completely blind, but severely sight impaired, shows how she uses Seeing AI for detecting colours. This data fragment was captured during an observational session at her home, and before the following took place she demonstrated some regular uses of Seeing AI, such as reading documents. Then, in Fragment 4.7, P11 selects the colour detection mode and demonstrates how it works.

```
1 P11    : ((scrolls through scanning modes in Seeing AI))
```



(Segment continues on next page).

```
 2 PHONE : colour preview
 3 P11   : [ that's colour
 4 PHONE : [ green and grey
 5 P11   : [ but that's not accurate completely
 6 PHONE : [ red (.) brown (.) grey
 7 P11   : ((holds phone over dress))
```



```
 8 PHONE : red and brown
 9 P11   : (...) so it detects the colour
10 P11   : (...) just sometimes when I'm getting ready
11 P11   : I do like it to be on my clothes
12 P11   : right? so it tells me what colour it is
13 P11   : but I don't rely on it a hundred per cent
14 P11   : I would ask someone as well
```

Frag. 4.7: Detecting colours using Seeing AI

This fragment showcases another common functionality of some OCR apps designed to support VIP. In contrast to the effortfulness and framing and aligning work required to scan a product in Segments 4.6e and 4.6f, colour detection is fairly straightforward, as P11 only has to select the mode for the colours that the camera is capturing to be automatically recognised and read aloud (lines 4, 6, and 8). Thus, P11 only needs to roughly direct the phone towards the object of interest, in this case, her clothing (line 7). She explains that she uses this colour detection feature for getting ready, however, she also acknowledges that it is not entirely accurate and she prefers to double-check with someone else. This is further evidenced through the example, in which colours such as green and brown do not appear in P11's dress.

Competencies Exhibited. This fragment has shown how a person with VI can detect information from the environment, such as colours. This brief fragment adds upon previous instances of OCR apps use but does not entail the same level of precision, spatial awareness, and exploration. Initially, P11 requires engaging with the mobile phone and

VoiceOver through **touching, gestures, and reacting to the auditory feedback** (as shown in Segments 4.2a–4.2e). Further, some level of **orientation and direction** is displayed when positioning the phone over her clothing. Lastly, P11 mentions **verifying the AI result with a person**, as she has learnt through past experiences that the app is not always accurate enough.

4.2.3.2 Moving Inside the Home through Specific Space Arrangements

Similarly to the data segments 4.4a-4.4c, in this eighth fragment I present a brief compilation of 'vivid exhibits' encountered during the fieldwork at participants' homes. Although not comprehensive, given that indoor mobility was not the main focus of the study, these excerpts are evidence of the variety of aids and home-made adaptations employed by participants to move around their spaces and for identifying the objects within, that in turn allow them to conduct various activities. Thus, Fragment 4.8 shows examples of participants' space arrangements.

Frag. 4.8: Participants' adaptations and clear spaces at home

Participants observed at home expressed comfort and safety in their private space. Naturally, home spaces tended to be subject to considerable configuration work by participants to establish them as sites that worked for *their* particular characteristics. Such configuration is comprised of specific space arrangements and also add-ons or alterations to the objects within (see also shelf adaptation in Segment 4.6a). Inside their own spaces, participants demonstrated significant knowledge and confidence moving around and locating specific items or areas, not needing canes or other assistance to support their mobility, instead exploring the spaces and surfaces through bodily work (as surfaced in Segments 4.6a, 4.6c, 4.6e). Naturally, such mobility accomplishment at home is produced through inhabiting their 'perspicuous settings' (Garfinkel and Rawls, 2002, p.181-182), that is, mobile fluidity is locally produced and locally ordered in *these* specific spaces, with *these* specific arrangements, and made to work with *their* specific conditions. Take for example the cases of P2 and P4, who live on their own and whose spaces are mostly clear of objects, except for those against walls and corners (panels 5 and 6). Moreover, they use markers as points of reference to aid their movement and exploration, for example, P4 uses coloured items that contrast with the background, such as a dark coloured carpet indicating the floor level at the bottom of the stairs (panel 4). Participants also tend to establish special locations for several items, where they *must* be placed after each use so they can be easily found the next time they are needed (panel 2). For participants living with others, mobile fluidity also depends to a great extent on the ongoing attunement of co-habitants towards participants and vice versa (Bennett et al., 2020) so as to establish the location and changing state of items within the home (e.g. doors open or closed). This allows participants to collaboratively conduct some activities at home; for example, P10 mentioned cleaning her house to the extent possible and then having her personal assistant 'finish' or complement the task (*"She can see where I can't"*).

To identify objects, participants rely on touching items and surfaces, although two of them indicated their fingertips are not as sensitive and some surfaces are hard to discern. To work around this issue, P2 reported using his fingernails to identify ridges and bumps in knobs and appliances. Ten participants reported employing tactile or high contrast bands around objects (e.g. remote control in panel 3), and a variety of adhesive or glued plastic bumps on switches, home appliances (e.g. microwave buttons in panel 1) and touch screens (e.g. mobile phones and digital displays). Similarly, P11 creates Braille labels and sticks them to personal products (e.g. makeup) so she knows what they are, their colour or material, or whatever she finds relevant (see also Braille labels in Segment 4.4c). Placing bumps and creating labels usually requires co-located or remote assistance from others (e.g. exact location of bumps, product description), but thereafter participants can complete tasks on their own by using such markers.

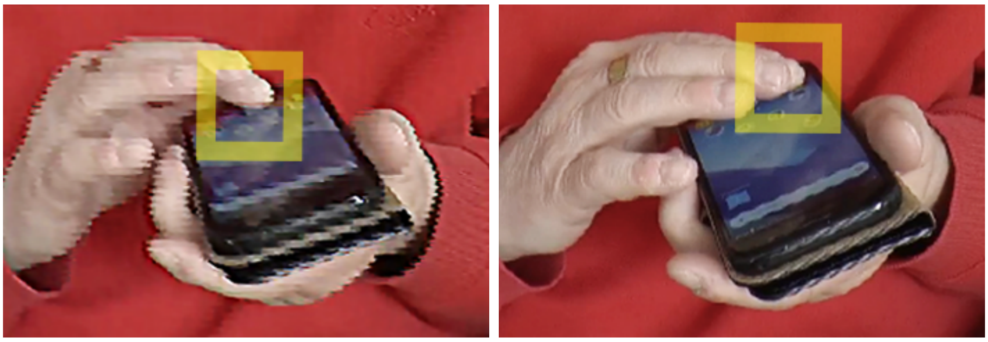
Competencies Exhibited. This fragment showing a brief compilation and description of spatial arrangements and adaptations employed by participants at home does not show a specific use of technology; however, it serves to explain why **participants do not use any technological aid to move around their known spaces**. On the contrary, participants reported that some technologies such as OCR apps are not helpful to operate home appliances (e.g. washing machines, microwaves), as they cannot indicate the location of specific settings and they cannot detect the information in digital displays. Thus, as technology becomes less useful to support home mobility, participants rely on their **spatial awareness**, spatial and surface **exploration and tactility**, which are all supported by specific **home arrangements and adaptations** that turn into personal and collective **habits and attunements** over time.

4.2.3.3 Booking a Taxi through a Mobile App

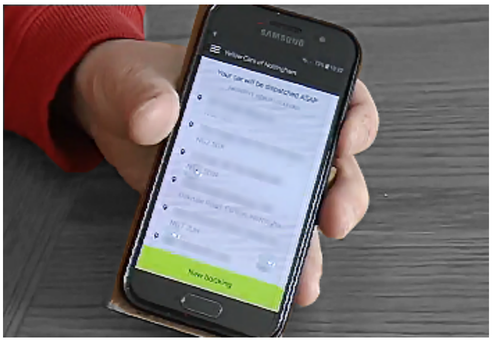
Away from home, matters get complicated. Some participants mentioned frequently visiting specific places (e.g. shops, the charity office) and feeling confident about their paths to get there and about such spaces. However, most participants expressed deliberately avoiding unfamiliar places or going out without company. Alternatively, four participants reported using taxi apps every week. This medium provides convenience, not having to navigate on their own outdoors, but allowing them to get to places without waiting for assistance for the journey. In Fragment 4.9, P7, who is partially sighted, shows and describes a taxi app on his mobile phone that he regularly uses for booking transport.

```
1  P7     : there's an app on there called yellow cars
2  P7     : ((shows home screen)) right to the bottom
```

```
3  P7     : [ ((taps on the bottom)) ((taps slightly to the left))
4  PHONE  : [       apps (.)                messages (.)      yellow cars
```



```
5  P7     : ((double taps to open))
6  P7     : and you'll see the list of places there ((shows screen))
```



```
7  P7     : so if I want to go to [PLACE] I tap on [HOME-ADDRESS]
8  P7     : and then it'll give me destination
9  P7     : I tap on [PLACE-ADDRESS] (...) then I will place booking
10 P7     : then it will say pay by cash
11 P7     : and then I select yes and place booking or done usually
12 P7     : and then I get a text saying that the car's been booked
13 P7     : and then when it's been dispatched
14 P7     : I get the text to tell me it's been dispatched and who the driver is
```

Frag. 4.9: Locating and describing taxi app

Firstly, this fragment has showcased, yet again, how a person with VI uses a mobile phone with a screen reader enabled. In this case, P7's residual vision allows him to see some parts of the screen but without acuity. The first part of the fragment illustrates how P7 knows the rough location of the taxi app ("right to the bottom", line 2) but not where it exactly is, nor can he directly see this. Thus, he taps on the bottom screen and moves towards the left side until reaching the correct app (lines 3-4). Here, he is also guided by the auditory feedback from the phone (line 4). Once P7 hears the "yellow cars" description read aloud, he opens the app. From this point onwards, P7 broadly describes the whole process of booking a taxi, without actually doing it, as this would request unwanted transport. However, it can be noted that P7 knows well the steps in the process, also evidencing pre-established activities such as a list of recently used locations or addresses. This detailed description of steps also illustrates P7's knowledge of the screens and buttons in the app. Although this fragment misses out a crucial part of using a taxi, which is boarding and alighting, it suggests that P7 is fairly comfortable conducting this activity for going to different places.

Competencies Exhibited. This fragment has illustrated how a partially sighted person uses a digital platform to book transport. Once again, the data fragment has showcased how a partially sighted person uses his mobile phone with the screen reader enabled. To do so, he employs a combination of **residual vision**, **tactile input** and **listening to the phone's auditory feedback**. Moreover, P7 has provided a step-by-step account of the taxi booking process, which implies **experience conducting the activity**, leading to **establishing sets of options** for easing future use, and good **memory and knowledge** of the steps, the elements on the screen, and the overall task.

4.2.3.4 Taking the Dog for a Walk without Technological Aid

Notably, regarding technological aids all smartphone users from this study chose not to use mobile applications tailored for outdoor use (e.g. wayfinding, object recognition) due to safety (e.g. apps not accurate enough) and privacy concerns (e.g. being exposed as a person with VI in public). In a similar way to Fragment 4.8, this fragment does not exhibit the use of technology but offers an example of how participants deal with everyday matters without such aids. In the following (Fragment 4.10), P10, who is partially sighted, provides an account of a daily task of hers: taking the dog for a walk.

```
P10 : when I take the dog out for a walk I go the same route
P10 : because I trip over things and as I get older I find it more difficult
P10 : so I go the same route every day
P10 : the dog I keep on the lead
P10 : I used to take him off the lead
P10 : but there's no way I can catch him if he runs off
P10 : I've got poo bags and I pick up after him
P10 : but I have to be literally behind him to see where he does it
P10 : cause if he does it a distance away from me
P10 : although I've got a rough idea where he's done it
P10 : when I get close to it I can't see it
P10 : with such things like that
P10 : when I get from a distance I can see what I've missed
```

Frag. 4.10: Describing taking the dog for a walk

This fragment shows the reasoning behind P10's actions which is mostly based on her individual characteristics. Using the same route helps her to feel more confident when walking, and familiarity with it reduces the chances of tripping. It can also be noted that calculating the distance and space plays a crucial role in this practice, as it allows her to position herself, and her reduced sight, in relation to the open space and to the dog. This example shows how routines in outdoor mobility are highly relevant for VIP. Other mobility accounts of participants that did not include high-tech support included the use of white canes, guide dogs and/or sighted guiding. In addition, older adult participants (i.e. P4 and P9) reported feeling very confident about navigating in their neighbourhoods and local shops or establishments, after living in the same area for several decades. This does not only comprise the knowledge and routines acquired throughout the years, but the acquired network of people who know them and support them in such spaces. P9 indicated: "I'm very good at asking for help, you just have to be honest. When I go out now, if I'm on my own I've always got a white stick, so people recognise the problem".

Competencies Exhibited. This fragment has described how a partially sighted person conducts navigation outdoors, specifically for walking her dog. Firstly, the **use of known routes** is crucial. Secondly, establishing and following certain **rules to ensure security and confidence** (e.g. keeping the dog on the lead). Further, a **knowledge of her own**

residual vision in relation to the space and elements around, so as to **position herself** at the right distance and direction. Moreover, the accounts of other participants also surfaced the relevance of navigating towards and within known places and establishing ways to request help from others.

4.2.3.5 Summary and Relation with Other Practices

It has been shown from this compilation of instances that participants' mobility and environment practices are naturally dependent on their particular settings and contexts. Firstly, participants adapt their own home spaces to fit their own needs (e.g. high contrast or physical markers, furniture arrangement) in order to move freely without external support (i.e. from people or aids). On the other hand, outside the home and especially in unfamiliar settings, participants tend to rely on well-established methods of navigation such as white canes, guide dogs and/or sighted guiding, as well as sticking to their own acquired and matured routines that work for their particular VI (e.g. using the same routes or shops). Although other technological aids exist to support indoor and outdoor navigation (e.g. mobile apps, smart canes, smart glasses), the participants in this study do not use them in their day-to-day due to security, privacy, and convenience. Conversely, some participants use tools for environment recognition (e.g. colours, light, currency) that can be used at home and elsewhere. In the same vein, participants reported using voice assistants such as Siri and Alexa to ask for environment-related information (e.g. time, weather, current location).

Moreover, participants reported using alternative services that complement traditional navigation methods and/or substitute them; for example, by developing and maturing their use of digitally enabled services such as booking transport through a mobile app. Likewise, six participants reported shopping online on a regular basis, and five participants expressed positive comments about their banking apps, in which they can perform a set of tasks from their home (e.g. consulting balance, transferring money). By engaging with these activities online, they work around the navigation issues presented on-site. Nonetheless, challenges with inaccessible websites still occur, directing their choices towards shops, banks and other services that provide good digital accessibility.

4.3 Contributions

In this chapter, I have outlined three main sites where technology is—and is not—involved in the everyday lives of people with VI: social relations and communication practices, textual reading practices, and mobility practices. By analysing various instances of participants' practices, I have investigated the methods they use for accomplishing such tasks, specifically locating their situated and interactional competencies. In this section, I will first summarise the competencies I unpacked from the data fragments, positioning them as the main contribution of this chapter, and then I will discuss the implications of these findings for the remainder of the thesis. Further, I will touch upon demonstrations as pervasive phenomena captured during fieldwork that have been exhibited throughout the fragments herein presented. Together, competencies and demonstrations form the key findings of this chapter and thus motivate and shape the subsequent research conducted, described in Chapter 5 and Chapter 6.

4.3.1 Competencies of Visually Impaired People

Through analysing the practical accomplishment of technology practices conducted by participants with various forms of VI, in the form of transcribed instances and compilations of vivid exhibits, I have unpacked and uncovered diverse competencies, articulated in various methods that recruit sensory capacities, tools, particular motivations, individual preferences, and networks of support. The findings reveal participants' configuration work of relations, environments and devices which allow them to accomplish their practices with little or no interference, or the least interference possible. This view does not preclude requesting assistance from others but rather recognises the participant's own methods (or 'ways') of 'getting on' in everyday life. By employing an ethnomethodological orientation, these findings highlight how participants' competencies comprise more than their visual condition.

The competencies exhibited in the data presented in this chapter are varied and broadly range from engaging with the senses and cognitive capacities to navigating different degrees of social interaction and establishing configurations that better suit their needs and preferences. Table 4.2 presents a summary of these key observations.

Table 4.2: Participants' sets of competencies.

Competency	Domain	Exemplars (Fragments)
Auditory	**Sound recognition** (e.g. Trewin et al., 2010), **speech recognition** (e.g. Guerreiro & Gonçalves, 2014), **speech rate** (e.g. Bragg et al., 2018).	Detecting sound cues from devices and apps (F1, F2, F6); listening to screen readers (F2, F6, F7, F9) at a fast rate (F2); listening to audio-books (F4).
Tactile	**Surface and object exploration** (e.g. Song & Yang, 2010; Zhao et al., 2018), **touching and pressing items** (e.g. Nicolau et al., 2015), **performing gestures** (e.g. Smaradottir et al., 2018).	Exploring the touchscreen (F2; F6, F7, F9); modifying screen reader settings through gestures (F2), locating and pressing physical buttons (F1, F4, F5); reading and typing Braille (F4); exploring home surfaces and objects (F6, F8).
Visual	**Item recognition** (e.g. Jacko et al., 2000; Szpiro et al., 2016), **reading** (e.g. Ahn et al., 2016), **navigation** (e.g. Min Htike et al., 2021).	Locating elements on the screen (F1, F3, F9); reading text in large-font (F3, F4, F5); high contrast for reading and recognising objects (F3, F5, F8); navigation indoors (F8) and outdoors (F10).
Verbal	**Speech input** (e.g. Azenkot & Lee, 2013).	Texting via voice (F1, F3); commands to a voice assistant (F1, F4).
		Continued on next page

Table 4.2 – continued from previous page

Competency	Domain	Exemplars (Fragments)
Spatial	**Space awareness** (e.g. Oliveira et al., 2011; Song & Yang, 2010), **object orientation and positioning** (e.g. Vázquez & Steinfeld, 2012).	Awareness of screen layouts (F2, F6, F9); locating shelf, cupboard, and tin (F6); pointing phone towards objects (F5, F6, F7); navigation indoors (F8) and outdoors (F10).
Embodied	**Task-specific bodily work** (e.g. Oh & Findlater, 2014; Rector et al., 2013).	Moving phone close to face for reading (F1) and dictating (F3); aligning, framing and/or steadying devices (F5, F6).
Memory	**Information and experience recall** (e.g. Sánchez & Flores, 2003).	Recalling the location of visual elements on the screen (F2, F3, F9); recalling steps of taxi booking process (P9); recalling walking route (F10).
Social	**Requesting assistance** (e.g. Bennett et al., 2018; Kameswaran et al., 2018), **visibility in public** (e.g. Faucett et al., 2017), **access conflict management** (e.g. Hofmann et al., 2020).	Voice assistant for blending in public (F1); asking someone to read a document aloud (F4, F5); verifying with a person the colours detected by an OCR app (F7); decreasing speech rate of screen reader for others (F2).

Continued on next page

Table 4.2 – continued from previous page

Competency	Domain	Exemplars (Fragments)
Configuration	**Digital settings** (e.g. Kane et al., 2009; Wahidin et al., 2018), **physical adaptations** (e.g. Branham & Kane, 2015a; Bennett et al., 2019), **routines** (e.g. Due & Lang, 2018), and **adapting to situations** (e.g. Abdolrahmani et al., 2016).	Accessibility shortcuts (F2), features (F3, F5); installing Velcro stations (F6) and other adaptations at home (F8); acquiring magnifiers and reading sources in different formats (F4); carrying earphones (F1) and magnifier (F5); walking the dog on the same route (F10); dictating message outdoors (F3).

Across the ten data fragments presented, I located a range of competencies that I have labelled as auditory, tactile, visual, verbal, spatial, embodied, memory, social and configuration. In the following, I present a brief description of them.

The first three competencies were prevalent throughout the fragments, representing substantial methods that enabled participants' practices, depending on their specific VI. **Auditory** competencies were exhibited through listening and detecting sounds and speech by the devices used, **tactile** competencies refer to participants' exploration of surfaces and objects including touchscreens and the digital elements on them, and **visual** competencies highlight the relevance of residual vision for some of the partially sighted participants. In the context of technology interaction, only a couple of exemplars of **verbal** competencies were present in the data, in the form of speech input. However, it could be argued that participants' verbal accounts in demonstrating their technology use are also evidence of such competency (see Chapter 5 for further exploration of these accounts as part of demonstration occurrences). Moreover, **spatial** competencies were showcased as awareness of the area around self and between items, both physical and digital, while also comprising orientation and positioning towards them. **Embodied** competencies refer to the bodily work employed by participants in relation to the devices in use, such as interacting with a smartphone and scanning a product or magnifying printed text. **Memory** competencies include recalling information and past experiences, such as rough locations of items and steps of a specific task. Furthermore, **social** competencies were considerably important in the data fragments, as observable-and-reportable examples such as requesting assistance for reading a document or managing an access conflict when the screen reader is set to speak at a very fast rate, and as tangential accounts of other everyday experiences such as managing their visibility as VIP in public. Lastly, **configuration** competencies encompass a fundamental part of participants' methods for accomplishing everyday tasks. These were exhibited in the form of digital settings such as features or shortcuts, physical adaptations of spaces and tools, the development of habits or routines and adapting to situational factors such as environment conditions.

Naturally, some of the competencies overlap one another or are used in conjunction with each other. For example, I can highlight the relationship between tactility and audio detection when operating a device with the screen reader enabled, or the association between spatial and embodied competencies for practices that require some form of mobility or device alignment and framing, or the link between recalling the location of certain items that in turn enables surface explorations through touch.

Although the scope of this study was focused on participants' technology practices, it can be argued that the competencies exhibited in these data fragments are also employed by them in other non-technology related affairs. Certainly, the competencies outlined in Table 4.2 are not exhaustive of the VIP's lived experience given that core senses such as taste and smell, and other possible competencies, are not represented in the data collected during fieldwork. Nonetheless, I suggest that these findings are helpful to give a solid overview of how VIP 'do things' beyond traditional beliefs and assumptions about them, such as ableist notions of the development of 'super senses' as a result of vision absence (see section Chapter 7 for further reflection of the conceptualisation of the capabilities of VIP and its limitations).

The articulation of the above competencies represents the main contribution of this chapter and acts as the foundation of this thesis. The findings herein presented broadly depart from a major strand of past work in Accessible Computing by drawing on empirical observations of practical accomplishments and locally situated knowledge, rather than measuring performance, locating access barriers, or understanding people's perceptions and attitudes. Before the outlined competencies are positioned as a framework in development (4.3.3), in the following I summarise the members' methodologies found in this chapter as a matter of ethnomethodological interest.

4.3.2 Ethnomethodological Takeaways

This chapter has unpacked a range of everyday activities conducted by VIP. In this section I will highlight what has been learned methodologically about VI. The fundamental point at issue is that sighted people heavily rely on visual methods to conduct these activities; for instance, they visually scan physical settings or digital screens and thus obtain a broad picture of them, helping them to locate specific items of interest they can interact with. In contrast, VIP scan and locate items in different methodological ways which include *listening to scene and item descriptions*, *configuring and searching for salient markers* and *moving through the space encountering items*. This means that VIP often need to first interact with the setting or the items (through touch, voice or the body) in order to obtain a broad picture of what they are, where they are and what can be done next. Although sighted people also interact with the world through touch and the body, VIP primarily employ them as resources for *exploration and identification* that work around or aid their VI. For example, methodologically, scanning items through audio on a smartphone involves *moving or flicking through each item, often in a linear sequence*. There are a range of methods that VIP employ to speed up this process, including only listening to the first syllables and rapidly moving to the next item, increasing the speed of the spoken audio, using points of reference to directly locate specific items, and using voice commands or dictation to automate the manual actions. In addition, seeing for partially sighted people is achieved not only through vision but is methodologically *aided with* *embodied movements and salient characteristics* (e.g. large font, high-contrast, textures) that make the items noticeable and recognisable for their specific VI.

This chapter presented three examples of modalities employed by VIP to send text messages (using a voice assistant, a screen reader and voice dictation) as a matter of socialising and communicating with others, which reveal a shared methodological organisation; that is, text messaging is accomplished through *selecting a recipient*, *composing a message*, and *sending* it. This, in the first instance, presumes the existence of the recipient as a saved contact or conversation to be found within the stored catalogue. Methodologically, *finding a recipient* is bound to the specific modality employed for interacting with the device (i.e., voice or touchscreen, seeing or listening items on screen). Likewise, composing a message is bound to the specific interaction modality used (i.e. typing or dictating) which is brought to bear through specific material actions (e.g. coupling finger action with auditory cues, moving phone close to face), as described in 4.3.1. Lastly, sending the message is done as a last confirmatory step that may involve *checking* (reading or listening) it beforehand. Through these methods and interaction modalities, seamless communication with others is made possible, enabling participation in social life. Notably, the methodologies employed by VIP for text messaging are similar to those used by non-VIP; however, VIP's technology practices implicate the need for accessibility support that is strictly tied to the particular individual and the particular situation they are involved in. Whilst, as a matter of method, *accessibility settings are preset* to fit the person's practical need and preference, it is also a methodological feature of VIP's device use that members *monitor the situation* to *adjust the settings* accordingly.

This chapter has also shown how textual reading is *spatially distributed* and is contingent to the text format (e.g. print, audio) and tools available to access it (e.g. magnifiers, speakers). Methodologically, reading for VIP presupposes the *acquisition* of relevant textual information in the suitable format (e.g. a calendar in large font) and of tools that convert the text to the appropriate format for them (e.g. audio, large font). Therefore, *individual and situated appropriateness* of text format and tools is also a feature of reading. In broad terms, using a tool over text for reading it is done by the *alignment of the two* *independent items*. Methodologically, this is achieved by members by *fixing one of the items while moving the other within its range* (e.g. paper on desk and magnifier over it, phone on shelf and tin under it). Each specific configuration of tool-over-text implicates specific material and embodied methods for operation, as described in 4.3.1. It should also be noted that reading is *temporally bounded*, where VIP recognise what constitutes *quick or time-consuming* reading, and, as a matter of method, use different resources on that basis.

Lastly, this chapter has exhibited that mobility practices in the home, for VIP, are *spatially distributed*, aided by a range of bumps, markers, furniture and spatial arrangements that allow them to freely and competently move in, and interact with, the setting. Methodologically, mobility at home is achieved through routinely *maintaining* certain configurations such as clear open spaces as a matter of assuming that no obstacles are present. Specific embodied actions are contingent upon the setting and the position of the person relative to the environment, as described in 4.3.1.

As mentioned in 3.2.3, these methodological features observed within the practices of VIP refer to the machinery that is made possible through interaction. These methods, then, are not only relevant to this cohort of participants, but some form of generalisation can be drawn, likely to be found elsewhere in the practices of other VIP, observable-and-reportable and naturally account-able in and through their communication, textual reading and mobility practices, regardless of who they are and the specific devices that they use.

4.3.3 Implications and Next Steps

Next, the implications of a competencies framework will be briefly discussed, pointing towards its practical application. Then, the following will highlight how demonstrations were prevalent in the data captured during fieldwork serving as a device for uncovering participants' competencies. Thus, demonstrations will be positioned as a tool worthy of deeper examination.

4.3.3.1 Advancing a Competencies Framework of Visual Impairments

Returning to the competencies outlined in Table 4.2, it can be noted that, evidently, past research has explored and targeted each competency across various domains (see exemplar references for the domains listed). Given that competencies are used in conjunction with each other, as I previously stated, past research often investigates and aims to leverage more than one competency at a time; for instance, by focusing on modalities of interaction and feedback provision entailing the use of auditory-tactile (Smaradottir et al., 2018), auditory-spatial (Vázquez & Steinfeld, 2012), or tactile-spatial (Song & Yang, 2010) combinations. Furthermore, recent work has increasingly looked into the social factors and relations impacting AT use, thus signalling that social competencies must be carefully considered in design as well (Bennett et al., 2018; Faucett et al., 2017).

Although the idea of focusing on specific senses, relations, or external factors is not new for researchers and designers of specialised technologies for VIP, the notion of holistic, or at least more nuanced, perspectives of VI are not common outside of Accessible Computing sub-domains (Shinohara et al., 2018b). Thus, compartmentalising the competencies in such a way can help to ascertain how everyday practices are enabled by a range of competencies, beyond the traditionally recognised senses such as hearing and touch. Additionally, I suggest that having a framework of competencies that spans sensorial, cognitive, bodily, and social capacities, could be beneficial for research and design endeavours to enable careful consideration of the multiple layers involved in VIP's everyday technology practices, as others have previously proposed (e.g. see Frauenberger, 2015).

Advancing such a framework would entail exploring what can be achieved through a model that focuses on competency rather than deficit or impairment. However, in this thesis I divert from stances in past HCI work that emphasise ability rather than disability in the development of specific technological systems or prototypes (Wobbrock et al., 2011), as this framework does not seek to inform specific design ideas or projects as an immediate next step in the research process—although a viable and worthwhile path, and a traditional outcome of ethnomethodologically-informed studies (Randall et al., 2021). Instead, in alignment with increasing calls for including disabled people in the design process, especially from early stages and even before there is no clear specification of a technological solution (Williams et al., 2021), I geared towards exploring how a competencies framework could be used for engaging people with and without VI in sensitising activities before any system or prototype design takes place. Such exploration of a practical application of a competencies framework is described in Chapter 6.

4.3.3.2 On the Pervasiveness and Value of Demonstrations

As initially described in the Introduction, demonstrations can be defined as a secondary finding of the present ethnographic study or as a research subject 'falling out' of the initial investigation. It is worth stressing that demonstrations were not collected as 'demonstrations' on purpose but rather emerged during fieldwork as a practical way for participants to show the subject of interest.

The analytical process conducted with the data collected—including gathering an ethnographic record and making sense of the data recorded—allowed me to identify a large subset of demonstrations within the data corpus which comprised over 80% of the whole video data. The prevalence of demonstrations in the conducted fieldwork has been hinted at by seven of the data fragments presented in this chapter:

- Frag. 1: Demonstrating the use of Siri for text messaging
- Frag. 2: Demonstrating the use of VoiceOver for text messaging
- Frag. 3: Demonstrating the use of dictation for text messaging
- Frag. 5: Demonstrating the use of a portable electronic magnifier for reading print
- Frag. 6: Demonstrating the use of Seeing AI for reading a tin label
- Frag. 7: Demonstrating the use of Seeing AI for detecting colours
- Frag. 9: Demonstrating the use of a taxi app for mobility

Whilst these demonstrations proved to be effective for capturing participants' everyday use of technology and for analysing in detail their interactional and situated competencies, these episodes are additionally interesting from a methodological perspective. Employing an ethnomethodological approach enabled particular characteristics of demonstrations to become apparent during the course of the initial investigation, such as the several remarks made by participants throughout the demonstrations (e.g. “you’d probably call me a liar now” by P2 in Fragment 6) and the similarities and differences in the structure of each demonstration (e.g. introducing topics, using a device). Furthermore, some episodes occurring in between the technology use instances were remarkable but out of the scope of this chapter focus; for instance, brief episodes in between this chapter’s segments that had to be excluded for brevity purposes included short exchanges between the participants and me or moments of transition conducted by participants.

In broad terms, it can be said that participants are not engaging in naturally occurring activities, but instead the activities displayed in these fragments are deliberately produced for the benefit of the investigation. Thus, demonstrations were quickly noted in the data captured, first as a concern of potential naturalistic critique (see discussion in 7.2), and then as thought-provoking episodes that further kindled my interest in them (as stated in 2.2.2). This chapter has exposed that there is much more occurring within a demonstration that is often not taken into consideration. These observations become relevant when the focus shifts towards understanding demonstrations as the phenomena of interest and investigating what can be learned about VI through them.

Making use of the rich subset of demonstration data collected during the ethnographic study and further identified as a research subject throughout this chapter’s investigation, Chapter 5 presents an in-depth examination of demonstrations and—in ethnomethodological terms—‘demonstrational work’. Such investigation provides insights and directions for the final study in this thesis, as video demonstrations form the other component of the workshop approach described in Chapter 6, which presents an example of their practical application. Lastly, both of the following chapters include the reappearance of competencies of VIP as concrete outcomes of inspecting demonstration instances, thus establishing their entangled relationship within a competencies framework (see Discussion).

Chapter 5

Demonstrating Interaction: The Case of Assistive Technology

This study chapter presents an in-depth analysis of 102 video-recorded demonstrations captured during the ethnographic fieldwork described in Chapter 4. Such demonstrations were performed by participants with VI in the course of investigating their everyday technology practices; however, in this chapter the focus is shifted towards examining 'demonstrations' as the main phenomenon of interest. In contrast to naturally-occurring instances of technology use, these demonstrations can be seen as performances of the activity, conducted with the purpose of allowing me, a sighted investigator, to obtain a breakdown and close picture of the actual practice. Demonstrations, then, became a secondary finding of the initial investigation. In this chapter I further investigate how they served as a device to gain insight on the lifeworld of VIP, helping me to make sense of a world that is not mine. As described in Chapter 3, an ethnomethodological analytical orientation drives the work in this chapter. Through analysing the demonstrational subset of data and by unpacking some demonstration instances, in this chapter I will exhibit core features of demonstrational work, further highlighting the relevance of meta-activities occurring around and within such episodes, which are oftentimes overlooked or unremarked-upon. The main goal of this chapter is to help to shed light on what demonstrations are, how they are brought to bear in empirical HCI research, and further examine their relationship with VI, assistive technology, and accessibility.

5.1 Study Approach

The work presented in this chapter is based on a subset of data collected for an ethnomethodologically–informed ethnography that investigated everyday technology use of VIP, with a focal emphasis on uncovering their interactional and situated competencies (Reyes-Cruz et al., 2020), which was presented in Chapter 4. The procedure of such a study and broader information about it has been described in detail in section 4.1; hence, in this section I mainly present characteristics particular to the demonstrational subset of data, including the participants that performed them and the analytical process.

Ethnomethodology is the overarching analytical orientation employed in this thesis (see Chapter 3), and in this chapter such an approach is applied to enhance the understanding of demonstrations as practical accomplishments, drawing attention to 'mundane' practices that people enact and describing the 'members' methods' underpinning them (Garfinkel, 1967). Thus, when I refer to demonstrations as a 'method' in the data collection and analysis, I mean an ethno-method, a participant method, or 'members' method', *not* a research method purposefully employed from the outset (a topic discussed in Chapter 7). Therefore, it is worth remarking that the approach to data collection was ethnographic and demonstrations 'fell out' as phenomena of interest from that initial study.

Through analysing the social organisation of this set of demonstrations conducted by VIP during the ethnographic study, I aim to posit demonstrations as a tool worthy of attention and valuable for accessibility research and HCI research more broadly, which I continue exploring in Chapter 6. In the following sections, I describe the demonstration data and the undertaken analysis.

5.1.1 Demonstrational Data and Participants

In summary, I draw from a subset of the initial ethnographic data: 4.5 hours of video material that contain 102 identified instances of demonstrations conducted by 10 different participants (7 participants observed at their homes and the rest at a charity office) and supporting fieldnotes and audio material.

See 4.1 for a detailed description of the ethnographic study. Out of the 11 participants recruited for one-on-one sessions, only one was not video recorded showing their technology use due to participant-researcher availability, therefore, the sample in this chapter is reduced to 10 participants. Three of them were observed at the reception desk of the charity office where they regularly volunteer. Table 5.1 contains the details of all the participants whose data was analysed for the work presented in this chapter, including a pseudonym (for differentiating from the numbering scheme used in the previous chapter), gender, age, visual condition, and the setting.

Table 5.1: Participants in demonstrations data subset and data collection methods.

Pseudonym	**G**	**Age**	**Visual Condition**	**Setting**
James (P1)	M	28	Partially sighted (Glaucoma)	Charity office
Nick (P2)	M	50	Blind	Home
Ben (P4)	M	93	Partially sighted (Cataracts)	Home
Alice (P5)	W	28	Blind	Home and reception desk
Liam (P6)	M	55	Partially sighted	Reception desk
Paul (P7)	M	67	Partially sighted	Home
Tim (P8)	M	40	Blind	Reception desk
Sarah (P9)	W	80	Partially sighted (Retinitis Pigmentosa)	Home
Gayle (P10)	W	70	Partially sighted	Home
Tina (P11)	W	35	Partially sighted (Retinitis Pigmentosa)	Home

Participants consented to be audio and/or video recorded and throughout the study I made sure they knew when recordings were started and stopped. They gave permission to use such research data to understand their everyday experiences and technology use within them. Participants gave permission to reuse their data for future research and learning, including related investigations, data sessions and presentations, as long as it was anonymised (i.e., removing personal identifiable data, blurring faces, distorting voices) and destroyed after 7 years, in accordance with guidelines by the University of Nottingham.

The demonstrations captured in this data arguably emerged because the original study was purposefully exploratory. Participants were not explicitly asked to perform pre-defined tasks or follow a specific structure. However, I tended to enquire, as is natural in the course of ethnographic work, how participants performed some activity of interest (elicited with utterances such as "can you show me?" or "how do you do X?"). On other occasions participants provided descriptions and explanations without immediate solicitation (as they were knowingly participating in fieldwork and as such adopted a particular stance towards the researcher (Brown et al., 2011).

5.1.2 Data Analysis

Ongoing engagement with the charity and participants informed something akin to an 'iterative' analysis (as described in 3.1.1), repeatedly returning to the data collected to better understand fieldwork experiences. As mentioned earlier, demonstrations developed as central and pervasive occurrences within the fieldwork, which is why I turn towards the video recordings as they helped provide reminders of such instances of this phenomenon. A complete review yielded a total of 102 recognisable demonstrations within the video data. Each participant conducted a varying number of demonstrations, ranging between 1 and 20 (mean = 10.2, SD = 8.65). A broad picture of this data corpus is provided in Table 5.2. Demonstrations have been grouped thematically by type of subject demonstrated, including the number of instances per category, and some examples have been provided to illustrate them. Note that no quantitative claims on the basis of 'counting instances' are sought, but rather they are provided to assist the reader in gathering a sense of the range and nature of the phenomenon.

Furthermore, I organised, pre-selected and transcribed a range of video fragments depicting demonstrations in action each of which exhibited variations from other instances. This process was part of creating an inventory of the demonstrations in the data subset, first consisting of identifying demonstration instances and noting down the object and/or activity demonstrated (see column Examples in Table 5.2) and timestamps for easing access to the material during the analysis. Then, through initial data passes (i.e., watching the whole data corpus while making notes of potential interesting observations) a range of

Table 5.2: Content of demonstrational data corpus

Demonstration subject	**Freq.**	**Examples**
Non-digital tasks or tools	19	Personal customisations for the home: Velcro stations, indoor cane, stickers or labels on appliances.
Digital tools interacting with physical settings	25	Image recognition mobile apps: text detection, light detection, face recognition, product recognition.
Digital tasks or tools	58	Mobile phone and laptop use: screen readers, accessibility features, general purpose apps, voice assistants.
TOTAL	102	

fragments were pre-selected on the basis of being substantial but self-contained instances; that is, demonstrations could be recognised having a clear beginning and end, whilst displaying rich interaction material of participants with the devices, the environment and with me as the researcher. For example: instances of gesture or command performance in using screen readers, of embodied interaction while explaining the use of camera apps, and of relevant exchanges between participant-researcher.

