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The Care Work of Access

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ABSTRACT

Current approaches to AI and Assistive Technology (AT) often foreground task completion over other encounters such as expressions of care. Our paper challenges and complements such task-completion approaches by attending to the *care work of access*—the continual affective and emotional adjustments that people make by noticing and attending to one another. We explore how this work impacts encounters among people with and without vision impairments who complete tasks together. We find that bound up in attempts to get things done are concerns for one another and how well people are doing together. Reading this work through emerging disability studies and feminist STS scholarship, we account for two important forms of work that give rise to access: (1) mundane attunements and (2) non-innocent authorizations. Together these processes work as sensitizing concepts to help HCI scholars account for the ways that intelligent ATs both produce access while sometimes subverting people with disabilities.

Author Keywords

Artificial Intelligence; Assistance; Blind; Disability; Care; Interdependence; Vision Impaired.

CSS Concepts

• **Human-centered computing~Accessibility**; Empirical studies in accessibility.

INTRODUCTION

A growing investment in artificial intelligence (AI) has given rise to assistive technologies (ATs) that incorporate sophisticated computational underpinnings and that promise corresponding benefits to users—what we call AI ATs. For example, object and human recognition algorithms underpin numerous apps and services which are integrating into the lives of vision impaired people to help them ‘see’ [4], [27], [55], [88]. By taking on an approach that focuses on task completion, researchers and developers have identified and address particular accessibility barriers such as increasing access to information and participation on social media.

These developments have created important opportunities for vision impaired people to complete a variety of tasks from reading text to commenting on their friends’ photos.

However, these approaches to access—made increasingly prevalent and powerful through AI—emphasize achieving defined tasks over less discrete interactions. For example, consider an AI AT designed to help a vision impaired person gain awareness of their surroundings while walking. The system may leverage computer vision and GPS to inform a user that they have met a passerby approaching on their left and that they should change directions to a more efficient route. But the AI AT may well miss the fact this ‘passerby’ is a companion who has been walking alongside them. What looks to the AI AT as a chance meeting on the wrong route is instead a purposeful, leisurely stroll. In this example, the AI AT overlooks key affective dimensions which may not be easily measured: the pair’s rapport and enjoyment.

Echoing concerns of “third-wave” HCI to push past metrics such as efficiency [9], we note that a task focus risks defining the lives of people with disabilities and specifically vision impairments in terms of problems in need of solutions. While the benefits of such an approach should not be underplayed, this approach largely overlooks how people with specific disabilities orientate to their surroundings and with one another in meaningful ways. AI ATs may promise to give blind and vision impaired people a sense of their social as well as physical surroundings, but may miss the emotional sensitivities and ‘affective labors’ from which the ‘social’ is comprised [30].

This paper complements the task-based focus that underlies much of AT design by attending to the *care work of access* and how it impacts encounters among people with and without disabilities. As we discuss further below, the *care work of access* describes the continual affective work of attending to one another. We use this concern to rethink how we in HCI approach AI ATs. Rather than breadth, we concentrate on a small number of cases to examine the intricate means by which people living with and without vision impairments do things with each other. Specifically, we observed pairs of close colleagues and companions as they worked together to complete everyday tasks indicative of their ongoing working relationships. Unique in these pairs is that each member had a different type of vision than the other. In observing how they throw and catch balls, shop together, and prepare for an event, we learn that much more

is going on than task completion. Indeed, they negotiated, sometimes humorously, to do something differently when troubles arose. We find that acts of caring and working well together become integral to expanding the capabilities with which people interdependently traverse ordinary or mundane activities. We show too, however, that these adjustments can at times reinforce narrow norms about what capabilities people should have, which in turn feed into ableism—prejudice against people with disabilities [13].

Building from this work, we make three central contributions to HCI. First, our analysis helps accessibility scholars move beyond a dominant focus on individual capacities (what a person can do) to focus instead on the collective care that makes those capacities possible (how people work together to create attentive relationships).

Second, we contribute new perspectives on the work of building access. Specifically, we offer two concepts—*mundane attunements* and *non-innocent authorizations*. *Mundane attunements* highlight how access requires continuous work and routine, everyday adjustments to practice. This view contrasts with an understanding of accessibility as a binary assertion—either achieved or not. Instead, we suggest HCI researchers support the continual work of building access. *Second, non-innocent authorizations* orient analysts to how even with the best of intentions, work to build access still falls in and out of moments where people with disabilities are treated as the recipients of assistance, running the risk of overlooking or erasing their work and experience. This view suggests that we should always look for those moments of erasure, make them visible, and offer ways to address them.

