Supporting Awareness of Visual Impairments and Accessibility Reflections through Video Demos and Design Cards

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ABSTRACT

Disabled people's experiences and knowledge are oftentimes not central in design processes. Further, the burden of outreach and sensitising others to these experiences and knowledge is frequently not recognised. This paper offers a workshop approach for including disabled people in the early stages of design and supporting accessibility awareness among non-disabled design practitioners. Our approach and associated tools—designed to help support this deeper participatory work—bring together users, researchers and design specialists with different visual abilities (blind, partially sighted and sighted). We describe how these groups were engaged with video demos and reflective design cards for prompting conversations about technology, accessibility, and visual impairments (VI). Eight online workshops were conducted with 17 participants (2-3 participants per session) and found varied types of interactions between them. Overall, the approach and tools enabled participants to learn about, share, and reflect on how technologies are used by visually impaired people (VIP).

CCS CONCEPTS

• **Human-centered computing → Accessibility design and evaluation methods**; *Collaborative and social computing design and evaluation methods.*

KEYWORDS

accessibility, reflective design, participatory reflection, mixed visual abilities, design cards, video demos

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1 INTRODUCTION

Low accessibility prioritisation and lack of awareness of user diversity in the design and development of technologies are commonplace [63, 65]. Despite the existence of accessibility guidelines and standards [74], and the increasing incorporation of accessibility topics in Computer Science curricula [41, 42], much of the design and development workforce continues to know very little about how disabled people use technologies and overall are inadequately prepared to engage with them [53]. This in turn causes not only inaccessible products and services, but also advocacy and access labour that disabled people must engage with, which mostly remains invisible or under-recognised [14].

In this paper we propose and present results of a workshop approach to help raise awareness of VI and accessibility, whilst centring on the participation and experiences of VIP.[1] The approach brings together people with different visual abilities (blind, partially sighted and sighted) from different technology backgrounds (users, researchers and design specialists) to discuss technology used by VIP, through the use of two key materials: 1) video demos to show examples of technology in-use, and 2) a set of reflective design cards representing different layers of VIP's experiences (i.e. competencies, tools, activities, relations, and locations). These materials are threaded together to prompt conversations about accessibility and VI, scaffolding participant reflections. Our main contribution lies in the articulation of such an approach and materials, building on some of our previous work. Here we provide a practical application of video demos in research [59] and the creation of the reflective design cards which are rooted in previous empirical work [7, 13, 25, 58, 66]. In this paper we describe and contextualise the background of our workshop approach and the materials developed. Then, we describe results obtained by conducting 8 online workshops with a total of 17 participants with varied visual abilities (blind, partially sighted and sighted). Only 2 or 3 people took part in each workshop to help foster conversation. From these, we identified five different types of interaction between participants triggered by the use of video demos and design cards. These interactional forms consist of:

- Noticing and relating to particular experiences around visual impairment.

[1] We acknowledge the diverse language used for referring to disability (e.g. identity-first vs people-first) and visual impairments (e.g. low vision vs partially sighted) depending on people's personal preferences and conventions by geographical regions. As such, in this paper we use both identity-first and people-first terms. We use participants' own descriptions (i.e. blind or partially sighted), and use the term 'visually impaired' to encompass all the participants who are not sighted. Lastly, we use the term 'different visual abilities' to refer to all of the participants.

- Asking about and explaining the unfamiliar.
- Requesting and giving technology advice.
- Recognising and exchanging experiences in common.
- Adding nuance to technology use perceptions.

We discuss the effectiveness of our approach and materials for enabling a shared understanding of basic topics across visual abilities, as well as aiding people to consider the functional, social and situational aspects of using technology as VIP. Lastly, we provide recommendations for using this approach within design or outreaching activities, hoping this contribution adds to efforts seeking to move away from disability simulations or similar design activities based on assumptions or replacement of VIP's participation, towards methods that recognise their experiential knowledge and help sighted stakeholders to engage with and learn from them [9, 70].

2 RELATED WORK

Here we review two main areas that relate to and shape the present work. We examine sensitising practices in HCI and design relating to disabilities, and then we review works for engaging people with different visual abilities in design.

2.1 Sensitising HCI Practices for Accessible Design

Different forms of sensitising work have been extensively implemented in HCI and professional design to help researchers and designers consider a variety of users within their practice. The quintessential example is User-Centred Design [56], which—while having clear limitations [27]—invites a consideration of potential users, their needs and contexts, from early stages. Nevertheless, this is not always translated into practice, especially when referring to a diverse set of users such as people with disabilities. Moreover, those outside of the accessibility domain tend to know very little of disabled people and how to engage with them [53].

Thus, several design approaches for disability have emerged in HCI for: orienting designers to focus on people's abilities [78], helping them consider social factors in accessible design [67], encouraging empowerment of people with disabilities in design processes [39], and for advocating a deeper development of empathy with these users [52]. Likewise, important groundwork to make disabled stories visible in mainstream discourses continues to develop, including accounts of technology and design [8, 80]. However, critiques and tensions remain. For example, using toolkits or personas portraying people with disabilities for prompting design consideration have been pointed out as methods that encourage replacement rather than direct participation of intended users [9], sometimes misrepresenting them and reinforcing stereotypes [19, 23]. Similarly, some empathy-building and simulation exercises or tools have been pointed out as insufficient in conveying holistic lived experiences and thus, perpetuating harmful notions of disability [9, 45].

Moreover, despite the advancement of participatory and co-design approaches directly engaging a variety of participants in various stages of design, there are concerns about extractive or exploitative design practices, in which ideas and knowledge are taken without credit or direct benefit [20]. Thus, more work is needed to reshape design processes to integrate the input and participation of disabled people within them, not only for prototyping and testing but also for early stages of design [39].

In this paper, we contribute to support awareness and sensitising practices 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. We focus on provoking and scaffolding conversation, centring learning and reflection over problem-solving.

2.2 Engaging Different Visual Abilities in Design

There have been increasing efforts for involving VIP in co-design projects [3, 44, 47], exploring different design activities such as ideation [11, 49] and prototype creation [46], by using scenarios [17, 60], audio-tactile mockups and audio diaries [46], multisensory storytelling [21], and iterative evaluation of prototypes [47]. More specifically, research has explored design endeavours with mixed-visual-ability people. For example, technologies that help to facilitate and enrich interactions between children in schools [21, 47, 51] or supporting recreation activities [5]. These works are community or organisational based, which although valuable for rapport-building and gaining deep understanding of the settings and their members, do not engage with non-disabled people who are *designing* mainstream technologies, and rather focus on dedicated projects. A relevant approach addressing these gaps is the Design for Social Accessibility (DSA) Framework [63–65, 67] which establishes three tenets: 1) the incorporation of users with and without disabilities, 2) the consideration of both functional and social factors in design, and 3) the use of tools for stimulating such consideration. For this last tenet, Shinohara et. al have created a design space and design method cards [65] to aid design considerations in several implementations of the DSA approach with non-disabled designers and students, making them engage with users with different visual abilities in one-off workshops and across design courses.

We contribute to this body of work by proposing an approach for engaging people with different visual abilities in reflective practices rather than co-design. We respond to calls for first allowing learning about disability without the pressing need to devise solutions [34]. In this work we do not aim for a final design outcome, and instead offer insights on how participants responded to our materials and how they further interacted with each other.

3 BACKGROUND OF THE WORKSHOP APPROACH

Here we provide background information guiding the decisions behind the approach we have devised and implemented, which also heavily draws from our own previous research findings and experiences engaging with VIP [58, 59].