This chapter begins to address the second research question and sub-questions of the thesis:

- RQb) How can the findings from empirical work be used to motivate new practical ways to approach research and design with VIP?
  - RQb.1) What is the composition and social organisation of demonstrations?
  - RQb.2) What research and design insights can be obtained through demonstrations?

Seven video fragments were selected as candidates, consisting of demonstrations of: a Velcro station, an OCR app for reading text, an OCR app for light detection, a workplace task, typing on a laptop using a screen reader, navigating elements on a mobile phone and text messaging using the screen reader. These fragments were roughly transcribed to support subsequent data sessions held with the supervisory team in which the video-fragments and transcripts were viewed repeatedly. Doing so forced us to focus on just how demonstrations were being produced in the context of the research encounter (as an aid to post-hoc reflection on my encounters during these). Particularly relevant fragments exhibiting noteworthy instances (Clift, 2016) were selected for more detailed orthographic transcription and further analysis. The fragments chosen happened to 'represent' each category and were substantial self-contained demonstrations but short in duration (i.e., no longer than 2 minutes); they are described and unpacked in the following section.

5.2 Findings: Unpacking Demonstrational Work

In order to unpack the composition and social organisation of demonstrations, I have selected four fragments that exhibit a range of assistive or accessible technologies as exemplars of the demonstrational work of participants across the subjects identified: one non-digital tool, one digital tool that interacts with physical elements and two different digital devices, as these were more prevalent in my encounters with participants. I use these four fragments to illustrate similar or very particular instances observed across the corpus.

Similarly to the data in Chapter 4, I present these data fragments in the format that best communicates the specific demonstration in question, by combining linear thoroughly detailed transcripts, including utterances, silences, overlapping talk or actions (Heath et al., 2010), and comic strips focused on body movements, visual occurrences, overlapping talk or actions (Laurier, 2014). The transcript notation can be found in Appendix B. Participants' names are fictional. Their faces and other personal information that could identify them have been anonymised in the data fragments. Again, throughout the chapter these have been broken down and presented as segments (e.g., 1a, 1b, 1c) to improve clarity and readability, but continuous versions can be found in Appendix D.

In the following, I present and unpack each of the four data fragments selected, beginning the exhibit of demonstrational work by exploring an example of demonstration with and around primarily non-digital features such as leveraging objects' physicality with little bearing on their digital interactional features. Then, I analyse a mixed scenario where digital tools are used to extract information from the physical setting (i.e., Optical Character Recognition of a sheet of paper). Lastly, I examine two demonstrations of more conventional accessible technologies which prioritise digital elements (magnification feature on desktop PC and screen reader on laptop).

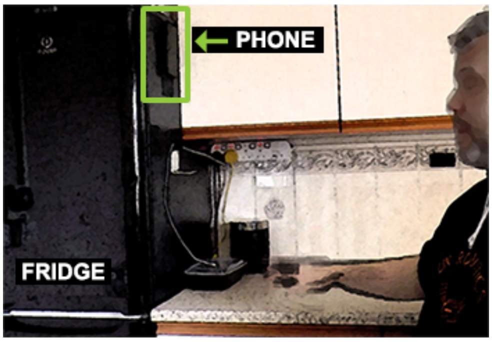
1. Demonstrating a Non-digital Tool at Home
2. Demonstrating a Digital Tool to Extract Information from the Physical World
3. Demonstrating a Workplace Task Using a Digital Device
4. Demonstrating Complex Actions Using a Digital Device

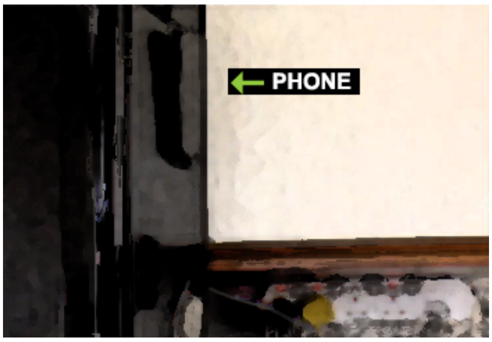
5.2.1 Demonstrating a Non-digital Tool at Home

The first fragment in this chapter involves Nick (P2), who is a 50-year-old blind participant living on his own. He is an experienced iPhone user, being highly familiar with VoiceOver, Siri, and apps designed for blind people such as Seeing AI. Like many VIP, Nick has spent time customising or configuring his objects and home setting so as to better support himself, for example adding stickers or labels to home appliances for locating and identifying buttons or settings, shown in the previous chapter (see Fragment 4.8). In this fragment Nick exhibits a more unusual instance of such customisation work. The specific example Nick demonstrates below is a Velcro station very similar to the one he used for scanning the tin label (see Fragment 4.6). Both of these stations are located on the side of the fridge in his kitchen. However, rather than helping him scan a product, this second Velcro station enables him to place his mobile phone in a readily accessible place, and as such its configuration is different. Instead of a shelf for placing the phone horizontally, this station only consists of a Velcro patch glued to the fridge surface where he (vertically) attaches his mobile phone that has the other side of the Velcro glued to the phone case. This configuration will be elucidated throughout the demonstration.

The demonstration session with Nick begins in this setting, with Nick sitting next to his kitchen fridge. His phone is attached to the Velcro station, leading to the station becoming the central topic of his demonstration (Segment 5.1a).

1 NICK: hi I'm Nick em I am visually impaired (well) er I'm severely sighted





2 NICK: [now as you can see I've got my mobile phone
3 NICK: [((reaches fridge surface))

4 NICK: [which is in a protective case
5 NICK: [((feels his way to the phone and holds it))

6 NICK: that's attached to the fridge
7 NICK: [and one I use is a Velcro patch on the back of my phone
8 NICK: [((takes phone from fridge)) ((shows Velcro patch))

Seg. 5.1a: Showing a Velcro station at home

Firstly, Nick gives a brief introduction as an opening to this demonstration. Not only does he remark that he is visually impaired, but he emphasises he is severely sight impaired (i.e., an official term for blind individuals used by the UK's health service). In doing this he is building a framing for what he is about to show to me as the investigator. He starts by highlighting the location and composition of his mobile phone ("in a protective case that's attached to the fridge"), and he does that while reaching out to it. In line 3, he makes use of his spatial awareness as he reaches out to the fridge surface, roughly below the mobile phone, and then he slides his hand up, exploring the surface to locate it (line 5). He further proceeds to show and point out the patch on the back of the phone, making it clear how the pieces fit together (i.e., patch on the case attaches to the Velcro on the fridge).

In the following (Segment 5.1b), he then simulates an undesirable scenario.

```
 9 NICK: so what happens is
10 NICK: ((puts phone on counter))
```

```
11 NICK: ┌if I put (0.8) my phone o:n the:re (0.9) if I:: come awa:y (0.7) I'm at
12 VO  : └   one notification  (.)  fro:m  (0.5) twenty one hours ago (          )
13 NICK: ┌(0.3) risk of (1.4) >dropping it on the floor< (1.5) and damaging the phone
14 NICK: └          ((simulates dropping the phone from kitchen counter))
```

Seg. 5.1b: Simulating dropping the phone from counter

By simulating brushing the phone off the counter accidentally, he gives a glimpse of something that becomes an issue for a person who is blind, that is, not knowing if an object is on a surface, then dropping it and damaging it. In demonstrating the Velcro station, Nick highlights its specific physical configuration, underlining the creative and practical solution he has come up with for adapting his environment to a typical problem faced in his day-to-day life. In this sense it is an account of his everyday practices in and about his home.

Notably, this segment also provides a natural example of a screen reader delivering continuous feedback in the background while the participant performed the demonstration. In line 12, Nick's phone's VoiceOver (i.e., Apple's screen reader) starts communicating aloud his pending notification while he is in the course of providing a verbal account of the undesirable scenario (lines 11 and 13). Nick carefully interweaves his talk with the output from VoiceOver, either by briefly pausing or elongating some words. In line 13, he briefly pauses before delivering his follow-up talk more rapidly ("dropping it on the floor"). This pause and fast talk coincide with VoiceOver not reading aloud anymore.

He later adds commentary to the scenario just introduced and simulated (Segment 5.1c).

```
NICK: ┌ so: the whole idea is to put the phone out of the wa:y
VO  : │ one notification (.) fro:m  (0.5) twenty one hours ago (              )
NICK: └ ((feels the Velcro on fridge))     ((feels the Velcro patch on phone))
```

(Segment continues on next page).

```
18 NICK: ┌      like so  (2)
19 NICK: └ ((attaches phone back to fridge))
```


```
20 NICK: now (.) one of the things that-
21 NICK: one of the: things that I do like to use is SIRI
22 NICK: and I'll give you an example (.) HEY SIRI WHAT TIME IS IT?
```

Seg. 5.1c: Explaining and using a Velcro station at home

He remarks and makes very explicit the reason he implemented the Velcro station in the first place ("the whole idea is to put the phone out of the way"). As evident as this might be, by being a demonstrator, Nick's role is to make as visible or transparent as possible the subject of interest, and he does it through his embodied actions (i.e., taking phone off the station, showing the Velcro patch on phone –in Segment 5.1a, line 8) coupled with his verbal accounts.

Once again VoiceOver has started reading aloud the pending notification that overlaps with Nick's talk (lines 15-16). Yet, this time, he did not pause or deliver his words at a different pace as in lines 11 and 13 (Segment 5.1b). From this, Nick's different methods to talk around or over the screen reader can be highlighted. Moreover, note that the demonstration also contains elements of natural 'troubles' encountered in everyday activities, and captures Nick's improvisation around unexpected events, as VoiceOver's feedback overlapping his talk was not 'part' of the Velcro station demonstration.

He brings this demonstration to a close by putting the phone back to the place where it was at the beginning of the fragment (lines 18-19). The demonstration performed up to this point has achieved two broad purposes: allowing Nick to disclose and explicate the composition and motivation of the object, while simultaneously providing an illustration of some ways in which Nick locates (Segment 5.1a, lines 3-5), senses (Segment 5.1c, line

17) and uses (Segment 5.1c, line 19) the station and his phone.

While he is attaching the phone back to the fridge, there is a brief pause (end of line 18) that serves as a transition to the next demonstration (lines 20-21) in which Nick introduces Siri (i.e., Apple's voice assistant) that incidentally makes use of the Velcro station he just contextualised for the investigator. Further, again there is a brief introduction that contextualizes the subject about to be shown ("one of the things I do like to use is"). There is thus a noticeable sequential organization of the demonstrations exhibited in this first fragment.

Similar to this data fragment, other non-digital or purely physical tools and tasks were part of the demonstrational data corpus—19 demonstrations in total. For example, a short indoor cane, stickers on shower controls (see Fragment 4.8), Braille labels on game cards (see Fragment 4.4c) and various types of low-tech magnifiers (see Fragment 4.4a). However, not necessarily all demonstrations require or concern pre-existing customisations like Nick's. There are also other specific activities that could be demonstrated and that display the work involved in doing so. The next fragment presents one of those instances.

5.2.2 Demonstrating a Digital Tool to Extract Information from the Physical World

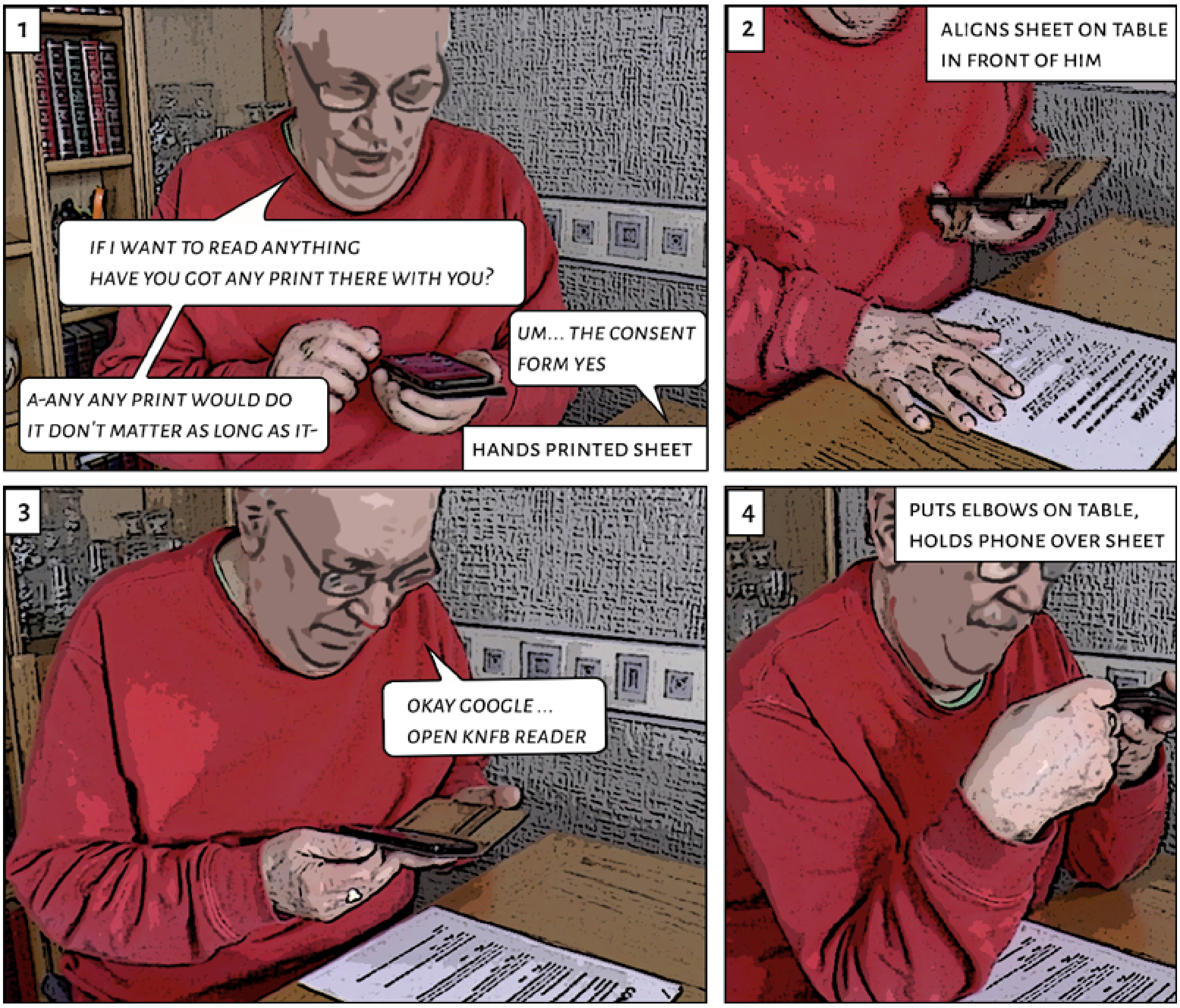
The demonstrator in the following data fragment is Paul (P7) who is a partially sighted participant (67 years old) being observed at his home, sitting at the dining table. He has some residual vision but is not sufficient to read small print. Paul is also a tech-savvy person, using his smartphone for several everyday activities such as communicating with others via text messages and emails, checking information online, requesting local taxis (see Fragment 4.9), and reading printed text. In this fragment, Paul uses an Android phone and its corresponding built-in screen reader (i.e., TalkBack) as he demonstrates some apps on his mobile phone.

In the following, Paul shows how he uses KNFB reader[1], which is an OCR app similar to Seeing AI, illustrated in Fragment 4.6 and Fragment 4.7. However, differently from those

[1] https://knfbreader.com/

previous fragments, here Paul uses the app to read a printed document rather than to scan a product or detect colours.

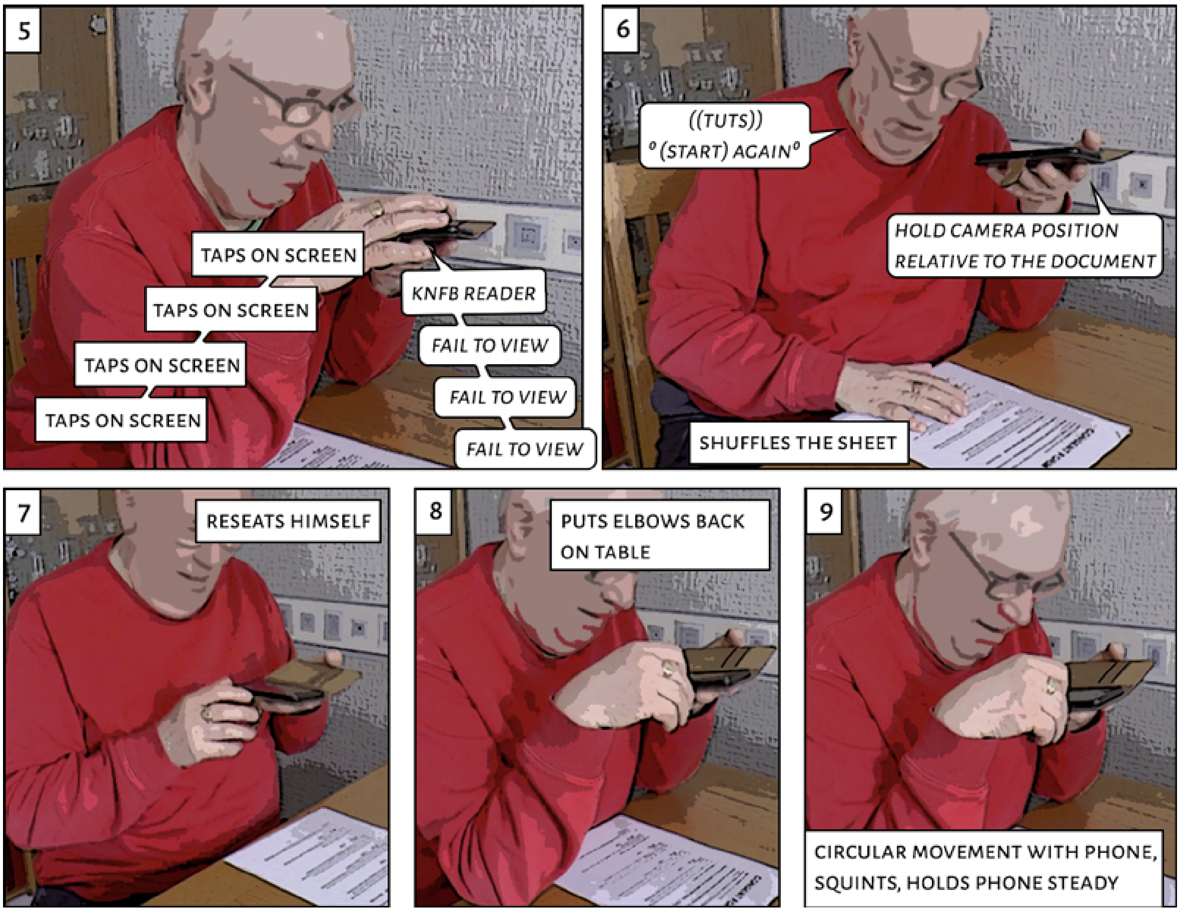
Before the demonstration shown in Segment 5.2a, Paul demonstrated how he reads his emails (via Gmail).



Seg. 5.2a: Preparing to read a printed sheet using KNFB reader app

This segment showcases how Paul needs to have the right resources and conditions to perform his demonstration. Here he needs printed text to proceed with it. The document I have at hand is the consent form for the study, as would be expected for ethnographic fieldwork. Upon my hesitancy he remarks that "any print would do". For Paul, the relevance is for the production of a demonstration, so what is adequate here as material is judged on that basis. Once he has the sheet he continues creating or 'staging' the required conditions to deliver the demonstration. To do this he aligns the paper in front of him (panel 2), then continues placing his elbows on the table with the phone atop his hands, using a method that presumably supports him for distancing, steadying and aligning the phone over the paper (elbows on table in panel 4).

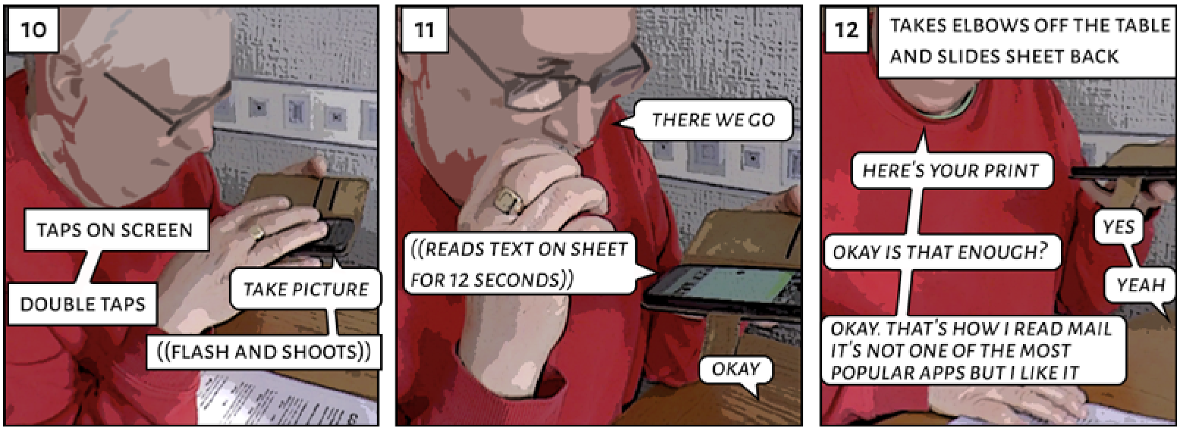
Paul's staging of the demonstration also includes opening the app through voice command, an action he must time appropriately before continuing (Segment 5.2b).



Seg. 5.2b: Failed attempt to use KNFB reader app

In this segment Paul taps the screen four times (panel 5) of which the last three attempts receive feedback of unsuccessful progression. He responds by first tutting and then a brief formulation where topicalisation of the activity itself is made; that is, by muttering "(start) again" in panel 6. He gives a commentary of where-we-are with the demonstration, which is making the demonstration progress available to me. In a sense, such a comment might not be necessary for conducting the activity, but it gets repurposed in any case for the demonstration itself.

Subsequently, in panels 6-9, he 'redoes' the whole staging from the start by taking his elbows off the table, shuffling the paper, reseating himself and getting his bodily comportment 'into the demo' again, i.e., putting elbows back on table with phone atop hands once more. Staging here also needs to work with and around Paul's particular eye condition, as he is partially sighted, but he did not demonstrate modalities in which auditory or verbal feedback give support on better aiming the camera (e.g., Vázquez & Steinfeld, 2012; 2014). Rather, he relies on his own embodied method as previously described and shown in Segment 5.2a. In panel 9 he does a circular movement with the phone and what looks like squinting before attempting to take the picture again. This could be functional for him, but in any case, works to show an effortfulness involved in getting the app working. Then he reaches the point of the demonstration (Segment 5.2c) when the picture is taken, the and text processed and read aloud.



Seg. 5.2c: Reading a printed document using KNFB reader app

The brief exchange in panel 11 ("there we go", "okay") between participant and investigator are further moments of recognition that this performance of the demonstration has been successful. Twelve seconds after the document started being read, Paul starts the closure of this demonstration, breaking his bodily staging by taking his elbows off the table and handing back the paper to me. In panel 12 he nevertheless confirms the closure by assessing the adequacy of the demonstration ("is that enough?") and possibly calibrating the expectations of the demonstrator and the observer. Overall, this fragment showcases the significance of Paul's bodily work, not only of its centrality to doing the demonstration, but also, in this case, of building a witnessable 'version' of the activity he is demonstrating. That is, all the staging activities that enable him to use the OCR app to read printed text can be observed i.e., table positioning, materials to hand, ensuring alignment, correction of alignment, timing of taps, squinting, etc.

Several other instances of demonstrations in this data corpus that exhibit digital tools extracting information from the real world include the same or similar apps or devices like the one Paul used for detecting light or products (see Fragment 4.6) and for recognising faces or different types of print (see demonstration of portable electronic magnifier in Fragment 4.5). A few other demonstrations involved pairing a mobile device with an external physical device via Bluetooth, for example speakers or a wireless keyboard. In total, 25 demonstrations from this category were observed in the set.

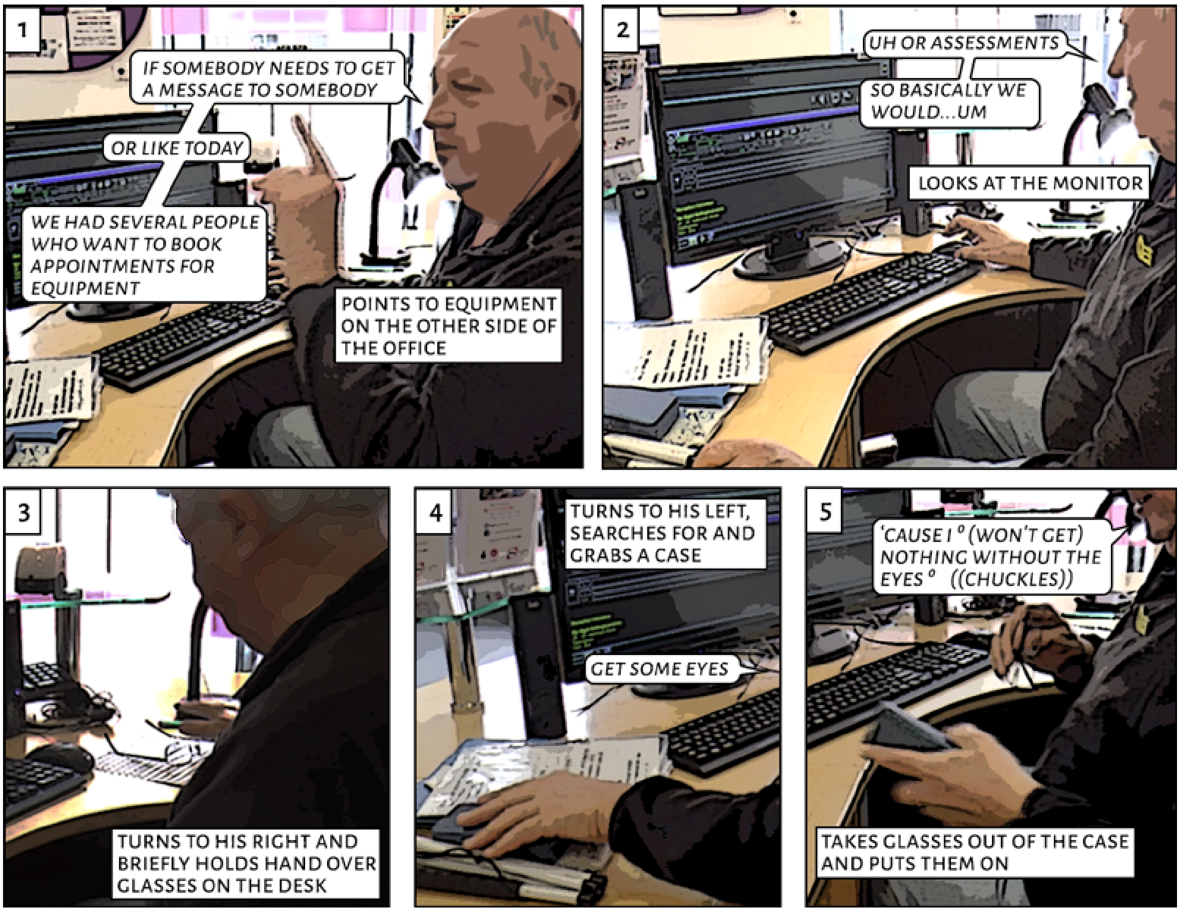
So far, fragments 5.1 and 5.2 have presented exemplars of 'whole' demonstrations, where participants introduced the subject, added context of use, staged the demonstration in place if needed, and delivered the activity intended. However, moments in which participants produced partial demonstrations were also found, where for a variety of reasons some steps could not be performed. The following fragment illustrates this.

5.2.3 Demonstrating a Workplace Task Using a Digital Device

In this fragment the demonstrator is Liam (P6), a 55-year-old partially sighted participant. He reported feeling slightly less confident about technology, but learning through the charity and other service users the features and apps that can support him best given his visual condition. He performed a series of demonstrations (see Fragment 4.3 and Fragment 4.5) at the charity office where he carries out work as a receptionist.

Before the fragment, Liam described to me the tasks he normally conducts at this workplace, for example, dealing with calls requesting information or appointments, giving information to visitors, directing them through the visitor registration, and sorting out the room, office or person they are looking for. He is sitting at the reception, in front of a desktop PC, and various other office and personal tools laying on the desk. The monitor displays an email application, open and ready to use for composing a new email. The monitor also shows the particular configurations Liam needs to operate the PC, being partially sighted: screen colours are inverted (i.e., the screen background is black) and a magnification feature is turned on (i.e., the top half of the screen shows a magnified view of the elements at the bottom half of the screen). These settings were also observed in other devices such as his mobile phone (see Fragment 4.3) and his portable electronic magnifier (see Fragment 4.5). During fieldwork I prompted him to demonstrate some of the tasks described ("is there something you can show me?"). He responded by recounting the activities, gesturing or pointing at the objects on the desk (e.g., the landline phone, note taking paper).

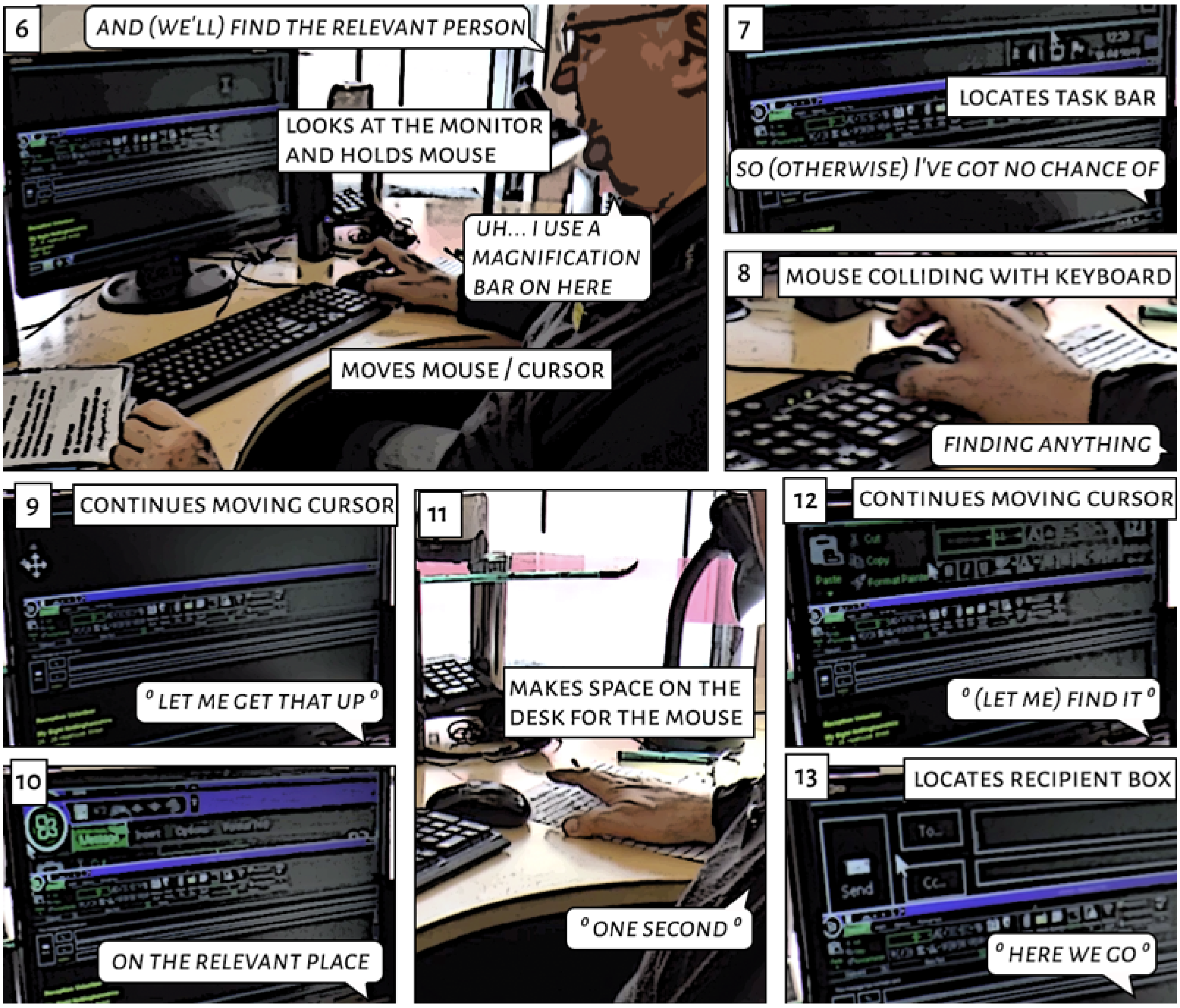
In Segment 5.3a, Liam then starts to demonstrate what he does when people phone the reception, resulting in him often composing an email to deal with the call.



Seg. 5.3a: Explaining receptionist task and getting ready to show it

Liam starts by presenting a scenario that would typically occasion the activity he is about to demonstrate ("if somebody needs to..."), and this is promptly tied to a real recent event ("like today... we had several people who want to...."). While he describes that people request appointments for equipment, he points to the equipment displayed at the reception, so to clarify what he means by 'equipment' for the benefit of the observer. In panel 2, he seems to state the beginning of the demonstration ("so basically we would"), but interrupts himself after looking at the monitor. He slightly turns to his right, seemingly about to grab his pair of glasses laying on the desk. Immediately he turns to his left, and searches for something. He finds a case and pulls a second pair of glasses from it. Similarly to Paul in the previous fragment, the demonstration here reveals to us the ways in which Liam has to stage *himself* in order to perform the activity. Moreover, and differently to Paul, Liam accounts for the interruption by clarifying what he is doing and why ("get some eyes, 'cause I (won't get) nothing without the eyes"). He did not, however, explain the reason for and the difference between the two pairs of glasses. But what is evident from this fragment, is that each pair of glasses has specific purposes for Liam, a fact that was confirmed during the fieldwork with him.

Then, Liam picks up the demonstration where he left it (Segment 5.3b), before the *staging* interruption.

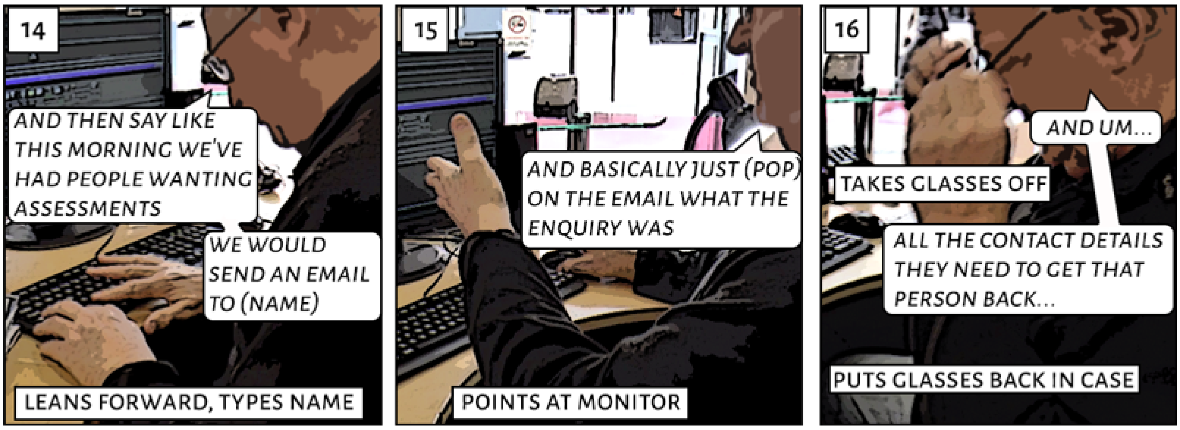


Seg. 5.3b: Using a PC with a magnification feature enabled

After putting his glasses on, he continues describing the first step in the task ("find the relevant person"), and then engaging with the action, by holding and moving the mouse. However, he inserts again additional commentary (panels 6-8), topicalising the accessibility feature set in the PC and explaining why it is needed ("I use a magnification bar on here… (otherwise) I've got no chance of finding anything"). These accounts that clarify the need for glasses and magnification are clearly not part of the task of composing an email but are performed as part of the demonstration for the benefit of the onlooker. These accounts make explicitly accountable to the onlooker the required steps to move on with the task.

Further, in panels 7-12, Liam struggles to locate the recipient box for carrying out the current step in the process (i.e., find the relevant person). He first locates the task bar at the bottom and as he tries to move the cursor up, he seems to struggle to handle the mouse, which is colliding with the keyboard. He then makes some space on the desk to address this issue. Interestingly, he provides a commentary, but this is different from the previous accounts about the glasses or the magnification bar. Instead, he gives a stream of utterances that help me to know the state of the demonstration ("let me get that up... one second... let me find it... here we go)". Again, these formulations are not essential for the task performance, but are performed for the sake of the demonstration as they index the progression through the demonstration.

Lastly, he closes up his demonstration by describing the remaining steps in the task (Segment 5.3c).



Seg. 5.3c: Partially showing how reception messages are forwarded

Finally, after Liam locates the recipient box, he types the name of the person in charge of the request of the scenario he has given (panel 14). However, he does not continue performing the rest of the steps, instead opting to describe them. Note that he goes 'out of the demo' in panel 16, as he takes his glasses off and stores them back in the case where they were at the beginning of the fragment, thus 'un-staging' the demonstration. By doing this he concluded the demo. Notably, Liam did not perform an evaluation check for stopping the demonstration or deeming it successful, as Paul did in the previous fragment.

In this data corpus 58 demonstrations primarily involved showing digital tools, such as in Liam's fragment. Other demonstrations in this group consisted of different mobile phone or laptop uses, such as specific gestures or commands to control screen readers, text-to-speech features, voice assistants and smart speaker uses, and a variety of general-purpose apps or websites; for example, text messaging (see Fragments 4.1, 4.2, and 4.3), e-mail, online shopping, transport (see Fragment 4.9), etc.

So far, Fragments 5.1, 5.2 and 5.3 have presented examples of relatively straightforward demonstrations, where depending on familiarity with the subject displayed, some of the participants' actions and accounts could seem obvious or self-explanatory. Nevertheless, by applying similar features to more complex scenarios and activities, demonstrations in these cases could help to create better understanding for the observers. In the following fragment, one of those cases is presented.

5.2.4 Demonstrating Complex Actions Using a Digital Device

Alice (P5) is a 28-year-old blind participant. In the session conducted with her, she demonstrated her use of her laptop, among other devices such as her mobile phone (see Fragment 4.2), an audio-labeller and an electronic Braille note taker. Alice is also an experienced technology user, making use of several devices, features and apps that enable her to conduct everyday tasks, such as communicating with others via text message and email, doing college work, and labelling, locating, and identifying personal items. Furthermore, she is quite proficient at performing gestures on the mobile phone and a set of commands on the laptop.