Third, our work highlights the importance of attending to care in AI AT research. We draw attention to affective relationships and labors that can be easily overlooked in the design of ATs and foreground how the execution of a task is not the only measure of its success. Sometimes it has more to do with the moment-by-moment sense of how well people are interacting and feeling together. Thus, we suggest AI ATs might experiment with unconventional approaches. For example, since AI ATs learn from data that can never represent everyone's experience, developers might look for ways to account for outliers over population trends. This, we believe, widens the emphasis in design, by shifting our focus toward supporting the highly particular and emerging relations between people and the settings they move through.

Together these contributions provide a provocation for us, in HCI, to take seriously the challenges of incorporating AI into ATs and to orient us towards the complex sensibilities and caring labors involved in making access possible.

BACKGROUND AND LITERATURE REVIEW

Forming a backdrop to the work we report here and elaborated in this section are literatures on the use of AI to enhance ATs for visually impaired people to complete tasks and traverse social interactions. Then, we additionally draw

from disability studies and Feminist Disability studies perspectives to expand current conceptions of access and care in HCI.

AI ATs and Social Interactions

The design and use of ATs is a now established thread of research in HCI. Relevant, for example, are projects that have used computer vision to support people with vision impairments to complete tasks like identifying objects, people, and the contents of photos on social media [8], [40], [41], [49], [53], [78], [88], [90], [91], [92], [93], [94], [95]. For example, VizWiz [8] allowed blind people to photograph images for algorithms or crowd workers to describe. Subsequently, a suite of apps and services providing such access have become widely available and affordable [4], [27], [55], [88], [91]. However, these apps and services respond little to social environments and cues. As such, some research has begun to identify needed design improvements. For example, since blind people may over trust automatic captions, MacLeod et al. [53] recommend providing an accuracy rating alongside captions to calibrate user trust. These explorations, like ours, begin to reveal and complicate the lives and ecosystems implicated by AI ATs.

A somewhat overlapping and formative thread of research is work examining how people with vision impairments (and passersby) make sense of and interact in social situations [1], [10], [11], [56], [76], [77], [79], [80], [86], [95], and whether this might offer opportunities to make greater use of one's senses in conjunction with the adaptive and learning capabilities of AI [3], [58], [65], [78], [92], [95]. In two separate studies, Thieme et al. [80] and Williams et al. [86] accompanied people with vision impairments on social and navigation activities, examining the myriad ways people work together and triangulate cues from their traveling companions, technologies, and environments to get where they want to go and, critically, to enjoy themselves. This work reveals how assistance entangles with an affectual character to everyday life: rather than being wholly separate or burdensome, friends can fluidly work together according to one another's strengths and find nonvisual interactions and discovery enjoyable. At the same time, ample miscommunications can interfere with collaboration, even amongst friends and family [11], [86]. Thus, while the literature leans markedly toward informing AI ATs that support functional needs like finding specific items and locations, such work begins to complicate instrumentalist assumptions about assistance.

Where HCI and AT scholarship typically treat access as a physical state, a technological configuration with a certain degree of fixity (e.g., a feature might be 'accessible' or 'inaccessible'), to trouble instrumentalist assumptions about access, we instead explore what might be gained from examining access as a process, an effortful and moving assembly of actions. To make this shift in ontological status, moving from noun to verb, we draw from disability studies scholarship and activism [28], [29], [42], [57], [81] and

particularly the work of Louise Hickman [34], which frames access as a form of ongoing work. By access, we thus mean the continuous negotiations undertaken to create opportunities for people with disabilities to approach and understand phenomena [21].