3.1 Demonstrations as a tool for HCI research

Video demos are a powerful tool to communicate technology use in action, especially to unfamiliar audiences (e.g. [69]). While many works have analysed videos available online [4, 12, 18] to better understand user practices and perceptions, and others have analysed

the motivational [22] and interactional [73] 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 [50], little has been done to explore their methodical character and to understand how people respond to them within research activities. A relevant example addressing the latter is the work of Shklovski and Grönvall [68] investigating how people experienced public demonstrations of a system that makes data leakage tangible, by communicating it through electrical muscle stimulation. They argue for the value of public demonstrations as critical design interventions and position them as sites for participatory speculation [29]. Likewise, although the role of film and documentaries for raising awareness of disability [35, 57] has been explored, and video demos are promoted for teaching accessibility [24, 55], little is known about *what* type of reflections are occasioned by them.

To address some of the above mentioned shortcomings, we have deeply engaged with demonstrations performed by VIP, collected in empirical research investigating their use of technology [59]. By analysing a series of video demonstrations we have 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. Thus, such work serves as a baseline for the workshop approach in which we explore the practical application of video demos in HCI research.

3.2 Design Cards for Communicating VIP's experiences

Design cards are a well-established method in HCI and design for encoding and communicating concepts and knowledge [1, 79]. They further help to level the field between stakeholders from different backgrounds by making the concepts accessible and by fostering collaborative engagements between them [75]. Lucero et al. [43] point out that the purposes and uses of design cards are widely varied, envisioned to support stakeholders throughout the design process, including but not limited to ideation and inspiration, engaging non-designers, stimulating problem solving, developing sensitivity or empathy, and iterating-refining-evaluating designs. In the context of disability-related work, some toolkits and cards have been created for encouraging consideration of human diversity and promote inclusive design [36, 48], but as Shinohara et al. [65] pointed out, these place accessibility as an ad hoc consideration and do not emphasize social factors. As a response, they created the Design for Social Accessibility method cards, which includes six cards to help designers think of social scenarios experienced by disabled people and encourage designs that are both usable and socially accessible [26]. Thus, the deck of cards we have designed aim to encompass the various layers in the experiences of VIP, including social and situational factors. Rather than encouraging the replacement of VIP, we used them as conversational prompts between people with different visual abilities.

4 THE 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, we believe some of the key features mentioned above made them appropriate for online engagements, given the Covid-19 restrictions at the time the study took place. For example, the descriptive nature of the demos in which demonstrators verbalised their ongoing actions and the abstraction and conciseness of the design cards for conveying information. We also created different accessible versions of the materials, as described in 5.2. In the following, we describe the content of our tools.

4.1 Video Demos of Assistive Technology in Use

The first workshop material was a set of four video demonstrations performed by different VIP. These demos were captured in a prior research project investigating technology use by VIP [59] and were selected from such dataset based on their short duration (i.e. less than 2 minutes), and the simplicity, clarity and conciseness of the activities demonstrated. We chose demos in which the demonstrators were particularly descriptive of their actions as they unfolded and chose examples that were representative of the technologies VIP use in their daily life. The aim was to collate a small set of video demos that could provide a glimpse of assistive technology use for people not familiar with it or VI, whilst being accessible to VIP. Our set of video demos consisted of:

- A partially sighted person demonstrating VoiceOver on mobile phone.
- A partially sighted person demonstrating KNFB reader app for reading print.
- A blind person demonstrating Seeing AI app for detecting environment lights.
- A blind person demonstrating how to send a text message using VoiceOver.

To illustrate them, Figure 1 shows simplified fragments from the VoiceOver and Seeing AI demos. The faces and voices of demonstrators were anonymised and closed captions were added to the video materials used in the workshops.

4.2 VI Reflective Design Cards

The second material was created through a process in which high-level categories were defined first and then items for each category were listed [30]. The cards were then refined through discussions within the research team. The categories defined and the content of each card were informed by our own previous work [58] coupled with past literature of VI. The cards were designed building on a competencies-based approach which is focused on the skills of VIP and their everyday experiences rather than on their impairment. We further included social and relational aspects of their use of technology [7, 25, 66], and common tools and locations involved in their regular activities [13, 76, 82]. Table 1 shows a summary of the five categories in the deck of cards: competencies, tools, activities, relations, and locations. It lists all the cards created for the workshop study. Each card consists of a title, a short description,

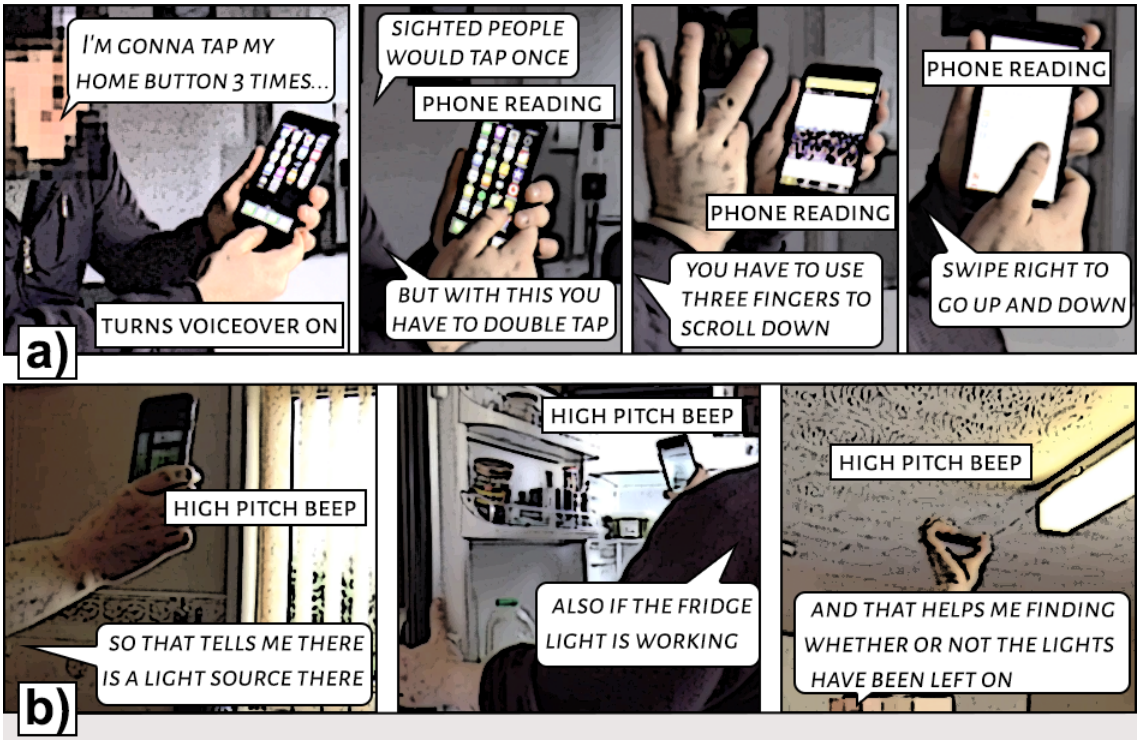

Figure 1: Video Demos Stills: a) using VoiceOver on iPhone (top) and b) detecting light with Seeing AI app (bottom)

an image or illustration (adapted from the free image repository https://pixabay.com/), and visual identifiers such as colour and a shape. Figure 2 shows a selection of cards in the 'Competency' category. The full deck of cards is included in Appendix A and will be made available for use via a Creative Commons license (see http://doi.org/10.17639/nott.7231 for downloadable resources and alternative formats).

5 THE ONLINE WORKSHOP APPROACH

Eight online workshops were conducted with 17 participants with different visual abilities (blind, partially sighted, sighted) –2 or 3 participants per workshop. Sessions lasted 90 minutes approximately, and there was at least one participant with VI in each of them. Here we describe its details, procedure and analysis.