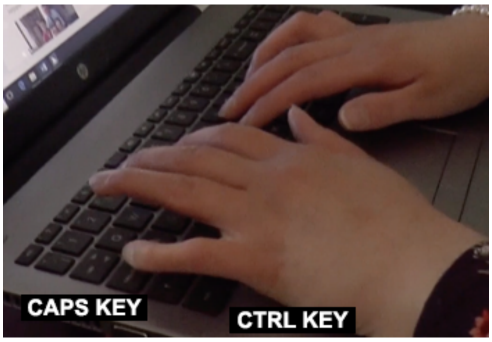
In this fragment, she was not asked to perform anything in particular but rather show her regular practices with the laptop. At the beginning she explained that she mostly uses the laptop for her college work which involves Microsoft Word and Excel apps. But before she engaged in specific demonstrations, she took advantage of two occasions—while waiting for a system response—to explain how she is able to use the keyboard. First, while the laptop was loading after turning it on, she brought my attention to the small ridges on keys F and J. Later, after typing her login password, when waiting for the system to load, she highlighted a set of stickers on specific keys such as the number 5, Home, Enter and arrow keys. The ridges are originally part of the keyboard whereas the stickers are a personalisation of hers, analogous with that of Nick's kitchen fridge and other adaptations at home (see Fragment 4.8). Brief accounts of the configuration and use of the keyboard enabled Alice and me to establish a basic shared understanding of the sense of the landmarks used to locate and press specific keys.

The following fragment is an extract of her demonstration involving a Word document and a variety of keyboard commands to read the text through the laptop screen reader (JAWS[2] for Windows). It is important to note that such particular command practices were not completely visible to me at the moment of conducting fieldwork, nor are they identifiable in the video recording, as Alice's hands cover parts of the keyboard. Moreover, JAWS is set to a very fast speaking speed and, similarly to Fragment 5.1, on some occasions the screen reader output becomes disruptive.

Before the fragment begins, Alice explained which keys she presses to perform certain actions: "if I want to read a text I usually go down arrow [...] if I misheard or can't remember what I read I go up arrow [...] if I want to go top of the page I press control and home [...] if I want to go end of the page I press control and end". The fragment here (5.4) starts with the cursor positioned at the beginning of the document.

[2] https://www.freedomscientific.com/products/software/jaws/

```
ALICE:  so if I want to know what document is this so I press er::
ALICE:  ((hands resting over keyboard))
```




```
ALICE:  ((presses caps lock key)) um ºone secondº ((holds down caps + (  ) keys))
JAWS:   ((reads)) (0.5)
ALICE:  ((stops JAWS by pressing control key)) so this er::
ALICE:  like a: (.) er:: space bar?
INVE:   uh huh
ALICE:  (no) capital key (.) caps::
ALICE:  (.) caps ah key isn't it? ((presses caps lock key))
INVE:   (yes) yes
ALICE:  caps key I press down (and) hold this down and then press T
ALICE:                        ((presses and holds down caps key)) ((presses T key))
JAWS:   ((reads document title)) (2)
ALICE:  ((stops JAWS)) what article this (.) so read the document's name
ALICE:  (what's) actually mean I mean (.) what document is it
```

Frag. 5.4: Demonstrating JAWS (screen reader) commands to read text on a Word document

Throughout her demonstration, Alice announces the next actions she will perform. The way she does this is to introduce them as scenarios in which they would be invoked in a regular situation, e.g., "if I want to know what document is this" in line 1. Such a format "if I want to know [X]" serves as a preparation for the imminent demonstration. Further, note in this fragment a form of rehearsal of some actions by the participant. Similarly to Paul and Liam in the previous fragments, in line 3, Alice provides a formulation of the state of the demo by murmuring "one second" while performing the command. By doing so, she carries out a kind of 'rehearsal' to check whether the key combination actually does the expected action (i.e., describing what document this is).

In lines 5-9, Alice seemingly struggles to name one of the keys involved in the command she just rehearsed. In this, there is self-repair and also a question in order to obtain the correct name of the key (line 9). The name of the key is relevant as part of her ongoing interaction with me as the investigator or observer and what it means to participate in the fieldwork (to attempt to render ones' practices visible): not knowing the key name surfaces a kind of friction between the phenomenology of the participant and the phenomenology of the demonstrational work. Rendering the key's name is important for the demonstration but not the action that the demonstration is demonstrating (i.e., performing the command). Resources have to be mapped by the participant from their circumstances to those of the investigator. The basic work of achieving intersubjectivity is thus made available—laid bare—by the demonstration itself as a phenomenon.

Similar to previous fragments, we get to see the actual demonstration (line 9) after some staging takes place. Thereafter in line 14, there is a post-demonstration explanation of what the command just did. This template employed by Alice was observed throughout her keyboard command demonstrations in a sequential form, that is, first announcing the action, then performing, and at last summing up. Then again used in that order to demonstrate the next command.

Throughout this fragment non-highlighted actions in between the commands can be observed. These are, by contrast, not explicitly introduced during the demonstration. For example, pressing the control key to stop the screen reader in lines 5 and 14. The continuous action to stop the screen reader was highly present in all demonstrations on the laptop, as it allowed Alice to provide her verbal accounts without major disturbance, in contrast to Nick's demonstration in Fragment 5.1. Notably, this is also an exemplar of a frequent and routine action of hers, one that is unremarkable to her or taken-for-granted as she did not explain or topicalise it, as Liam did Fragment 5.3.

This fragment is a very short extract of a chain of demonstrations that could be very difficult to follow for non-familiar audiences. It is in this type of complex scenario—not completely visible to the camera nor the observer—that a systematic breakdown of steps taken are useful for comprehension. The demonstration creates these opportunities for highly skilled individuals like Alice to slow down and require them to produce shared understanding.

5.3 Contributions

In this chapter, I have unpacked four demonstration examples conducted by different participants with VI from the subset of data collected as part of the ethnographic study described in Chapter 4. Through analysing the composition of these instances in detail I have exhibited various features of demonstrational work which I synthesise and present below. Additionally, in this section I will link back demonstrations to the previously established concept of competencies, showcasing how these are *revealed* by the particular features employed through demonstrating and how demonstrations enable the locating of opportunities for design in turn. Ethnomethodological insights obtained through the analysis in this chapter are also provided.

As I have established so far in this thesis, demonstrations—in particular those encountered in empirical research—have received little methodical attention within HCI; therefore, this initial articulation of demonstrational features represents the main contribution of the present chapter. Note that I emphasise these features as an initial attempt at explaining demonstrations whilst recognising that they are multifaceted and a broad phenomenon, thus hoping this contribution helps to inspire future work that examines other forms of demonstrations and continues investigating their significance. In the Discussion, I reflect on the implication of the features herein outlined for both accessibility and HCI research.

5.3.1 Demonstration Features

Demonstrations have been a common element of HCI research for studying people's activities, tools and environments, however, in order to understand their untapped value, researchers need to be able to identify their features–i.e., what constitutes them *in and as* demonstrations in the first place.

Firstly, the detailed analysis presented in this chapter adds to past work asserting that demonstrations entail more than merely showing technology functionality (Smith, 2004); the data fragments delineate the different embodied and verbal resources employed by demonstrators for **showing**, **using** and **simulating** tasks or artifacts within a demonstration, for **checking upon** the onlooker for signs of comprehension and validation of the demonstration itself, and **providing accounts** to make their actions recognisable for other people. The various embodied interactional resources are central to produce and recognise these instances as demonstrations. For example, I can pinpoint moments where participants, aware of their role as demonstrators, directed their actions or objects towards the camera or towards me. Conversely, there were moments where they had to fully engage with the action, or get 'into the demo', in order to move on with it, even if that meant making the activity demonstrated less clear for the observer. While the first fragment draws attention to assistive physical customisations of the home, the other three fragments emphasise the bodily, coordination and haptic work required for performing the activity (e.g., framing a shot, performing keyboard commands). Moreover, in between the interwoven modalities of using and showing, some demonstrations also comprised simulating a scenario or context of use; for example, Nick simulating dropping the mobile phone from the counter in Fragment 5.1 as justification of his personal customisation at home. All the embodied actions are of course inextricably intertwined with participants' ongoing talk which is employed variously to explain, contextualise, draw attention, validate, or open and close the demonstration itself. The data in this and the previous chapter illustrates some of these different uses of verbal accounts within the demonstrations:

- Accounts of steps within the activity or object being demonstrated (e.g., "the idea is to put the phone out of the way, like so" in Fragment 5.1).
- Accounts of the state of the demo itself (e.g., "one second" in Fragment 5.4).
- Accounts of steps merely described but not performed (e.g., "and basically just (pop) on the email what the enquiry was" in Fragment 5.3).
- Accounts of additional information (e.g., "it's not one of the most popular apps but I like it" in Fragment 5.2).

Further, I want to bring attention to the **staging** process; that is, all the meta-activities preceding the actual demonstration, or *the use in action.* Again, the entanglement of embodied and conversational resources is a key feature throughout staging, leading to and providing the building blocks of the demonstration itself. This was especially the case for Fragment 5.2, where Paul engages in a series of actions to obtain the required printed material to be read. The fragment lets us examine how required conditions to scan the paper are practically and physically achieved, by aligning, steadying, and framing the phone. In Fragment 5.3, Liam engages in a series of actions that do not necessarily encompass the task of composing a workplace email. He moves 'into' and 'out of' the demo as he gets his glasses and puts them on, and then traces those steps back after he deemed his demonstration complete. In Fragment 5.4, Alice builds up the demonstration by announcing it and quickly verifying the keys before explicitly performing their use. In the demonstrational data, most of these meta-activities occurring before the demonstration were key to understand participants' experiences with technologies and their use in context, despite the brevity of the episodes. Some of these meta-activities also took the form of practical troubles emerging within and around the demonstration (e.g., failing to scan a document, struggling to move the cursor), and the inclusion of extra steps within the demonstration to explicate related information (e.g., topicalising the need for glasses and a magnification tool). Thus, all the meta-activities preceding or intertwined with the demonstration gave me relevant information about the person, the activity, and artifact in question, and furthermore, about other elements unfolding to the sides or behind the demo, as others have previously pointed out (Taylor, 2015; Smith, 2004).

Secondly, demonstrations are social interactions (Smith, 2004). Although this is somewhat obvious the implications are not. They are about making something visible, transparent, or explicit to an observer, investigator, audience, or co-present other(s). Nevertheless, even in simpler scenarios such as Fragments 5.1, 5.2, and 5.3, this extra work of explicating and performing provided relevant information about the object or activity being demonstrated. The nature of demonstrations is such that demonstrators are sensitised to the need to clarify commonplace assumptions. Moreover, demonstrations can give insights from very complex—interactional—situations, such as the one in Fragment 5.4, that could be unintelligible if it were not for Alice's interwoven accounts of her actions. Arguably the overriding purpose of demonstrations is to create the **intersubjective shared understanding** of the subject being showcased. Demonstrations are not merely a display of a series of actions, but they are interspersed with talk that checks upon, confirms, and works to generate mutual understanding of the demonstrated activity between the demo-er and demo-ee. Participants' self-awareness of their role within the research is illustrated by Paul in Fragment 5.2, checking with me whether his demonstration was successful for the purposes of the investigation. It is *in and through* the continual—interactional—production of verbal, physical, digital, and embodied actions that this intersubjectivity is achieved, and thus, the demonstration can be seen to serve its purpose.

Third, like all social interaction, demonstrations are constituted in and as recognisable and repeating sequences of action (i.e., the 'machinery of interaction'; Sacks, 1992). Demonstrations can look to **follow a 'template'** that may make them appear almost scripted, even when demonstrators had not prepared or choreographed their actions in advance, as is common with public technology demos (Johri, 2016). Demonstrations are thus underpinned by unspoken but shared-in-common expectations about 'how a demo is done' and 'what a demo looks like' as a recognisable social object. This work expands Lazar et al.'s suggested pattern that, for them, descriptive demonstrational case studies broadly follow (Lazar et al., 2017a). Their stated pattern consists of a participant introduction and context of use (e.g., Fragment 5.1), how they used the system (e.g., Fragment 5.4), problems faced (e.g., Fragment 5.2), strengths of the system (e.g., Fragment 5.3) and opinions (e.g., Fragment 5.2). However, my detailed analysis provided a closer look into some of these broad steps. For example, in Fragment 5.4, this 'template' involved Alice conducting her command demonstrations in recognisable phases i.e., announcing, performing, and summing up. Moreover, on some occasions she had to quickly rehearse before moving on to the 'official' performance. Notably, these actions were brought to bear specifically because of the demonstration, so these do not only concern how she uses the system, but also how she explicates her use of it. Although it can be observed that other participants performed their actions *while* explaining, instead of announcing in preparation, it is worth remarking that all the fragments included a scenario statement that set the demonstration in motion or helped to contextualise it (e.g., "*if* I want to read anything").

It is worth noting that the features above described are not *all* of the features relevant to demonstrations at large, but key observations from this data subset which was collected in the context of an empirical ethnographic investigation. As I have stressed before, different forms of demonstrations exist within and beyond HCI—such as technology demonstrations for a public audience—and thus I do not claim that these features are universal and applicable to *all* of the types of demonstrations we can encounter. Nevertheless, this analysis is a step forward towards better understanding demonstrations and the outcomes they can bring about for HCI research and design. In the following section, I present some of the results that could be drawn out from analysing demonstrational material.

5.3.2 Competencies and Design Opportunities Observed in Demonstrations

Demonstrations involve attempts by participants to surface the embodied nature of their everyday interactions 'in the world'. They are not phenomenologically 'the same' as those everyday actions but instead they *evoke* them. In this way they have the potential to surface *some* of what it means to live with a VI, and to make this available (recognisable) to others, furnished with all the possible challenges and required skilfulness in their accomplishment. Demonstrations surface the importance of the adaptations done by VIP to configure both their situation and environments in which assistive technologies are used. I build on my previous work described in Chapter 4 articulating the particular competencies that people with visual impairments use in their everyday lives (Reyes-Cruz et al., 2020), which are often seen-but-unnoticed or taken-for-granted. Herein I locate and highlight the situated competencies that the participants exhibited through demonstrating. I then provide exemplary design areas in which future design work could be done to support the demonstrated competencies. Table 5.3 summarises the activities and competencies demonstrated and unpacked in this chapter, as well as potential design areas they relate to.

Past work has been concerned with gathering evidence and reflections of the adjustments or adaptations that people with disabilities implement to create more accessible home and work settings that fit their individual and social needs, pointing out their invisibility and unrecognised characteristics (Kane et al., 2009; Branham & Kane, 2015b, Bennett et al., 2019). As showcased by Nick in Fragment 5.1, demonstrations can give complementary insights of such configurations that might only be prompted by this type of performance and that could be overlooked if they were *only* asked for verbal accounts perhaps via interview. For example, the undesirable case scenario brought up by Nick when demonstrating his Velcro station showed a very specific concern that involved the particular setting in which the demonstration took place; that is, he showed what it meant to leave the phone on the counter right next to the Velcro station and in doing so exhibited the possibility of dropping and damaging his phone. Perhaps another evident reason for his adjustment is to easily locate his phone, but for the account given in his demonstration, this is incidental. Through this example Nick also demonstrates how he moves around and locates objects at his home, which could be valuable for technological research on indoor navigation. Likewise, Fragment 5.3 gives a glimpse of Liam's workplace and the necessary arrangements for the tasks he conducts at his desk station. He shows his personal configuration of tools, both physical (i.e., landline phone, paper, two pairs of glasses, PC) and digital (i.e., magnification feature on the PC). Asking Liam to demonstrate something *in use*, I moved with him beyond 'touring' the workstation or going through the tools. In doing so, I obtained a deeper understanding of what tools are essential for the activity demonstrated and how some tools have specific purposes (e.g., a second pair of glasses for using the PC).

There are also insights for research on the embodied interactions of people with disabilities. In this chapter, a simple and conventional example of bodily work has been illustrated by Liam, who demonstrated how he operates a mouse and a magnified screen while having residual vision. A more specific example of bodily work has been displayed by Paul when demonstrating the OCR app on his phone, which involved framing the camera over the paper through a series of actions (elbows on table, aligning the paper, crafting his posture,

Table 5.3: Design insights obtained from analysis of demonstrational work

Demonstration	**Activities (Competencies)**	**Design Areas/Opportunities**
Customisation at home	-Reaching fridge, locating device, showing it to the investigator (tactile, spatial) -Simulating use case scenario dropping the phone (spatial, adaptation) -Talking over and around screen reader in the background (verbal, auditory, social)	-Indoor navigation and orientation towards others (e.g., Guerreiro et al., 2018; Grayson et al., 2020) -Safety mechanisms for mobile devices or other objects (e.g., He et al., 2020) -Use of pauses and slow and fast talk around screen readers
OCR app for reading printed document	-Framing, steadying and aligning document for scanning (bodily camera work) -Redoing steps after failed attempt (bodily camera work)	-Supporting camera focus and alignment (e.g., Jayant et al., 2011; Vázquez & Steinfeld, 2014) -Use of embodied methods for taking pictures
Task at reception desk	-Arrangement of tools in a workspace (spatial, tactile, configuration) -Selecting and using tools for specific purposes (configuration, visual) -Moving cursor and finding elements on screen (spatial, visual)	-Accessibility arrangements in work settings (e.g., Branham & Kane, 2015b; Albusays et al., 2017) -Configuration and use of tools by people with low vision (e.g., Szpiro et al., 2016) -Magnification tool research
Screen reader commands on laptop	-Starting at a resting position and performing commands (tactile, spatial) -Naming keys for the investigator's benefit (social, intersubjective) -Stopping screen reader in order to talk (auditory, tactile, social)	-Tactile references in non-visual activities (e.g., Race et al., 2019) -Mixed-visual abilities settings (e.g., Metatla et al., 2019) -Use of stop-shortcut with audio output in social settings

positioning the phone, squinting, etc). Although there is significant work on designing assistive technologies that support VIP to aim and align their mobile phone to take pictures for different purposes, including reading documents by themselves or others (Jayant et al., 2011; Vázquez & Steinfeld, 2014), the major emphasis is on design and evaluation of technological prototypes or existing solutions and their different modalities (Cutter & Manduchi, 2017; Neat et al., 2019). Photographs taken by VIP are often of poor quality or not usable for the intended purpose (e.g., computer vision systems or crowdsourcing services), and thus the practice still entails crucial challenges (Gurari et al., 2018). Future work in this area could benefit from systematically employing demonstrations by VIP in various situations or settings and thus designing for supporting and enhancing the embodied methods people *already* use for e.g. taking pictures.

Lastly, I have presented cases in which the pervasiveness and sometimes disruption of screen readers' output is evident. It can be seen in Nick's demonstration how he improvises and crafts his talk and performance around VoiceOver. In this example, timing and sequencing are key elements to carry on talking while the assistive technology continues communicating his pending notification. By contrast, Alice's demonstration highlights a routine action—pressing a control key—to continuously stop JAWS, so to clearly provide her aligned (verbal) accounts of the ongoing demonstration without interruption by the subject of it. These fragments showcase relatively short demonstrations, which have provided brief opportunities to examine and understand these two types of interactions involving dealing with a screen reader in the background. Future work on interdependent practices (Bennett et al., 2018) could further explore the use of screen readers in social situations through demonstrations, as they are intrinsically a social occurrence (i.e., needing at least two parties).

5.3.3 Ethnomethodological Takeaways

This chapter has also revealed ethnomethodological insights about VI obtained through the demonstrations. In contrast to ordinarily-sighted people, VIP do not have the visual resources to know if the observer is paying attention to the point of interest. Therefore, when demonstrating, VIP employed methods to *draw attention* to the relevant objects or spaces such as pointing at, gesturing at, touching, or bodily orienting themselves towards them. Nonetheless, this alone does not let VIP monitor the observer's attention and thus they also employed, as a matter of method, *verbal exchanges to confirm or check-upon* the state and outcome of the demonstration. Although these physical and verbal resources can also be used by sighted people to emphasise their actions, for VIP they are routine ways of producing their demonstrations and ensuring they have fulfilled their purpose.

The demonstrations in this investigation showcased embodied case scenarios of regular activities as conducted by the participants, providing a sense of the routine and their familiarity with them, unless they made a statement to the contrary. These have shown how participants solve the issue of *finding something* when there is partial or no vision. Whilst a sighted person would simply visually scan the scene to locate an item, VIP scan and locate visual objects through other methods that allow them to know where they are, as described in 4.3.2. This chapter, however, provides further insights into how maintaining awareness of the whereabouts of an object is achieved. Methodologically, it is ensured by routinely putting the item in a *designated location* or *keeping it in proximity*. This methodological feature was observed throughout the demonstrations, as participants tended to close their demo by automatically putting the objects back in their original location, suggesting that it is a common action conducted in their day-to-day.

Crucially, as a key salient feature of demonstrations learnt from the analysis in this chapter, participants verbally accounted for the demonstrated activity so as to make their particular VI *practically understood* by the observer. As a method, this was done by explaining why certain tools were needed or why certain actions were conducted in specific ways as a response to their particular VI. In other words, VIP *disclose or remind about the state* of their vision, not in medical but practical terms, in order to sustain intersubjectivity. Arguably, this could suggest that VIP ordinarily express their VI, related access needs and actions to others in such practical ways in order to make them observable-and-reportable.

As described in 3.2.2, endogenous or incarnate reflexivity explains that members' practices are naturally accountable in and through their methodical and organised actions; that is, they are intelligible in the course of, and through, being accomplished. The demonstrations were collected at a point when VIP's practices were not naturally accountable or self-explicating to me, a non-member, albeit one in the course of developing vulgar competence in VI. On the other hand, there is a recognition by VIP that their membership is niche and non-VIP may need explanation of their practices so they could be intelligible; therefore, demonstrations acted as an invitation into their world helping me to make sense of it. As has been exhibited in this chapter, for VIP, announcing actions (prefacing, interweaving, or recapping them) is an act of natural accountability for the benefit of the other. In most cases, participants explained and broke down their practices into demonstrations as a way of letting me see and understand *how* and *why* they perform them, whereas in other cases demonstrations did not include thorough explanations but let me *witness* that VIP can competently conduct the practice.

Lastly, it was observed how participants competently *dealt with interruption and failure* within the demonstration. Confirming findings from the previous chapter, VoiceOver turned out to be a common source of interruption for VIP as it continuously read text aloud during the demonstrations. Methodologically, VoiceOver was dealt with by 1) stopping it, 2) interweaving talk with it, and 3) talking over it. On the other hand, the methodological features of dealing with failure included *repeating the action* while under the same conditions and *re-setting the conditions* before repeating the action.

5.3.4 Implications and Next Steps

Having ascertained some of the key features involved in demonstrating as part of an empirical HCI investigation, and having illustrated some of the outcomes that can be obtained through them, in the following I explain why the previously introduced Competencies Framework of VI was revisited and expanded by incorporating demonstrations as a fundamental piece of the subsequent workshop approach which I present in Chapter 6.

5.3.4.1 Incorporating Demonstrations into a Competencies Framework of Visual Impairments

In closing, I wish to draw out two main implications from the analysis of demonstrations presented in this chapter that become relevant in the development of a Competencies Framework of VI. Firstly, I want to highlight that the previously established concept of 'competencies' of VIP has a foundational relationship with demonstrations as a source material wherein they can be located, as evidenced in Table 5.3. I argue that the actual nature of demonstrations, explained by the features I have outlined, enable competencies to become salient or observable-and-reportable—expressed in ethnomethodological terms. That is, the breakdown of tasks into steps interspersed with various types of verbal accounts, as well as the employment of a 'template' that signals their actions about to be performed or just performed, allow us to pinpoint the demonstrators' interactional and situated competencies. I suggest that such competencies could go unnoticed or be less clear if observed through a lens or episode different in nature to a demonstration; for example, through observing naturally occurring activities.

Secondly, in this chapter I have shown that the features I ascertained in turn facilitate intersubjectivity between demonstrator and observer; that is, some demonstrators' physical actions and verbal accounts are produced with a view towards making the activity evident and clear for the party observing or witnessing the demonstration. Moreover, the same breakdown of steps that enables locating competencies also allows the activity to be followed and potentially understood. Of course, demonstrations are a valuable instrument for researchers of assistive and accessible technologies to enrich their understanding of users; nevertheless, I suggest that demonstrations can also be a highly valuable tool and resource for people far less familiar with the particular technologies being demonstrated, and overall, with visual impairments. As a matter of fact, demonstrations of technology by VIP have gained popularity on online and social media platforms as part of their work conducted to raise awareness of the experiences of VIP, as mentioned in Chapter 2 (see e.g., Lasker, 2020 and Wilson, 2020).

Hence, in Chapter 6 I explore the practical application of a selected catalogue of demonstrations collected during the ethnographic study I conducted, but for engaging people with and without VI from different technology backgrounds (i.e. users and technologists, familiar and unfamiliar with assistive technologies and VI) into reflective activities. After analysing demonstrations and suggesting a pathway for finding design opportunities from them, a natural course of action would involve outlining implications for design and/or informing specific design projects, as I have recounted when describing this thesis approach in Chapter 3 (section 3.3.1). Nevertheless, inspired by critical reflections in accessibility research (Mankoff et al., 2010), disability studies (Hamraie, 2016), and disability activism (Jackson et al., 2022) on the shortcomings of technological endeavours for disabled people (as reviewed in Chapter 2), I employ the insights obtained through the empirical analyses presented in chapters 4 and 5 to inform a workshop approach aimed to address the lack of awareness of VI in design rather than the creation of a particular design solution.

Chapter 6

Design Critique for Awareness and Shared Understanding of Visual Impairments

This final study chapter presents a design critique in the form of an online workshop which was informed by the insights obtained through the ethnomethodological work described in Chapters 4 and 5, as illustrated in Figure 3.1. This chapter proposes and implements a design critique approach for including VIP in the early stages of design and supporting accessibility awareness among design practitioners who are not VIP. Thus, this study brings together people with different visual abilities (i.e., blind, partially sighted and sighted) from different technology backgrounds (i.e., users, researchers, and design specialists). In order to do so, two key materials were developed: 1) a set of video demos to show examples of technology in use, and 2) a deck of reflective design cards representing different layers of VIP's experiences (i.e., competencies, tools, activities, relations, and locations). These materials were threaded together to prompt conversations about technology design, accessibility and VI, scaffolding participant reflections. In the following, the design of the materials, the workshop structure, and the study implementation are described. Through analysing how participants responded to the materials and interacted with each other during the sessions, in this chapter I will exhibit the import of video demonstrations and reflective design cards that integrate the knowledge and experiences of VIP to support awareness and shared understanding of VI. The main goal of this study is to advance accessibility research by contributing with a set of tools and practices that can be adopted in design to centre the involvement of disabled people while fostering the development of relations with them rather than replacing their participation in design processes.

6.1 The Study Materials

The workshop structure was defined around two materials that served as prompts to inspire and direct conversations between participants. Although the video demos and design cards are highly visual in nature, they possess key features that were considered potentially useful for online engagements, given the Covid-19 restrictions at the time the study took place. For example, the descriptive nature of demos in which demonstrators verbalise their ongoing actions (as found in the second investigation of this thesis; see demonstration features summary in 5.3.1) and the abstraction and conciseness of design cards for conveying information (as established in 3.4.1). In addition, different accessible versions of the materials were created, and I aimed to provide access to participants throughout the study, as will be described later in the chapter.

This section provides background information guiding the decisions behind the two materials, which were heavily drawn from the insights obtained from conducting ethnographic work with VIP. That is, these tools are shaped by both the analytical-conceptual results from the previous research in this thesis and my experiences engaging with VIP during fieldwork. In the following, I will also describe in detail the content of the materials:

- Video Demos of Assistive Technology in Use
- Reflective Design Cards of Visual Impairments

6.1.1 Video Demos of Assistive Technology in Use

The present study explores the practical application of video demos in HCI and accessibility research, serving as tools for specifically engaging VIP in reflections with non-VIP. Naturally, this work is motivated by the findings ascertained in Chapter 5. In summary, by analysing a series of video demonstrations I outlined core features that constitute them *as* demonstrations. These include 1) different verbal and embodied resources for showing, using and simulating the activities being demonstrated, 2) a variety of verbal accounts providing detailed descriptions of the activities as they unfold, 3) a staging process or meta-activities preceding the actual demonstration, and 4) an overriding purpose of achieving a shared understanding between demonstrator and audience. Such previous work serves as a baseline for the design critique approach presented in this chapter.

In terms of content, the first workshop material consisted of a set of four video demonstrations performed by different VI individuals. These demos were captured during the previous ethnographic study investigating technology use by VI people (described in 4.1; the collection of the demonstrational dataset was described in 5.1). The demos were selected from the dataset based on their short duration (i.e. less than 2 minutes), and the simplicity, clarity and conciseness of the activities demonstrated. I chose demos in which the demonstrators were particularly descriptive of their actions as they unfolded and chose examples that were representative of the technologies VI people use in their daily life. The aim was to collate a small set of video demos that could provide a glimpse of AT use for people not familiar with it or VI whilst being accessible to VIP. The set of video demos consisted of:

1. A partially sighted person demonstrating VoiceOver (i.e. Apple's screen reader) on the mobile phone.

2. A partially sighted person demonstrating KNFB reader app (i.e. An Optical Character Recognition mobile app that recognises text in a picture and reads it aloud) for reading print.

3. A blind person demonstrating Seeing AI app (i.e. Microsoft's app implementing AI

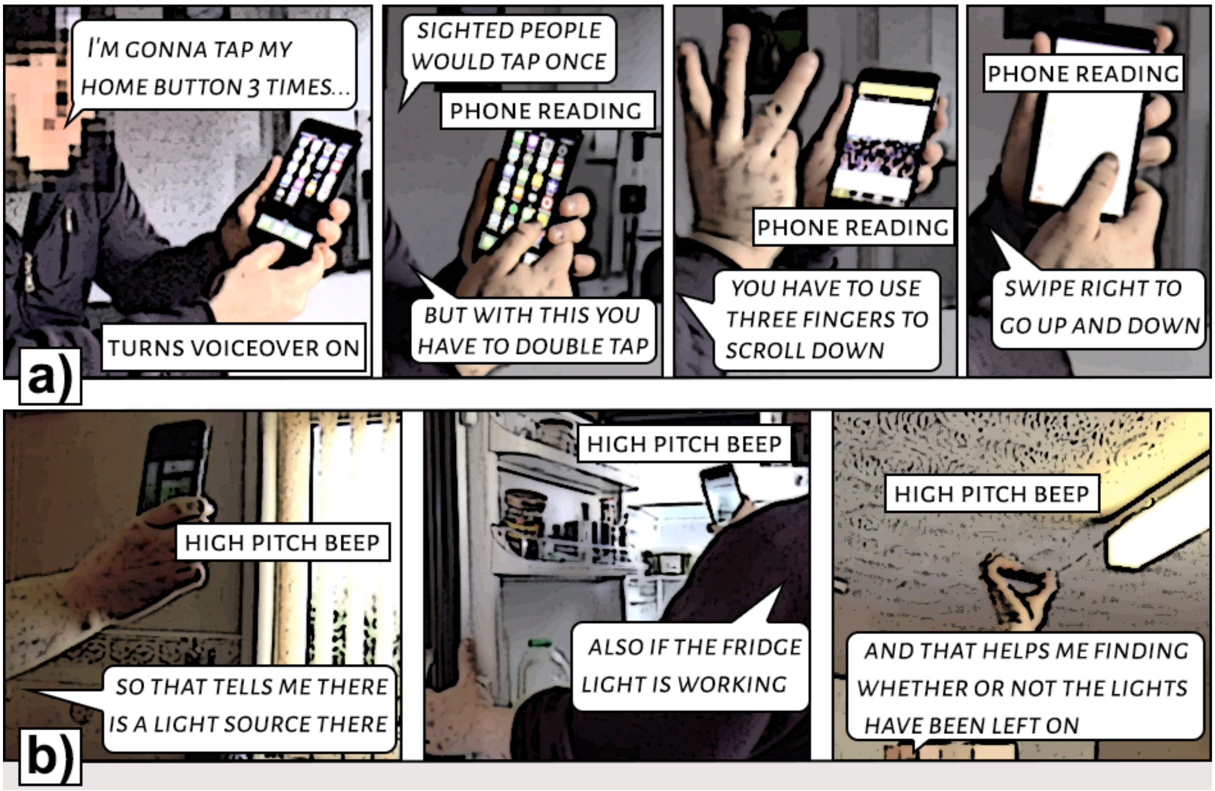


Figure 6.1: Video demos stills: a) using VoiceOver on iPhone (top) and b) detecting light with Seeing AI app (bottom)

for Character, Product, and Object Recognition of documents, objects and scenes pointed at by the phone's camera or photographed) for detecting environment lights.

4. A blind person demonstrating how to send a text message using VoiceOver.

The demonstration of the KNFB reader app for reading printed text has been previously presented in this thesis (see Fragment 5.2). Similarly, the text messaging demonstration consists of extracts from a previously shown data fragment (see Fragment 4.2). The other two demonstrations (i.e. VoiceOver and Seeing AI) are roughly illustrated in the stills in Figure 6.1. The faces and voices of demonstrators were anonymised in the video materials used in the workshops.

6.1.2 Reflective Design Cards of Visual Impairments

These cards were defined and designed following Golembewski & Selby's process (2010), as described in 3.4.1. Having already established the project domain (i.e., reflecting on

Table 6.1: Reflective Design Cards: categories and content

Category	Cards
Competency (Yellow)	Auditory, Tactile, Visual, Verbal, Spatial, Memory, Assistance, Visibility, Negotiation
Tool (Green)	Aids, Devices, Features, Voice Assistant, Camera apps, Remote help apps, Navigation apps, General purpose apps
Activity (Blue)	Personal, Social, Shopping, Cooking, Work, Leisure, Housework, Going out
Relation (Red)	Coresident, Close person, Assistant, Acquaintance, Customer Service, Stranger
Location (Purple)	Home, Known places, Unknown places

technology experiences of VIP), I first defined the category suits and then the instance cards within them. Table 6.1 shows a summary of the categories and cards.

To define category suits and instance cards, I principally drew from my previous work (Reyes-Cruz et al., 2020), and complemented the contents with findings from other relevant literature on VI in accessibility research. The categories and cards were reviewed and refined through discussions within the research team. At this point, I creatively engaged with the instance cards, by deciding how to better depict their subjects. In doing so, a short description and illustration (adapted from the free image repository `https://pixabay.com/`) were defined for each card. Golembewski & Selby (2010) stress the importance of exploring the content of the instance cards as a self-contained theme rather than in relation to the project domain. Therefore, generic and abstract descriptions and illustrations were mostly employed. Lastly, I designed all the cards using Adobe Illustrator software. As per deck creation standards (ibid, 2010), each category was assigned a colour and shape to visually identify them. Figure 6.2 shows the structure and content of each card in this deck.

The deck of cards employed in this study was iterated once after a set of internal pilot sessions (mentioned later in the study approach section). The changes included improving conciseness (i.e., reducing description text of all cards), clarity (i.e., changing technical or confusing words), open-endedness (i.e., adding a blank card in all categories), and visual accessibility (i.e., increasing font size). Moreover, although these materials were designed to be employed in an online study, I also considered how they could be used for in-person

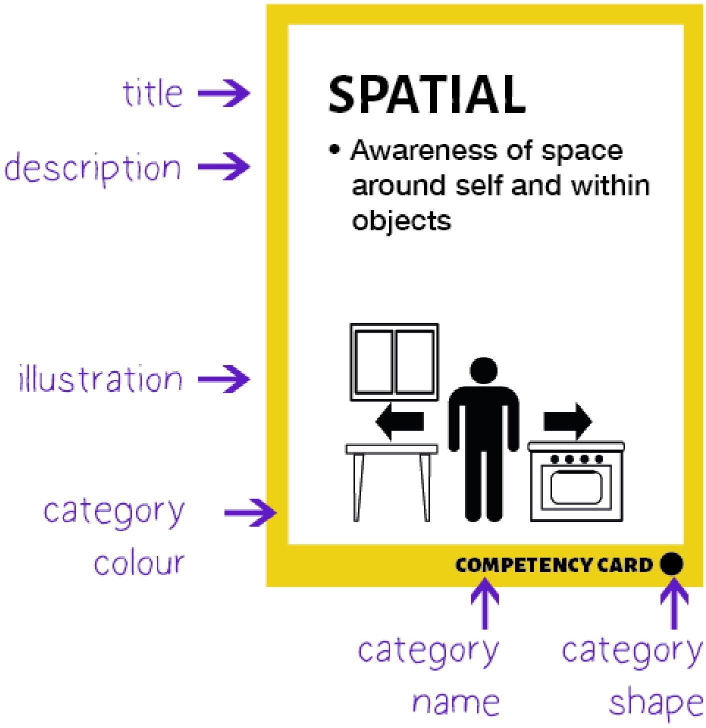


Figure 6.2: Card elements: content and category identifiers

research in the future. These aspects are discussed later in this chapter, including how the materials were made accessible for blind and partially sighted participants in this study (see 6.1.3).

In the following, the five categories and corresponding cards are contextualised, including a few card examples. The full deck of cards can be found in Appendix E and have been made available for use via a Creative Commons license (see `http://doi.org/10.17639/nott.7231` for downloadable resources and alternative formats).

- Competency Cards
- Tool Cards
- Activity Cards
- Relation Cards
- Location Cards

6.1.2.1 Competency Cards

Evidently, the Competency category is directly informed by the analytical and conceptual outputs obtained from the first investigation in this thesis (see the summary of competencies in 4.3.1). This competency-focused perspective has roots in ethnomethodology (see Chapter 2). Therefore, the first intention of this category is to pull such an emphasis on membership competence into design activities more tangibly and interactively than establishing them as implications for design (as discussed in 3.3). Moreover, the second intention of this Competency category is to move away from a focus on impairments or constraints–which is often used in materials that promote inclusive design (e.g. Microsoft's Inclusive Design Toolkit, 2018)–towards interactional skills and knowledge of VIP and their everyday experiences. Nonetheless, this category needed not to be solely reducing VI to a functional dimension (Holloway & Barbareschi, 2021). For that reason, social competencies found in this PhD's empirical work were broken down and included as individual cards (i.e., Assistance, Visibility, and Negotiation).

It is important to note that not all of the competencies outlined in 4.3.1 were employed in this set of cards; namely, the embodied and configuration competencies. The reasoning for this is two-fold. Firstly, I had not outlined the embodied competencies at the time I defined and created the reflective design cards, as they were matured as an analytical output only after the investigation in Chapter 5 took place (including analysis, write-up and revisions). This can be seen in the initial publication emerging from this thesis (Reyes-Cruz et al., 2020) that does not include embodied competencies. The publication presents a preliminary version of all the competencies, which was refined and matured throughout the remainder of this PhD work. Secondly, the configuration competencies are highly dependent on particular technologies, situations, and settings, making the category difficult to stand on its own, which in turn inspired the creation of other card categories such as tools and locations.

Thus, this category consists of ten competency cards: Auditory, Tactile, Visual, Verbal, Spatial, Memory, Assistance, Visibility, Negotiation, and an empty card representing other competencies not herein included. These cards are yellow and associated with a circle.