Care and its Complexities

Turning to care in HCI, scholars have attended to the complicated relationships people build with one another. Care here, borrowing from the work of Lara Houston and Steven Jackson, refers to “[w]hat we do together to make the world a more liveable place” [37]. Much of the research on this care in HCI concerns the self- and collaborative-management of health [63], [64]. Learnings from such projects include tensions that can arise when caregiving interferes with patient self-determination [12], care practises that respect and account for team member values [7], and how HCI might support informal caregivers’ wellbeing [51]. However, the attention to care work in HCI exceeds body and mind maintenance. There is a growing concern for care in other sociotechnical encounters and a spectrum of activities from education [43], to appropriating data collection for affordable housing [89], to logistics of humanitarian aid [37], to maintenance and repair of technologies and their associated sites of development and modification [38], [39], [83], and even to the relationships subjects have with research projects [36]. Recognizing this breadth, Toombs, et al. [82] have shown a particular investment in thinking through the complexities and complications of care. Indeed, a common theme of care work both inside and beyond HCI is that it involves seemingly simultaneous exercises of doing good while making compromises. For example, Kaziunas et al. [44] use care to think through the data-orientated systems for tracking biometrics of children with diabetes. While such information importantly alerted patients to symptoms, constant monitoring also pressured parents to inform all decisions related to their children’s diabetes with data, and data tracking systems offered little control over privacy and sharing. Their frame of caring-through-data reminds us that care and data are experienced in multiple ways which cannot be smoothed over with technical solutions.

Adding a further dimension to this perspective, Bennett et al. [5] introduced interdependence from intersectional disability justice activism to help researchers attend to the under-recognized work disabled people do to build access [10], [11]. By attending to relationships, Bennett, et al. establish a space for thinking about ATs as integral to the ways people relate to one another. Here, we adopt and expand this concept of interdependence by exploring and problematizing the particular form it takes as care work. For example, while interdependencies reveal collective access which can be healing and pleasurable, they are also necessitated by state sanctioned ableism, racism, transphobia and other prejudices which underfund and gatekeep attendant- and health-care. To this end, queer, femme, disabled activist of color, Leah Lakshmi Piepzna-Samarasinha writes of the mundanity yet

desperation of care work, “In the face of systems that want us dead, sick and disabled people have been finding ways to care for ourselves and each other for a long time. ... care webs are just life, just what you do” [48] p. 43. We examine how care acts as an opening to account for the sensibilities actors exercise to do well together--especially when they also produce inequities.

Finally, although a variety of works use an attention to care to enliven alternative ways of being in the world and to politicize the uneven distribution of affective labor [14], [15], [23], [62], [66], [67], [68], these examinations remain largely separate from popular solutionist approaches to access and ATs and void of disability justice perspectives. Some notable exceptions to the latter include work by disability studies and feminist STS scholars Kelly Fritsch [20], Christine Kelly [45], [46], Laura Mauldin [54], and Ingunn Moser [59], [60], [61]. For example, Christine Kelly draws out these complexities with her term, accessible care or, “an unstable tension among emotions, actions, and values, simultaneously pulled toward both empowerment and coercion” [45] p.790 (see also [46]). Writing of her “frien-tendant” relationship with a man with disabilities, she shares how care is multiple. It is in their mutual friendship, in her assisting him with daily tasks, and in the ways these acts seamlessly blend. But care also threads through her discomforts with the ways she is simultaneously perceived superior to her disabled friend while subverted through the feminized devaluing of care work, marking complex tensions that may be subverted if the focus remains on efficient completion of care-related tasks. Our thinking on care thus connects these strands of work to account for the relationships necessary to do things with others and to do them *well* together, if imperfectly. From this perspective, we aim to deepen an attention to AI AT development with and against ideals [61] of “assistance as a ‘solution’” [45] p. 792.

METHODS

The work reported here forms part of a larger and still ongoing research project exploring the role for AI in assistive technologies for the blind and vision impaired. Along with an interdisciplinary group from Microsoft Research, we undertook a grounded empirical study of how blind and vision impaired people use the resources around them to develop a sense of their social surroundings. The resulting qualitative interviews, observations and video analysis played a formative part in the wider project’s design and technical research.

The materials we present below take the form of detailed transcripts of fragments from video. We recorded the video while authors, Bennett and Taylor, accompanied pairs of people who had consented to be filmed and also in some cases wore small cameras during routine, everyday outings. We sought pairs with experiences guiding one another. As research demonstrates [11], [80], [86], learning from people with established relationships can inform the design of technologies to complement, rather than replace or interfere,

access-building. To this end, three pairs were recruited in total; two consisted of one person with a vision impairment and a fully sighted person employed via a government scheme to assist them with work-related tasks—nevertheless, both these pairs had hired people with whom they were already good friends. The third pair consisted of a couple, each with different classifications of visual impairment. Each was accompanied by researchers for about three hours. For their time, participants were given gift cards to an online store.