5.1 Workshop's Structure

The workshops were structured so that the demos and cards were employed in conjunction for generating conversations around accessibility and technologies used by VIP. Due to Covid-19 restrictions, the study was designed to be conducted online. An overview of how the materials were linked together is shown in Figure 3. Participants were explained that these materials would be used as prompts for discussion during the session. 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 or differ from those in the video clips. Then, a 'linear' approach was used for introducing the cards to ensure the attention of all attendees was focused on the same material throughout the session. The cards were presented category by category instead of all of them at once, and within card categories, the facilitator went through each card reading the card title and, in some cases, the card description. Participants were prompted to select specific cards of their interest or curiosity to discuss in more detail. The initial two card categories (Competencies and Tools) were used to reflect on the demos previously played (e.g. what competencies or tools were used, what other tools could support the activities in the demos). The remaining card categories were used (Activities, Relations and Locations) to continue discussing other everyday activities by specifically selecting a new Activity card or continuing a topic from previous conversations. VIP were given the option to share some of their personal experiences in relation to the activity under discussion, and then all participants were asked to reflect how technology plays a role into them (e.g. whether technology is used differently depending on the people or places involved). Besides introducing the materials and asking participants to select topics of interest, the first author sporadically took part in conversations for helping to clarify doubts and elaborate follow-up questions.

5.2 Participants and Procedure

We recruited participants over 18 years old and that 1) had a VI; 2) were accessibility researchers, students, or technologists; and/or 3) researchers, students, or technologists not working in accessibility but interested in the topic. We arranged sessions with small groups

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, Other

Table 1: Reflective Design Cards: categories and content

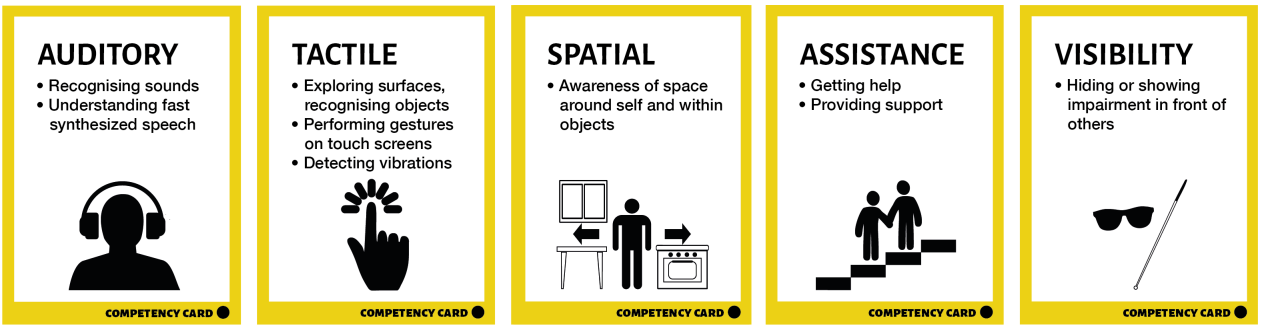

Figure 2: Examples of Competency Cards

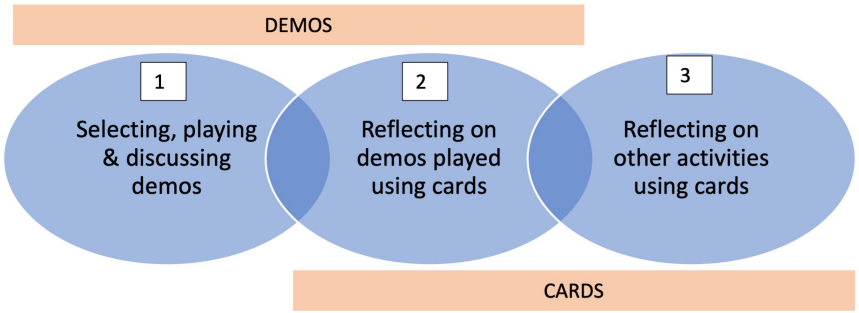

Figure 3: Materials and structure used in workshops

of 2-3 participants to foster deeper conversations. Our only strict condition for arranging the sessions was that at least one VIP were 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 embraced as potentially useful for learning about VIP's understanding and reactions to the materials, in addition to supporting accessibility awareness for sighted people. 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 2 contains the list of participants, the workshop they attended, their occupation and visual condition as self-reported, and additional information shared. Participants' gender is not included in the table to add a layer of anonymisation for the non-binary participant [61]. For the same reason, the stereo blind participant has been listed as sighted.

The workshop study was approved by our university department's ethics committee and conducted by the first author. Participants were given a £15 voucher as compensation. Aiming for a continuous commitment to access needs, VIP were provided with the materials before their corresponding session took place. The textual description of the video demos and the design cards were offered in different formats including digital (large print, Word document or tagged PDF optimised for screen readers) and Braille versions (if located in the same country as the research team). Participants were also prompted to suggest their preferred videoconferencing platform for the meeting. The 8 workshops were held online via MS Teams, Zoom and Google Meets. Before the main activities described in 5.1 took place, the first author 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 learning and reflecting from the materials and personal experiences. Moreover, the first author shared some key stances such as

P	WS #	Occupation	Visual condition	Other info
P1	W1	Accessibility consultant	Sighted	Autistic
P2	W1	Psychology student	Partially sighted	Tunnel vision
P3	W1	Software developer	Sighted	Implementing accessibility at work
P4	W2	PhD student & occupational therapist	Sighted	Not familiar with AT for VI
P5	W2	Lawyer	Partially sighted	No central vision
P6	W3	Call centre agent	Blind	-
P7	W3	Lecturer & AT researcher	Sighted	-
P8	W4	Artist & trainer	Blind	-
P9	W4	UX researcher	Sighted	Some knowledge of accessibility
P10	W5	Software engineer	Blind	IT event volunteer
P11	W5	Retired worker	Blind	IT trainer volunteer
P12	W6	Retired civil servant	Partially sighted	IT charity volunteer
P13	W6	Sighted guiding organiser	Blind	-
P14	W7	Unemployed	Partially sighted	Hard of hearing and autistic
P15	W7	Charity intervention worker	Blind	-
P16	W8	IT trainer	Blind	-
P17	W8	Researcher	Sighted	Some knowledge of accessibility

Table 2: Participants' information

not wanting to encourage replacement of VIP nor treating them as spectacle. In the discussion we touch upon power imbalances and different contribution by participants.

5.3 Data Analysis

All workshops were recorded, transcribed, and analysed using Reflexive Thematic Analysis (RTA) [16], a flexible approach for identifying and interpreting patterns of meaning. We followed the analytical stages as defined by Braun and Clarke: defining the coding approach, data familiarisation, data coding, searching for themes, reviewing themes, defining and naming themes, and writing-up. The coding was performed by the first author, as in this approach is common for one researcher to code the entire dataset. The first author is sighted but has conducted research and volunteering activities with VIP in the past, after having received sighted guide training. Thus, we acknowledge that the first author's understanding of some VIP's experiences discussed was inherently brought when conducting the analysis. The data was analysed inductively (i.e. no pre-defined codes were used) [15] seeking to understand what kinds of reflections and interactions were provoked by the video demos and the reflective design cards. The analysis was conducted following a semantic meaning. Themes were developed and collectively discussed and reviewed. By employing RTA, we acknowledge that various different themes can be developed from the same data depending on the research interests and lens employed, thus it is important to note that in this paper we merely present results developed in relation to participant's responses and reactions to the workshop tools.

6 INTERACTIONS AND REFLECTIONS IN RESPONSE TO THE MATERIALS

Through the analysis conducted, we identified 5 types of interactions between participants in our 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, we elaborate on and unpack each of these interactions. As a reminder, participants with and without VI took part in some of the workshops (W1, W2, W3, W4 and W8), whereas only VIP took part in the remaining ones (W5, W6 and W7). Participants' visual condition is included in parentheses (B-blind, PS-partially sighted, S–sighted).