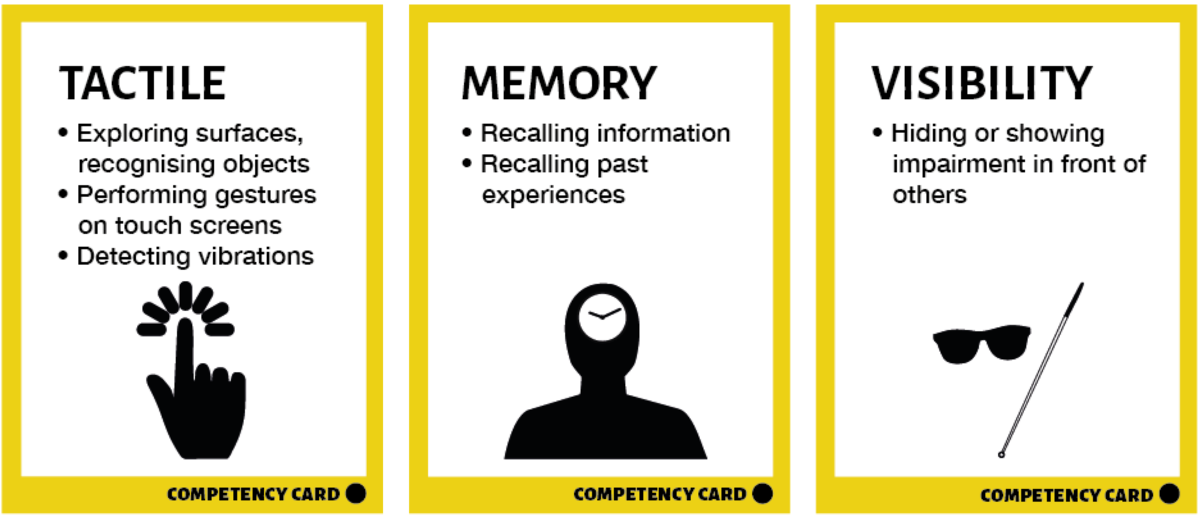


Figure 6.3: Examples of Competency category cards

Figure 6.3 shows three cards from this category. The remaining cards are included in Appendix E.1.

6.1.2.2 Tool Cards

Similarly to the previous category, the Tool cards were directly informed by the empirical findings from the ethnographic study presented in Chapter 4, as several mainstream and assistive technologies employed by VIP were therein identified. These common tools are also repeatedly reflected in literature on VIP and their technology use (Ashraf et al., 2016; Bhowmick & Hazarika, 2017; Hersh & Johnson, 2008; Senjam et al., 2021). However, I chose to include additional technologies not necessarily unpacked in detail in this thesis, but that participants mentioned knowing of their existence while not using them with regularity, such as mobile apps that support remote help by volunteers, assistants, or crowdsourcing (Avila et al., 2016; Lee et al., 2020; Brady et al., 2013). Likewise, although participants in the ethnographic study reported not using navigation apps, these are a major emphasis in the domain of technology designed for VIP (Bhowmick & Hazarika, 2017), and I therefore included them in this set of cards. Lastly, aiming to maintain brevity in each category, I made the decision to group low-tech aids, devices, and features within those devices, in one card each. Only those specific technologies that were considered more prominent in my own empirical findings and past literature were defined as individual

Figure 6.4: Examples of Tool category cards

cards.

Thus, this category consists of nine tool cards: Aids, Devices, Features, Voice Assistants, Camera Apps, Remote Help Apps, Navigation Apps, Other Apps, and an empty card for other tools herein not included. These cards are green and associated with a triangle. Figure 6.4 shows three cards from this category. The remaining cards are included in Appendix E.2.

6.1.2.3 Activity Cards

In Chapter 4, three main everyday technology practices were ascertained: social relations and communications, reading, and mobility. For the purposes of creating the cards, they were nonetheless broken down into more isolated activities. For instance, reading can take place in a range of everyday activities such as shopping, work, leisure, or housework (i.e., reading mail). Moreover, and mirroring the decisions taken for the Tool category, other activities not unpacked in detail in the ethnographic study were also included in the Activity cards. Some of these additional cards reflected activities that participants hinted at in the fieldwork such as using Braille labels for identifying clothing or makeup (i.e., Personal card), whilst others were included to provide a more rounded perspective of common everyday activities (e.g. shopping for food implies the need for cooking or meal preparation). As per Golembewski & Selby (2010), instance cards should be self-

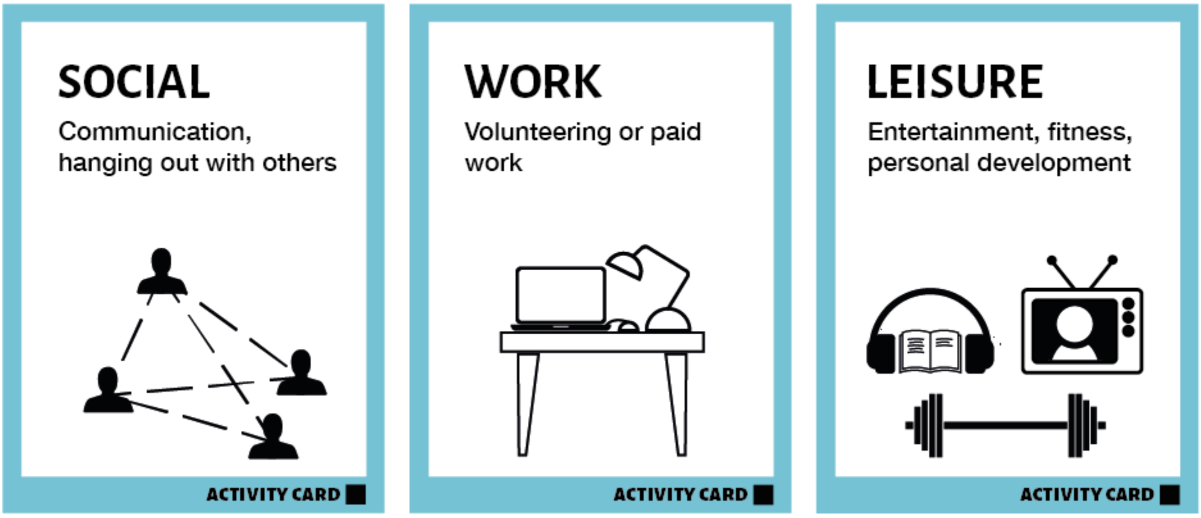


Figure 6.5: Examples of Activity category cards

contained rather than have a direct relation to the project purpose; that is, it was not considered necessary to establish strict use of technology in these activities. This precept was also employed in the development of the Relation and Location categories.

In summary, the Activity category consists of nine cards: Personal, Social, Shopping, Cooking, Work, Leisure, Housework, Going Out and an empty card for other activities not included in this list. These cards are blue and associated with a square. Figure 6.5 shows three cards from this category. The remaining cards are included in Appendix E.3.

6.1.2.4 Relation Cards

This category was predominantly inspired by accessibility research in HCI recognising the crucial role of social and relational aspects involved in using technology when individuals have a disability; for instance, the work of Shinohara & Wobbrock (2016) exhibits how disabled people feel self-conscious about using AT when in public or social settings, and the work of Branham & Kane (2015a, 2015b) reveals that creating access for VIP is tightly linked with particular aspects of personal relationships at home and expectations around performance and capabilities at work. Similarly, Faucett et al. (2017) explored notions of showing or hiding one's impairment in front of others depending on the type of relationship the individual has with them (which is also represented in the Visibility card in the Competency category). Lastly, this category draws from the work of Bennett

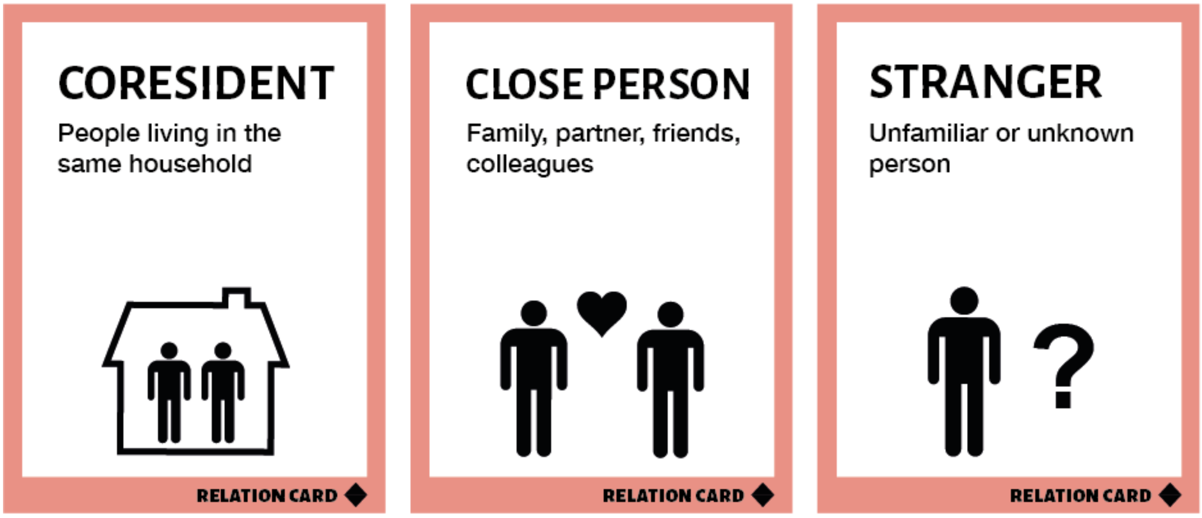


Figure 6.6: Examples of Relation category cards

et al. (2018) arguing that accessibility is habitually enabled through relations with other people, AT, and the environment, not only through AT.

Although not the main focus of the ethnographic study in this thesis, its findings also confirmed the notions described above. For instance, participants in Chapter 4 repeatedly mentioned that often the most practical way of conducting everyday activities is through the assistance of others, even when technologies exist for achieving the task. Likewise, participants stated feeling safer with a sighted guide rather than using navigation technologies. Thus, both the insights obtained through the literature and the fieldwork conducted (e.g. participants living on their own or with others, participants having a personal assistant) were employed to formulate these instance cards.

In summary, there are seven relation cards in this category: Co-resident, Close person, Personal Assistant, Acquaintance, Customer Service, Stranger, and an empty card for other relations not included in these cards. This category is red and associated with a diamond. Figure 6.6 shows three cards from this category. The remaining cards are included in Appendix E.4.

6.1.2.5 Location Cards

As previously mentioned, this category suite was inspired by the role of situational aspects in the use of technology by VIP found in Chapter 4. In a similar vein to previous

Figure 6.7: Examples of Location category cards

categories, past literature also informed the need for this set of cards (Williams et al., 2014; Yuan et al., 2017). Nonetheless, in order to maintain the deck of cards at a practical number, given the number defined, I made the decision to outline high-level instance cards for this category instead of exploring specific locations such as shops, public transport or restaurants. Moreover, and informed by the ethnographic study findings, I chose to define a card solely for Home. As described in 4.2.3, the mobility and environment practices of participants are remarkably different for them at home, as it is a setting highly configured to their own needs. Thus, they move more freely and confidently there than in other locations. I further used this notion of known and unknown places to develop the remaining cards.

In summary, this category consists of four location cards: Home, Known Places, Unknown Places and an empty card for other locations not included in these cards. This category is purple and associated with a star. Figure 6.7 shows three cards from this category. The remaining cards are included in Appendix E.5.

6.1.3 Making the Materials Accessible

Having established the rationale of the materials designed for the study, it is worth acknowledging the evident limitation of using these types of visual material (i.e., videos and cards) for activities with VIP. In the following, I describe how I aimed to mitigate it by providing accessible alternative formats and designing the structure of the study in consideration of such a limitation.

Firstly, it should be noted that VIP are known consumers of content in visual formats such as traditional films and television shows (American Foundation for the Blind, 1997; Ellis, 2015), and increasingly of images, photographs, and video resources on various internet platforms (Bennett et al., 2018; Seo & Jung, 2017). Whilst static image content requires the provision of alternative text descriptions for VIP to have access to the information or scenes depicted (dos Santos Marques et al., 2017; Stangl et al., 2020), video content that originally conveys information through audio provides an immediate initial layer of access for VIP (e.g., a person talking directly to the camera, a scene where two people or more are having a conversation). However, when the video material is conveying a scene or other information only in a visual modality, alternative provisions are needed; for instance, VIP can enable audio descriptions for some television programs and films that narrate whatever is being shown on the screen (Rohrbach et al., 2017). Similar options for internet content consist of providing audio captions and descriptions of the video materials (Liu et al., 2021). Thus, it was considered that both the video demonstrations and the design cards could be useful for design activities, as long as adequate alternative descriptions were provided to VIP.

Secondly, and before going into detail about the different formats I offered to the visually impaired participants, I wish to further elaborate on the reasoning for not exploring other materials in mediums beyond the audiovisual. Past work in accessibility research has extensively explored resources and modalities for prompting ideation and co-creation with VIP or mixed visual ability groups, such as audio and tactile mock-ups (e.g., Metatla et al., 2015) and objects with different textures and shapes (e.g., Morrison et al., 2017). Nonetheless, given the main objective of this study (i.e., bringing together VIP and non-VIP to discuss and reflect on technology, accessibility and VI), I took into consideration the pitfalls of activities in design that prompt non-disabled people to imagine or simulate having a VI, as I will discuss in Chapter 7. Hence, a key concern in the design of this study was maintaining the focus on awareness and reflection based on empirical evidence instead of prompting speculation enabled by putting oneself in the position of VIP. Therefore, the study approach defined sought to balance the use of these materials that are visual in nature and centring the participation and input of visually impaired participants. In order to do so, I turned my attention to ensuring accessibility of both the workshop activities and materials by following established guidelines for accessible format provision (European Blind Union, n.d.) and also reviewing the study plan with two known VIP.

The structure of the workshop (as will be described in 6.2) was defined with careful consideration of access provision to VIP and the practical constraints presented, given that the study had to take place online and there would be fewer opportunities for exploring the materials in an open-ended manner. Then, I opted for a 'linear' or sequential approach to the activities; that is, introducing the videos and cards to participants in a staggered way to ensure the attention of all attendees was focused on the same material throughout the session, which in turn would allow for the clarifying of any details unclear or inaccessible to VIP. For instance, the cards were presented category by category instead of all at once, and, within card categories, I went through each card reading the card title and, in some cases, the card description. A key point established in the study design is that accessibility of the materials is also strongly tied to the accessibility of the activities.

Textual descriptions of the video demonstrations and the design cards were produced in different digital and physical formats and were offered to visually impaired participants so they could choose the version(s) fitting best for their individual visual conditions and preferences. They consisted of descriptions of the activities depicted in the four video demonstrations and relevant contextual information to understand them and thorough accounts of the content and visual imagery portrayed in the design cards (see accessible materials available on `http://doi.org/10.17639/nott.7231`). The digital versions offered to participants were: 1) a PDF document including the cards in large print, 2) a Microsoft Word document using the recommended structure for accessibility (i.e., using built-in headings and sub-headings for easy access with screen readers), and 3) the tagged PDF version of the Word document optimised for screen readers.

Braille versions of such a document were requested and purchased from a professional transcription service.[1] Originally, the intention was to produce the physical cards and send them to participants, sticking Braille labels containing the card information on every card. Moreover, the visual design of the cards was defined by taking into consideration how to simultaneously provide the information through touch; for instance, a small Braille label at the bottom (e.g. 'Competency Card') and a texturised sticker in different shapes (e.g. circle, triangle, square, diamond, star) at the right bottom corner of each card indicating the type of card as a tactile equivalent to colour identification (see Figure 6.2). In the end, given the online medium and after consultation with the transcription service and personal contacts who are VIP, I decided to provide the textual description of the demos and the cards as a Braille document (i.e., comb-bound A4 pages). This format would enable easier access to the card information as opposed to having a full deck of 39 cards, especially as conducting this study remotely would not allow me to have better control of the study setting to facilitate the materials. Moreover, the intention was to make the activity less burdensome for VIP. However, note that Braille versions were only available to participants located within the UK and were provided to those who were happy to share a mailing address.

Lastly, subtitles were provided in the video demo clips, initially only for screen reader output that could be unintelligible for sighted participants. However, after the initial workshop sessions, the inclusion of full subtitles in all the video clips was provided, as recommended by participants who are non-native English speakers.

6.2 Study Approach

In total, eight online workshops were conducted with 17 participants with different visual abilities (i.e., blind, partially sighted, sighted)—2 or 3 participants per workshop. Sessions lasted approximately 90 minutes, and there was at least one participant with VI in each of them. Here I describe the study structure, participants' characteristics, study procedure and the data analysis.

[1] A2i Transcription Services – Accessible Formats and Document Transcription https://a2i.co.uk/

6.2.1 Workshop Structure

The workshops were structured so that the demos and cards were employed in conjunction by prompting and directing participants into conversations around accessibility and technologies used by VIP. Due to Covid-19 restrictions, the study was designed to be conducted online. Three pilot sessions with members of the Mixed Reality Lab research group were conducted to initially test the activities and materials. Additionally, known VIP contacts were consulted to improve the accessibility of the study (as described in 6.1.3). This feedback helped to shape and refine the structure herein described.

An overview of how the materials were linked together is shown in Figure 6.8 and described as follows. First, the participants were presented with the four video demos as options, from which they selected one or two video clips, depending on the time available. The demos selected were introduced, played, and described in case they were unclear. Participants were then prompted to discuss anything that caught their attention from the demos and how their experiences relate to or differ from those in the video clips. Then, cards were introduced per category. The initial two (Competencies and Tools) were introduced and used to reflect on the demos previously played (e.g., what competencies or tools were used, and what other tools could support the activities in the demos). Then, the remaining categories of cards were introduced (Activities, Relations, and Locations) to continue discussing other everyday activities by specifically selecting a new Activity card or continuing a topic from previous conversations. VI participants were given the option to share some of their personal experiences concerning the activity under discussion, and then all participants were asked to reflect on how technology plays a role in them (e.g., whether technology is used differently depending on the people or places involved).

6.2.2 Participants

Participants were recruited through known contacts from the previous study and my volunteering work, mailing lists, and social network platforms. As the aim was to bring a diverse mix of participants for each workshop, the call-for-participants was directed to people who were over 18 years old and 1) had a VI; 2) were accessibility researchers, stu-

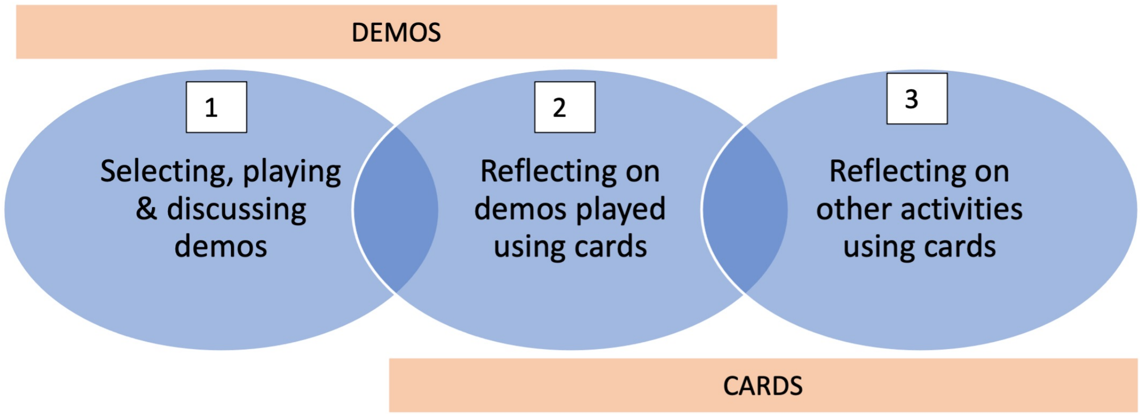


Figure 6.8: Materials and structure used in workshops

dents, or technologists; and/or 3) were researchers, students, or technologists not working in accessibility but were interested in the topic. I arranged sessions with small groups of 2-3 participants to foster deeper conversations, given the online medium. The only strict condition for arranging the sessions was that at least one visually impaired participant was to take part in each workshop. Participants were scheduled on a first-come, first-served basis on the dates of their preference; three workshops (W5, W6, and W7) were conducted with only VIP, as no sighted people were available for them. These sessions were considered potentially useful for learning about VIP's understanding and reactions to the materials, in addition to supporting accessibility awareness for sighted people. Given the disruption caused by the Covid-19 pandemic, a follow-up study at the local charity that facilitated the ethnographic study to present results to, and obtain feedback from, the same participants was not possible. Thus, this study could also serve the purpose of exploring whether the content of the design cards reflected the competencies, tools, activities, relations, and locations relevant to the experiences of participants with VI.

In total, 17 participants took part in the study: 8 blind, 3 partially sighted, 5 sighted and 1 stereo blind (not perceiving 3D); 6 women, 10 men and 1 non-binary person. Table 6.2 contains the list of participants, the workshop they attended, their occupation, visual condition as self-reported, country where they were located when they attended the online workshop, their nationality, and additional information shared. Note that for some participants only one country is listed, as it accounts for both their location and nationality. Participants' gender is not included in the table to add a layer of anonymisa-

Table 6.2: Details of participants in workshop study

P	W#	Occupation	Vision	Location/ Nationality	Other information
1	W1	Accessibility consultant	Sighted	UK	Autistic
2	W1	Psychology student	Partially sighted	UK	Tunnel vision
3	W1	Software developer	Sighted	UK/Spain	Implementing accessibility at work
4	W2	PhD student & occupational therapist	Sighted	UK	Not familiar with AT for VI
5	W2	Lawyer	Partially sighted	Ireland	No central vision
6	W3	Call centre agent	Blind	UK	-
7	W3	Lecturer & AT researcher	Sighted	Mexico	-
8	W4	Artist & trainer	Blind	UK	-
9	W4	UX researcher	Sighted	Argentina	Some knowledge of accessibility
10	W5	Software engineer	Blind	UK	IT event volunteer
11	W5	Retired worker	Blind	UK/India	IT trainer volunteer
12	W6	Retired civil servant	Partially sighted	UK	IT charity volunteer
13	W6	Sighted guiding organiser	Blind	UK	-
14	W7	Unemployed	Blind	UK	Hard of hearing & autistic
15	W7	Charity intervention worker	Blind	UK	-
16	W8	IT trainer	Blind	USA	-
17	W8	Researcher	Sighted	UK/Spain	Some knowledge of accessibility

tion for the non-binary participant (Scheuerman et al., 2020). For the same reason, the stereo-blind participant has been listed as sighted.

6.2.3 Procedure

The workshop study was approved by the School of Computer Science's ethics committee at the University of Nottingham and conducted entirely by myself. As mentioned before, due to Covid-19 restrictions at the time the study took place, it was conducted online. Participants' signed consent was gained before they took part in the study, and they were further reminded that the meeting was going to be recorded at the beginning of the sessions. The information sheet and consent form that were given to participants are in Appendix F. These documents were also produced and offered to participants in large-print and digital versions optimised for screen readers. Participants were given a £15 voucher as compensation.

As described in 6.1.3, aiming for a continuous commitment to ensuring access, visually impaired participants were provided with the materials before their scheduled session took place. Different formats and versions of the materials were offered to them. Furthermore, centring accessibility required flexibility in choosing online platforms and a window period of preparation; for instance, sending the digital documents in advance and allowing enough time to post Braille materials to participants that chose this format located in the UK. Participants were also prompted to suggest their preferred videoconferencing platform for the meeting, given that the accessibility settings vary across them and as such VIP can feel more comfortable with familiar tools. The 8 workshops were held online via Microsoft Teams, Zoom and Google Meets. Participants were also offered training and testing sessions with the platforms in preparation for the workshop; only P11 requested it.

Before the main activities described in 6.2.1 took place, I made clear to participants that the session was not meant for following a specific design, nor for collecting design ideas to turn into products, but rather for discussing the materials and personal experiences. Moreover, I shared some key principles such as not wanting to encourage the replacement of VIP or treating VIP as a spectacle. In the Discussion, I touch upon grappling with power imbalances in this research and elaborate on the different types of contributions by participants.

6.2.4 Data Analysis

The main data collected in this study were the audio-visual recordings of the workshop sessions; each lasted 90 min approximately. Additionally, I took supporting notes throughout. As described in 3.4.3, Reflexive Thematic Analysis (RTA) (Braun & Clarke, 2022) was employed as an approach to analyse the discussions prompted by the video demos and design cards and understand their potential usefulness for engaging people with mixed visual abilities in design conversations, or their lack thereof.

The systematic data analysis was practically conducted entirely by myself, but discussions with and guidance from my supervision team supported the process, especially in phases 4 and 5, related to reviewing and refining the themes. Once the results were written, I also received feedback on the manuscript to strengthen it. Data familiarisation occurred as I revised and corrected the automatically generated transcriptions (produced using Microsoft Stream) of all the workshop recordings while making brief notes about casual observations or analytical insights. Then, I systematically coded the dataset by myself.

As a reminder of my positionality in relation to this study topic, I am a sighted person, but at the time the study took place I had conducted research and volunteering activities with VIP, including taking part in sight loss awareness and sighted guide training. Moreover, as a non-disabled person who is informed and motivated by disability and accessibility work, I am aware of my position of difference and privilege in relation to VIP. Thus, I acknowledge that my understanding of some VIP's experiences was an inherent influence when conducting the thematic analysis. I was also aiming to keep as a key tenet that VIP are the experts of their own lived experiences. This was further facilitated by my ethnomethodological background and past work focusing on members' methods and interactional accomplishment, and my inclination towards not ascribing theoretical concepts to the data.

I analysed the data inductively; that is, no pre-defined codes or concepts were used in the coding. As I sought to understand what kind of discussions were provoked by the materials (i.e., videos and cards), using RTA allowed me to be exploratory at the beginning by capturing both semantic (i.e., at a surface or explicit level) and latent (i.e., at an underlying or implicit level) meanings in the coding. As the coding and generation of initial themes progressed recursively, I chose to focus on the semantic meaning, given the focus on conversations as they unfolded during the workshops. Moreover, I became interested in the *interactions* between participants prompted by the materials, and as such, the analysis became primarily interpretative of those interactions. Then, themes were reviewed and refined, each capturing a different type of interaction, with implications for what we can learn from using video demos and design cards and how we can integrate VIP and non-VIP in design discussions.

In employing RTA, I acknowledge that different themes could have been developed from the same data depending on the research interests and lens employed. It is important to note, then, that in this chapter I merely present results developed concerning participants' responses and reactions to the workshop materials.

6.2.4.1 Summary of Materials Selected by Participants

Before presenting the themes generated through RTA, I first provide a summary of the prevalent topics discussed across the 8 workshops to paint a broad picture of how the conversations unfolded. Although these revolved around the video demos and cards presented, I identified some common topics of interest. Table 6.3 shows the demos and activity cards selected for discussion by the participants in each workshop. Due to time and/or technical constraints, only one demo could be played and discussed in some workshops (W2, W3, W5) and no activity could be discussed in detail in W3.

Sighted participants were more prominently drawn to the demos concerning the use of mobile phones through VoiceOver and light detection (See Figure 6.1). They mostly expressed curiosity and interest to see the activities, as well as remarking on their unfamiliarity with them. In contrast, most of the participants with VI expressed their familiarity with many of these topics and expressed feeling comfortable discussing any of them. On some occasions, they indicated their desire to discuss specific subjects (e.g., In W5, personal challenges encountered when typing). Similarly, participants were drawn to four activities among the nine activity cards available: Going Out (W4, W5, and W7), Leisure (W2 and W6), Socialising (W1) and Shopping (W8).

Naturally, the specific demos and activities shown in Table 6.3 prompted conversations on related subjects. For example, the VoiceOver demo led to reflections on web and app design and accessibility, the light detection demo led to discussions about smart homes and IoT, and the 'Going Out' card led to discussions on navigation apps and the

Table 6.3: Materials discussed by participants in workshop sessions. Workshop column indicates the visual condition of participants attending each session: blind (B), partially sighted (PS), or sighted (S).

Topic Selected by Participants	**Material Type**	**W# (Participants)**
Using VoiceOver on mobile phone	Demo	W1 (PS, S, S) W2 (PS, S) W4 (B, S) W6 (B, PS)
Reading printed text with KNFB reader	Demo	W6 (B, PS) W7 (B, B) W8 (B, S)
Detecting light with Seeing AI	Demo	W1 (PS, S, S) W3 (B, S) W4 (B, S) W7 (B, B) W8 (B, S)
Sending a text message using VoiceOver	Demo	W5 (B, B)
Socialising	Activity Card	W1 (PS, S, S)
Leisure	Activity Card	W2 (PS, S) W6 (B, PS)
Going Out	Activity Card	W4 (B, S) W5 (B, B) W7 (B, B)
Shopping	Activity Card	W8 (B, S)

challenges of blind navigation. Interestingly, other topics ran across the workshops over different demos and activities. For example, the potential of voice assistants to do more to support a variety of everyday activities on the phone and at home, the potential of smart glasses and emerging technologies such as LIDAR for interpreting the visual world, and the tensions and trade-offs between the use of technologies and sighted assistance.

6.3 Interactions and Reflections in Response to the Materials

Through the thematic analysis conducted, I identified five types of interactions between participants in the workshop data: 1) Noticing and relating to particular experiences around VI, 2) Asking about and explaining the unfamiliar, 3) Requesting and giving technology advice, 4) Recognising and exchanging experiences in common, and 5) Adding nuance to technology use perceptions. In this section, I elaborate on and unpack each of these interactions. As a reminder, participants with and without visual impairments took part in some of the workshops (W1, W2, W3, W4 and W8), whereas only participants with VI took part in the remaining ones (W5, W6 and W7). Participants' visual condition is included in parentheses (B-blind, PS-partially sighted, S–sighted).

6.3.1 Noticing and Relating to Particular Experiences around Visual Impairment

An interaction triggered between participants across all workshops, regardless of their visual abilities, was participants noticing something of interest in the materials, either a new insight or a particular experience of their own. Expressions such as "interesting" and "curious" were used throughout the workshop study, mostly by sighted participants, regardless of their familiarity with accessibility topics. In some cases, they provided further insights and made explicit what was being learnt during the study; for example, in W4 a sighted and a blind participant share their thoughts after watching/listening to the VoiceOver demo:

> ***P9 (S):*** *Something I noticed, like a difference, is that we [sighted people] don't access the content in a linear way, however technology assumes it, it keeps reading (...) And the other thing is the impact that a minor change can have on a design, saying let's say Apple decides to regroup the options in a different way, change the screen. If you–*
>
> ***P8 (B):*** *((laughs))*
>
> ***P9 (S):*** *–already have users that rely on a certain logic, you will be affecting them more than able bodied individuals who can otherwise look randomly at any spot, and I hadn't realised that impact.*
>
> ***P8 (B):*** *Yeah, very perceptive, [P9 name], very perceptive. I remember they changed, I think between version 12 and 13 or something, and they completely changed the layout, didn't they? They (moved) some of the things to the bottom*

> *and how you moved messages and stuff like that, you have to learn a completely different way of doing it... So any minor changes in visual layout usually that help somebody that's sighted can often do the exact opposite for somebody that can't see...*

This exemplifies participants' insights generated by observing/listening to the VoiceOver demo on how information is presented in a different—linear—way to screen reader users and the consequences of system redesign it brings about. P9 mentions that the technology "keeps reading" the content, compared to strategies used by sighted users, presumably glancing and skimming. Moreover, P8 recaps that sometimes less friction for some users translates into problematic experiences for others. The above data example illustrates how participants collaboratively reflected on mainstream and assistive technology design and access of information by VIP, based on insights from the demo and related personal experiences. Here, I would also like to highlight P9's statement "and I hadn't realised that impact", a sentiment expressed similarly by other sighted participants and even a couple of participants with VI that were not familiar with the technology presented in the demos (e.g. "I actually haven't even realized that people could need that because I live with sighted people" P2 (PS) in response to the light detection app demo). There were other examples of participants collaboratively reflecting on the competencies employed by VIP in the demos, using the cards as aids; for example in W1 after playing the VoiceOver and the light detection app demos:

> ***P3 (S):*** *I think both have Auditory, because the first one was a screen reader and the second one used sound to let the user know that there was light.*
>
> ***P1 (S):*** *I'm not sure whether the Assistance card means from just from people (or whether) we see–– both of the videos, they are forms of self assistance, to use the screen reader and then to use the light detecting thing. Ways to help yourself.*
>
> ***P2 (PS):*** *And I guess the screen reader used the Tactile competency because you have to perform gestures and stuff and I don't think that the second one*

used that, but definitely the screen reader. And also I was saying Memory because you have to memorize what gestures to use and how to use them to perform this.

P1 (S):*The Spatial one was with the detecting light, 'cause it's about knowing where you are in. It helps to give you a mental picture of where you are in relation to the light sources. So it kind of gives you that awareness (of) 'wait OK I must be here so OK, so window's there and so I know that the fridge is here'. Yeah so it kind of gives you that, helps like orientate yourself in space.*

P3 (S): *We've been talking about negotiation before. I think you gave us the same example, or some people may need to change the speed of their voice [VoiceOver] to understand the message.*

Although some of the cards were more obvious (e.g. 'Auditory', 'Tactile') than others (e.g. 'Negotiation', 'Visibility'), engaging with the rest of the card categories, such as 'Relations', enabled participants to think about concepts that were less straightforward at the beginning; for example, participants across workshops reflected on the role of 'Close persons' and 'Strangers' as relevant factors in technology usage and further reflected on how visibility or negotiation come into play. An instance of that occurred later in W1, where participants talked about how technology use varies based on different kinds of people around:

P2 (PS): *I sometimes use my phone to take pictures of things and then zoom-in on them if I can't see something far away. But if I would be working with students from my class, I probably wouldn't do that. I would just, ignore it or try to see it myself, 'cause I guess with different types of people that fear of maybe not being liked.*

P3 (S): *Or maybe if you, if you are using a screen reader, and you are with close people, maybe you use the speakers on, but if you are surrounded by strangers, you may prefer to use headphones.*

This illustrates how the card contents engendered co-constructed reflections on social and situational factors influencing technology use. However, I also want to mention a few situations in which the approach failed to engage participants and encourage reflections as they could not relate to them or notice anything of interest. For example, in W3 both participants could not comment much about the light detection app demo. P6 (B) expressed not feeling the need to use technology when the light state can be checked by touching the light switch and P7 (S) agreed, stating that they had trouble imagining scenarios in which such an app could be used. Similarly, in W6 and W7, participants did not find anything new or interesting in the video demos, as they were all visually impaired and thus highly familiar with the activities demonstrated. Nevertheless, they provided some meta-commentaries about this being the case. For example in W7, P14-P15 thought that the demos and cards could be more useful for people who know little or nothing about the technologies and activities shown in them. P15 and P12-P13 also suggested existing websites or communities that produce and share a variety of demos (e.g. Blind Life) that could be potentially helpful for developers or designers wanting to learn about assistive technologies for blind people.

6.3.2 Asking About and Explaining the Unfamiliar

Exposing participants to the video demos and cards provoked an interaction common across three workshops with sighted and VIP (W2, W4 and W8) who had different levels of accessibility knowledge. In these, sighted people asked questions generated by engaging with the materials and their workshop partners promptly responded, without being explicitly indicated in advance to do so by the researcher. For example, in W2 the sighted participant had a series of questions about the VoiceOver demo that covered basic functionality and gesture standards across devices. The start of such a conversation is as follows:

> ***P4 (S):*** *I was just wondering how, how does it? How does it? Well, like, how do you access that? Is it software? Is it an app? How is it set up in that way?*
>
> ***P5 (PS):*** *Believe it or not, like with the iPhone, actually it's interesting because the iPhone and the VoiceOver, it's called VoiceOver, and it's actually*

built into the, it's actually built into the operating system itself. So, all you have to do is actually just turn it on and it– It's just there, it is, you know. And like–

P4 (S): *That's interesting 'cause I would have no idea that that was even there.*

P5 (PS): *Yeah, and you know there's a whole– I don't know if you're an iPhone user, [P4 name] or not, but, if you are, you would go to the settings menu on your phone and then you'd find, there's a setting called accessibility. And as an OT [occupational therapist] some of it would be very interesting possibly for you...*

The above example illustrates how the video demos provoked a series of basic questions by sighted participants, indicating their unfamiliarity with the technology. In this case, P5 not only answers in relation to the demo but goes further to provide details that could be useful to P4. I might wish to say that participants adopted—although certainly not in any formal sense—something akin to 'teaching' and 'learning' roles here. Similarly to this, there were other instances of sighted participants recognising something not familiar or understood by them and opened up to ask about it, with VIP jumping in to provide an explanatory account on the subject. These instances include questions provoked by the video demos such as VoiceOver origins (P4-P5), current capabilities of voice control instead of using VoiceOver gestures (P8-P9) and how blind people centre the phone camera to scan a document (P16-P17). Some questions were also occasioned by the cards, for example about specific technologies represented in the Tool cards such as 'Be My Eyes' app, covering what it is and how it works (P4-P5). Lastly, there were a couple of cases in which sighted participants asked about the terms or concepts used in the cards, for example, P3 (S) asked about the meaning of the 'Negotiation' card. To clarify it, I provided an example. Later on in the workshop, both P2 (PS) and P1 (S) expanded on that concept for the benefit of P3 (S), by explaining how sometimes they have to negotiate with friends going to specific locations depending on if these are loud or crowded, and this is consequently uncomfortable or inaccessible for them as partially sighted (P2) and autistic (P1) people.

6.3.3 Requesting and Giving Technology Advice

Having no opportunities to respond to questions or expand on insights by sighted participants, workshops with only VIP (W5, W6 and W7) enabled another type of interaction in which one of them explicitly asked the other for advice on specific technologies related to the ongoing conversation. For example, in W6 one participant takes the opportunity to ask for recommended apps for reading printed text after the related demo was played:

> ***P13 (B):*** *I'm actually looking into getting scanner software at the moment, so I was going to ask if [P12 name] got one.*
>
> ***P12 (PS):*** *I've got about 10 I've gathered over the past, since retired, so about seven or eight years. I started off with KNFB and progressed through different models. They all come at different prices. The latest one I got, the one I use most even for– I cook and things for myself, so they're good at reading what you've got labelled– is Voice Dream Scanner (...) And the other one– I have a selection of them but I try different ones. ((Mentions Eye-D, Envision AI, vOICe, Supersense)). But the one that does interest me, which I have to buy a new phone for, is something called Super Lidar, which uses the iPhone 12 pro technology. It actually gives you–– even measure with it and you can observe obstacles and things (...) But certainly, if you've got Voice Dream Scanner, it does most of the, most things like that.*

The request of P13 might be understood in relation to the increasing number of apps that support VIP in reading printed text or detecting objects—both human and AI powered—and as showcased by P12, the time required to try different options and get a general sense of what works for specific situations or personal preferences. Similarly to what P12 mentioned at the beginning ("I started off with KNFB and progressed through different models"), other VIP (P14, P15, P16) agreed that KNFB reader (i.e. the app showed in the video demo) is not one of the best options available, as other apps are more accurate or convenient. Moreover, I also noted that some VIP keep themselves up to date with the most recent technological innovations such as Lidar (Light detection and ranging) technology (P12, P15, P16). Participants mentioned how they learn about technology through the aforementioned websites and communities, but also charity organisations and friends. Other examples of requesting and giving technology advice include: P11 asking P10 about GPS apps and smartwatch functionality for navigating outdoors when talking about the 'Going Out' card and the various tools used for such activity, and P11 asking about the existence of services that allow a sighted person to remotely control their mobile phone for accessibility support. In addition, I noted instances in which advice was given without an explicit request based on the personal challenges shared in the discussion. For example, when talking about their mobility experiences when going out, P14 mentioned feeling uncomfortable or unsafe using the phone and earphones while walking as a hearing aid user. P15 promptly suggested known available earphones that are compatible with hearing aids, and advised to contact the Apple disability helpline to consult options.