6.1 Noticing and Relating to Particular Experiences around Visual Impairment

An interaction triggered between participants across all workshops, regardless of their visual abilities, refers to participants noticing something of interest in the materials, either by being 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 participants 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 and/or 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. In here, we 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 VIP 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). 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. 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'... 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 card categories, such as 'Relations', enabled participants to think about concepts less straightforward at the beginning. Participants across sessions reflected on the role of 'Close persons' and 'Strangers' as relevant factors in technology use and 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 cards contents engendered co-constructed reflections on social and situational factors influencing technology use. However, there were also a few situations in which the approach failed to engage participants in reflection as they could not relate to them or notice anything of interest. 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 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 VIP and thus highly familiar with the activities demonstrated. Nevertheless, they provided some meta-commentaries about this being the case. 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.

6.2 Asking About and Explaining the Unfamiliar

Exposing participants to the video demos and cards provoked an interaction common across all three workshops with sighted and VIP (W2, W4 and W8) with different knowledge of accessibility. 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 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. We 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, the first author provided an example. Later on in the workshop, both P2 (PS) and P1 (S) expanded on that concept for 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 consequently uncomfortable or inaccessible for them as partially sighted (P2) and autistic (P1).

6.3 Requesting and Giving Technology Advice

Having no opportunities to respond questions or expand on insights by sighted participants, workshops with only VIP (W5, W6 and W7), enabled other 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.*

We might understand P13's request due to the increasing number of apps that support VIP in reading printed text or detecting objects—both human or 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. For example, 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, we 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 smartwatches 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, we 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 for consulting options.

6.4 Recognising and Exchanging Experiences in Common

In other occasions, the materials prompted instant recognition of experiences that participants found in common, and consequent agreement or understanding expressions, 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. In 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 existent voice technologies such as inaccuracy, poor recognition of a variety of accents and the unnaturalness 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). We 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).

6.5 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 opposite accounts of them, so that different or diverse perspectives of technology use were showcased. For example, in W8, the blind participant 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.*

We note P17's insights provoked by the demo, similar to those in section 6.1, noticing the technology functionality. 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 such reflection into a comment responding to what other 'Tools' can be used to support the activity shown in the demo: *"Smartphones and homes equipped with Internet of Things devices, but again, like we 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 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 a balance between sighted assistance and maintaining independence when using their technology.

7 DISCUSSION

Critical reflections in accessibility research [28, 45], disability studies [31, 32] and activism [38] 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. We have implemented a workshop approach for bringing together people with different visual abilities; by providing supporting materials in the form of video demos and reflective design cards, we have encouraged them to think and converse with each other about technology, accessibility, and VI. In analysing their insights and interactions, we found meaningful outcomes from employing our approach, that we discuss next. Then, we lay out the roles and exchanges between participants. Lastly, we provide lessons from, and limitations of, using video demos and design cards as a vehicle for thinking and learning about accessibility and VI, as well as recommendations for researchers and design specialists wishing to employ them.

7.1 Accessibility Gets Framed as Dynamic

The different types of insights shared by our participants, regardless of how new or familiar were for them, covered functional, social, and situational factors in technology use as VI. For example, 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 in 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). By this, accessibility

was able to be conceptualised more as a complex and continuously changing phenomenon, rather than a static status [10]. In addition, some of the participants' reflections touched upon the role of technology design, designers, and companies in making them accessible and inclusive for disabled people, rather than focusing on new ideas to 'fix' their impairments. 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 [33]. 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.

Although many of the insights collected in our workshops are arguably obvious information for specialist researchers and users (as evidenced by P8's laugh in response to P9's hypothetical scenario), we see this as an indication of how little design specialists know about VIP and the tools that they use in their everyday lives, even though some our participants reported having some knowledge of accessibility. Overall, their insights 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. We think the value of our approach lies in how it engenders such reflections; no matter how well-known this information is in specialist domains, as for unfamiliar audiences these were new insights provoked and guided by the materials and the expert contribution of VIP. We recognise that the conversations collected were directly initiated by the specific materials chosen for our study and geared towards the topics depicted in them. Likewise, we must recognise that the workshop structure, the facilitator input, and the specific participants in each session also played a relevant role in scaffolding reflections. However, the intention of this paper was to explore an exemplary approach using topics that could be understandable by any participant, regardless of their familiarity with accessibility and technology for VIP. Future work could explore narrowing subjects and testing out other methods to deepen the understanding of how to better promote constructive conversations between groups with different visual abilities.

7.2 Shared Understanding across Different Visual Abilities

As other approaches that advocate designing for disability, we believe that the work of sensitising and raising awareness with design practitioners is crucial for accessible design [48, 52, 54, 65]. However, we depart from some of these approaches in three main ways: first, we do not aim to producing a design outcome but primarily encourage reflection; second, we purposely used open-ended questions and broad basic themes, so that, the reflections were ultimately user-led [37] instead of following a specific design prompt; and third, we centre the role of VIP and their co-participation with mixed-visual-ability partners [26, 63]. For doing so, we build upon notions that interpret 'reflection' as a *"perspective-changing account"* [6, p. 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"* [6, p. 6].

In analysing our data, we firstly found that it was the sighted participants who primarily engaged in such reflections by noticing and bringing up aspects of assistive technology use they had just learnt or found interesting; and supported by the VIP in the session, those initial insights were further developed. We found the use of video demos acted as an introductory piece for non-disabled participants, **unlocking their interactions** with VIP and allowing them to be open about the subjects not known, no matter how simple or basic their questions were. We further found that VIP consistently positioned themselves and each other as **expert actors** [2], both in the workshop sessions and within their communities. For the former, they 1) adopted a 'teaching' role towards sighted participants who had questions they could answer, 2) gave or requested advice to and from the VIP in their session, and 3) overall shared their experiences and perspectives as a recognised common account or in contrast to simplistic perspectives. For the latter, several VIP highlighted their own expertise as trainers and supporters of others in groups of VIP and close circles and emphasised the existent demo culture in online spaces created by and for VIP, from which they regularly consume, learn, and share. We believe that such resources available online are a rich material not only for investigating user practices and perceptions [62], but also for supporting the work of outreaching and sensitising design specialists [40, 77]. As critiques to traditional empathy-building exercises in design related activities, such as disability simulations, come up [9] and alternatives to them are sought [72], we offer our approach and materials as another option to continue moving away from replacing VIP in technology design towards engaging with them, striving for building a shared understanding that is rooted in learning about and from the other.

7.3 Lessons from and Limitations of Using Video Demos and Reflective Design Cards

Overall, participants found the tools helpful to start and guide the conversations; whilst video demos were a familiar resource, the cards were a new concept for many participants. The content of video demos was 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). Moreover, the cards were useful to convey key ideas from disability theory and activism that were unheard of or not considered before by some participants (i.e. Negotiation, Visibility). Yet, future work could further evaluate these materials against similar resources or compare reflections when no prompts are provided. We offer lessons and limitations that can inform participatory endeavours with disabled and non-disabled people.

7.3.1 Re-centring Participant Input. In an effort to frame VIP's experiences from a positive lens, the baseline of our reflective design cards are the various competencies used in their daily activities, rather than having the focus on their impairment. Weary of not using disabled people as a spectacle in both our cards and videos, we stated our concern at the beginning of each workshop, and thus made sure that in every workshop at least one participant was VI, avoiding getting sighted participants together to discuss and speculate on their own. Certainly, we found the **direct input** from VIP highly valuable, not only for teaching and adding nuance to the conversations, but for clarifying indirect doubts or assumptions. In the context of this workshop, VIP stated being comfortable

sharing their personal experiences, responding questions, and clarifying assumptions, and some others obtained practical advice on technology use. Thus, future work should explore how to leverage community building and peer-support through this approach whilst mitigating burden caused to disabled educators. Their role should be made more visible or explicit, and discussions about how to better compensate for their work in meaningful ways should take place with them.

7.3.2 Power Imbalance and Exploitation Tensions. In devising this workshop approach, we had to grapple with tensions between sighted-VIP participation and access needs prioritisation. Firstly, to mitigate exploitation concerns, we focused the workshop approach on prompting reflection rather than design ideation or concept development. To avoid VIP to become a spectacle [9], we limited the number of participants per session hoping to aid a one-to-one conversation, rather than an imbalanced personal experience sharing, for example as done in design consultations that include disabled guests among large groups of non-disabled people. Nevertheless, we recognise tensions and imbalances are not necessarily absent in our approach, such as in the accessibility of the materials. Although they were highly visual in nature, we believe the provision of adequate versions (e.g. videos with clear audio, Braille version of cards) can alleviate access issues whilst engaging all participants in the awareness exercise. Thus, we wish to stress the importance of maintaining the closeness in the sessions, both in keeping small groups and by stating expectations to the participants. For example, by letting sighted participants know that their **role is one of learning, reflecting and engaging with** VIP. Further, through facilitation; while the reflective cards may seem practical for large awareness encounters, we profoundly recommend a sensible use, always in presence of VIP that can add upon or correct initial assumptions caused by them. Lastly, by being careful that the cards are not used to objectify VIP as source of inspiration for non-VIP [81].

7.3.3 Future Disability Engagements. This study was conducted online due to pandemic restrictions, thus was focused on prompting verbal discussions. 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. Furthermore, aware of concerns of disability oversimplification [34], we aimed to provide a nuanced account of VIP's experiences by expanding our 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, we recognise that our cards and approach do not take into account how people with different and multiple disabilities co-exist. Future research could explore reflections by disabled and non-disabled people **without a delimitation by functional impairment**. Likewise, we recognise limitations in our recruitment, as participants in our study had a required level of digital literacy for joining the online sessions. Hence, future work should strive to diversify the participant groups, and explore opportunities for integrating an intersectional lens [71] in the materials and collaborative reflections.

8 CONCLUSION

We have proposed, and presented results of, a workshop approach that incorporates the use of video demos of technology used by VIP and a deck of design cards representing their everyday multifaceted experiences, threaded together to stimulate conversations in small groups of people with different visual abilities. In analysing their reactions and responses to the materials presented to them, we identified five types of interactions between them, depending on their visual ability, technology background, familiarity with accessibility and VI, and the combination of such participants' characteristics. We found that this approach provided them with opportunities for paying attention to unnoticed and unknown subjects and reflect on their own experiential knowledge. With this work, we illustrate how HCI and accessibility research can take advantage of the power of demos for participatory reflection, and contribute a deck of reflective cards that aim to centre the abilities and layered experiences of VIP.

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REFERENCES

[1] Tessa Aarts, Linas K. Gabrielaitis, Lianne C. de Jong, Renee Noortman, Emma M. van Zoelen, Sophia Kotea, Silvia Cazacu, Lesley L. Lock, and Panos Markopoulos. 2020. *Design Card Sets: Systematic Literature Survey and Card Sorting Study.* Association for Computing Machinery, New York, NY, USA, 419–428. https://doi.org/10.1145/3357236.3395516

[2] Ali Abdolrahmani, Kevin M. Storer, Antony Rishin Mukkath Roy, Ravi Kuber, and Stacy M. Branham. 2020. Blind Leading the Sighted: Drawing Design Insights from Blind Users towards More Productivity-Oriented Voice Interfaces. *ACM Trans. Access. Comput.* 12, 4, Article 18 (Jan. 2020), 35 pages. https://doi.org/10.1145/3368426

[3] C. Andrews. 2014. Accessible Participatory Design: Engaging and Including Visually Impaired Participants. In *Inclusive Designing*, P. M. Langdon, J. Lazar, A. Heylighen, and H. Dong (Eds.). Springer International Publishing, Cham, 201–210.

[4] Lisa Anthony, YooJin Kim, and Leah Findlater. 2013. Analyzing User-Generated Youtube Videos to Understand Touchscreen Use by People with Motor Impairments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 1223–1232. https://doi.org/10.1145/2470654.2466158

[5] Mark S Baldwin, Sen H Hirano, Jennifer Mankoff, and Gillian R Hayes. 2019. Design in the Public Square: Supporting Assistive Technology Design Through Public Mixed-Ability Cooperation. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–22.

[6] Jeffrey Bardzell and Shaowen Bardzell. 2013. *What is "Critical" about Critical Design?* Association for Computing Machinery, New York, NY, USA, 3297–3306. https://doi.org/10.1145/2470654.2466451

[7] Cynthia L. Bennett, Erin Brady, and Stacy M. Branham. 2018. Interdependence as a Frame for Assistive Technology Research and Design. In *Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (Galway, Ireland) *(ASSETS '18)*. Association for Computing Machinery, New York,