6.3.4 Recognising and Exchanging Experiences in Common

On other occasions, the materials prompted instant recognition of experiences that participants found they had in common, and consequent expressions of agreement or comprehension, as well as opinions and feelings about them. This type of interaction occurred in three workshops (W4, W5 and W6). An example of it occurred in W5, as the two blind participants talk about the shortcomings of using Siri for communicating with others via text message or phone calls, after playing the related video demo (i.e. Sending a text message using VoiceOver):

> ***P11 (B):*** *Another thing I found with Siri, sometimes when you got a missed call, I say "what are the last missed calls?" and say "repeat to me who the last missed call was from?" and she's like "would you like me to call?" and I say yes or no, but occasionally doesn't ask and it calls the person, and I don't want to do that, I want to check before I call.*
>
> ***P10 (B):*** *Yeah! and that's–*

> ***P11 (B):*** *Did you find that [P10 name]?*
>
> ***P10 (B):*** *Yeah, and that's one of the main reasons I don't use Siri that much, 'cause I'll just get super embarrassed if it calls someone, even if I manage to hang up in time. I find if a piece of technology does something that I don't want it to do, it's a bad thing.*
>
> ***P11 (B):*** *That's right. And then even if you manage to come out of it, they will call you back because you–– they will find you called them.*
>
> ***P10 (B):*** *Yeah, and then it sort of damages people's expectations around your abilities. Cause they're like "oh he can't use a phone", but it's not like I can't use a phone, is that the phone isn't working properly. And to be honest, all it took was a couple of times of Siri doing that for me to sort of stop using it as much as I was before. I don't take the chance.*

Although seemingly convenient for VIP, Siri and similar voice assistants have limitations, such as inconsistently asking for confirmation of the actions to be performed. Most likely, the confirmation message or the action underway are communicated visually and can be detected and corrected straightaway by sighted individuals. By contrast, screen reader users would take more time to identify and stop the same event triggered by Siri. P10-P11 empathise with each other and together expand on the social implications of Siri calling someone when they have not instructed it to do so, even if they are able to correct the mistake. Along those lines, other participants (P5, P8-P9, P12-P13) talked about the shortcomings of existing voice technologies, such as inaccuracy, poor recognition of a variety of accents and the awkwardness of using a wake word for every intent, which in sum have caused lessened use. Other instances of recognising and exchanging experiences in common include participants identifying tools that have provided very good services to them such as the 'Be My Eyes' app (P10-P11, P12-P13) or recalling the variety of mainstream and assistive devices used throughout the years (P12-P13). I also observed some instances of participants reflecting on their own competencies used in specific activities such as 'Going Out' and agreeing on the personal and cultural perceptions of showing or hiding their impairment in public spaces (P10-P11).

6.3.5 Adding Nuance to Technology Use Perceptions

A last type of interaction driven by the materials, particular to W7 and W8, consisted of participants providing contrasting or opposing accounts of them, so that different or diverse perspectives of technology use were showcased. For example, in W8, the participant with VI reflects on the practicalities and assumptions of the ideas suggested by the sighted participant after watching the light detection app demo:

> ***P17 (S):*** *I found it interesting how light was mapped into sounds. I was also wondering whether that's the most effective way of monitoring the state of lights in your house, or rather having something in your sockets or in the devices themselves that is connected to your smartphone and then tells you "Hey, you've got these lights switched ON and these ones are switched OFF" and maybe being able to, either knowing which lights are switched ON or OFF, or also being able to turn ON and OFF from the smartphone app (...)*
>
> ***P16 (B):*** *The thing with what you're describing is it would require some other hardware solutions that would have to be custom made, right? I'm not sure they would really benefit a lot of other people. Whereas those light detector apps, that's exactly their purpose, and it's a very necessary thing for a blind person. We can turn the lights ON and OFF. We don't have a problem with that, but we don't know if they're ON in the first place.*

P17's insights provoked by the demo are similar to those in section 6.3.1, i.e. noticing the functionality of the technology. In this interaction, however, P16 did not relate to or agree with P17's suggestions. Rather, P16 provided a sceptical account of the speculative comment, indicating the cost-benefit and the actual need. Later on in the workshop, P17 incorporated this reflection into a comment responding to what other 'Tools' can be used to support the activity showed in the demo: *"Smartphones and homes equipped with Internet of Things devices, but again, like I mentioned before, whether these are the most practical or cost-effective devices, I don't know"*. Similarly, they discussed the cost-benefit of adaptive touchscreens that conveyed visual information by tactile modality, that is, that the elements on a website or app could be felt by touch (P16-P17). Another instance of participants providing contrasting perspectives on technology use occurred when P14-P15 discussed their personal experiences when ‘Going Out’. P15 shared highly positive comments about using professional video-mediated sighted assistance via the Aira app[2] for navigation outdoors and P14 responded with concerns about confidence, safety and privacy in using technology for navigation. Likewise, they talked about the importance of finding balance between sighted assistance and maintaining independence when using their technology.

6.4 Contributions

In this chapter, I have outlined five types of interactions between participants occurring in response to the video demonstrations and reflective design cards presented to them: noticing and relating to particular experiences around VI; asking about and explaining the unfamiliar; requesting and giving technology advice; recognising and exchanging experiences in common; and adding nuance to technology use perceptions. By analysing exemplars of those interactions, I have detailed various reflections produced collaboratively by the participants, which I will summarise in this section. In doing so, I will also discuss the main contribution of this chapter; that is, the design critique approach in the form of an online workshop and its corresponding materials. Further, I will provide some practical lessons learned from its implementation. In the Discussion, I will critically reflect on the broader implications of this study in relation to the fields where it is situated and its limitations.

6.4.1 Supporting Awareness and Shared Understanding of Visual Impairments through Collaborative Reflection

In this study, I designed and implemented a workshop approach for bringing together people with different visual abilities. Through providing supporting tools in the form of

[2] https://aira.io/

video demos of technology and reflective design cards of VIP's experiences, I encouraged them to think and converse with each other about technology, accessibility, and VI. In analysing their insights and interactions, I found meaningful outcomes from employing this approach, which I outline next.

Firstly, the reflections provided by participants from engaging with the workshop materials and with each other demonstrate that **accessibility gets framed as a dynamic matter**. The different types of insights shared, regardless of how new or familiar they were to participants, covered **functional, social, and situational factors in technology use as VIP**. For instance, how information is communicated in a linear way through screen readers and thus the impact of even small changes in the design layout (functional), the impact on the perception of one's abilities by others when a voice-assistant calls someone by accident (social), and how technology is employed differently depending on the people around or the location they are in (situational). From this, accessibility was able to be conceptualised more as a complex and continuously changing phenomenon, rather than a static status (Bennet et al., 2020). Given that the focus of this exercise was on reflection rather than ideating new concepts, some of the participants' reflections touched upon the role of design, designers, and companies in making technology accessible and inclusive for disabled people. On occasion, VIP pushed back on design speculations or isolated accounts that did not seem practical or attainable to them, as noted in participatory work conducted with other underserved populations (Harrington et al., 2019); for example, considering the cost-effectiveness of implementing IoT technologies at home, or considering personal characteristics and feelings towards using a mobile phone for outdoor navigation.

Secondly, the insights of non-VIP ranged from learning how VIP use common technologies, most of which were new to them, to considering the source, impact, and challenges of inaccessible design. Many of these insights collected in the workshops can be arguably **obvious information for specialist researchers and users**, as evidenced by P8's laugh in response to P9's hypothetical scenario, and by the failure of the materials to prompt new perspectives in W3 that included P7, an experienced AT researcher. Nonetheless, these were **new insights for the rest of non-VIP doing design and research professionally**. I see this as an indication of how little they know about VIP and the tools they use in their everyday lives, even though a few sighted participants reported having some knowledge of accessibility. Herein, I argue that the value of the approach presented in this chapter lies in how it engenders such reflections provoked and guided by the materials and the expert contribution of VIP. No matter how well-known this information is in specialist domains, for unfamiliar audiences it is experienced as new knowledge.

Third, and related to the previous point, I found that it was the sighted participants or the less experienced visually impaired participant who primarily engaged in such reflections by noticing and bringing up aspects of AT use they had just learnt or found interesting. Supported by the companion VIP in their workshop session, those initial insights were further developed. I found that the use of video demos acted as an introductory piece for non-disabled and less familiar participants **unlocking their interactions** with the VIP and allowing them to be open about the subjects not known, no matter how simple or basic their questions were. Moreover, the use of the cards allowed for a **deeper reading into the topic discussed, often produced collaboratively**, as is common in focus group engagements. While the video demos were appreciated as *"enlightening"* (P4) by some and highly commonplace to others, the cards were helpful to *"add layers of context"* (P9) and *"make you think"* (P12). Notably, the cards were useful to convey key ideas that might be well known in disability communities and theory but were unheard of or not considered before by some participants (i.e. Negotiation, Visibility).

Lastly, I further found that VIP consistently positioned themselves and each other as **expert actors** (Abdolrahmani et al., 2020), both in the **workshop sessions and within their communities**. That is, within the study, they adopted a 'teaching' role towards sighted participants who had questions they could answer, gave advice to the other visually impaired participant, and shared their experiences and perspectives as a recognised common account or in contrast to simplistic perspectives. Outside of the workshop session, several VIP highlighted their own expertise and occupations as trainers and supporters of other VIP in communities and close circles. They further emphasised the existing 'demo culture' in those groups, including online spaces created by and for VIP, from which they regularly consume, learn, and share content, as mentioned in Chapter 2.

6.4.2 Practical Lessons from Conducting Online Workshops

Although the core materials of this study are by their nature less accessible to VIP (as discussed in 6.1.3), I found them highly informative to sighted participants. To address that information gap, I provided detailed textual descriptions of the videos and cards before the workshops took place, and then recapped and clarified the content during the session. However, a few participants expressed that the audio of some video demos was not entirely clear, specifically those clips in which phones or screen readers are reading information aloud in the background. In such cases, I clarified the spoken words and described in detail the indistinct parts.

Likewise, although I made sure to read aloud and remind participants of the content of the cards, I found that many participants, both sighted and visually impaired, had trouble keeping track of the previous card categories as the sessions went on. As such, the participants who had at hand the card descriptions provided before the session, either in Braille or digital versions, engaged more actively with them.

Moreover, although most of the workshop sessions ran smoothly, there were technical issues in a couple of them, as can be the case with online activities; for instance, in the video demos not being reproduced correctly through the online meetings or with participants disconnecting momentarily from the meetings due to Internet issues. In one case, this further caused the workshop to be not as fruitful for reflection as the rest, noting that participants struggled to relate to the topics provided, and thus had less engagement with each other (i.e., in W3).

Challenges during planning also occurred, for example, having to forego the University of Nottingham's recommended video conferencing platform (i.e., Microsoft Teams) in favour of other platforms that were not only accessible but preferred by VIP. Likewise, visually impaired participants using screen readers were concerned that these were not disruptive to the meeting, thus using a different audio output for them or enabling/disabling the feature as needed. However, due to my remote location, I obtained very little insight into such arrangements and practices. Notably, the participants in this study needed a minimum degree of digital literacy to join it.

Together, these practical lessons obtained through conducting the workshop study online help to inform direct recommendations and suggestions for future work wishing to adopt similar approaches or materials. I offer such guidance as part of the *Competencies Framework of Visual Impairments* described in the next chapter.

Chapter 7

Discussion

In this chapter, I will return to the research questions established in the Introduction of this thesis, and answer them in light of and through the empirical work conducted. The overarching question pursued in this research is:

- RQ. How can the participation, knowledge, and experiences of VIP be integrated in early stages of technology design?

To answer RQ, the following two sequential sub-questions were also posed:

- RQa. How do VIP use technology in their everyday lives and what are the interactional competencies they employ?
- RQb. How can the findings from empirical work be used to motivate new practical ways to approach research and design with VIP?

In order to address these questions, I first turned to investigate the technologies used by VIP in their everyday lives. Through ethnomethodologically-informed ethnography I unpacked *how* they are used *interactionally*, thus uncovering sets of competencies exhibited by VIP. By means of such an investigation, I identified technology demonstrations by participants captured during fieldwork as a pervasive and relevant phenomenon that helped me to gain insight into VIP's world, and therefore I further analysed them in fine-grained detail. Then, I used the findings from the empirical work to develop a design critique approach and its accompanying materials consisting of a set of video demonstrations of

Table 7.1: List of contributions of this thesis and contribution types

Thesis Contribution	Contribution Type
A. Detailed accounts of everyday technology practices and interactional competencies of VIP.	Empirical
B. Methodical examination of empirical demonstrations.	Methodological
C. Design and implementation of a design critique approach for supporting awareness and shared understanding of VI, including a deck of reflective design cards and video demos as forming materials.	Artifact, Methodological, Empirical
D. Competencies Framework of Visual Impairments.	Conceptual

technology from the ethnographic corpus and a deck of reflective design cards. When the approach and materials were implemented, this brought together VIP and non-VIP from different technology backgrounds to answer the main research question.

In the following, I will discuss the above contributions presented in this thesis, situating them within and along past work in accessibility and HCI research. Specifically, the thesis offers empirical, methodological, and conceptual contributions, as shown in Table 7.1 and elaborated on in this chapter.

7.1 Detailed Practices and Competencies of Visually Impaired People

This thesis is not the first to investigate the technology practices of VIP. However, although a range of assistive and mainstream tools employed by this population has been long researched and designed, as reviewed in Chapter 2, this thesis provides unique, thoroughly detailed accounts of some of their core everyday technology practices. Certainly, this would appear to be the first study to unpack in fine-grained detail *how* those practices are accomplished, and moreover, the first to ascertain the *interactional and situated competencies* enabling them. In this section, I discuss this contribution alongside and in contrast to existing work focused on understanding technology use by VIP. Moreover, I discuss how past accessibility research has considered and conceptualised the abilities of VIP. In doing so, I argue that VI continue to be understood or assumed as a deficit in technology design, as others have recently pointed out from a broader disability perspective

(Williams et al., 2021; Wu, 2021).

7.1.1 Current Practices are Overlooked and Mundane Members' Methods are Missed Out

Overall, the high-level findings presented in Chapter 4 are consistent with the literature: primarily, that many VIP are regular or expert users of various devices including smartphones (Ye et al., 2014; Rodrigues et al., 2015; Khan & Khusro, 2021; Kim et al., 2016), computers (Szpiro et al., 2016; Wahidin et al., 2018), smart speakers (Pradhan et al., 2018; Storer et al., 2020), electronic readers (Danielsen et al., 2011), Braille and other specialised hardware (Guerreiro et al., 2013; Hynes et al., 2019), and a range of magnifiers (Hanumara et al., 2017; Szpiro et al., 2016). Moreover, accessibility features aiding the use of such devices were also observed in practice, such as large font-size, screen colour-inversion, and screen readers (Evans & Blenkhorn, 2008; Smaradottir et al., 2018). Through the ethnographic fieldwork conducted, I identified three main practices in which those technologies feature within the daily lives of VIP: social relations and communication, textual reading, and mobility and environment practices. These, however, often overlap each other and are in some cases strictly related to specific devices (e.g., smartphones for communication) or other related activities not explored in detail in this thesis (e.g., online information seeking). As such, the practices I identified and analysed have been previously explored in accessibility research to different extents, either directly, such as reading practices of VIP (Neat et al., 2019; Storer & Branham, 2019), or indirectly, such as touchscreen typing performance (Nicolau et al., 2015), commonly used for communicating with others via emails or text messages as shown in the data fragments.

More specifically, the instances unpacked in Chapter 4 shed light on three different ways in which VIP compose and send text messages (i.e., via the voice assistant, typing using the screen reader, and through dictation), various methods employed for reading (i.e., using large-print, Braille and other dedicated devices, an electronic magnifier and an Optical Character Recognition mobile app), and some exemplars of mobility and environment detection (i.e., getting colour information via Optical Character Recognition app, moving inside the home through specific space arrangements, booking a taxi using a mobile app and taking the dog for a walk without technological aid). It could be argued that some of these technology-use instances are too basic or ordinary and are not worthy of deeper examination as they might be already widely known and understood within the field. A pressing question, then, would be: what is found through these thoroughly detailed accounts that provide new insights to accessibility researchers and designers? The analysis conducted in this thesis provides evidence of two intertwined key arguments: that *current* everyday technology practices of VIP are oftentimes overlooked, and that some crucial VIP's methods employed in their *actual* practical accomplishments are missed out by research and design.

Firstly, in situating this thesis' findings within the wider context, I found that although the high-level topics explored in Chapter 4 are evidently researched in Accessible Computing at large, explorations of specific *current* everyday use are far less common than systematic usability evaluations (Babu et al., 2010; Fukuda et al., 2005; Gonçalves et al., 2018; Smaradottir et al., 2018; Wentz & Lazar, 2011) or experimental measurements of performance and accuracy (Grussenmeyer & Folmer, 2017; Kane et al., 2011; Neat et al., 2019; Shair et al., 2010). Further, empirical investigations are commonly formative, i.e., heavily tied to informing the design of specific prototypes, and thus they tend to be short and focused on producing direct user requirements (Brulé et al., 2020). Even within qualitative investigations of existing technology use, reflective accounts are mostly favoured through the use of interviews over observations of actual practices (Mack et al., 2021). Naturally, a persistent challenge encountered is how to capture actual use *in-the-wild* without compromising validity, which would explain why controlled studies in the laboratory are standard practice. Nonetheless, the need for understanding VIP in the real world is increasingly sought through mixed-method approaches capturing both experimental tasks in the lab and logged device interactions over given periods of time (Nicolau et al., 2015; Rodrigues et al., 2020).

Secondly, although quantitatively capturing input interactions of VIP with devices (e.g., areas where participants touched the screen, gestures performed and time taken) can be

Figure 7.1: Comparison of finger configuration for performing the rotor gesture on iPhone. Left: Suggested finger configuration by Apple. From: `https://support.apple.com/en-gb/HT204783`, last accessed in November 2021.). Right: Gesture as performed by P5 in Fragment 4.2b.

informative about their real-world use, here I argue that their physical and embodied accomplishment *in the world* tends to be missed out by those investigations. Take for instance Fragment 4.2b, in which P5 makes use of VoiceOver's 'rotor' feature in her iPhone. Although the instructed way of performing such a gesture is to *"rotate two fingers as if turning a dial"* and to *"keep rotating them to hear more options"* [1], P5 employs a completely different strategy by using her two hands and performing simultaneous flicks in opposite directions with two fingers. Figure 7.1 shows the comparison between instructed finger configuration for the gesture and P5's actual gesture performance. This example resembles the characteristic design critique of instructed plans against situated actions (Suchman, 2007).

Notably, whilst P5 proficiently interacted with the rotor in a matter of seconds, the literature on gesture performance by VIP has consistently found that users struggle to use such a feature (Buzzi et al., 2017; Ernst et al., 2017; Rodrigues et al., 2020). VoiceOver and similar alternatives are the quintessential assistive technology for VIP in current times, yet, strikingly, the physical and embodied ways in which VIP execute touchscreen gestures would seem to not be investigated or documented in the same prominence that other factors are attended to, such as attitudes, preferences, performance, and accuracy. In other words, the emphasis is put on the gestures and their outcomes, rather than how these are

[1] About the VoiceOver rotor on iPhone, iPad and iPod touch `https://support.apple.com/en-gb/HT204783`

brought to bear. Moreover, since the release of VoiceOver for mobile devices, a particular strand of literature has put efforts into eliciting *new* gestures (Vatavu & Vanderdonckt, 2020). Despite intending to improve the user experience for VIP, this strand tends to dismiss existing practices and methods in favour of introducing and evaluating new sets of gestures that could be easier for VIP.

In a similar vein, a great deal of research in Accessible Computing has a strong interest in developing and evaluating computer vision (CV) and artificial intelligence (AI) applications for recognising visual information and conveying it to VIP (Bhowmick & Hazarika, 2017). However, the research emphasis tends to reside on the technical side of these applications (Massiceti et al., 2021); that is, how to improve the recognition, how to better train the machine learning algorithms, and how to process pictures taken by VIP that are commonly blurry, unfocused, or incomplete. Whilst sociotechnical factors such as privacy concerns and ethical considerations in automated recognition of people (Sadjo et al., 2021) have also been investigated, again, *how* the practices employing those CV and AI-infused apps are accomplished *materially* is broadly overlooked. Two data fragments unpacked in this thesis shed light in that regard. Both Fragment 4.6 and Fragment 5.2 present specific bodily (e.g., spatial exploration, elbows on the table) and configuration (e.g., using a custom made shelf) methods employed by participants that enable them to scan a tin label and a printed document respectively. These findings are difficult to situate within the existing literature, as it would appear that no previous studies have been conducted specifically analysing the material, embodied, or physical methods employed for using CV and AI-infused mobile apps for visual recognition. Moreover, I suggest that even looking at low-tech device use in fine-grained detail could be beneficial to strengthen the understanding of scanning practices; for instance, the tactile and spatial methods exhibited in using a portable electronic magnifier in Fragment 4.5.

Lastly, the work in this thesis invests meaning and significance in the everyday life of VIP. The analysis of participants' technology practices revealed the importance of personal configurations and adaptations that make their everyday activities possible; for instance, all the home arrangements and customisation of objects around that enable their movement in the setting and interaction with elements in it, as shown in Fragments 4.4c, 4.6, 4.8, 5.1, and 5.3. Although these adaptations are widely known in disability communities (Jackson, 2018), more work is needed to document the myriad of resources and strategies employed by VIP from a perspective of recognition of creativity and resilience (Bennet et al., 2019; Branham & Kane, 2015a), instead of only locating them in relation to access issues in need of technological intervention (Shew, 2020).

Caught in-between constantly having to 'patch-up' inaccessible products and environments, and striving for innovation (as reviewed in Chapter 2), Accessible Computing Research misses out *how* VIP conduct a range of practices. My argument here is that existing practices of VIP–with and without technology–must be taken into serious consideration before moving toward introducing new interaction techniques and modalities that disrupt the currently established ways VIP have of being in the world (Hamraie & Fritsch, 2019; Kafer, 2013).

7.1.2 Who Takes Visually Impaired Competencies for Granted?

It is a common belief that the absence of a sense produces further development of other senses (e.g. blind people heavily rely on their hearing sense). More specifically, within accessibility research, there has been a longstanding argument for using the special skills of 'extra-ordinary' people (Newell & Gregor, 1999) in mainstream technology design. Nevertheless, this can unintentionally exoticise disabled people at the expense of understanding what constitutes 'normal' or regular activities for them. Moreover, research often fails to centre those special skills as the main focus of investigation or documentation. When emphasis resides on locating barriers and developing technological solutions to remove them, there is a risk of overlooking people's current practices, as I have already argued in this chapter. However, this in turn may cause people's abilities to go unheeded too. While past research has further investigated social and material workarounds providing noteworthy accounts of them (Bennett et al., 2019; Branham & Kane, 2015b; Kane et al., 2009; Shinohara & Tenenberg, 2007; Shinohara & Wobbrock, 2011; Thieme et al., 2018), the present thesis adds to this body of knowledge by delivering more explicit and detailed instances not often found in accessibility research. Furthermore, the main contribution lies in the stance towards recognising and uncovering competency in disability by centring the emphasis on 'what people can do', a core component of the ability-based design framework (Wobbrock et al., 2011), which has been an influential baseline for considerable accessibility research. Nevertheless, specifics of what those abilities can be are not provided, as the authors only outline seven principles to orient designers towards moving the burden of adaptation from the user to the system. Thus, projects using this framework or similar tend to ascertain ability in terms of performance, accuracy, and speed (Persad et al., 2007; Kane et al., 2008), as I previously hinted at. While such a tendency is highly valuable for improving interaction techniques and automatically adapting systems to users' functional abilities, a broader consideration of the abilities of VIP is missing. Moreover, they do not include other elements, individual (e.g., personal attitudes) and external (e.g., social situation), that also play an important role in the adoption and use of technologies (Shinohara & Wobbrock, 2016).

The work in this thesis aligns with recent work exploring design around VIP's *sensory knowledge* (Brulé & Bailly, 2018) and adds to a recent call for reorienting the design practice by taking advantage of the existing multisensory and embodied capabilities of people with disabilities (Bandukda et al., 2021), as opposed to concentrating efforts towards sensory substitution, which accounts for a substantive trend and projected future direction in technology design for VI (Bhowmick & Hazarika, 2017). A notable example of this is Brulé & Bailly's work (2018) developing tools that exploit ambient sounds to be used in geography lessons in mixed visual ability classrooms, in contrast to the myriad of tools aimed at translating visual imagery into auditory or haptic feedback (Olivetti et al., 2009). The difference may be considered subtle at first, but here I argue that explicitly highlighting VIP's existing capabilities, abilities, knowledge, or competencies, can be fruitful in deepening such a distinction. This, I suggest, is profoundly needed, as sensory substitution continues to pose vision as the ultimate guiding goal, whether inadvertently or not. In such a way, future design efforts could align more with what people already do, rather than proposing and designing new practices that require VIP to adapt their competencies to them.

This contribution asserting VIP's competencies is deliberately explicit, in contrast to general guidelines and precepts that ask to recognise and centre people's abilities but fail to provide more direct instruction on what those are or how to identify them. Drawing on an ethnomethodological tradition for outlining those competencies of VIP, I provide a complementary approach to current frameworks and paradigms in the field that could help to obtain a richer understanding of VIP's experiences in their everyday activities and how these are practically achieved. Naturally, and as discussed in 4.3.1 (see all competencies in Table 4.2), previous work has addressed and engaged with the competencies herein unearthed to different extents; for example, by designing and evaluating prototypes that make use of them. However, to the best of my knowledge, the few attempts to characterise and construct the spectrum of human abilities only comprise sensory and cognitive layers (Persad et al., 2007). The present research would appear to be the first in articulating VIP's abilities and the methods employed in their everyday lives in terms of competencies. Moreover, the competencies I have ascertained were unpacked (i.e., observed and reported) from empirical data rather than emerging from theoretical or computational models. Seen another way, it could be argued that I have used empirical data as a tool to communicate my understanding of VIP's competencies. The present contribution also aligns with recent calls to consider AT embeddedness in society (Branham et al., 2018; Kameswaran et al., 2018; Shinohara & Wobbrock, 2016), and thus, I present an understanding of competency in disability that comprises functional, social, and adaptation levels. Determining abilities in this way can help to extend or support people's current abilities (competencies) rather than substituting or obstructing them through the use and development of technological aids (Thieme et al., 2018). By emphasising competencies, designers and researchers can then be sensitised to them, providing a lens for rethinking their design practice. I suggest awareness of these competencies could be used as another starting point for future work that explores how they are comprised, obtained, or developed, and how they could be supported or expanded.

Furthermore, I wish to acknowledge that, certainly, for many experienced accessibility researchers, the competencies identified in this thesis might not be earth-shatteringly novel. Nonetheless, they are seldom found in the literature as an explicit outcome of the research or as a specific resource for design (other than the quintessential auditory-tactile dyad for system input and output). I suggest that accessibility researchers might take these competencies for granted, in much the same sense that any member of a particular group can become so familiar and proficient with their own mundane actions and interactions that these pass to the background and go unnoticed and unremarked-upon (Garfinkel, 1967). It is worth stressing that I am not implying that researchers and designers whose expertise has been built around VI do not care or not know about the competencies of VIP, but quite the opposite. As I discussed in Chapter 3, my research approach entailed developing vulgar competency in the study topic and in the members of the group of interest, for which I had to orient a particular ethnomethodological analytical sensibility. However, for seasoned researchers and designers in the field, vulgar competency in VI is an inherent occurrence from deeply engaging with VIP over the years. Thus, my argument builds upon Garfinkel and colleagues' work (1981) challenging formal scientific methods and reports of outcomes as fundamentally *incomplete*; that is, much of the empirical knowledge gained through interacting with and researching VIP is missed in formal scientific papers and articles.

The empirical results presented in this thesis are offered as a step forward in documenting some of this tacit knowledge of visually impaired 'mundanity'. I believe doing just that is essential to the advancement of accessibility for VIP, as despite increasing commitment to the lived experience of disabled people (Hofmann et al., 2020; Thieme et al., 2018; Shinohara & Tenenberg, 2007), recognition and respect of their abilities (Bandukda et al., 2021; Wobbrock et al., 2011), and development of deep relationships with them (Kane et al., 2014; Williams et al., 2021), these practices are not standard in Accessible Computing or HCI at large. More specifically, several strands of related scholarship are often merely concerned with the technical aspects of assistive technologies and, as such, have a minimum or superficial engagement with end-users. Therefore, I believe it is crucial to communicate VIP's competencies across and beyond fields, for both less human-centred or socially-oriented areas and newcomers to accessibility. To that end, the resulting publication of this thesis (Reyes-Cruz et al., 2020) can act as an example of a primer report on the technologies used by VIP, how they do it, and the core competencies enabling them. Likewise, it can be seen as a kind of handbook for a style of approach or disposition towards studies of disability in accessibility research.

7.2 Foregrounding the Value of Empirical Demonstrations

Technology demos have had cultural significance in Computer Science and HCI (e.g., 'the Mother of All Demos', n.d.) as mediums for communicating and exhibiting the capabilities of newly designed systems. However, research-based demonstrations, in which *users* showcase and explain tools or activities that are part of their daily routines, had not been considered a methodological object worthy of examination despite being part and parcel of empirical HCI research. This thesis represents the first academic effort to study demonstrations conducted by research participants collected during empirical fieldwork, more specifically, when demonstrators are VIP. Therefore, the work in this thesis produces novel insights on the features and composition of demonstrations, as summarised in 5.3.1. Building upon the research I conducted, in this section, I discuss the value and implications of demonstrations as part of the methodological toolset for HCI and accessibility researchers, as signified by demonstrations' occurrence or even pervasiveness in other data collection methods, such as home tours, ethnographic fieldwork and observational research.

7.2.1 Members' Methods within Research Methods

Demonstrations in this thesis are a finding that 'fell out' from the initial research. As the video data collected during fieldwork was found replete with demonstrations, repeatedly and motivatedly performed by me and the participants in a co-constructive work in building 'research data' that helped me to make sense of VIP's world, the focus of the second investigation was on understanding what makes demonstrations recognisably demonstrations in the research site. This finding particularly draws from Garfinkel's work analysing the taken-for-granted practices underpinning research methods that are routinely ignored in formal methodological accounts. In their analysis of an audiotape of the work of a group of astronomers the night they discovered a 'pulsar' (i.e. a transcendent astronomical object that exists independently of particular observers), Garfinkel et al. (1981) observed that such an achievement was made through a series of intersubjective efforts of verification, gradually evolving from the identification of a vague object to its confirmation as a pulsar. However, when the astronomers reported their scientific discovery, they did it in terms of numerical collections of their observations and measurements, rather than the actual methodical ways (i.e., members' methods) in which they discovered the object. As Crabtree et al. (2012) put it:

> *"Scientific methods everywhere, be it in social science research, astronomy, biology, mathematics, medicine, etc., are intertwined with and rely upon members' methods for their accomplishment, yet the latter are rarely attended to even when a setting's member make enquiries into the organisation of their work and its conduct."* (Crabtree et al., 2012, pp. 73)

The work presented in Chapter 5, then, enhances the understanding of demonstrations as practical accomplishments of participants and researchers within research engagements and addresses the gap in the literature in which demonstrations in empirical research and their methodical practice are often overlooked or unremarked upon. By focusing on the methods employed by members for demonstrating in the course of producing data for the ethnographic investigation, the value of demonstrations for empirical HCI and accessibility research is foregrounded, serving as a basis for reflecting upon and discussing their practical and ethical implications. These are discussed next.

7.2.2 Revealing Caveats and Opportunities of Employing Demonstrations

The close examination of naturally emerging demonstrations performed by participants in the course of the ethnographic fieldwork (i.e., a members' method), shed light on the use of demonstrations as a practical method for collecting data (i.e., a research method). The analysis conducted in Chapter 5 has highlighted *just what* makes particular practices recognisable as demonstrations (i.e., showing, using, simulating, staging, checking upon and providing accounts to the onlooker, and producing intersubjective shared understanding). In turn, this has served to cultivate a richer understanding of the limitations, ethical considerations, opportunities, and consequences of conducting demonstrations as a research instrument, which I discuss next.

Practical limitations

Inevitably, there were cases during fieldwork in which the tools or activities **could not be demonstrated** because of practical purposes (e.g., GPS for navigation, taxi booking app), technology not working (e.g., disconnected internet/WiFi) or for privacy reasons (e.g., banking app). Alternatives had to be employed, taking the form of partial demonstrations (e.g., only showing the home page of the taxi booking app, without actually requesting the taxi, in Fragment 4.9) coupled with verbalised accounts or made entirely in this latter modality. Thus, the practical limitations of demonstrating the topic of interest should be carefully considered in order to anticipate or navigate around them. However, as Fragment 5.3, in which a participant demonstrates a task at the reception desk of the charity office has further shown, even when demonstrations are partial, relevant elements about participants, their use of a system and the unfolding context can still be observed. Therefore, I would also suggest not dismissing partial or incomplete demonstrations as they could also provide valuable empirical insights.

Realism concerns

Some might argue that demonstrations in which study participants' 'perform' for a researcher invalidate the research or portray unrealistic or exaggerated actions or opinions. Firstly, it is a fallacy to assume a dichotomy of 'naturalistic' vs 'un-naturalistic' research investigations (Rooksby, 2013). Secondly, I found that conducting the demonstrations within the ethnographic fieldwork allowed me to make sense of or probe my assumptions and gain a broader perspective of the activity and/or object demonstrated. Moreover, the multiple demonstrations performed by each person allowed me to pinpoint relevant factors about them, their activities, their tools, and their competencies in action; for example, the participant demonstration of the desktop computer in Fragment 5.3 was followed by a series of demonstrations of other personal artifacts, such as a portable electronic magnifier for reading (see Fragment 4.5) and a mobile phone for dictating a text message (see Fragment 4.3). Altogether, these moments provide a glimpse of the pragmatics of his particular visual condition in concert with his bodily work, the artifacts he manipulates, and the required configurations for doing so (e.g., light text on a dark background, glasses, large font).

However, I do not wish to claim that demonstrations in their own right can give a 'complete' picture of participants' lived experience, but rather that they throw into relief a few likely very essential elements that are core to them as visually impaired individuals (i.e., the ordinary, the unremarked-upon). In this thesis, I move away from long-standing concerns about capturing 'naturalistic' or 'authentic' phenomena, as done by seminal HCI work (Suchman, 2007), and have illustrated that demonstrations can actually provide relevant insights for understanding the practical mundanity of encounters with everyday technologies. By looking at demonstrational work I am **embracing 'simulations'** instead of treating them as categorically problematic, as compared with idealised 'real' interactions (Rooksby, 2013). Demonstrations as simulations let us investigate interactions' social and sequential organisation—and I take them for what they are rather than strive for realism (Hindmarsh et al., 2014) as a panacea for 'good' design. Further, I do not wish to draw an artificial connection between the place in which the technology is demonstrated (e.g., the home), and the 'naturalness' of that demonstration. Rather, this judgment, which is ultimately about the veracity of the demonstration, needs to be about **situational appropriateness**. Thus, it may be appropriate to demonstrate a mobile-embedded OCR reader anywhere, while a fixed Velcro station may really only be demonstrated appropriately in the home in which it is installed.

Ethical considerations

Further ethical considerations I wish to highlight are related to the demonstrational meta-activities I identified in the analysis, as summarised in 5.3.1. These meta-activities may occur throughout the demonstration but were particularly evident in the 'staging' phase; that is, everything leading to the demo itself. On several occasions interruptions or issues took place, and although some participants built them into the demonstration (i.e., accounting for them, explaining how to solve them as in Fragment 5.3, or explaining why they could not solve them), others surreptitiously dealt with them to continue with the demonstration (Fragment 5.2). Similarly, some 'unintentional' demonstrations occurred in the course of performing the main demonstration and were not always explicitly called upon or explained in detail (Fragment 5.4).

Here I argue that HCI researchers can do more to reflect on **how we account for or even acknowledge meta-activities around and within a demonstration**, and consider how and whether they implicitly inform or bias our understanding of participants. If issues come up or participants make mistakes during or even before the demonstration, are these considered part of the research? Moreover, are we being explicit about this with the participants? And if not, how should we go about making the data capture fair or more transparent? By this I do not wish to draw a line between what counts as a demonstration or not, but rather bring attention to the empirical observational practices that people in the HCI community are already conducting. Our orientation as HCI researchers can be one of capturing as much data as possible to let us understand participants' use of systems, their behaviour, and performance, but we may benefit from discussions and reflections coming from accessibility research that call for an ongoing consent process with participants that allows them to engage and disengage at their convenience (Williams, 2019a) or to employ a lens of micro-ethics in recognition of the situated judgements that need to be made in the field (Spiel et al., 2018). General recommendations when conducting fieldwork with blind and partially sighted participants include letting them know at all times, and giving reminders, that they are being recorded. In this work, I noted that some of the meta-activities in and around the demo were 'breaking' or making me pause the recordings. If a participant giving a home tour needs to engage with other interrelated activities in the course of demonstrating, are these automatically part of the data? When should we explicitly ask for participants' consent during such events? Setting up audio-visual recording devices across a setting at the beginning of a session and informing participants that data will be captured uninterruptedly might be a more straightforward and practical research custom, however, it has the potential to mask these ethical implications for both researchers and participants.

These insights resonate with Taylor's (2015) argument to pay attention to the set of relations happening behind and to the sides of the demo itself (although he referred to Engelbart's demo). By this, I also mean paying attention to the participant-researcher or demonstrator-spectator relation, as demonstrations are a form of social interaction. Throughout fieldwork, there must be a **clear understanding of the purpose of the demonstration**. Is the focus on the system, the activity, or the person? Most likely we will not be able to separate the interwoven relations between the actors, but is this clear to participants? Their understanding of our research motivation could affect the ways they conduct their demonstrations. In my work this was illustrated by, on the one hand, **outcome-driven demonstrations**, and on the other, **process-driven demonstrations**. That is, showing that something exists and can be made to work (e.g., Fragment 5.2) and explaining in detail the steps of the activity or technology in question (e.g., Fragment 5.4).

Benefits and consequences

In spite of such limitations and if ethical considerations are carefully acknowledged, I believe that demonstrations are **effective in providing fruitful accounts of real-world activities**, thus adding to the methodological toolset for understanding human practices regardless of the setting where they take place (Rooksby, 2013). The role of material artifacts in home and work life, and how the social organisation of members emerges around them, has long been investigated in HCI and CSCW literature, especially via ethnographic studies. Although fieldwork undertakings are characterised by rich and comprehensive findings, they tend to be lengthy in scope and time frame, especially if they attempt to follow 'naturally occurring' activities. By contrast, demonstrations can reduce some of those application inconveniences, while, as I exhibited in this thesis, revealing significant (versions of) mundane practices. Moreover, I point out that demonstrations can be particularly helpful to understand and **break down complex scenarios**, especially **involving skilful, proficient performers and specialised practices**. A demonstration of a particular activity can also reveal the performer's capabilities in an intelligible manner, that is, it can surface how professionals make sense of and articulate the particular events and resources relevant to their community of practice (Goodwin, 1994). This ties back to accessibility research, in which recognising disabled individuals as skilled or power users has become a powerful and focal stance (Abdolrahmani et al., 2020; Bennett et al., 2019; Reyes-Cruz et al., 2020), which I discuss in 7.2.3.