NY, USA, 161–173. https://doi.org/10.1145/3234695.3236348
[8] Cynthia L. Bennett, Burren Peil, and Daniela K. Rosner. 2019. Biographical Prototypes: Reimagining Recognition and Disability in Design. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (San Diego, CA, USA) *(DIS '19)*. Association for Computing Machinery, New York, NY, USA, 35–47. https://doi.org/10.1145/3322276.3322376
[9] Cynthia L. Bennett and Daniela K. Rosner. 2019. The Promise of Empathy: Design, Disability, and Knowing the "Other". In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3290605.3300528
[10] Cynthia L. Bennett, Daniela K. Rosner, and Alex S. Taylor. 2020. The Care Work of Access. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3313831.3376568
[11] Cynthia L. Bennett, Kristen Shinohara, Brianna Blaser, Andrew Davidson, and Kat M. Steele. 2016. Using a Design Workshop To Explore Accessible Ideation. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility* (Reno, Nevada, USA) *(ASSETS '16)*. Association for Computing Machinery, New York, NY, USA, 303–304. https://doi.org/10.1145/2982142.2982209
[12] Mark Blythe and Paul Cairns. 2009. *Critical Methods and User Generated Content: The IPhone on YouTube*. Association for Computing Machinery, New York, NY, USA, 1467–1476. https://doi.org/10.1145/1518701.1518923
[13] Erin Brady, Meredith Ringel Morris, Yu Zhong, Samuel White, and Jeffrey P. Bigham. 2013. Visual Challenges in the Everyday Lives of Blind People. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 2117–2126. https://doi.org/10.1145/2470654.2481291
[14] Stacy M. Branham and Shaun K. Kane. 2015. The Invisible Work of Accessibility: How Blind Employees Manage Accessibility in Mixed-Ability Workplaces. In *Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility* (Lisbon, Portugal) *(ASSETS '15)*. Association for Computing Machinery, New York, NY, USA, 163–171. https://doi.org/10.1145/2700648.2809864
[15] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health* 11, 4 (2019), 589–597. https://doi.org/10.1080/2159676X.2019.1628806 arXiv:https://doi.org/10.1080/2159676X.2019.1628806
[16] Virginia Braun, Victoria Clarke, Nikki Hayfield, and Gareth Terry. 2019. *Thematic Analysis*. Springer Singapore, Singapore, 843–860. https://doi.org/10.1007/978-981-10-5251-4_103
[17] Robin N. Brewer. 2018. Facilitating Discussion and Shared Meaning: Rethinking Co-Design Sessions with People with Vision Impairments. In *Proceedings of the 12th EAI International Conference on Pervasive Computing Technologies for Healthcare* (New York, NY, USA) *(PervasiveHealth '18)*. Association for Computing Machinery, New York, NY, USA, 258–262. https://doi.org/10.1145/3240925.3240981
[18] Elizabeth Buie and Mark Blythe. 2013. Meditations on YouTube. In *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces* (Newcastle upon Tyne, United Kingdom) *(DPPI '13)*. Association for Computing Machinery, New York, NY, USA, 41–50. https://doi.org/10.1145/2513506.2513511
[19] Daniel G. Cabrero, Heike Winschiers-Theophilus, and José Abdelnour-Nocera. 2016. A Critique of Personas as Representations of "the Other" in Cross-Cultural Technology Design. In *Proceedings of the First African Conference on Human Computer Interaction* (Nairobi, Kenya) *(AfriCHI'16)*. Association for Computing Machinery, New York, NY, USA, 149–154. https://doi.org/10.1145/2998581.2998595
[20] Sasha Costanza-Chock. 2020. *Design justice: Community-led practices to build the worlds we need*. The MIT Press, Cambridge, MA.
[21] Clare Cullen and Oussama Metatla. 2019. Co-Designing Inclusive Multisensory Story Mapping with Children with Mixed Visual Abilities. In *Proceedings of the 18th ACM International Conference on Interaction Design and Children* (Boise, ID, USA) *(IDC '19)*. Association for Computing Machinery, New York, NY, USA, 361–373. https://doi.org/10.1145/3311927.3323146
[22] Rodrigo de Oliveira, Christopher Pentoney, and Mika Pritchard-Berman. 2018. YouTube Needs: Understanding User's Motivations to Watch Videos on Mobile Devices. In *Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services* (Barcelona, Spain) *(MobileHCI '18)*. Association for Computing Machinery, New York, NY, USA, Article 36, 11 pages. https://doi.org/10.1145/3229434.3229448
[23] Emory James Edwards, Cella Monet Sum, and Stacy M. Branham. 2020. Three Tensions Between Personas and Complex Disability Identities. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '20)*. Association for Computing Machinery, New York, NY, USA, 1–9. https://doi.org/10.1145/3334480.3382931
[24] Yasmine N. El-Glaly. 2020. Teaching Accessibility to Software Engineering Students. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (Portland, OR, USA) *(SIGCSE '20)*. Association for Computing Machinery, New York, NY, USA, 121–127. https://doi.org/10.1145/3328778.3366914
[25] Heather A Faucett, Kate E Ringland, Amanda LL Cullen, and Gillian R Hayes. 2017. (In) visibility in disability and assistive technology. *ACM Transactions on Accessible Computing (TACCESS)* 10, 4 (2017), 1–17.
[26] Centre for Accessibility and Inclusion Research (CAIR). 2018. Tools and Techniques to Encourage Inclusion in Design Thinking. Retrieved 04 August 2021 from https://cair.rit.edu/projects.html#tools
[27] Jodi Forlizzi. 2018. Moving beyond User-Centered Design. *Interactions* 25, 5 (aug 2018), 22–23. https://doi.org/10.1145/3239558
[28] Christopher Frauenberger. 2015. Disability and Technology: A Critical Realist Perspective. In *Proceedings of the 17th International ACM SIGACCESS Conference on Computers &; Accessibility* (Lisbon, Portugal) *(ASSETS '15)*. Association for Computing Machinery, New York, NY, USA, 89–96. https://doi.org/10.1145/2700648.2809851
[29] Christopher Frauenberger. 2019. Entanglement HCI The Next Wave? *ACM Trans. Comput.-Hum. Interact.* 27, 1, Article 2 (Nov. 2019), 27 pages. https://doi.org/10.1145/3364998
[30] Michael Golembewski and Mark Selby. 2010. Ideation Decks: A Card-Based Design Ideation Tool. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (Aarhus, Denmark) *(DIS '10)*. Association for Computing Machinery, New York, NY, USA, 89–92. https://doi.org/10.1145/1858171.1858189
[31] Aimi Hamraie. 2016. Universal Design and the Problem of "Post-Disability" Ideology. *Design and Culture* 8, 3 (2016), 285–309. https://doi.org/10.1080/17547075.2016.1218714 arXiv:https://doi.org/10.1080/17547075.2016.1218714
[32] Aimi Hamraie and Kelly Fritsch. 2019. Crip technoscience manifesto. *Catalyst: Feminism, Theory, Technoscience* 5, 1 (2019), 1–33.
[33] Christina Harrington, Sheena Erete, and Anne Marie Piper. 2019. Deconstructing Community-Based Collaborative Design: Towards More Equitable Participatory Design Engagements. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 216 (Nov. 2019), 25 pages. https://doi.org/10.1145/3359318
[34] Megan Hofmann, Devva Kasnitz, Jennifer Mankoff, and Cynthia L Bennett. 2020. Living Disability Theory: Reflections on Access, Research, and Design. In *The 22nd International ACM SIGACCESS Conference on Computers and Accessibility* (Virtual Event, Greece) *(ASSETS '20)*. Association for Computing Machinery, New York, NY, USA, Article 4, 13 pages. https://doi.org/10.1145/3373625.3416996
[35] Seray B. Ibrahim, Asimina Vasalou, and Michael Clarke. 2020. Can Design Documentaries Disrupt Design for Disability?. In *Proceedings of the Interaction Design and Children Conference* (London, United Kingdom) *(IDC '20)*. Association for Computing Machinery, New York, NY, USA, 96–107. https://doi.org/10.1145/3392063.3394403
[36] IDEO. 2018. Unlocking Creativity in the Name of Inclusion. Retrieved 20 January 2022 from https://www.ideo.org/perspective/creative-inclusion-and-bias-breaking
[37] Netta Iivari and Kari Kuutti. 2017. Critical Design Research and Information Technology: Searching for Empowering Design. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (Edinburgh, United Kingdom) *(DIS '17)*. Association for Computing Machinery, New York, NY, USA, 983–993. https://doi.org/10.1145/3064663.3064747
[38] Liz Jackson, Alex Haagaard, and Rua Williams. 2022. Disability Dongle. Retrieved 04 August 2021 from https://blog.castac.org/2022/04/disability-dongle/
[39] Richard E. Ladner. 2015. Design for User Empowerment. *Interactions* 22, 2 (feb 2015), 24–29. https://doi.org/10.1145/2723869
[40] Alex Lasker. 2020. Blind teen captivates social media with reading and writing lesson: 'This blows my mind'. Retrieved 04 August 2021 from https://uk.finance.yahoo.com/news/teen-reveals-she-able-read-150657934.html
[41] Megan Lawrence and Mary Bellard. 2017. Teach Access: Preparing Computing Students for Industry (Abstract Only). In *Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education* (Seattle, Washington, USA) *(SIGCSE '17)*. Association for Computing Machinery, New York, NY, USA, 700. https://doi.org/10.1145/3017680.3022392
[42] Amanda Lazar, Jonathan Lazar, and Alisha Pradhan. 2019. Using Modules to Teach Accessibility in a User-Centered Design Course. In *The 21st International ACM SIGACCESS Conference on Computers and Accessibility* (Pittsburgh, PA, USA) *(ASSETS '19)*. Association for Computing Machinery, New York, NY, USA, 554–556. https://doi.org/10.1145/3308561.3354632
[43] Andrés Lucero, Peter Dalsgaard, Kim Halskov, and Jacob Buur. 2016. *Designing with Cards*. Springer International Publishing, Cham, 75–95. https://doi.org/10.1007/978-3-319-29155-0_5
[44] Charlotte Magnusson, Per-Olof Hedvall, and Héctor Caltenco. 2018. *Co-designing together with Persons with Visual Impairments*. Springer International Publishing, Cham, 411–434. https://doi.org/10.1007/978-3-319-54446-5_14
[45] Jennifer Mankoff, Gillian R. Hayes, and Devva Kasnitz. 2010. Disability Studies as a Source of Critical Inquiry for the Field of Assistive Technology. In *Proceedings of the 12th International ACM SIGACCESS Conference on Computers and Accessibility* (Orlando, Florida, USA) *(ASSETS '10)*. Association for Computing Machinery, New York, NY, USA, 3–10. https://doi.org/10.1145/1878803.1878807
[46] Oussama Metatla, Nick Bryan-Kinns, Tony Stockman, and Fiore Martin. 2015. Designing with and for people living with visual impairments:

audio-tactile mock-ups, audio diaries and participatory prototyping. *CoDesign* 11, 1 (2015), 35–48. https://doi.org/10.1080/15710882.2015.1007877 arXiv:https://doi.org/10.1080/15710882.2015.1007877

[47] Oussama Metatla, Alison Oldfield, Taimur Ahmed, Antonis Vafeas, and Sunny Miglani. 2019. Voice User Interfaces in Schools: Co-Designing for Inclusion with Visually-Impaired and Sighted Pupils. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3290605.3300608

[48] Microsoft. 2018. Inclusive Design. Retrieved 04 August 2021 from https://www.microsoft.com/design/inclusive/

[49] Cecily Morrison, Edward Cutrell, Anupama Dhareshwar, Kevin Doherty, Anja Thieme, and Alex Taylor. 2017. Imagining Artificial Intelligence Applications with People with Visual Disabilities Using Tactile Ideation. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility* (Baltimore, Maryland, USA) *(ASSETS '17)*. Association for Computing Machinery, New York, NY, USA, 81–90. https://doi.org/10.1145/3132525.3132530

[50] Brad A. Myers. 1998. A Brief History of Human-Computer Interaction Technology. *Interactions* 5, 2 (March 1998), 44–54. https://doi.org/10.1145/274430.274436

[51] Isabel Neto, Hugo Nicolau, and Ana Paiva. 2021. Community Based Robot Design for Classrooms with Mixed Visual Abilities Children. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 31, 12 pages. https://doi.org/10.1145/3411764.3445135

[52] A F Newell, P Gregor, M Morgan, G Pullin, and C Macaulay. 2011. User-Sensitive Inclusive Design. *Universal Access in the Information Society* 10, 3 (2011), 235–243. https://doi.org/10.1007/s10209-010-0203-y

[53] Rohan Patel, Pedro Breton, Catherine M. Baker, Yasmine N. El-Glaly, and Kristen Shinohara. 2020. Why Software is Not Accessible: Technology Professionals' Perspectives and Challenges. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '20)*. Association for Computing Machinery, New York, NY, USA, 1–9. https://doi.org/10.1145/3334480.3383103

[54] Hans Persson, Henrik Åhman, Alexander Arvei Yngling, and Jan Gulliksen. 2015. Universal design, inclusive design, accessible design, design for all: different concepts—one goal? On the concept of accessibility—historical, methodological and philosophical aspects. *Universal Access in the Information Society* 14, 4 (2015), 505–526. https://doi.org/10.1007/s10209-014-0358-z

[55] Helen Petrie and Alistair Edwards. 2006. Inclusive design and assistive technology as part of the HCI curriculum. In *Proceedings of HCI Educators Workshop*, Vol. 2006. ., ., 23–24.

[56] Jenny Preece. 2015. *Interaction design : beyond human-computer interaction / Preece, Rogers, Sharp.* (4th ed. ed.). Wiley, Chichester.

[57] Cynthia Putnam, Christina Hanschke, and Anuradha Rana. 2019. Efficacy of Film for Raising Awareness of Diverse Users. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI EA '19)*. Association for Computing Machinery, New York, NY, USA, 1–6. https://doi.org/10.1145/3290607.3312992

[58] Gisela Reyes-Cruz, Joel E. Fischer, and Stuart Reeves. 2020. Reframing Disability as Competency: Unpacking Everyday Technology Practices of People with Visual Impairments. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376767

[59] Gisela Reyes-Cruz, Joel E. Fischer, and Stuart Reeves. 2022. Demonstrating Interaction: The Case of Assistive Technology. *ACM Trans. Comput.-Hum. Interact.* (jan 2022). https://doi.org/10.1145/3514236 Just Accepted.

[60] Nuzhah Gooda Sahib, Tony Stockman, Anastasios Tombros, and Oussama Metatla. 2013. Participatory Design with Blind Users: A Scenario-Based Approach. In *Human-Computer Interaction – INTERACT 2013*, Paula Kotzé, Gary Marsden, Gitte Lindgaard, Janet Wesson, and Marco Winckler (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 685–701.

[61] Morgan Klaus Scheuerman, Katta Spiel, Oliver L. Haimson, Foad Hamidi, and Stacy M. Branham. 2020. HCI Guidelines for Gender Equity and Inclusivity (Version 1.1). Retrieved 04 August 2021 from https://www.morgan-klaus.com/gender-guidelines.html

[62] Woosuk Seo and Hyunggu Jung. 2017. Exploring the Community of Blind or Visually Impaired People on YouTube. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility* (Baltimore, Maryland, USA) *(ASSETS '17)*. Association for Computing Machinery, New York, NY, USA, 371–372. https://doi.org/10.1145/3132525.3134801

[63] Kristen Shinohara, Cynthia L Bennett, Wanda Pratt, and Jacob O Wobbrock. 2018. Tenets for social accessibility: Towards humanizing disabled people in design. *ACM Transactions on Accessible Computing (TACCESS)* 11, 1 (2018), 1–31.

[64] Kristen Shinohara, Cynthia L. Bennett, and Jacob O. Wobbrock. 2016. How Designing for People With and Without Disabilities Shapes Student Design Thinking. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility* (Reno, Nevada, USA) *(ASSETS '16)*. Association for Computing Machinery, New York, NY, USA, 229–237. https://doi.org/10.1145/2982142.2982158

[65] Kristen Shinohara, Nayeri Jacobo, Wanda Pratt, and Jacob O Wobbrock. 2020. Design for Social Accessibility Method Cards: Engaging Users and Reflecting on Social Scenarios for Accessible Design. *ACM Transactions on Accessible Computing (TACCESS)* 12, 4 (2020), 1–33.

[66] Kristen Shinohara and Jacob O. Wobbrock. 2016. Self-Conscious or Self-Confident? A Diary Study Conceptualizing the Social Accessibility of Assistive Technology. *ACM Trans. Access. Comput.* 8, 2, Article 5 (Jan. 2016), 31 pages. https://doi.org/10.1145/2827857

[67] Kristen Shinohara, Jacob O. Wobbrock, and Wanda Pratt. 2018. Incorporating Social Factors in Accessible Design. In *Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (Galway, Ireland) *(ASSETS '18)*. Association for Computing Machinery, New York, NY, USA, 149–160. https://doi.org/10.1145/3234695.3236346

[68] Irina Shklovski and Erik Grönvall. 2020. CreepyLeaks: Participatory Speculation Through Demos. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society* (Tallinn, Estonia) *(NordiCHI '20)*. Association for Computing Machinery, New York, NY, USA, Article 21, 12 pages. https://doi.org/10.1145/3419249.3420168

[69] ACM SIGCHI. 2021. Chieko Asakawa: "See What I Mean: Making Waves with the Blind" (ACM CHI 2021 Opening Keynote). Retrieved 04 August 2021 from https://www.youtube.com/watch?v=3LqCsIvYmX4

[70] Katta Spiel, Kathrin Gerling, Cynthia L. Bennett, Emeline Brulé, Rua M. Williams, Jennifer Rode, and Jennifer Mankoff. 2020. Nothing About Us Without Us: Investigating the Role of Critical Disability Studies in HCI. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '20)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3334480.3375150

[71] Cella M Sum, Rahaf Alharbi, Franchesca Spektor, Cynthia L Bennett, Christina Harrington, Katta Spiel, and Rua M Williams. 2022. Dreaming Disability Justice in HCI. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA. https://disabilityjusticeinhci.org/assets/pdfs/chi22m-sub1216-cam-i31.pdf

[72] Garreth W. Tigwell. 2021. Nuanced Perspectives Toward Disability Simulations from Digital Designers, Blind, Low Vision, and Color Blind People. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, Article 378, 15 pages. https://doi.org/10.1145/3411764.3445620

[73] Sylvaine Tuncer, Barry Brown, and Oskar Lindwall. 2020. *On Pause: How Online Instructional Videos Are Used to Achieve Practical Tasks*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3313831.3376759

[74] W3C Web Accessibility Initiative (WAI). 2020. Web Content Accessibility Guidelines (WCAG) Overview. Retrieved 04 August 2021 from https://www.w3.org/WAI/standards-guidelines/wcag/

[75] Richard Wetzel, Tom Rodden, and Steve Benford. 2017. Developing ideation cards for mixed reality game design. *Transactions of the Digital Games Research Association* 3, 2 (2017), 175–211.