Nevertheless, the consequences and trade-offs of employing demonstrations should also be considered. It should be kept in mind that demonstrations and other forms of simulation cannot–and should not–replace ethnography and studies of naturally occurring activities. Although demonstrations can furnish insights into the members' world, they will inherently provide an incomplete picture of the work and its details, whether as a result of practical constraints or as a feature of not remarking upon the taken-for-granted. Moreover, the demonstrations presented in this thesis are produced from the participants' perspectives and **do not comprise the social nature** of the practice as naturally occurring *in situ*. HCI and systems design turned away from lab-based simulations in the first place as the computer and interactive systems permeated the workplace and everywhere else in everyday life, seeking to factor the social into design (Crabtree et al., 2012). Although in this thesis, demonstrations have been positioned as social interactions, they do no represent the full experience of VIP using assistive technology in public or around and with others. Naturally, people can comment and reflect on these instances, but the many contingencies and circumstances *in situ*, as they normally happen, will likely not be subject to replication. Therefore, the suggestion here is neither fully abandoning traditional ethnography nor entirely dismissing simulations, but considering demonstrations as yet another tool of ethnographic fieldwork, helping the investigators to develop vulgar competence in the members and the setting, and providing them with sensitising information as to the nature of the work and its organisation. Demonstrations, then, can be seen as an initial step into further investigations of naturally occurring phenomena or, conversely, as a practical device narrowing down naturalistic observations into enquiries of specialised lifeworlds that require a breakdown, as explained and performed by its members, in order to make sense of them.

7.2.3 Recentring the Role of Visually Impaired People in Empirical Research

In this thesis, I propose eliciting demonstrations as a research method that can support some people with disabilities in **representing themselves in the research process**, if taking benefits and caveats into consideration. Williams and Gilbert have pointed out that *"the researcher has a duty to return voice to whomever it has been withheld from"* (2019a, pp. 127). For my investigation of technology practices, demonstrations provided an opportunity to capture how people chose to show and explain their activities and artefacts, as it was mainly **participants (as demonstrators) who led the narrative** of the encounter. In this case, participants were not asked to craft, learn, and rehearse a particular choreography or narrative in advance for demonstrating, as is common in technology demos performed by developers or designers, but participants knew the general purpose of the research and, in and through their demonstrational work, they displayed their expectations of what I, as the researcher, might be interested in. This co-orientation to the research encounter—as an achievement of intersubjectivity—is what helps drive the demonstration and make it productive as a research encounter.

In this thesis, I argue that a better conceptualisation of demonstrations can help deepen thinking in **accessibility research approaches** such as autoethnography (Jain et al., 2019) or biographical prototypes (Bennett et al., 2019)—approaches that have sought to recognise and elevate the experiences of people with disabilities through descriptions and reflections of personal experiences and collecting design counter stories (i.e., stories of personal adaptations or adjustments that tend to be ignored by traditional design). **Rather than dismissing or invalidating the performative** element in user-generated (Wilson, 2020; Lasker, 2020) demonstrations (as discussed in 7.2.2), or those emerging in the course of research activities, we should aim to fully engage with them, listening to users and what they have to say about the systems, especially when they have been systematically excluded from traditional design processes—and this work shows what can be uncovered in doing so. Future work could examine some of that online video material, as it has been analysed sparingly, and, in less detail (e.g., Anthony et al., 2013; Seo & Jung, 2017).

Making use of existing data sources or doing remote video demonstrations can be viable alternatives to doing observational research in times or contexts where in-person encounters are not possible. However, future efforts should also devise alternatives for clarifying assumptions and misinterpretations or resolving uncertainty when there is little context in such videos (Anthony et al., 2013), as well as grappling with the ethical implications of using data available on the internet or reusing video data for further research purposes for which the material was not originally intended. For example, Seo and Jung (2018) provide an example of how to start handling such ethical considerations; they contacted the creators of the online videos used in the research and interviewed some of them to complement their video content analysis.

Furthermore, my analysis has revealed how participants **repaired their troublesome or uncertain interactions** by creating specific configurations (bodily, object customisations) that fit their needs, and by conducting routine methods such as resetting their actions after failed attempts or repeatedly verifying their actions to make sure they are correct. In such a way, the work of this thesis aligns with—and provides tangible examples of—a perspective that considers accessibility as something more complex than a binary outcome i.e., accessible or not, instead along the lines of an ongoing undertaking—or to use more ethnomethodological language, an accomplishment (Garfinkel, 1967). I suggest, then, that demonstrations can be treated as an approach to investigate the continuous negotiations and adjustments, or mundane attunements (Bennett et al., 2020), required in building access in the world.

Moreover, I wish to draw attention to the core purpose of demonstration: **achieving an intersubjective understanding** of the activity at hand. This becomes relevant in mixed abilities interactions, such as in the data fragments I presented where the demonstrator was visually impaired and I (researcher and audience) was sighted. I think that studying demonstrations to investigate just how intersubjectivity is achieved could provide insights for work on documenting the practices and relationships between parties with mixed abilities (Storer & Branham, 2019; Yuan et al., 2017). Moreover, it allows the positioning of the researchers as actors in the investigations with disabled participants, helping to expose assumptions or frictions in these relations and opening up space to move away from a 'modest witness' standpoint (Williams & Boyd, 2019) towards one of respect and recognition of disabled experiential knowledge.

Lastly, employing other forms of demonstration material (i.e., available online or remotely produced) can open a space to examine different types of demonstrational work and social interaction beyond the participant-researcher pairing, such as the creator-audience or teacher-student relationships, exploring their difference and similitude with empirical demonstrations. Most likely, achieving intersubjectivity can be a feature present throughout different types of demonstrations, but several other features and dynamics would surely vary depending on the source material. For example, the type of power imbalance that is present between participant and researcher and the participant's motivation of providing good data are elements specific to empirical demonstrations. Examining social interaction with other types of parties and circumstances would require us to consider questions such as who is producing the demonstrations, for what purpose and for what audience, who is consuming them, what their motivations are for doing so, and how they are being used.

7.3 An Ethnomethodologically-Informed Design Critique for Accessibility

The third contribution of this thesis is the product of the two initial ethnomethodological investigations of VIP's technology practices and competencies (Chapter 4) and the methodical examination of technology demonstrations conducted by VIP (Chapter 5). In turn, an ethnomethodologically-informed design critique was designed and implemented (Chapter 6). Two design materials were prepared and created, acting as the building blocks of this approach; firstly, a set of four video demonstrations of VIP collected during fieldwork, and secondly, a deck of reflective design cards representing VIP's competencies, tools, activities, relations, and locations. In the following, I discuss the insights obtained through implementing this design critique with VIP and non-VIP, situating them within other literature on accessible design processes and practices.

7.3.1 Towards Shared Understanding and Collaborative Reflection in Design

In this thesis, I position the design critique workshop approach as a response to critical reflections in accessibility research (Frauenberger, 2015; Mankoff et al., 2010), disability studies (Hamraie, 2016; Shew, 2020) and disability activism (Jackson et al., 2022; Wong, 2015) that continue to point out and caution against products and ideas envisioned by non-disabled designers that do not represent the realities or practical needs of disabled people.

Like other approaches that advocate designing for disability (reviewed in Chapter 2), I believe that the work of sensitising and raising awareness with design practitioners is crucial for accessible design (Newell et al., 2011; Persson et al., 2015; Shinohara et al., 2020). The work in this thesis departs from some of these approaches in three main ways: first, the aim is not to produce a design outcome but primarily to encourage reflection; second, I purposely used open-ended questions and broad basic themes, so that the reflections were ultimately user-led (Iivari & Kuutti, 2017) instead of following a specific design prompt; and third, the workshop centres the role of VIP and their co-participation with mixed visual ability partners (Shinohara et al., 2018). To do so, this approach builds upon notions that interpret 'reflection' as a *"perspective-changing account"* (Bardzell & Bardzell, 2013, pp. 8), that is *"not to explain what is known but to challenge us to see in new ways, to generate new modes of engagement or ideas"* (ibid., 2013, pp. 6).

Moreover, although well-intentioned, efforts in professional and academic design are often lacking meaningful practice and connection with disabled people. Bennett & Rosner (2019) examined and questioned empathy-building exercises commonly adopted in the early stages of human-centred design, describing how such practices actually distance disabled people from the processes they are supposed to be included in. For instance, disability simulations, in which non-disabled designers 'role-play' as disabled; that is, they use blindfolds or wheelchairs in order to put themselves into the 'shoes' of disabled people, thus attempting to develop empathy with them.

Disability studies scholars have continuously warned against the pitfalls of simulations, such as provoking narrow perceptions and reproducing negative stereotypes of disabilities (Kafer, 2013; Nario-Redmond et al., 2017). Despite these exhortations, design projects continue to employ simulations within HCI and Accessible Computing at large. For instance, blindfolded activities in technology design, used to simulate blindness and compare performance against that of blind people, continue to appear in work designing and evaluating interactive systems (Anagnostakis et al., 2016; dos Santos, 2021).

Disability scholar Ashley Shew (2022) outlines three consequences of employing disability simulations in design:

1. They provoke negative perceptions about the competence of disabled people, high-

lighting deficiency.

2. They prompt designers to neglect direct interaction with disabled people, giving a false perception of sufficiently understanding what it is like to have a disability, yet embodied and lived experiences are entirely ignored.

3. They present an homogeneous and simplified experience of disability.

Bennett & Rosner (2019) locate similar pitfalls in the use of persona toolkits (IDEO, 2018) employing disability prompts to encourage the ideation of more inclusive solutions. Although these toolkits often recognise that fully understanding disability experiences is not possible, the authors *"nonetheless read the possibility of a certain kind of empathy work: a capacity to create 'human connection' without direct engagement."* (Bennett & Rosner 2019, pp. 6). Thus, they warn against the risk of these tools inadvertently promoting disabled replacement. Furthermore, some toolkits emphasise functional impairments (i.e., what people cannot do) to inspire creativity under practical constraints (IDEO, 2018; Microsoft, 2018), whilst other card decks highlight social and situational aspects that affect accessible design, but do not include disabled people's competencies (i.e., what people can do) (Shinohara et al., 2020).

The workshop approach proposed in this thesis is positioned as a design critique in form and content; that is, it acts as an alternative, or as *resistance*, to traditional disability simulations and toolkits, whilst prompting participants to critically reflect on the key misconceptions about VIP and accessible technology design. In other words, through the use of the video demos and the design cards, participants were prompted to **assume and centre disabled competence**, to interact and converse with VIP[2], and to consider diversity within visually impaired experiences. As a result, participants were able to *collaboratively reflect* on the functional, social, and situational factors involved in the technology use of VIP, and in turn, frame accessibility as a dynamic matter rather than a binary status. Moreover, participants' reflections accounted for the notion that technology sometimes can disable rather than 'able' people, whether socially or situationally

[2]As a reminder, both sighted and visually impaired participants took part in workshops with another visually impaired person. In other words, there were workshop sessions with VIP-sighted and VIP only. See Table 6.2.

(Platypus Series, n.d.). Sighted designers and researchers observed episodes of technology use by VIP and further discussed them with VIP; in turn, they indicated how, through these activities, they were introduced to a world that was unknown to them, and reflected upon particular experiences of VIP they had not considered before (e.g. how VIP use a mainstream smartphone, how a screen reader works). Yet, although the workshops were fruitful in provoking the aforementioned reflections and enabling various types of interactions between VIP and non-VIP, the study did not explicitly explore whether sighted people's perceptions or understandings of VI changed. Assuming competence of VIP was a starting point of the study rather than a topic of investigation. However, it should be noted that the workshop study could have been strengthened by entry and exit research activities with sighted designers and researchers, such as interviews, surveys or diary entries. Likewise, follow-up activities or comparisons to other approaches could be conducted to further assess the effectiveness of the approach and materials and how they could be improved.

Whilst this thesis is not the first piece of work to use technology demonstrations to provoke reflection (Shklovski & Grönvall, 2020), it is seemingly the first to centre them as a resource to support awareness and interactions between disabled and non-disabled people. Likewise, although several other decks of cards and toolkits have been proposed to encourage the consideration of disabled people in design (IDEO, 2018; Microsoft, 2018; Shinohara et al., 2020; Yehia, 2020), this would appear to be the first attempt to implement a hybrid approach in which cards are used to analyse and reflect on video materials, as opposed to primarily boost ideation and practical design exercises.

As work in accessibility research moves to adopt and adapt participatory methods for integrating the meaningful participation of VIP in design (Baldwin et al., 2019; Meissner et al., 2017; Metatla et al., 2019; Neto et al., 2021), this thesis offers a design critique approach and accompanying materials as a complementary option to continue moving away from replacing VIP in technology design and towards engaging with them and striving to build a shared understanding that is rooted in learning about and from the other. Nevertheless, in doing so, I must recognise the tensions and limitations this approach presented, and critically reflect on how these were, or can be, addressed. In what follows, I elaborate on these themes.

7.3.2 Good Intentions Pave the Road to Harmful Design Practice

Participants' reflections in the workshop study were enabled by observing/listening and further picking apart the video demos of technology *in use*, as well as by considering the broken-down concepts and elements in the design cards. The demos were most effective for provoking insights and unlocking conversations between participants but also helped to introduce the design cards. Moreover, and as I have already pointed out in this chapter, participants' reflections were often produced in collaboration with each other. However, this occurrence introduces particular tensions in the roles each participant had in the study encounter; for instance, sighted participants mostly adopted an inquisitive and learning function, whereas the counterpart VIP embraced the role of expert and sharer, answering questions and clarifying assumptions. In what follows, I discuss the shortcomings of this workshop approach and its materials, including reckoning with the (unintended but plausible) harmful portrayal of VIP, the power imbalance and the access burden emerging in this research.

Competencies as a Spectacle

In an effort to frame the experiences of VIP using a positive lens, the basis of the reflective design cards is the various competencies used in their daily activities, rather than their impairments. These cards were directly informed by empirical ethnomethodological investigations ascertaining the interactional and situated competencies observed in VIP when using and demonstrating technology (as summarised in 4.3.1 and 5.3.2).

Despite this work being primarily motivated by ethnomethodology's interest in membership *competence* (described in detail in Chapter 2), and positioned within the strand of work in accessibility research that calls for recognising disabled knowledge and lived experience, in characterising the competencies of VIP it is imperative to recognise that disabled individuals are often objectified as a source of inspiration for non-disabled people.

For instance, Kafer suggests:

> *"... the paradoxical figure of the supercrip: supercrips are those disabled figures favored in the media, products of either extremely low expectations (disability by definition means incompetence, so anything a disabled person does, no matter how mundane or banal, merits exaggerated praise) or extremely high expectations (disabled people must accomplish incredibly difficult, and therefore inspiring, tasks to be worthy of nondisabled attention)."* (Kafer, 2013, pp. 90).

Working in conjunction with the 'supercrip' narrative, disabled activists have coined the term 'inspiration porn' (Young, 2014) to describe how portrayals of disabled people as special or superhuman for 'overcoming their impairment' are but a device to make non-disabled people feel better about themselves. These conceits are both harmful and dehumanising and thus ones that we must be aware of and strive to avoid perpetuating when conceptualising disabled people's competencies and when asking non-disabled people who are less familiar with disability scholarship and activism to consider them in design.

Wary of not using VIP as a spectacle (Bennett & Rosner, 2019) in the cards, videos, and during the sessions, I took some considerations into account, in the hope of avoiding, or at least minimising, the rendering of VIP as 'supercrips' that inspire sighted participants. Some considerations were more explicit, such as stating my commitments at the beginning of each session (i.e., not wanting to treat VIP as spectacle, nor aiming to obtain their design ideas). Others were more implicit, such as making sure that in every meeting at least one participant had a VI so as to avoid getting sighted participants together to discuss and speculate on their own. Certainly, I found that the direct input from VIP was highly valuable, not only for teaching and adding nuance to the conversations, but for clarifying indirect doubts or assumptions. This, however, introduces power imbalances and asymmetrical participation, which I discuss later in this chapter.

Furthermore, aware of concerns of disability oversimplification in design (Hofmann et al., 2020), I aimed to provide a nuanced account of VIP's experiences by expanding the materials beyond functional abilities (e.g. by including social topics in the 'Competency' cards), and by stating that they were not comprehensive but should be considered as starting points for conversation. Nevertheless, I recognise that my cards and approach do not take into account how people with different and multiple disabilities co-exist, which was promptly mentioned by some participants (i.e., in relation to autism and neurodiversity). In spite of these considerations taken, and the fact that no explicit accounts alluding to supercrip and inspiration porn narratives were present in the data collected, I cannot assert that harmful portrayals of VIP were not enabled by the study and materials. However, rather than rendering competencies as problematic from the outset, I point towards future research directions that further unpack the entangled relationship between the concept of competencies and these disability narratives. That is, instead of dismissing the troubled notion of using competencies as a resource for design, future work should grapple with these concerns and embed them within the design practice and process, in the spirit of 'staying with the trouble' (Spiel et al., 2018).

Power Imbalance and Access Burden

In devising this workshop approach, I had to contend with tensions between the role and contributions of sighted-VIP participation, as well as access needs prioritisation. Hence, I recognise that power imbalances are not necessarily absent in this approach, such as in the accessibility of the materials. However, although they were highly visual in nature, I believe the provision of accessible versions (e.g., videos with clear audio, Braille version of cards) was helpful to alleviate access issues whilst engaging all participants in the awareness exercise. Moreover, through designing and implementing this study, I learned that the accessibility of materials—or information—is strictly tied to the accessibility of the practice or activity (as described in 6.1.3). By this, I mean that going over each video and then card category sequentially allowed me and the participants to maintain the focus on a specific topic rather than letting the participants explore the materials at their convenience, as is common with design cards. Rather than dismissing this as a constraint, I embraced it as the central activity in the study. As such, I argue that asymmetries of power and participation in participatory approaches can be navigated and played around with, instead of avoided. For instance, the materials were purposely provided in advance only to VIP, not sighted participants. Thus, I further argue for the shaping of our design processes and practices around disabled participation, moving at their pace, foregrounding their accommodations, and committing to 'not leaving anyone behind' (Kafer, 2013; Piepzna, 2018).

Further, I wish to recognise the role of maintaining the intimacy in the sessions (i.e., by keeping the groups small, by stating expectations to the participants) in obtaining the results described in Chapter 6. That is, it cannot be guaranteed that collaborative reflection and shared understanding would be prompted in the same way if the number of participants is increased. Limiting the number of participants per session increased the chances of a one-to-one conversation, rather than an asymmetrical sharing of personal experiences; for example, as done in design consultations that include individual disabled guests among large groups of non-disabled people. Through implementing this approach, I learned the relevance of letting sighted participants know their role is one of learning, reflecting, and engaging with the VIP, against one of 'design saviors' (Irani & Silberman, 2016).

In the context of this workshop, VIP stated being comfortable, even enthusiastic, sharing their personal experiences, responding to questions, and clarifying assumptions. However, I cannot state that they were not subject to the kind of access burden I was aiming to alleviate with this approach in the first place (Kender & Spiel, 2022). In reckoning with this pitfall, I realise that the workshop sessions could have been complemented by entry and exit interviews or surveys, to elucidate the potential of causing a burden to VIP. Altogether, these lessons and reflections help to conceptualise the framework, which I present next.

7.4 A Competencies Framework of Visual Impairments

Lastly, in this section, I consolidate the findings and learning outcomes from the three study chapters in this thesis investigating technology practices and competencies of VIP (Chapter 4), demonstrational work (Chapter 5), and supporting awareness and shared understanding of VI (Chapter 6) into a framework to orient and sensitise technology design projects related to VI. It is my hope that this framework could also inform broader practices within accessibility and HCI research.

I must nonetheless remark that the intention here is not to position this framework in opposition to other frameworks and approaches designing for disabilities. If anything, this framework can be seen as an iteration or expansion that builds upon others' key precepts. For instance, focusing the attention on the abilities of disabled people as in the Ability-Based Design approach (Wobbrock et al., 2011), and involving people with and without disabilities and considering both social and functional factors in the design process as in the Design for Social Accessibility approach (Shinohara et al., 2018b).

In the following, I outline the key tenets and components of the *Competencies Framework of Visual Impairments*. I further provide a list of considerations to take into account when implementing it.

7.4.1 Tenets

The overall goal of this framework is to reorient research and design practices and processes to consider the taken-for-granted and seen-but-unnoticed competencies of VIP, as well as highlight the mundane and current practices VIP do. In order to do so, the tenets of this framework are:

1. **Consider the interactional and situated competencies of VIP**. Instead of concentrating their attention on the functional impairments of VIP and how to provide technological substitutions, researchers and designers should attend to their practical accomplishments. That is, how they 'move on', how they resolve trouble (whatever form this might take, including requesting assistance from others) and how they relate to and interact with tools, people, and the environment. Design should strive to support and expand these existing competencies, rather than disrupt, dismiss or ignore them.

2. **Foreground methods for locating competencies and design opportunities around them**. The work in this thesis has exhibited the value of demonstrations

as a method for doing just that. Therefore, I suggest that demonstrations of tools and tasks can deepen the understanding of the design space around competencies. Nonetheless, other methods such as empirical observation or analysis of media content can be further investigated and adapted to fulfill this purpose.

3. **Leverage shared understanding between mixed-abilities and levels of familiarity with accessibility**. Rather than promoting empathy exercises in which disability simulation or replacement are adopted, direct interaction between VIP and sighted stakeholders must be the standard. Ideally, designers outside specialist accessibility fields should be included in the activities, supporting awareness and sensitising through tools that prompt collaborative practice, such as reflection.

7.4.2 Tools and Activities

Researchers and designers should employ design materials, such as video demonstrations and reflective design cards (see Appendix E), to prompt consideration of the competencies of VIP and other social and situational factors.

In this thesis, I made use of technology demonstrations captured in the fieldwork to provoke insights and responses from participants; however, other forms of demonstrations could be explored as well, such as online sources shared with the objective of raising awareness of VI (i.e., video in social media platforms or podcast episodes). In this regard, directions in making use of media and online materials for accessible design have begun to be explored (Duval et al., 2022). Alternatively, video demonstrations can be purposely produced for the design activities. In such a case, I suggest paying special attention to the concurrent audio stream in the activity demonstrated (e.g., screen reader talking in the background); for instance, the output should be audible and clear to the extent possible. Further attunements before and during the design sessions should be followed, such as providing audio or Braille descriptions, transcripts, closed captions, playing the material as many times as needed, and providing subsequent verbal descriptions of unclear or confusing parts. Lastly, demonstrations in person could be an option whenever other materials are not available; however, I suggest paying attention to the accomplishment of the task at hand, rather than employing them as mere exhibits of the technology.

Moreover, in this thesis I implemented the use of the reflective design cards for the breaking down of the video demonstrations initially discussed by participants in order to consider the competencies and tools depicted in them. Furthermore, I used the other categories (activities, relations, locations) to prompt conversations about the personal experiences of VIP and how their competencies are used or disrupted within them. Of course, I invite researchers and designers to employ their own tools in a similar vein to the study herein presented. Nonetheless, I advise keeping the focus on the practical accomplishment rather than on the impairments, as outlined in the tenets. Moreover, while the reflective cards may seem practical for well-attended awareness exercises, I profoundly recommend a sensible use, i.e. always in the presence of VIP who can elaborate upon or correct initial assumptions evoked by them.

This framework was implemented in the context of early design where a specific design solution had not been developed, and instead the main objective was to engage in discussions and reflections about technology, accessibility and VI. However, I do not wish to position this framework as restrictive to initial design stages only. I hope researchers and designers can integrate the key tenets and tools herein offered into the many stages of the design process, regardless of their specific design projects and processes.

7.4.3 Participants and Roles

First and foremost, when employing a Competencies Framework of VI, researchers and designers should strive to **always include VIP** in the many phases and activities of design. My recommendation, especially when stakeholders less familiar with accessibility and VI topics are involved, is to keep the groups small for the fostering of a comfortable environment that could support awareness and shared understanding.

Secondly, it is very important to establish the roles of sighted and VIP in the design activities. In the context of prompting reflection, as demonstrated in this thesis, I suggest ensuring the visually impaired participants know that they could choose to adopt the roles of experts, sharers or 'teachers', and checking if they are comfortable with this or if this would cause any distress or burden. Likewise, it is important to remark to non-disabled designers that their role would be one of learning from, reflecting, and interacting with VIP.

7.4.4 Considerations

Lastly, in the following, I include a range of considerations that I have obtained from critical reflections throughout the development of this framework. However, rather than providing specific guidelines on how to solve these tensions, I can merely offer a set of questions to orient and nurture the practice of those who wish to implement the framework's tenets and tools in design activities across the whole design process (e.g., analysis, reflection, ideation, prototyping, etc.).

General Considerations to Avoid or Mitigate

- Is the design or activity promoting a harmful portrayal of VIP?
- Are VIP seen through a lens of a 'supercrip' and/or inspirational narratives? (i.e., praised for doing the ordinary, used as a source of inspiration for sighted people).
- Are VIP treated as a spectacle by others and by the design activity itself?
- What tensions and power imbalances between participants exist in the context of the design activity?
- Is the design activity relying on VIP to engage in access work, thus provoking access burden?
- How can access burden be mitigated and/or compensated?
- What asymmetries exist between the types of contribution and participation for different stakeholders?
- How can these asymmetries be flipped or balanced to centre the accommodations of VIP?

Considerations for Design Ideation and Prototyping

- Do VIP need or want this solution?
- Are there any low-tech alternatives to this solution?
- Do VIP already have an alternative workaround or adaptation that this solution is ignoring or aiming to replace?
- If workarounds and adaptations exist, how can they be acknowledged and integrated into the design space?
- Is this solution disrupting or breaking well-established practices and/or competencies of VIP?
- How can the solution be adapted to take advantage of well-established practices and/or competencies of VIP?

The list above is not exhaustive and should be taken just as a starting point for a meaningful and nuanced design practice that centres on the competencies of VIP.

Chapter 8

Conclusion

This thesis reported on an ethnomethodologically-informed ethnographic study that started at a local charity supporting VIP with the aim of investigating VIP's everyday technology practices. I outlined three main technology practices found within the data corpus related to communication, textual reading, and mobility. The emphasis, however, was on observing and unpacking *how* those practices are practically accomplished in order to uncover the interactional and situated competencies that enable them. Two main outcomes from this initial ethnographic investigation comprised the account of VIP's competencies and the identification of demonstrations performed by participants during the study as a subsequent research opportunity. Then, by examining demonstrational data in detail, I established core features of empirical demonstrations and continued elaborating on their relationship with the concept of competencies. Lastly, I brought it all together by defining and implementing a design critique study in which materials informed by the previous empirical work were used to aid awareness and shared understanding of VI.

In this chapter, I conclude by critically reflecting on the overarching limitations of the research conducted and outlining key takeaways offered by this thesis. In doing so, I also provide perspectives and suggestions for future work.

8.1 Limitations

The exploratory and inductive nature of this PhD research, in addition to the time constraints placed on it and other constraints faced due to the Covid-19 pandemic, resulted in a number of limitations and challenges with the work conducted in this thesis. In what follows, I discuss two key limitations: participant recruitment and the scope of this research.

Participant Recruitment

The findings of the research conducted in this thesis are inherently limited by the specific characteristics of the participants recruited. That is, for the initial ethnographic study I recruited a convenience sample of participants from the community of service users and volunteers at the local charity where I began the fieldwork. As such, I could not capture the use of many technologies that have been designed for and adopted by VIP; for instance, participants reported not regularly using mobile apps to aid navigation and/or explicitly expressed not feeling comfortable or safe exhibiting them as part of the research. This could be explained by the fact many participants in the sample are middle-aged or older adults. Moreover, for some, their specific visual characteristics (i.e., total blindness, enough partial vision to move comfortably using a white cane) preclude them from adopting these apps for independent navigation, either because they are not considered a necessity or because sighted assistance for mobility is preferred. Furthermore, previous research has shown that VIP are early adopters of technology (Zolyomi et al., 2017), yet, in this sample, participants with such characteristics were not included.

Similarly, given the pandemic context in which face-to-face research was not allowed, the workshop study had to be designed for and conducted through online mediums. The recruitment for this study was open worldwide, yet, this meant it was limited to participants with a certain level of digital literacy and experience with video conferencing platforms such as Zoom, Microsoft Teams, and Google Meet. This could be one of the reasons explaining why participants from the first study did not take part in the workshop study, even when some were invited to participate. In fact, through my occasional volunteering experiences with the local charity during the pandemic, I learned that a major challenge found by the organisation was establishing online communication with their service users, as many of them had never used videoconferencing platforms before.

However, it is worth remarking that the materials produced from the ethnographic empirical findings (i.e., design cards and video demos) were found relatable and agreed upon by a completely different set of participants in the workshop study. This suggests that the materials indeed represent the *shared cultural resources* (Crabtree et al., 2013) employed by VIP at large.

Moreover, most of the work in this thesis was conducted under a WEIRD context (i.e., in Western, Educated, Industrialised, Rich, Democratic countries or cultures) (Linxen et al., 2021) in terms of participant demographics and the content of the workshop study (e.g., content in cards). Hence, future work should strive to diversify the participant groups, and explore opportunities for integrating an intersectional lens (Sum et al., 2022) in the materials and collaborative reflections.

Scope and Practical Implementation

The two user studies conducted had limitations in scope and practical challenges associated with their implementation.

Firstly, the practices investigated and unpacked in the ethnographic study were strictly related to technology. This meant that many other everyday activities comprising the experiences of VIP were excluded, and in turn, relevant VIP's competencies were not captured in the data (e.g. smell sense). At the time this thesis is being concluded, I note an increasing interest in activities of daily living as conducted by VIP, such as cooking (Li et al., 2021) and makeup and cosmetic use (Li et al., 2022), investigated by employing content analysis of YouTube videos. Future work employing the Competencies Framework (7.4) presented in this thesis should strengthen and iterate the content of the cards and video demos to expand on the experiences discussed and explored here.

Secondly, having conducted the workshop study through an online medium due to the ongoing pandemic restrictions, this work was focused on prompting verbal discussions.

Therefore, co-located participants' interactions, and, more specifically, engagement with physical versions of the design cards both for sighted and VIP, remain to be explored in future work. Future endeavours could also explore reflections by disabled and non-disabled people without a delimitation by functional impairment, as cross-ability interaction is less investigated but equally important to the advancement of accessible design.

Lastly, the data captured during the workshop sessions was not sufficient to respond to some questions pertinent to the study implementation and how its contribution could have been strengthened. As I have mentioned in 7.3, participants' views before and after they took part in the study were not collected and, in hindsight, would have been valuable to complement, confirm, or deny the analytical findings presented in this thesis; for instance, exploring whether answering questions and explaining topics under discussion was burdensome to VIP, or whether non-VIP changed their views on VI, from understanding it as a dysfunction to apprehending the competencies involved in living with a VI.

8.2 Takeaways for Future Work

In the previous chapter, I have discussed at length the research in this thesis and positioned it against past literature in Accessible Computing and HCI. Here I recap the implications of the present work, further linking them with related areas such as Ethnomethodology and Disability Studies. Altogether, these lessons are offered with the hopes of orienting future research on VI, disabilities and/or employing ethnomethodological approaches.

8.2.1 Ethnomethodology as a Resource for Advancing Accessible Computing

Critics of the social model of disability (see 2.3.1) have called for a more nuanced understanding of the types of people who might be disabled and the centring of their embodied experiences. The adopted ethnomethodologically informed ethnographic approach (Crabtree et al., 2012) meant that I studied the material organisation of everyday activities. In tipping the focus from disability-as-problem more towards unpacking practical action, I focussed on building descriptions of *just how* participants 'move on' in their everyday lives. Nevertheless, I must underline that I am not arguing that research and design should neglect explanations of structural ableism in favour of situated local practices. Instead, they act as complementary approaches to inform and shape one another.

One of the concepts that ethnomethodology seeks to address is the 'taken-for-grantedness' (Garfinkel., 1967) that results from being a competent member of a group (i.e. membership competence). As I am not a member of that group—nor was I part of the larger communities in which VIP take part at the time I conducted this research—throughout the fieldwork, participants were prompted to reflect for my benefit on routine competencies that tend not to be developed by sighted persons, such as being able to comprehend synthesized speech at a very fast rate. In turn, a substantial part of the ethnographic data corpus was captured as demonstrations, which are phenomenologically different to capturing 'naturally occurring' activities. However, they allowed participants to give their personal accounts of the practices they were undertaking, highlighting elements that could pass unnoticed otherwise, given that they are, for participants, deeply unremarkable, and yet for me as the researcher, they are not.

This thesis, then, has illustrated how employing an ethnomethodological perspective can benefit and advance efforts in Accessible Computing. More specifically, efforts in recognising and unpacking the mundane attunements (Bennett et al., 2020) involved in having a VI, that is, the continuous, routine, and everyday adjustments needed to create access. Throughout this thesis I have argued for developing and strengthening the links between ethnomethodology and Accessible Computing. Moreover, this thesis has offered an example for advancing ethnomethodology's hybrid program (Garfinkel, 1996), making use of video data and empirically informed cards for enabling design reflection. In doing so, the present work demonstrates that ethnomethodology can offer more than just design implications to HCI and related design disciplines.

8.2.2 Demonstrational Work: from Research Artifact to Reflective Material

Demonstrations implicitly play a key role in a wide range of research contexts, but their methodical character had not been examined in depth to understand their practical accomplishment nor the opportunities they bring to HCI. Despite being a constituent part of popular approaches such as 'home tours', little was known of what can actually be achieved through demonstrating. Likewise, little has been done to adopt them and embed them within design activities (Shklovski and Grönvall, 2020).

A substantial part of this thesis was then concerned with arguing for the value of demonstrations in HCI and accessibility research. Throughout this PhD work, the versatility of demonstrational materials has been exhibited to the extent that they can serve as:

- Empirical tools for investigating VI.
- Sites for locating interactional competence and design opportunities.
- Material for provoking reflection.
- Knowledge sharing devices in communities of VIP.

This thesis has highlighted *just what* makes particular practices recognisable as demonstrations (i.e., showing, using, simulating, staging, checking upon and providing accounts to the onlooker, and producing intersubjective shared understanding). Moreover, it has illustrated how they can be used for prompting collaborative reflections. By doing so, this thesis provides an improved conceptual toolkit—benefits and caveats included—to help foreground demonstrations, so they may be identified within and delineated against other approaches such as ethnography, contextual inquiry, or other types of recorded interaction, and they can be considered for the supporting of different stages of the design process. This research thus uncovers a potential field of focused study of demonstrations in HCI.

Here I have shown how, in the case of technology demonstrations by VIP, demonstrational work can offer specific insights into the detailed ways in which technology use is accomplished—throwing into relief VIP's particular competencies. For instance, this research has shown how careful bodily 'camera work' was performed in the course of using a regular OCR app. These insights may then map onto design areas and opportunities, such as rethinking how embodiment might be brought to bear for visually impaired users of AT camera-based apps. Paying specific attention to the actions involved in staging the demonstration reveals valuable phenomena to generate these insights (and if no staging is required, I invite researchers to inquire what this might indicate).

Furthermore, I believe demonstrations—when tackled in a way that carefully accounts for their character as a specific sort of social encounter—also have broader value for other areas of HCI and Accessible Computing research. This is because, as I have shown, demonstrations have the potential to successfully generate design insights for difficult-to-capture situations or taken-for-granted practices. Future work should do two things. Firstly, it should bring together and examine existing examples of demonstrations and the role they have played in delivering research results (e.g., see Rooksby's account of Suchman's work, 2013). In other words, I feel there is a need to surface the latent achievements of demonstration within extant HCI literature in this way. Secondly, approaches that make a virtue of demonstrations as an eliciting technique can be applied to other settings; particularly, I would suggest, for domains in which more conventional observational, participatory or immersive approaches are difficult or out of reach in some way. This is *n*ot to say that demonstrations can somehow 'replace' such investigatory methods, and neither is it to say that they are exempt from the troubles approaches such as ethnography might regularly encounter. However, demonstrations do offer the potential for complementary alternatives to these.

8.2.3 Towards Including Disability in Mainstream Technology Research

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 at the very least, do not exclude them. Several design approaches have been outlined advocating designing for accessibility, and, increasingly, accessibility modules are being integrated into design or computer science university courses (Lawrence & Bellard, 2017; Lazar et al., 2019). However, the reality is that much work is left for accessibility to be considered an essential part of any technological design. Moreover, whenever the user population is comprised of disabled people, oftentimes the expertise and agenda of researchers and designers are privileged over those whom the design is supposed to serve (Bennett & Rosner, 2019). Disabled designer and activist Liz Jackson has recently coined the term 'disability dongle' to describe *"a well intended elegant, yet useless solution to a problem we never knew we had"* (2019). Further, by using the case of haptic shoes for blind people, Jackson et al. (2022) analyse how disability dongles are merely reinvented and failing over and over, without understanding what the problems of disabled people *actually are*.

In an attempt to address such concerns, this thesis proposed and implemented an approach to support awareness and shared understanding of VI, technology and accessibility through the use of video demos and reflective design cards, which are discussed in workshop sessions featuring the participation of people *with* and *without* VI. The focus was on provoking and scaffolding conversation, centring learning and reflection over problem-solving, and responding to calls to first allow learning about disability without the pressing need to devise solutions straight away (Hofmann et al., 2020). In doing so, this thesis promotes more person-centred disability awareness activities that can prevent non-disabled designers from envisioning products that disabled people do not need or want, and that are built on incorrect assumptions about them.

In analysing participants' reactions and responses to the materials I presented to them, I found that this design critique approach provided them with opportunities to pay attention to unnoticed and unknown subjects and reflecting on their own experiential knowledge. With this work, I illustrate how HCI, and accessibility research, can take advantage of the power of demos for participatory or collaborative reflection, and contribute a deck of reflective cards that aim to centre the abilities and layered experiences of VI people. Future work should continue exploring avenues to make disabled people's access labour visible, recognised, and facilitated.

In closing, I hope that the work in this thesis helps not only in the centring of disabled perspectives in disability-specific research but also to motivate researchers of mainstream or general population technologies to involve disabled participants within their practices and processes (Williams & Gilbert, 2019a). This, in my view, is one of the greatest current challenges, and yet, an imperative direction for advancing Accessible Computing.

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Appendix A

Ethnographic Study Information

A.1 Project Information Sheet

PROJECT INFORMATION

University of Nottingham
UK | CHINA | MALAYSIA

Date: 08-Jan-2019

Project: Accessibility and Inclusive Design for Voice User Interfaces.

School of Computer Science Ethics Reference: CS-2018-R24.

Purpose of the research. This project aims to explore and understand opportunities where technology, specifically voice interfaces (like Siri, Google Assistant or Alexa), could improve accessibility. As part of this research, an ethnographic study will be carried out, through observation, fieldwork and interviews, in order to understand firsthand the needs of, and challenges presented to, people with disabilities in their day-to-day lives, as well as learning about their use of voice assistive technology.