[76] Michele A. Williams, Caroline Galbraith, Shaun K. Kane, and Amy Hurst. 2014. "just Let the Cane Hit It": How the Blind and Sighted See Navigation Differently. In *Proceedings of the 16th International ACM SIGACCESS Conference on Computers & Accessibility* (Rochester, New York, USA) *(ASSETS '14)*. Association for Computing Machinery, New York, NY, USA, 217–224. https://doi.org/10.1145/2661334.2661380

[77] Mark Wilson. 2020. Meet the YouTuber who's schooling developers on how blind people really use tech. Retrieved 04 August 2021 from https://www.fastcompany.com/90535264/meet-the-youtuber-whos-schooling-developers-on-how-blind-people-really-use-tech

[78] Jacob O Wobbrock, Shaun K Kane, Krzysztof Z Gajos, Susumu Harada, and Jon Froehlich. 2011. Ability-based design: Concept, principles and examples. *ACM Transactions on Accessible Computing (TACCESS)* 3, 3 (2011), 1–27.

[79] Christiane Wölfel and Timothy Merritt. 2013. Method Card Design Dimensions: A Survey of Card-Based Design Tools. In *Human-Computer Interaction – INTERACT 2013*, Paula Kotzé, Gary Marsden, Gitte Lindgaard, Janet Wesson, and Marco Winckler (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 479–486.

[80] Alice Wong. [n.d.]. Disability Visibility Project. Retrieved 20 July 2022 from https://disabilityvisibilityproject.com/

[81] Stella Young. 2014. I'm not your inspiration, thank you very much. https://www.ted.com/talks/stella_young_i_m_not_your_inspiration_thank_you_very_much?language=en

[82] Chien Wen Yuan, Benjamin V. Hanrahan, Sooyeon Lee, Mary Beth Rosson, and John M. Carroll. 2017. I Didn't Know That You Knew I Knew: Collaborative Shopping Practices between People with Visual Impairment and People with Vision. *Proc. ACM Hum.-Comput. Interact.* 1, CSCW, Article 118 (Dec. 2017), 18 pages. https://doi.org/10.1145/3134753

A VI REFLECTIVE DESIGN CARDS

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 figures contain the 39 cards.

Figure 4: Competency cards

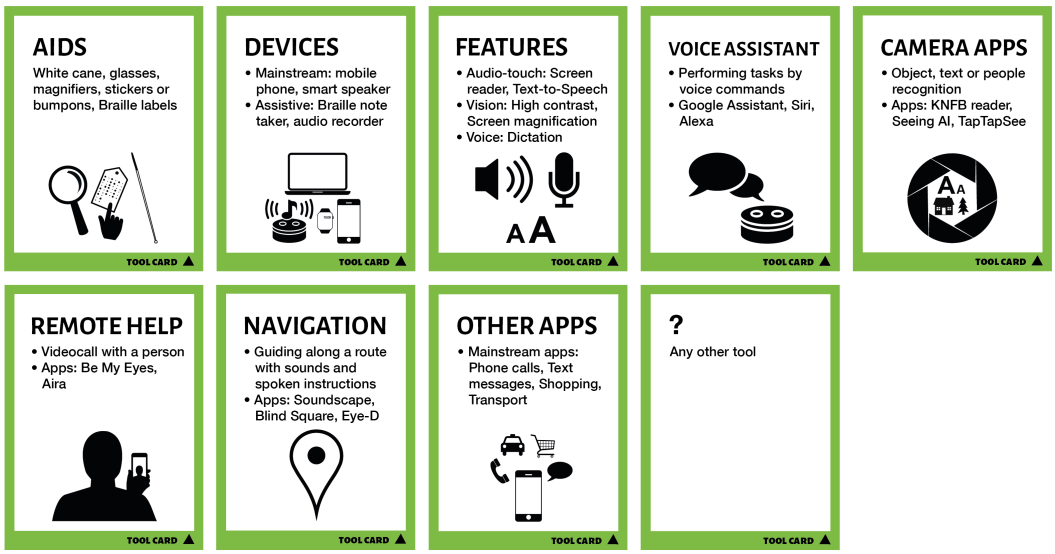

Figure 5: Tool cards

Figure 6: Activity cards

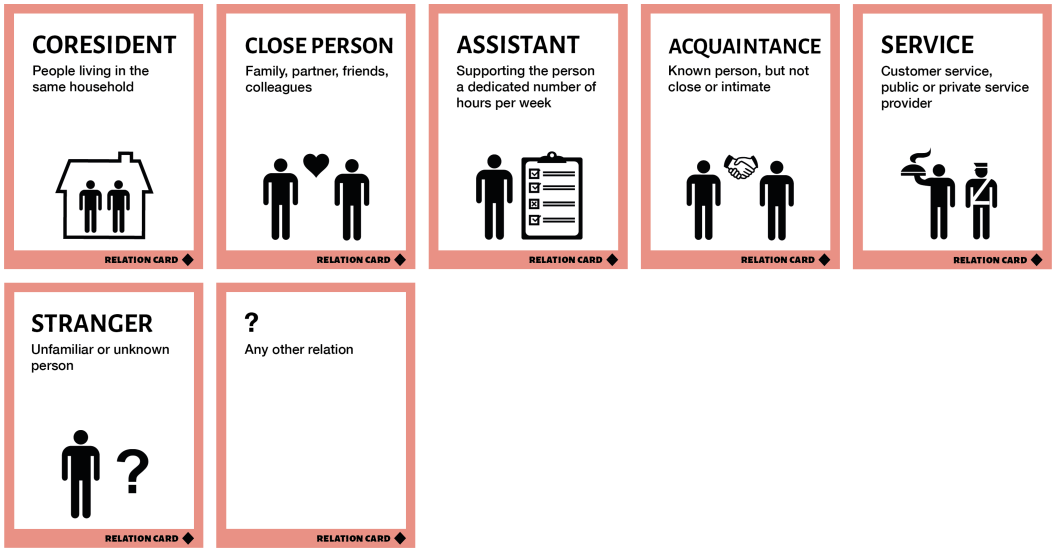

Figure 7: Relation cards

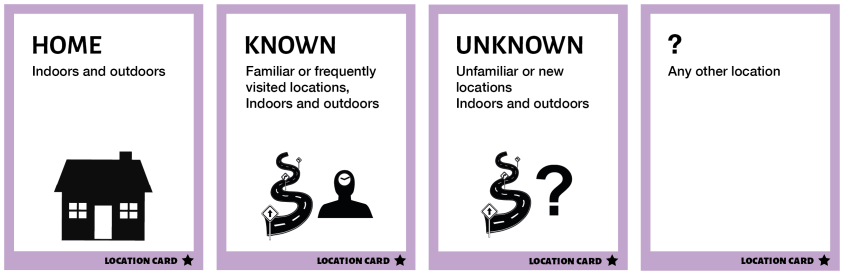

Figure 8: Location cards