Nature of participation. Participation in this research is voluntary and relies on you providing data.

Participant engagement. Taking part in the study requires you to engage in one or both of the following activities, arranged at your convenience between you and the researcher:

Activity 1: Interviews discussing your daily life and your use of technology within it. These will take between one and two hours. The researcher will take fieldnotes and audio recordings of the conversation. Video recordings or pictures could be taken as well if there is something arising from the interview that you would like to share, or the researcher finds relevant (e.g. use of a mobile app).

Activity 2: Researcher observation of some of your daily activities, some including use of voice technologies. It may require the researcher going along with you for a part or whole of a day. These will include fieldnotes and audio recordings of conversations, video recordings or pictures of activities relevant for the researcher (e.g. assistive technology use).

Benefits and risks of the research. Your participation may help us understand potential areas to improve Voice User Interfaces accessibility. There is a chance you may feel uncomfortable talking about subjects related to your disability, but you can refuse to answer any question or ask the researcher to stop the data collection (e.g. audio or video recordings) at any moment.

Use of your data. The data will be used by the researcher as to fulfil the study requirements to identify a range of topics that are relevant to research. Data may be used in supervision sessions to elaborate findings of the research. After analysis, personal data in results will be anonymised. Written extracts may be used as examples in written reports, conference workshops and presentations. Reports may contain transcriptions of audio/video, photographs, video frames pictures and / or written description of specific activities. All names used will be fictional. Faces will be blurred in any photograph or video used for public purposes.

Future use of your data. Your data may be archived and reused in future for purposes that are in the public interest, or for historical, scientific or statistical purposes.

Data will be stored using secure encrypted cloud storage services approved and procured by the University of Nottingham. Data will be kept in accordance with University guidelines on research data and will be destroyed after at most 7 years.

Procedure for withdrawal from the research. You may withdraw from the study at any time and do not have to give reasons for why you no longer want to take part. Your data will be destroyed and not used in any way. If you wish to withdraw please contact the researcher who gathered the data. If you receive no response from the researcher please contact the School of Computer Science's Ethics Committee.

Contact details of the ethics committee. If you wish to file a complaint or exercise your rights, you can contact the Ethics Committee at the following address: cs-ethicsadmin@cs.nott.ac.uk

A.2 Consent Form

CONSENT FORM

University of Nottingham
UK | CHINA | MALAYSIA

Date: 08-Jan-2019

Project: Accessibility and Inclusive Design for Voice User Interfaces

School of Computer Science Ethics Reference:

Please tick the appropriate boxes	Yes	No
1. Taking part in the study		
a) I have read and understood the project information sheet dated 08/01/2019 or it has been read to me. I have been able to ask questions about the study and my questions have been answered satisfactorily.	☐	☐
b) I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
c) I understand that taking part in the study requires taking part in interviews and allowing the researcher to observe and record audio and video of some of my daily activities, including my use of assistive technologies.	☐	☐
2. Use of my data in the study		
a) I understand that data which can identify me will not be shared beyond the project team.	☐	☐
b) I agree that the data provided by me may be used for the following purposes:		
– Presentation and discussion of the project and its results in research activities (e.g., in supervision sessions, project meetings, conferences).	☐	☐
– Publications and reports describing the project and its results.	☐	☐
– Dissemination of the project and its results, including publication of data on web pages and databases.	☐	☐
c) I give permission for my words to be quoted for the purposes described above, using a pseudonym in order to protect my identity.	☐	☐
d) I give permission for my visual image contained in photos or video gathered during the research to be used for the purposes described above. My face will be blurred in order to protect my identity.	☐	☐

Please tick the appropriate boxes	**Yes**	**No**
3. Reuse of my data		
a) I give permission for the data that I provide to be reused for the sole purposes of future research and learning. In accordance with University guidelines, it will be destroyed after 7 years.	☐	☐
b) I understand and agree that this may involve depositing my data in a data repository, which may be accessed by other researchers other than those involved in this project.	☐	☐
4. Security of my data		
a) I understand that safeguards will be put in place to protect my identity and my data during the research, and if my data is kept for future use.	☐	☐
b) I confirm that a written copy of these safeguards has been given to me in the University's privacy notice, and that they have been described to me and are acceptable to me.	☐	☐
c) I understand that no computer system is completely secure and that there is a risk that a third party could obtain a copy of my data.	☐	☐
5. Copyright		
a) I give permission for data gathered during this project to be used, copied, excerpted, annotated, displayed and distributed for the purposes to which I have consented.	☐	☐

6. Signatures (sign as appropriate)

______________________	______________________	________
Name of participant (IN CAPITALS)	Signature	Date

If applicable:

For participants unable to sign their name, mark the box instead of signing ☐

I have witnessed the accurate reading of the consent form with the participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

______________________	______________________	________
Name of witness (IN CAPITALS)	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

A.3 Fieldwork Questions

Guiding questions for sessions. Remind participants that all their personal data will be anonymised in written reports and their identity will be protected.

- Participant number
- Role/Stakeholder type
- Demographic data: age, gender, visual condition. Remind them that it's OK if they don't want to answer some of these.
- Everyday life
  - Occupation
  - Tell me about your typical day. What activities do you normally do?
  - Home arrangements and assistance.
  - Type of barriers encountered in day-to-day.
- Technology use
  - What technologies?
  - Purpose. What are you trying to achieve?
  - How often do you use it?
  - In which context?
  - Typical use case
  - Describe or rate overall experience
  - Suggested changes/improvements
  - Is there something you would like to do with it, that is not possible at the moment?
  - Accessibility perceptions
- Follow-up observations from mentioned use cases.

Thank participants and give inconvenience allowance.

Appendix B

Transcription Notation

The notation used for transcribing and presenting the data fragments in this thesis borrows elements from existing transcription conventions (e.g. Heath et al., 2010), however adaptations have been made for simplicity, solely attending to features of talk and action relevant to the data fragments presented. The transcript notation used is as follows:

- Embodied interactions or other events that are not talk are represented between ((double parenthesis))
- Brief pauses are represented by (.), some indicate duration in seconds (1.5).
- Interrupted or cut off talk is followed by a dash (-)
- Contiguous utterances with no interval between them are followed and started by equal signs (=)
- Other characters indicate how the talk was delivered, >fast<, °quiet°, or elonga::ted
- Square [brackets] and indentation over two or more lines indicate overlapping talk or actions
- Blank spaces ( ) between single paragraphs indicate inaudible or unintelligible talk
- Text between (single parenthesis) indicate unclear but estimated talk
- Omitted talk is represented by ellipsis (...) for clarity and conciseness

- In addition to talk and actions by participants (P#/name) and investigator (INVE), the transcripts include talk, sounds and visual indications by devices (PHONE), screen readers (VO, JAWS) and voice assistants such as Siri (SIRI) and Google Assistant (GA)
- Anonymised [NAMES], [PLACES], and other [PERSONAL-INFO] mentioned in talk appear in squared brackets and caps

Appendix C

Fragments in Chapter 4

C.1 Text messaging through a voice assistant

This fragment comprises segments 4.1a, 4.1b, 4.1c, and 4.1d.

```
P1   : one of the most common parts of Siri that a lot of visually impaired and
P1   : blind people do use is ask to message or phone- make phone calls (.) for
P1   : example ((presses home button))
SIRI : ((listening))
```


```
P1   : (1.1) make- send a message to [NAME]
SIRI : (2) what do you want to say? ((beeps))
P1   : so therefore is asking me the message
P1   : ((stops Siri by pressing the home button again))
P1   : ((presses home button))
SIRI : ((listening))
P1   : message [NAME]
SIRI : (1.5) what do you want to say? ((beeps))
P1   : [ hello (.) how are you?          ]
P1   : [((moves phone closer to his face))]((moves phone away from his face))
```


```
15 SIRI : (2.4) ((beeps)) here's your message (0.5) ready to send it? ((beeps))=
16 P1   : =yes
17 SIRI : (0.6) ((beeps)) okay (.) it's sent ((beeps))
18 P1   : so I've just messaged a friend in another room and now he would've
19 P1   : received that message
20 P1   : it saves me going into my phone if I'm out and about in public
21 P1   : and again it's a confidence thing
22 P1   : I don't really like having to hold my phone right to my face
23 P1   : ((moves phone very close to his face))
```

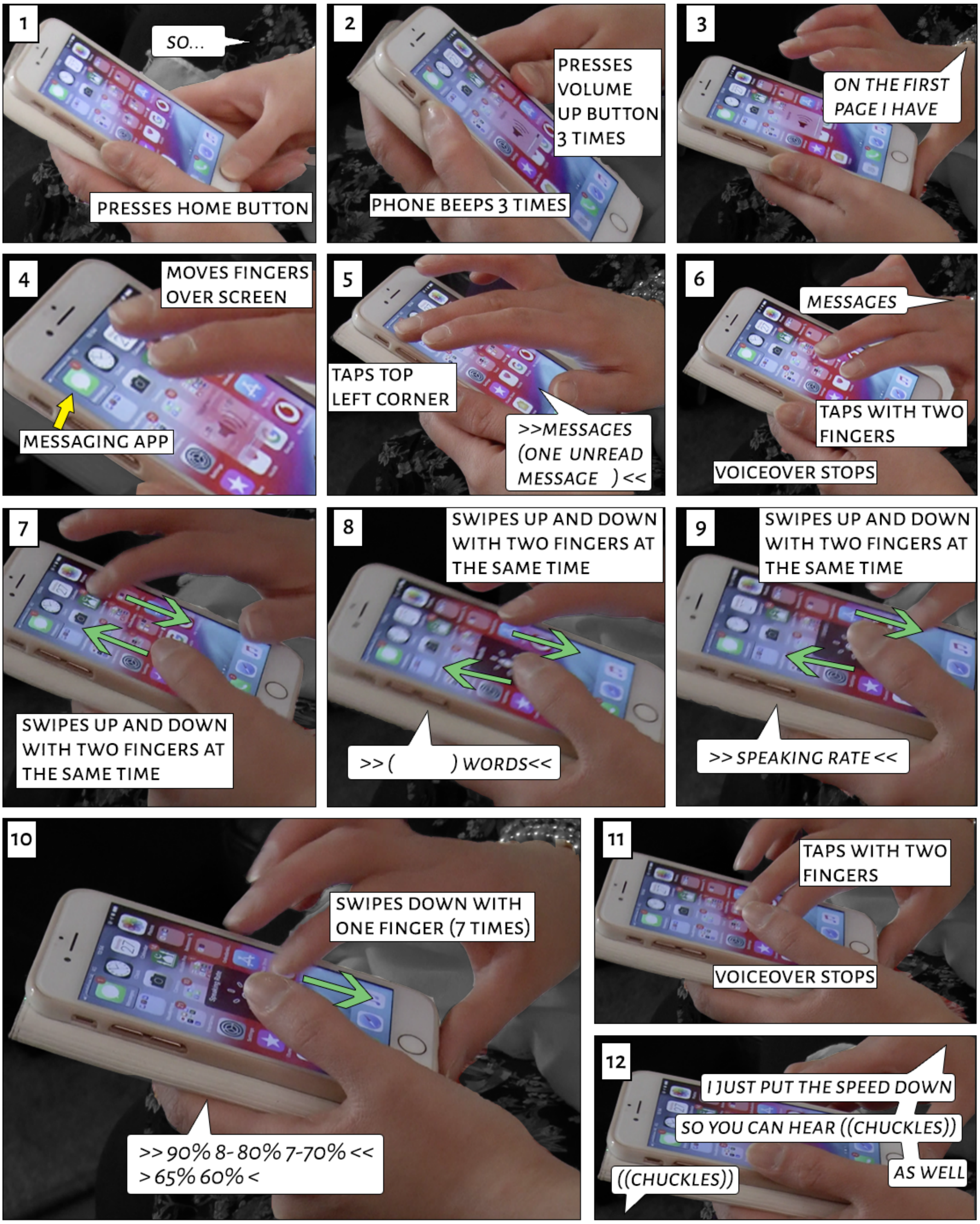
```
24 P1   : so when I've got my headphones in
25 P1   : headphone jack at the bottom ((points at the bottom of the phone))
26 P1   : I can just make a basic Siri command to send a message
27 P1   : it's the same again with a phone call
```

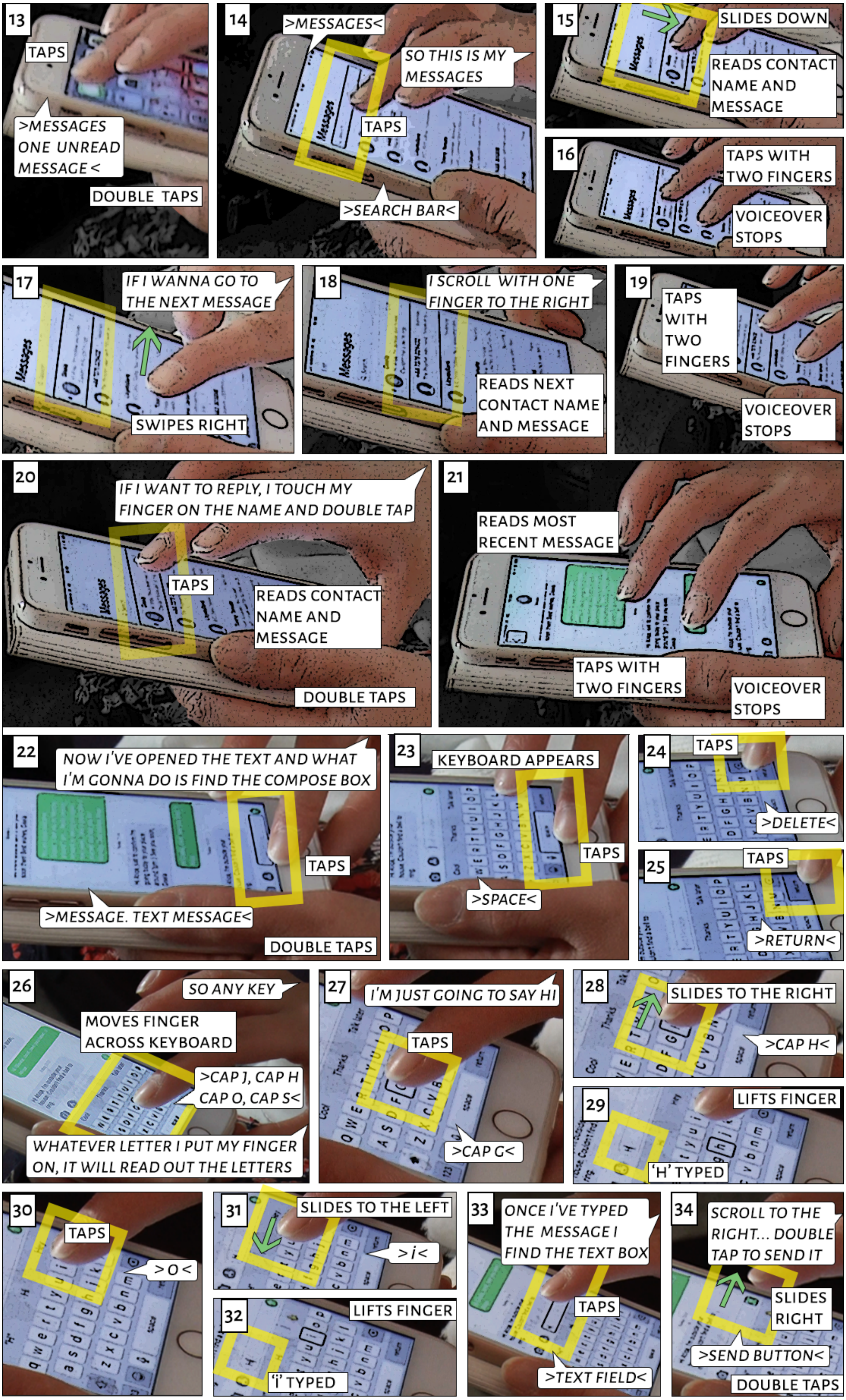
The following occurred after I prompted the participant to repeat the activity but with VoiceOver on, and after he enabled such a feature.

```
28 P1   : ((presses home button))
29 SIRI : ((beeps)) ((listening))
30 P1   : message [NAME]
31 SIRI : ((beeps)) (1.1) what do you want to say? ((beeps))=
32 P1   : =good afternoon (.) how are you?
33 SIRI : (2.5) ((beeps)) your message to [NAME] says good afternoon how are you?
34 SIRI : ready to send it? ((beeps))=
35 P1   : =yes
36 SIRI : (0.6) ((beeps)) okay (.) it's sent ((beeps))
37 P1   : the thing is (...) when you do send a message with VoiceOver on
38 P1   : it will read back the message you've just said (...)
39 P1   : so I know what's been said or if there's been any grammatical mistakes
```

C.2 Text messaging through a mobile screen reader

This fragment comprises segments 4.2a, 4.2b, 4.2c, 4.2d and 4.2e.



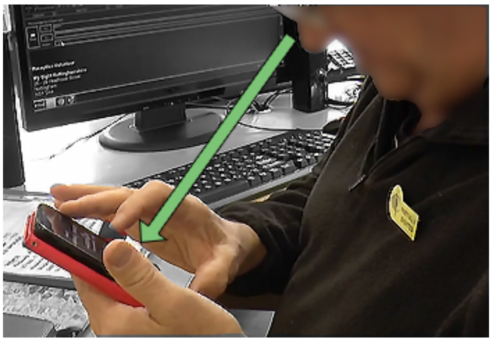

13
TAPS
>MESSAGES ONE UNREAD MESSAGE<
DOUBLE TAPS
14
>MESSAGES<
SO THIS IS MY MESSAGES
TAPS
>SEARCH BAR<
15
SLIDES DOWN
READS CONTACT NAME AND MESSAGE
16
TAPS WITH TWO FINGERS
VOICEOVER STOPS
17
IF I WANNA GO TO THE NEXT MESSAGE
SWIPES RIGHT
18
I SCROLL WITH ONE FINGER TO THE RIGHT
READS NEXT CONTACT NAME AND MESSAGE
19
TAPS WITH TWO FINGERS
VOICEOVER STOPS
20
IF I WANT TO REPLY, I TOUCH MY FINGER ON THE NAME AND DOUBLE TAP
TAPS
READS CONTACT NAME AND MESSAGE
DOUBLE TAPS
21
READS MOST RECENT MESSAGE
TAPS WITH TWO FINGERS
VOICEOVER STOPS
22
NOW I'VE OPENED THE TEXT AND WHAT I'M GONNA DO IS FIND THE COMPOSE BOX
TAPS
>MESSAGE. TEXT MESSAGE<
DOUBLE TAPS
23
KEYBOARD APPEARS
TAPS
>SPACE<
24
TAPS
>DELETE<
25
TAPS
>RETURN<
26
SO ANY KEY
MOVES FINGER ACROSS KEYBOARD
>CAP J, CAP H CAP O, CAP S<
WHATEVER LETTER I PUT MY FINGER ON, IT WILL READ OUT THE LETTERS
27
I'M JUST GOING TO SAY HI
TAPS
>CAP G<
28
SLIDES TO THE RIGHT
>CAP H<
29
LIFTS FINGER
'H' TYPED
30
TAPS
>O<
31
SLIDES TO THE LEFT
>i<
32
LIFTS FINGER
'i' TYPED
33
ONCE I'VE TYPED THE MESSAGE I FIND THE TEXT BOX
TAPS
>TEXT FIELD<
34
SCROLL TO THE RIGHT... DOUBLE TAP TO SEND IT
SLIDES RIGHT
>SEND BUTTON<
DOUBLE TAPS

C.3 Text messaging through a dictation feature

This fragment comprises segments 4.3a, 4.3b, 4.3c and 4.3d.

1 P6 : my settings have gone a bit weird ((opens settings))
2 P6 : just trying to find the accessibility setting because again ((scrolls))
3 P6 : there is already built in the phone these various options you can have
4 P6 : one which is what they call colour inversion
5 P6 : ((enables colour conversion setting))

6 P6 : so it does that the same as the computer and I can cope with that better
7 P6 : cause when it's a light screen I do struggle with the contrast
8 P6 : so I need it darker and then I should be able to find what I'm looking for
9 P6 : ((opens messages and scrolls through conversations))

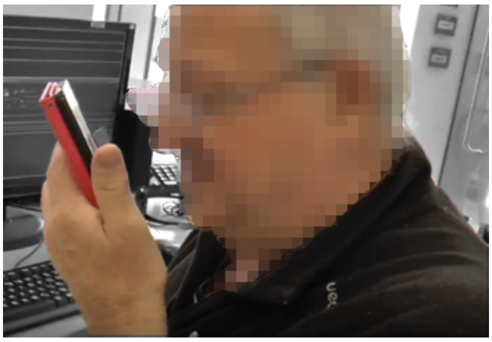


10 P6 : okay so I just tap on there ((taps on name)) ((conversation opens))


11 P6 : and then tap on type your message and then
12 P6 : instead of typing it it's got the voice key there ((taps on text box))

13 P6 : ((keyboard is displayed)) ((taps voice key))

14 PHONE : ((beeps))
15 P6 : and just go
16 P6 : ((phone close to face)) ((dictates message)) ((moves phone back away))

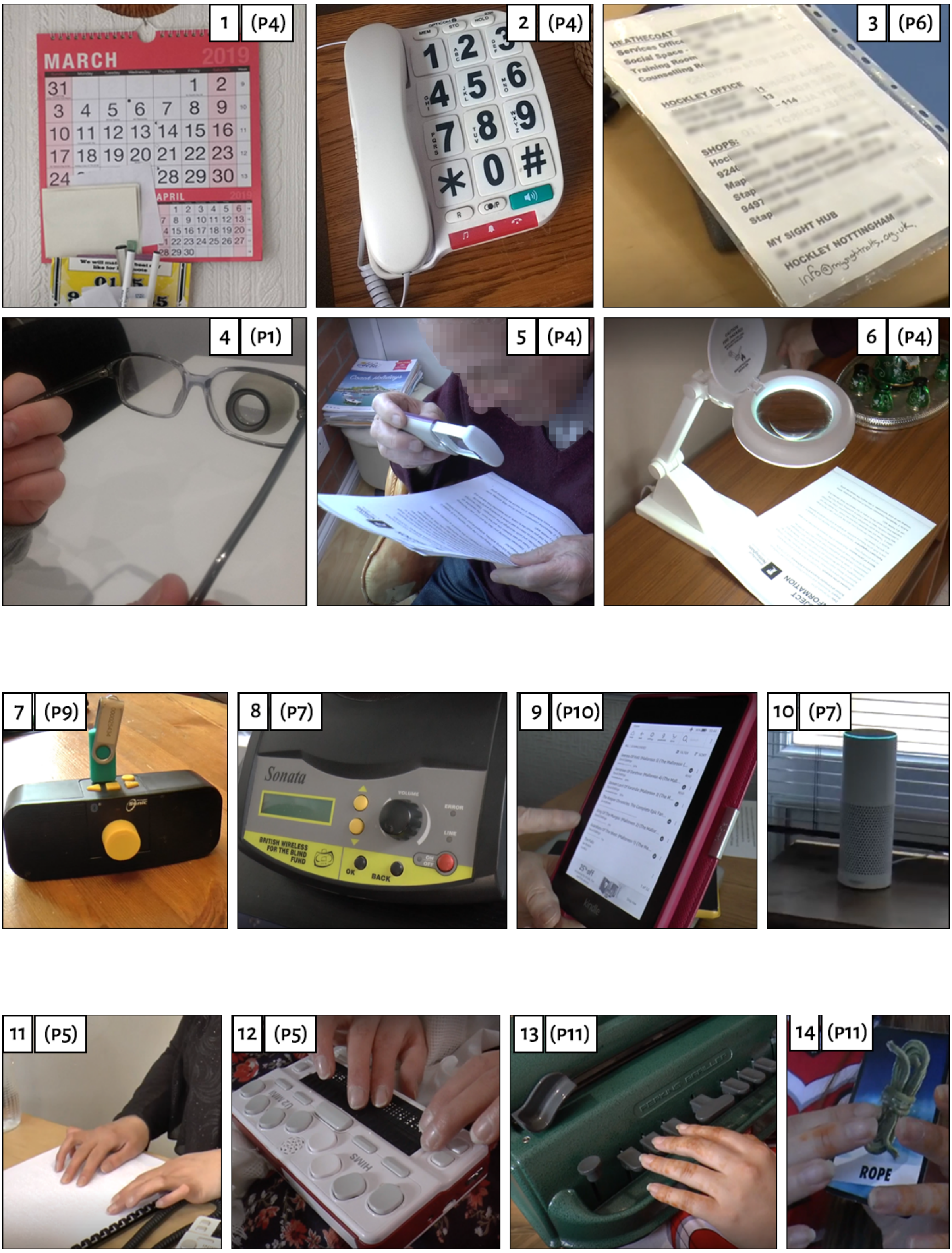


17 P6 : and it comes up so I don't have to type it
18 P6 : and then all you have to do is that key there to send it ((presses key))

19 PHONE : ((sends message))
20 P6 : and it's gone (.) so much simpler
21 P6 : I mean that would take me-
22 P6 : even that little message would take me you know three times as long
23 P6 : trying to find the keys and everything so that is
24 P6 : that is really helpful
25 P6 : especially like if outside is (.) is a bright sunny day
26 P6 : I've got no chance of finding the keys
27 P6 : so to be able to actually speak the text is marvellous

C.4 Reading through large-print, Braille, and other dedicated devices

This fragment comprises segments 4.4a, 4.4b, and 4.4c.



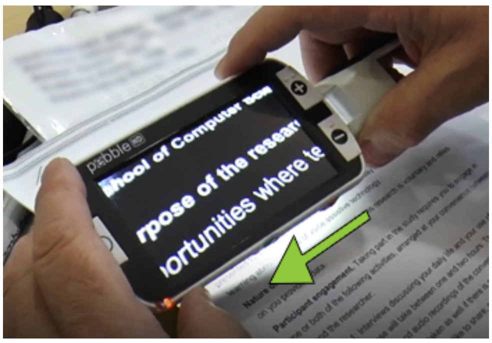
C.5 Reading a printed document through a portable electronic magnifier

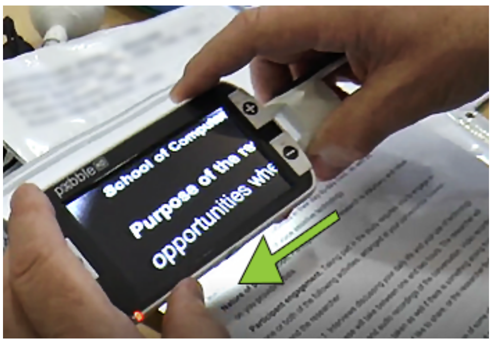
This fragment comprises segments 4.5a, 4.5b, and 4.5c.

```
P6  : I have a hand-held electronic magnifier
P6  : which if I had got the time
P6  : ((turns device on))
```

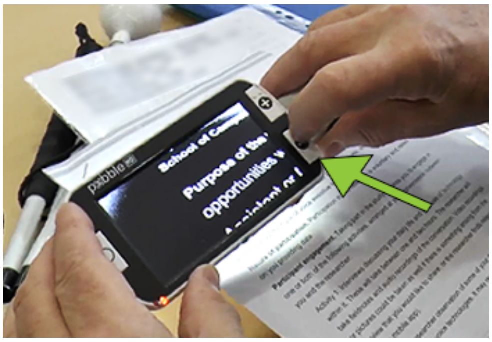

```
P6  : to go through like the consent form that we've just filled in
P6  : I could've probably done it eventually
P6  : but it would've took me a considerable amount of time
P6  : you know but I use this to help me do things
P6  : ((aligns sheet on the desk)) ((holds device over sheet with two hands))
```

```
P6  : so like I say it would've- I would've done this eventually
P6  : but it would take considerable time
P6  : ((slides device to the left))
```





```
P6  : and this has got an increase
P6  : you can increase it or decrease it
P6  : ((presses (-) button two times)) ((font decreases size))
```

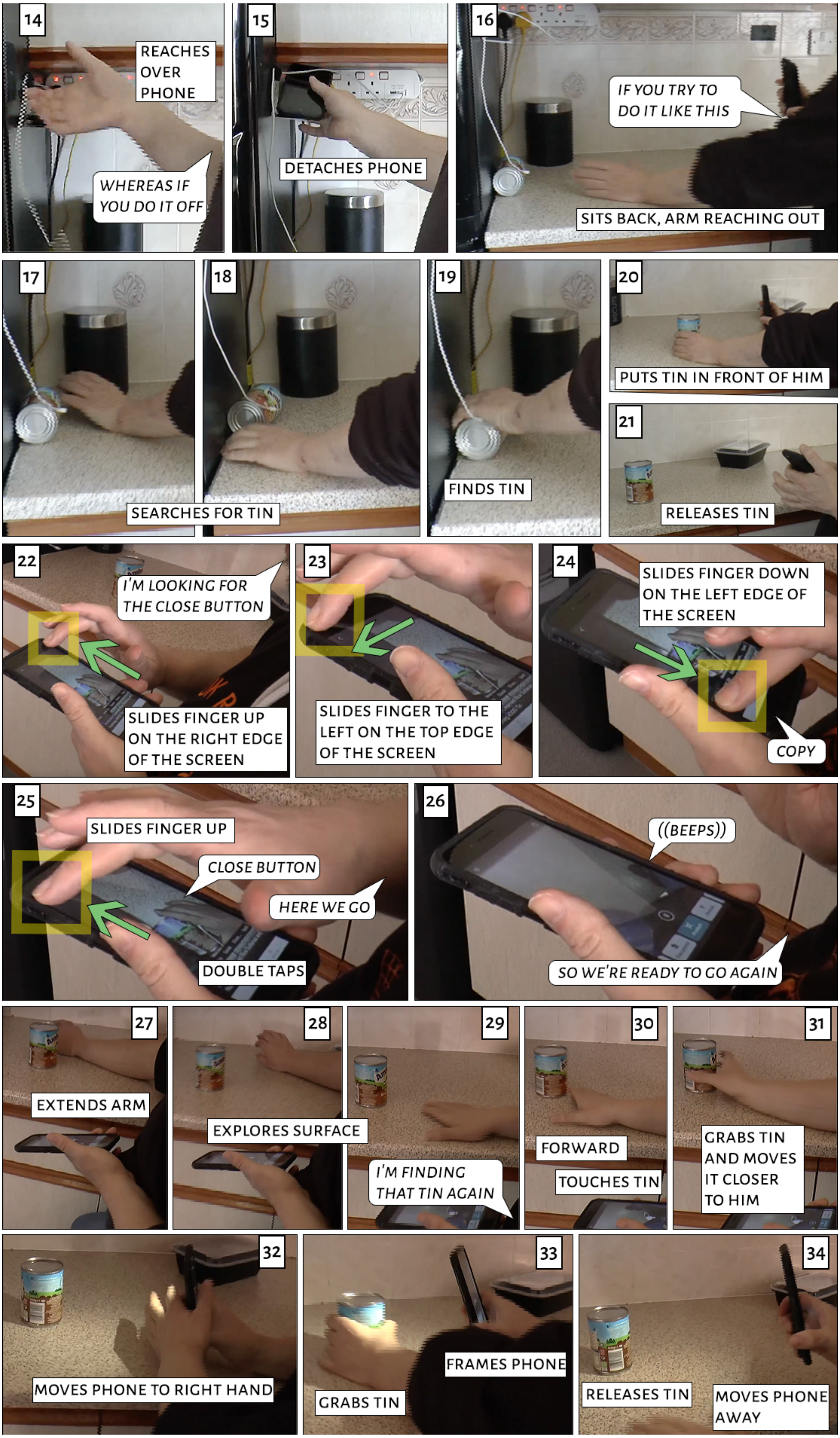


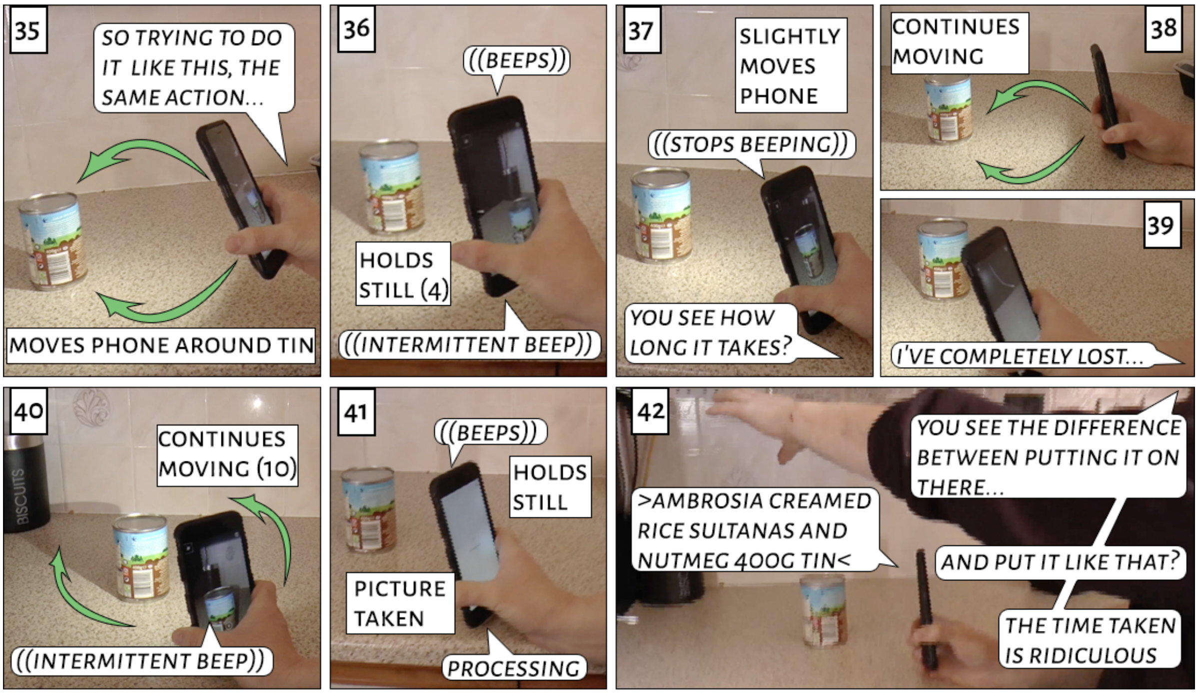
```
P6  : I prefer white writing on a black background (...)
P6  : and like I said depending on how big the print is you can actually
P6  : ((presses (+) button multiple times)) ((font increases size))
```

```
P6  : bring it up really large
P6  : so the only trouble with that is it does take a bit of time
P6  : but otherwise that helps me enormously
P6  : not just on here but everywhere
```

C.6 Reading a tin label through an Object Character Recognition app

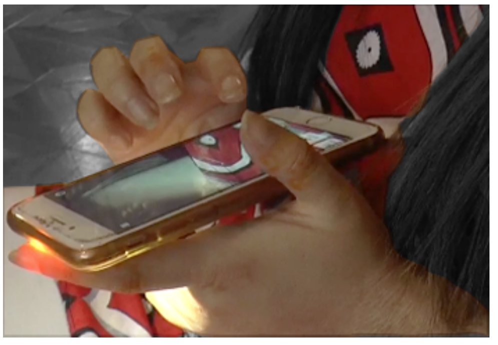
This fragment comprises segments 4.6a, 4.6b, 4.6c, 4.6d, 4.6e, and 4.6f.


14
REACHES OVER PHONE
WHEREAS IF YOU DO IT OFF
15
DETACHES PHONE
16
IF YOU TRY TO DO IT LIKE THIS
SITS BACK, ARM REACHING OUT
17
18
SEARCHES FOR TIN
19
FINDS TIN
20
PUTS TIN IN FRONT OF HIM
21
RELEASES TIN
22
I'M LOOKING FOR THE CLOSE BUTTON
SLIDES FINGER UP ON THE RIGHT EDGE OF THE SCREEN
23
SLIDES FINGER TO THE LEFT ON THE TOP EDGE OF THE SCREEN
24
SLIDES FINGER DOWN ON THE LEFT EDGE OF THE SCREEN
COPY
25
SLIDES FINGER UP
CLOSE BUTTON
HERE WE GO
DOUBLE TAPS
26
((BEEPS))
SO WE'RE READY TO GO AGAIN
27
EXTENDS ARM
28
EXPLORES SURFACE
29
I'M FINDING THAT TIN AGAIN
30
FORWARD
TOUCHES TIN
31
GRABS TIN AND MOVES IT CLOSER TO HIM
32
MOVES PHONE TO RIGHT HAND
33
FRAMES PHONE
GRABS TIN
34
RELEASES TIN
MOVES PHONE AWAY

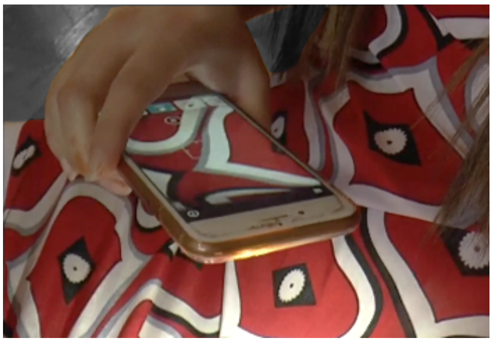

35
SO TRYING TO DO IT LIKE THIS, THE SAME ACTION...
MOVES PHONE AROUND TIN
36
((BEEPS))
HOLDS STILL (4)
((INTERMITTENT BEEP))
37
SLIGHTLY MOVES PHONE
((STOPS BEEPING))
YOU SEE HOW LONG IT TAKES?
38
CONTINUES MOVING
39
I'VE COMPLETELY LOST...
40
CONTINUES MOVING (10)
((INTERMITTENT BEEP))
41
((BEEPS))
HOLDS STILL
PICTURE TAKEN
PROCESSING
42
YOU SEE THE DIFFERENCE BETWEEN PUTTING IT ON THERE...
>AMBROSIA CREAMED RICE SULTANAS AND NUTMEG 400G TIN<
AND PUT IT LIKE THAT?
THE TIME TAKEN IS RIDICULOUS

C.7 Detecting colours through an Object Character Recognition app

```
1  P11   : ((scrolls through scanning modes in Seeing AI))
```



```
2  PHONE : colour preview
3  P11   : [that's colour
4  PHONE : [green and grey
5  P11   : [but that's not accurate completely
6  PHONE : [red (.) brown (.) grey
7  P11   : ((holds phone over dress))
```



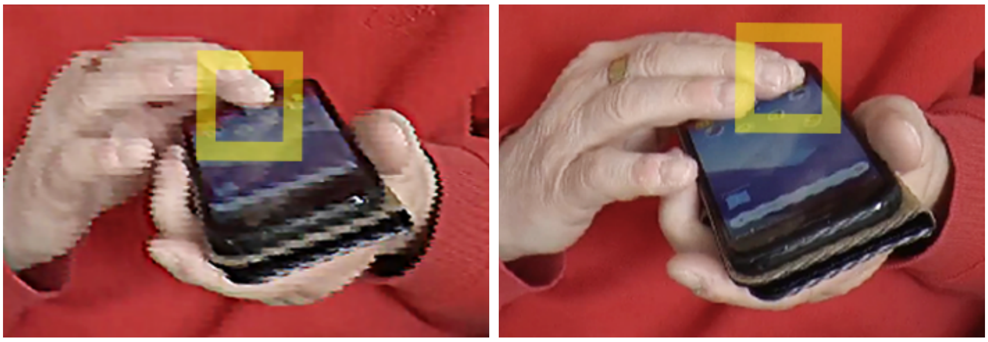
```
8  PHONE : red and brown
9  P11   : (...) so it detects the colour
10 P11   : (...) just sometimes when I'm getting ready
11 P11   : I do like it to be on my clothes
12 P11   : right? so it tells me what colour it is
13 P11   : but I don't rely on it a hundred per cent
14 P11   : I would ask someone as well
```

C.8 Moving inside the home through specific space arrangements

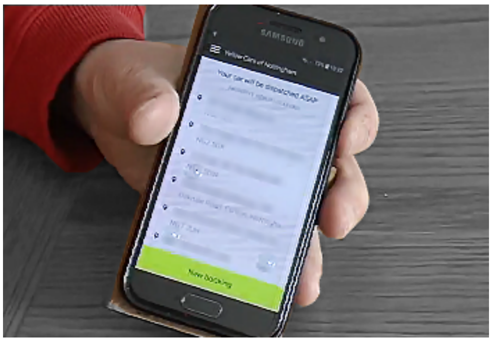
C.9 Booking a taxi through a mobile app

```
1 P7    : there's an app on there called yellow cars
2 P7    : ((shows home screen)) right to the bottom
```

```
3 P7    : [ ((taps on the bottom)) ((taps slightly to the left))
4 PHONE : [       apps (.)                  messages (.)      yellow cars
```



```
5 P7    : ((double taps to open))
6 P7    : and you'll see the list of places there ((shows screen))
```



```
7 P7    : so if I want to go to [PLACE] I tap on [HOME-ADDRESS]
8 P7    : and then it'll give me destination
9 P7    : I tap on [PLACE-ADDRESS] (...) then I will place booking
10 P7   : then it will say pay by cash
11 P7   : and then I select yes and place booking or done usually
12 P7   : and then I get a text saying that the car's been booked
13 P7   : and then when it's been dispatched
14 P7   : I get the text to tell me it's been dispatched and who the driver is
```

C.10 Taking the dog for a walk without technological aid

P10 : when I take the dog out for a walk I go the same route
P10 : because I trip over things and as I get older I find it more difficult
P10 : so I go the same route every day
P10 : the dog I keep on the lead
P10 : I used to take him off the lead
P10 : but there’s no way I can catch him if he runs off
P10 : I’ve got poo bags and I pick up after him
P10 : but I have to be literally behind him to see where he does it
P10 : cause if he does it a distance away from me
P10 : although I’ve got a rough idea where he’s done it
P10 : when I get close to it I can’t see it
P10 : with such things like that
P10 : when I get from a distance I can see what I’ve missed

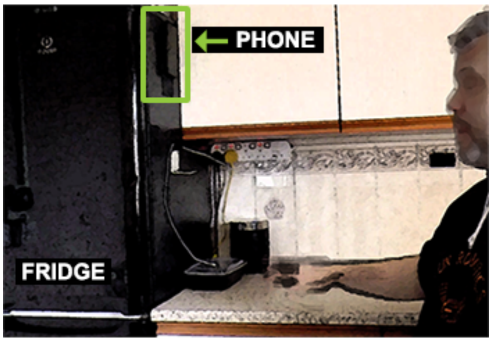
Appendix D

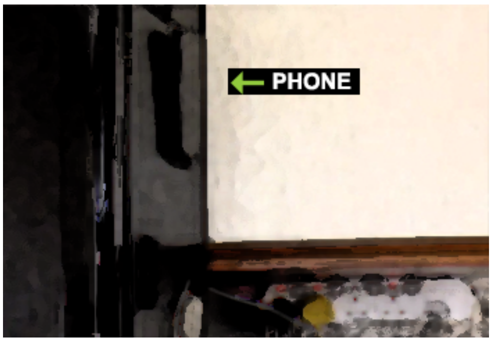
Fragments in Chapter 5

D.1 Demonstrating a non-digital tool at home

This fragment comprises segments 5.1a, 5.1b, and 5.1c.

```
1 NICK:  hi I'm Nick em I am visually impaired (well) er I'm severely sighted
```






```
2 NICK:  ┌ now as you can see I've got my mobile phone
3 NICK:  └ ((reaches fridge surface))
```

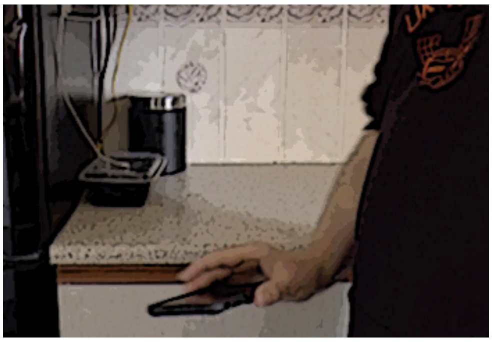
```
 4 NICK:   [ which is in a protective case
 5 NICK:   [ ((feels his way to the phone and holds it))
```

```
 6 NICK:  that's attached to the fridge
 7 NICK:   [ and one I use is a Velcro patch on the back of my phone
 8 NICK:   [ ((takes phone from fridge))             ((shows Velcro patch))
```


```
 9 NICK: so what happens is
10 NICK: ((puts phone on counter))
```

```
11 NICK:  [if I put (0.8) my phone o:n the:re (0.9) if I:: come awa:y (0.7) I'm at
12 VO  :  [   one notification  (.)  fro:m  (0.5) twenty one hours ago (           )
```

```
13 NICK: ┌(0.3) risk of (1.4) >dropping it on the floor< (1.5) and damaging the phone
14 NICK: └          ((simulates dropping the phone from kitchen counter))
```



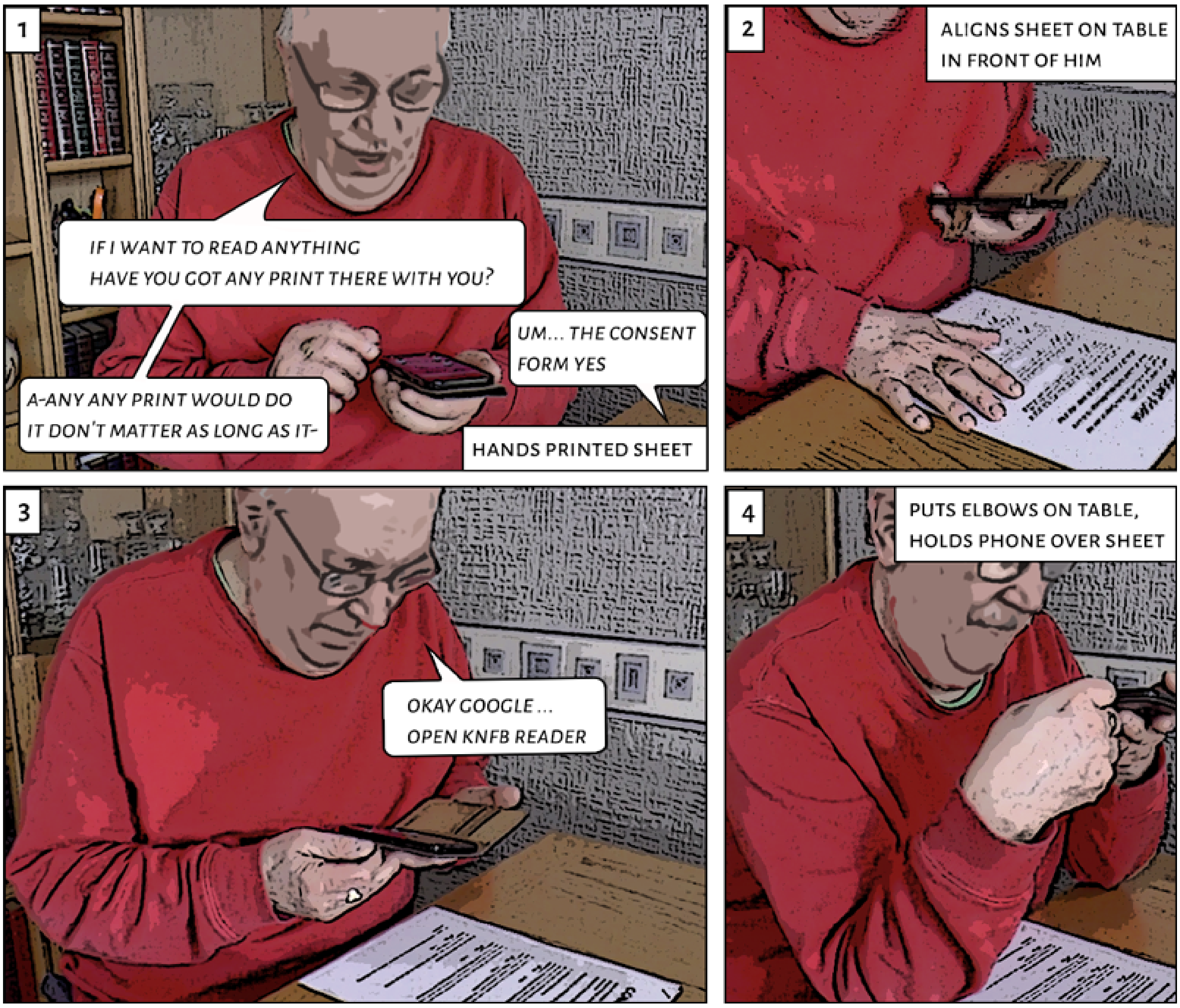

```
15 NICK: ┌ so: the whole idea is to put the phone out of the wa:y
16 VO  : │ one notification (.) fro:m  (0.5) twenty one hours ago (              )
17 NICK: └ ((feels the Velcro on fridge))     ((feels the Velcro patch on phone))
```

```
18 NICK: ┌      like so  (2)
19 NICK: └ ((attaches phone back to fridge))
```


```
20 NICK: now (.) one of the things that-
21 NICK: one of the: things that I do like to use is SIRI
22 NICK: and I'll give you an example (.) HEY SIRI WHAT TIME IS IT?
```

D.2 Demonstrating a digital tool to extract information from the physical world

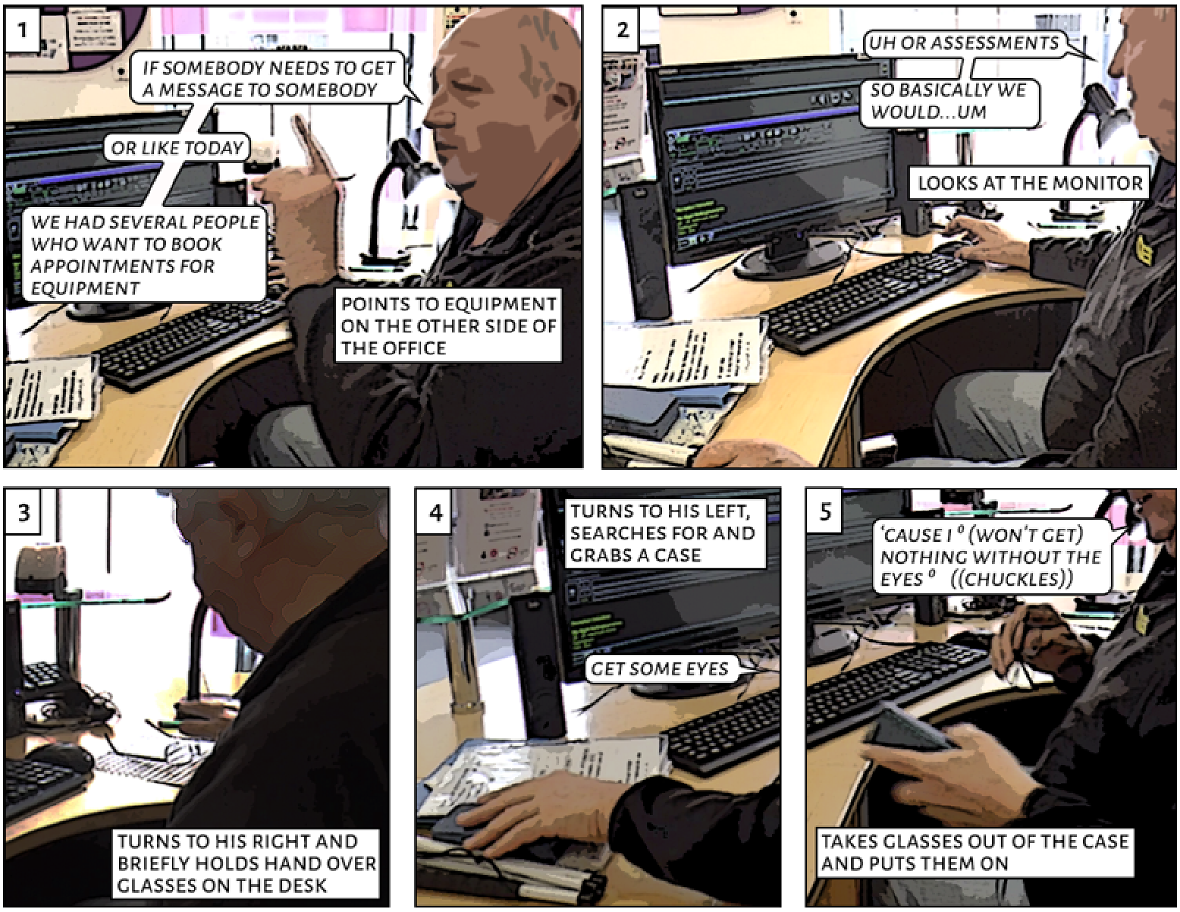
This fragment comprises segments 5.2a, 5.2b, and 5.2c.

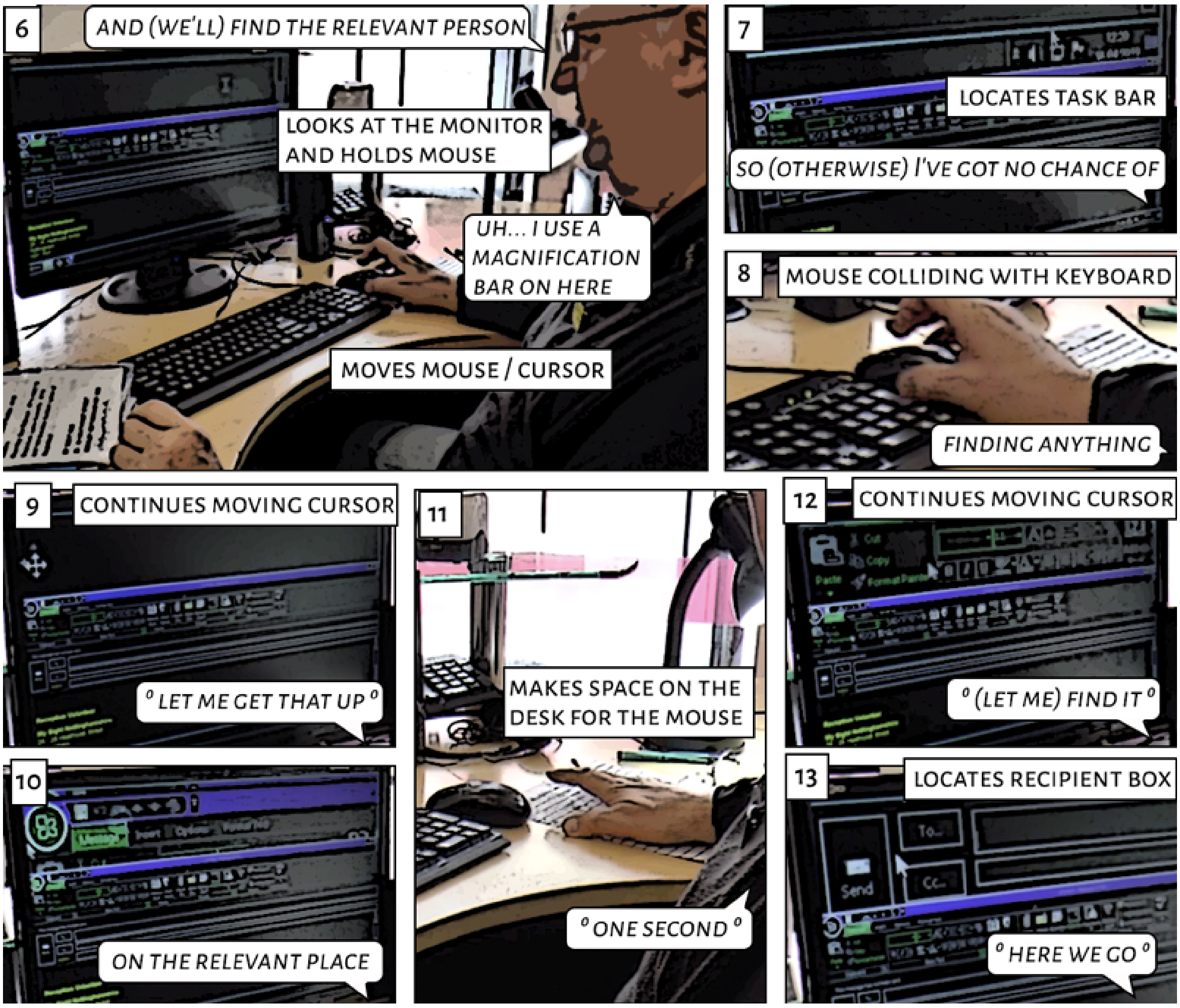


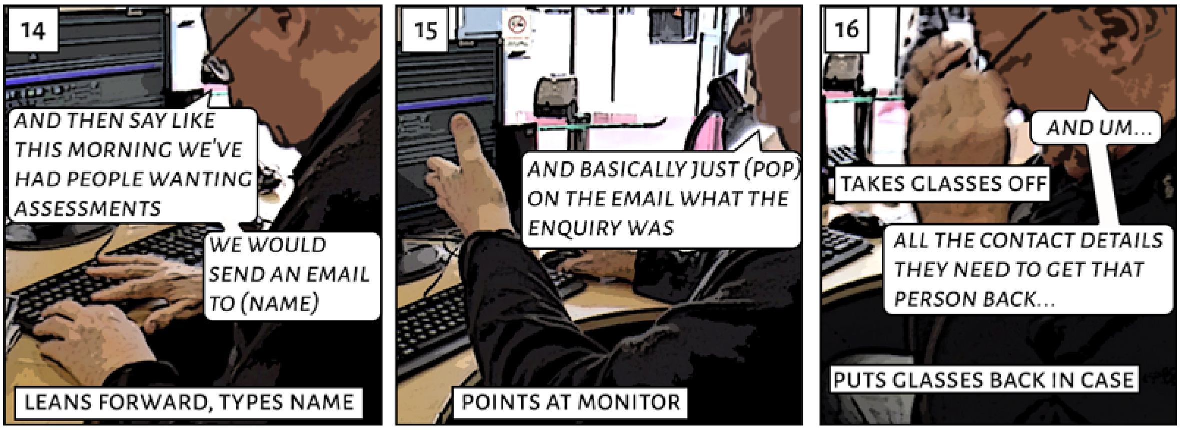

5
TAPS ON SCREEN
TAPS ON SCREEN
TAPS ON SCREEN
TAPS ON SCREEN
KNFB READER
FAIL TO VIEW
FAIL TO VIEW
FAIL TO VIEW
6
((TUTS))
° (START) AGAIN°
HOLD CAMERA POSITION RELATIVE TO THE DOCUMENT
SHUFFLES THE SHEET
7
RESEATS HIMSELF
8
PUTS ELBOWS BACK ON TABLE
9
CIRCULAR MOVEMENT WITH PHONE, SQUINTS, HOLDS PHONE STEADY
10
TAPS ON SCREEN
DOUBLE TAPS
TAKE PICTURE
((FLASH AND SHOOTS))
11
THERE WE GO
((READS TEXT ON SHEET FOR 12 SECONDS))
OKAY
12
TAKES ELBOWS OFF THE TABLE AND SLIDES SHEET BACK
HERE'S YOUR PRINT
OKAY IS THAT ENOUGH?
YES
YEAH
OKAY. THAT'S HOW I READ MAIL IT'S NOT ONE OF THE MOST POPULAR APPS BUT I LIKE IT

D.3 Demonstrating a workplace task using a digital device

This fragment comprises segments 5.3a, 5.3b, and 5.3c.

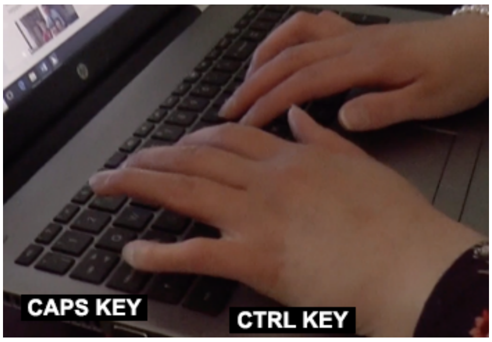



6
AND (WE'LL) FIND THE RELEVANT PERSON
LOOKS AT THE MONITOR AND HOLDS MOUSE
UH... I USE A MAGNIFICATION BAR ON HERE
MOVES MOUSE / CURSOR
7
LOCATES TASK BAR
SO (OTHERWISE) I'VE GOT NO CHANCE OF
8
MOUSE COLLIDING WITH KEYBOARD
FINDING ANYTHING
9
CONTINUES MOVING CURSOR
°LET ME GET THAT UP°
10
ON THE RELEVANT PLACE
11
MAKES SPACE ON THE DESK FOR THE MOUSE
°ONE SECOND°
12
CONTINUES MOVING CURSOR
°(LET ME) FIND IT°
13
LOCATES RECIPIENT BOX
°HERE WE GO°


14
AND THEN SAY LIKE THIS MORNING WE'VE HAD PEOPLE WANTING ASSESSMENTS
WE WOULD SEND AN EMAIL TO (NAME)
LEANS FORWARD, TYPES NAME
15
AND BASICALLY JUST (POP) ON THE EMAIL WHAT THE ENQUIRY WAS
POINTS AT MONITOR
16
AND UM...
TAKES GLASSES OFF
ALL THE CONTACT DETAILS THEY NEED TO GET THAT PERSON BACK...
PUTS GLASSES BACK IN CASE

D.4 Demonstrating complex actions using a digital device

ALICE: so if I want to know what document is this so I press er::
ALICE: ((hands resting over keyboard))



ALICE: ((presses caps lock key)) um °one second° ((holds down caps + ( ) keys))
JAWS: ((reads)) (0.5)
ALICE: ((stops JAWS by pressing control key)) so this er::
ALICE: like a: (.) er:: space bar?
INVE: uh huh
ALICE: (no) capital key (.) caps::
ALICE: (.) caps ah key isn't it? ((presses caps lock key))
INVE: (yes) yes
ALICE: caps key I press down (and) hold this down and then press T
ALICE: ((presses and holds down caps key)) ((presses T key))
JAWS: ((reads document title)) (2)
ALICE: ((stops JAWS)) what article this (.) so read the document's name
ALICE: (what's) actually mean I mean (.) what document is it

Appendix E

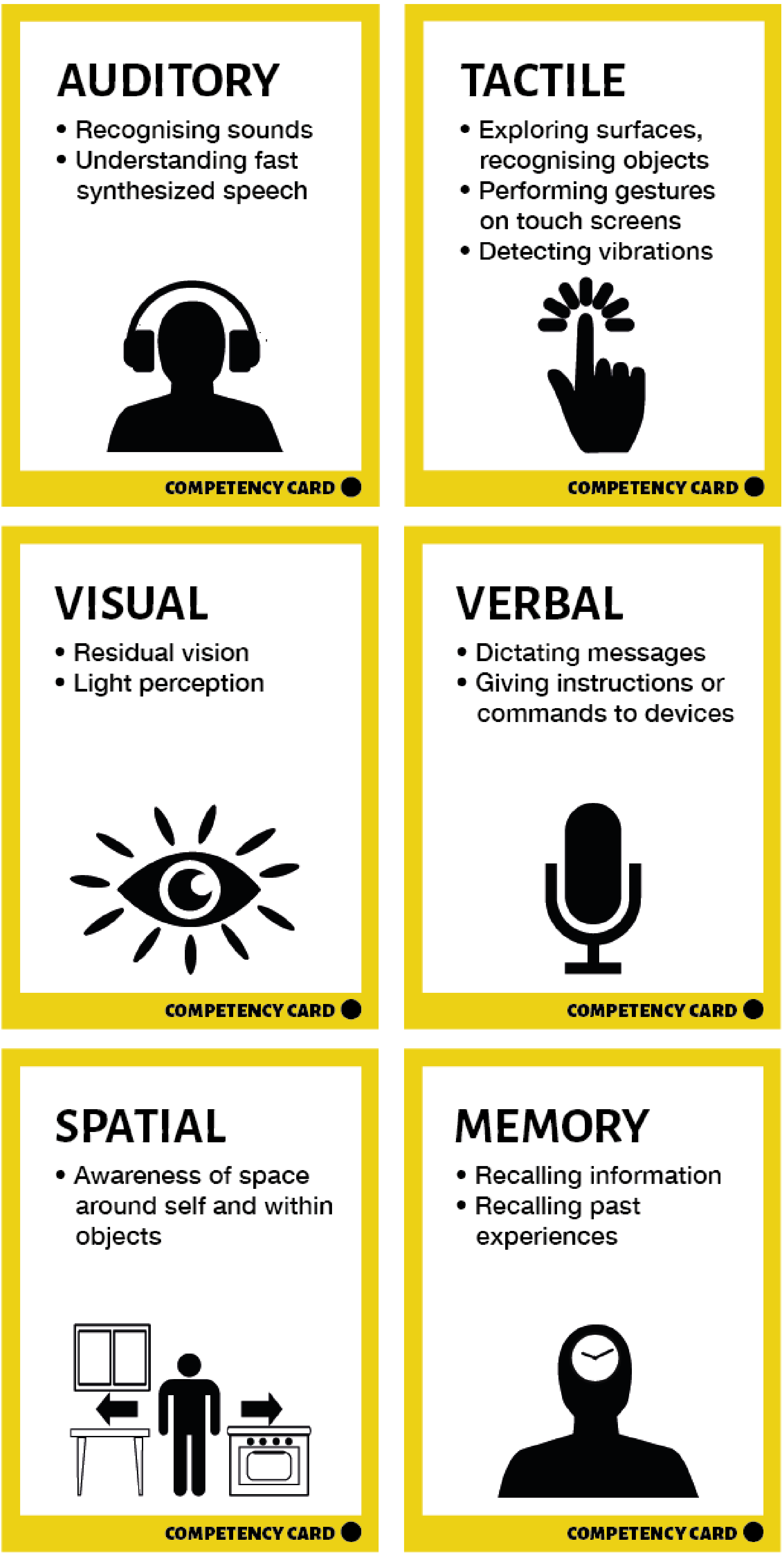
Reflective Design Cards of Visual Impairments: Full Deck

There are 39 cards in total, grouped in the following 5 categories: competency, tool, activity, relation and location. Each category has a colour and a shape to identify the cards:

- Competency Cards –yellow, circle.
- Tool Cards –green, triangle.
- Activity Cards –blue, square.
- Relation Cards –red, diamond.
- Location Cards –purple, star.

Each card consists of a title, a short description, an image, the category name and the category shape. All images are black and white illustrations. The following sections contain the 39 cards.

E.1 Competency Cards



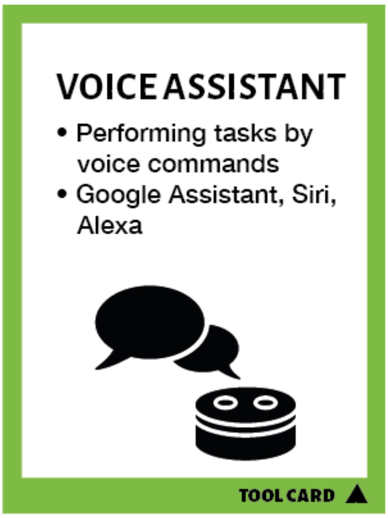

ASSISTANCE
• Getting help
• Providing support
COMPETENCY CARD

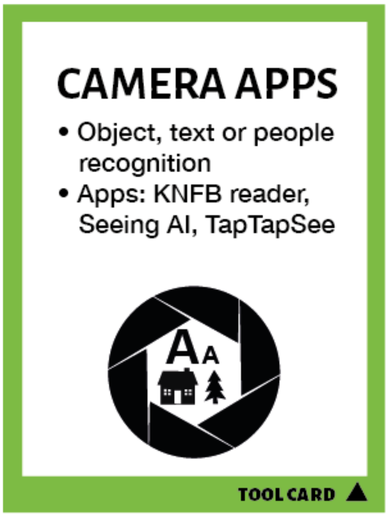

VISIBILITY
• Hiding or showing impairment in front of others
COMPETENCY CARD

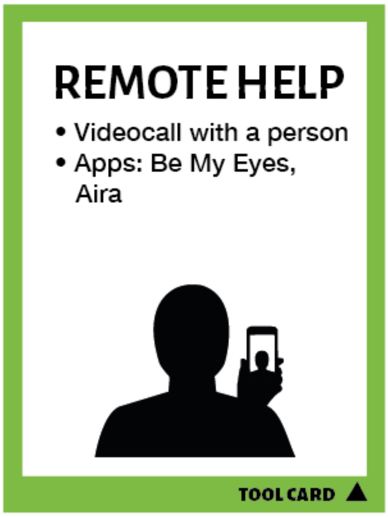

NEGOTIATION
• Managing access needs or conflicts
COMPETENCY CARD

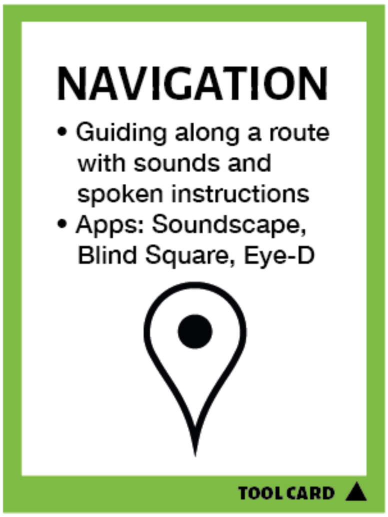

?
Any other competency
COMPETENCY CARD

E.2 Tool Cards



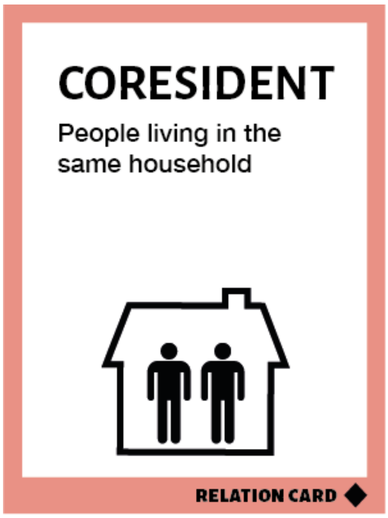


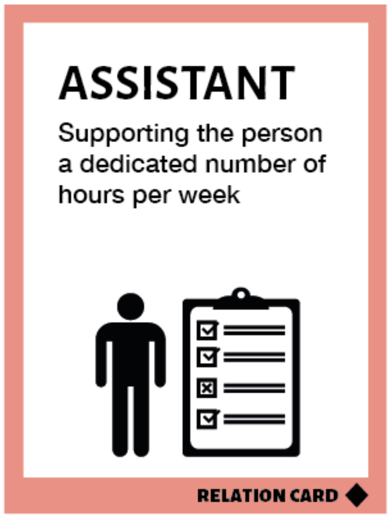


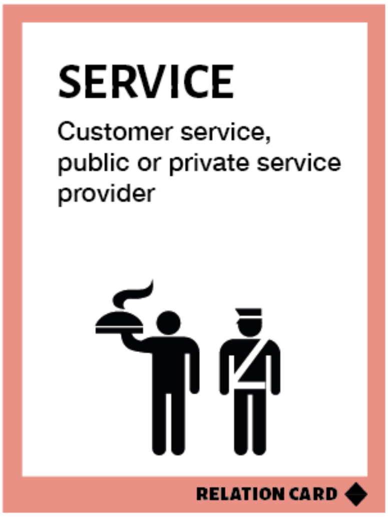


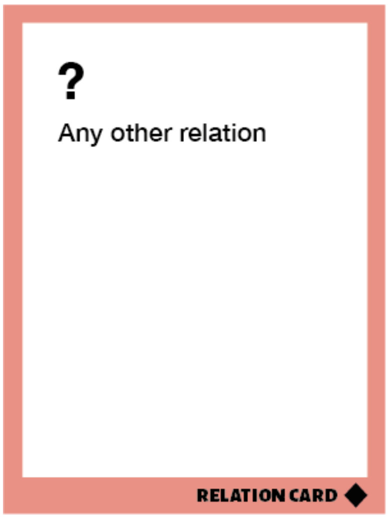
E.3 Activity Cards

E.4 Relation Cards

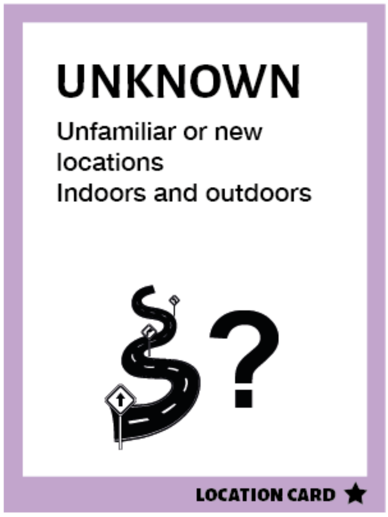








E.5 Location Cards



Appendix F

Workshop Study Information

F.1 Project Information Sheet

PROJECT INFORMATION

University of Nottingham
UK | CHINA | MALAYSIA

Date: 25th November 2020
Project: Facilitating co-design with visually impaired participants
School of Computer Science Ethics Reference:

Purpose of the research. This study aims to explore a competencies-based approach for co-designing with visually impaired and sighted participants. Through an online workshop, participants will reflect and discuss the various competencies that visually impaired people employ in their everyday life, drawing from personal experiences, exploring how these can be taken into consideration for technology design.

Nature of participation. Your participation in this research is voluntary and relies on you (the participant) providing data, by attending an online meeting and talking throughout.

Participant engagement. Participation in this research involves taking part in an online workshop. Each workshop will last approximately 2 hours. Each workshop will be conducted with either 2 or 3 participants (in addition to the researcher). Participants will be presented information and material such as cards and video clips and will be asked to reflect and share how the material presented relates to their own experiences as a visually impaired technology user and/or technology researcher/designer/specialist, and they will be asked to share ideas for more accessible future technologies. Wherever possible, participants will be asked to demonstrate activities or show personal objects related to the ongoing discussions.

Workshops will take place over a videoconferencing platform, preferably Microsoft Teams. Days before the workshop takes place, a brief session might take place for testing the communication platform with participants and checking other accessibility needs or concerns. Videocalls will be recorded only after getting participants' authorization.

Benefits and risks of the research. Your participation may help us understand potential areas to improve the accessibility of mainstream and assistive technologies. There are no foreseeable risks of taking part in this research, beyond the associated with talking about living with a visual impairment (if applicable). There is a chance you may feel uncomfortable talking about subjects related to this, but you can refuse to answer any question or ask the researcher to stop the recording at any moment.

Use of your data. The original data will be used in supervision sessions to elaborate findings of the research. During and after analysis, personal data will be anonymised for public purposes e.g., using fictional names in transcriptions of audio-visual recordings, blurring faces in video clips and screenshots. Written extracts or short video clips may be used as examples in written reports, conference workshops and presentations.

Future use of your data. Your data may be archived and reused in future for purposes that are in the public interest, or for historical, scientific or statistical purposes. Data will be stored using secure encrypted cloud storage services approved and procured by the University of Nottingham. Data will be kept in accordance with University guidelines on research data and will be destroyed after at most 7 years.

Mixed personal data. The research will gather 'mixed' personal data, i.e., data that simultaneously involves multiple participants and/or is irreducibly social in nature. In this case, mixed personal data includes multi-party conversation recorded on audio or video. We can only delete mixed personal data if all parties to it withdraw their consent. However, we will redact any data that identifies you in public presentations and reports of this research insofar as this is practicable and the data has not already been made public by yourself (e.g., posted on social media).

Procedure for withdrawal from the research. You may withdraw from the study at any time and do not have to give reasons for why you no longer want to take part. If you wish to withdraw please contact the researcher who gathered the data. If you receive no response from the researcher please contact the School of Computer Science's Ethics Committee.

Contact details of the ethics committee. If you wish to file a complaint or exercise your rights you can contact the Ethics Committee at the following address: cs-ethicsadmin@cs.nott.ac.uk

Researcher contact details.
A. Gisela Reyes Cruz.
[phone number redacted]
psxagre@nottingham.ac.uk

F.2 Consent Form

CONSENT FORM

University of Nottingham
UK | CHINA | MALAYSIA

Date: 25th November 2020

Project: Facilitating co-design with visually impaired participants

School of Computer Science Ethics Reference:

Please tick the appropriate boxes	Yes	No
1. Taking part in the study		
a) I have read and understood the project information sheet dated 25/11/2020 or it has been read to me. I have been able to ask questions about the study and my questions have been answered satisfactorily.	☐	☐
b) I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
c) I understand that taking part in the study requires me to provide data and that this will involve taking part in an online workshop that will be video recorded by the researcher.	☐	☐
2. Use of my data in the study		
a) I understand that data which can identify me will not be shared beyond the project team.	☐	☐
b) I agree that the data provided by me may be used for the following purposes:		
– Presentation and discussion of the project and its results in research activities (e.g., in supervision sessions, project meetings, conferences).	☐	☐
– Publications and reports describing the project and its results.	☐	☐
– Dissemination of the project and its results, including publication of data on web pages and databases.	☐	☐
c) I give permission for my words to be quoted for the purposes described above, using a pseudonym to protect my identity.	☐	☐
d) I give permission for my visual image contained in photos or video gathered during the research to be used for the purposes described above. My face will be blurred in order to protect my identity.	☐	☐

Please tick the appropriate boxes	Yes	No
3. Reuse of my data		
a) I give permission for the data that I provide to be reused for the sole purposes of future research and learning.	☐	☐
b) I understand and agree that this may involve depositing my data in a data repository, which may be accessed by other researchers, only after anonymisation.	☐	☐
4. Security of my data		
a) I understand that safeguards will be put in place to protect my identity and my data during the research, and if my data is kept for future use.	☐	☐
b) I confirm that a written copy of these safeguards has been given to me in the University's privacy notice, and that they have been described to me and are acceptable to me.	☐	☐
c) I understand that no computer system is completely secure and that there is a risk that a third party could obtain a copy of my data.	☐	☐
5. Copyright		
a) I give permission for data gathered during this project to be used, copied, excerpted, annotated, displayed and distributed for the purposes to which I have consented.	☐	☐

6. Signatures (sign as appropriate)

Name of participant (IN CAPITALS)	Signature	Date

If applicable:

For participants unable to sign their name, mark the box instead of signing ☐

I have witnessed the accurate reading of the consent form with the participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness (IN CAPITALS)	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Name of researcher (IN CAPITALS)	Signature	Date