To analyze the video fragments and produce the transcripts, we drew on a form of interaction analysis regularly used in workplace studies [52], [70] and CSCW [31], [32], [33]. This analytical perspective places an emphasis on the highly situated material and interactional resources people employ to accomplish activities; for example, how a family's members participate in conversational talk when speech is not directly available to all [25], [26].

For the purposes of our research, we opted for this orientation to help sensitize ourselves to the *work* of access. In small groups of two to four researchers, we discussed the observations, alongside reviewing fieldnotes, video excerpts, and transcripts. This helped us prioritize the deeper analysis of what we thought were moments where access work seemed particularly important. We were especially drawn to what we observed to be the ways the pairs actively collaborated through a combination of conversational talk and bodily gestures, and where specific questions arose around: how people with different degrees of sight use talk and their fine-grained movements to coordinate with each other, how pairs make their actions mutually intelligible to unproblematically (or sometimes problematically) get on with an activity, and where troubles arise in these interpersonal interactions.

Equally critical to the research, however, was inviting and thinking through alternative readings. Drawing heavily on our combined and complimentary commitments to disability justice activism, critical disability studies, and feminist STS, and accounting for our own varied experiences having disabilities, having close relationships with people with disabilities, and staying open to learning from disability experiences unfamiliar to us, a particular methodological commitment was in how our analysis might sensitize us to under-recognized labor. For example, we aimed to read signs of getting on well together critically as not only evidence of access-building, but as moments to question what else could be going on.

These tensions and frictions helped us recognize the struggle of access without resolving it. They helped us gradually attune to reading across the practical work of access to notice more. What we hope the following transcripts and analyses serve to reveal then are the struggles endemic in analytically grasping hold of access. Put differently, what is at stake is being open to much more than the material or indeed visible accomplishments of access work, but what is invested in

such work and how such work comes to be meaningfully expressed between members.

FINDINGS

To investigate more deeply how care work entangles with access, we present three cases—one from our time with each of the afore-mentioned pairs. As we recount the cases, we borrow from feminist STS and disability studies scholarship to help enliven what might be at first glance viewed as quite instrumental partnerships. Again, our aim here is to draw attention to the ways people bring care to the work of access. In the first case, we establish how interdependencies flow and hint to the difficult-to-grasp but ever-present investment in doing well together. In the second case, we show how this care work for one another's contributions shifts among actors and in fact threads through interdependencies. In the third and last case, we draw out how care shifts in and out of operating in ways that privilege certain senses—like vision—over others. Together, these cases show that accounting for care work in access may widen concerns for AT designers beyond the concrete outcomes of a task and toward working within the unevenly distributed and ordinary, ever shifting relations that constitute access.

Completing a Task Well Together

We begin with an excerpt from video we recorded of interlocutors William and Jason. We use the excerpt to illustrate how access is not something given (or received) but rather co-configured by the pair through their encounters. In particular, we highlight how the conditions for access come about through interdependencies and the shared hope that they do well together.

The video is of William and Jason in a meeting room. But, rather than sitting at its conference table, the two—some, along with other meeting participants and a group facilitator, Sandra, are standing in an open area. Sandra has instructed the group to form teams of two in preparation of an activity where each team will pass a ball back and forth. As a team, William and Jason place themselves to one side of the room, facing one another, and ready themselves to throw and catch.

Before turning to the details of this scene, it is worth noting that William contracted a vision impairment seven years prior to the observation. With a full field of vision, he sees large objects and colors within a few feet from him. Jason, William's guide (who has full sight), is employed via a government scheme to assist with work activities upon William's request. Their throwing and catching is an exercise in preparation for an upcoming event in which they will be working with young vision impaired children, helping them to improve their confidence participating in sports activities.

Let us turn then to the short excerpt in which William and Jason work to throw and catch, as instructed.

William: F-1 [Holds yellow oval-shaped ball out towards Jason and taps on it with fingers.]

Jason: I think you should drop kick it. [turns and faces William and looks to ball]

William: ^{F-2} I could do a drop kick. [Hands ball to Jason]

Jason: ^{F-3} [Says something inaudible while tapping hand against ball and handing it back to William.] We're sort of limited though.

William: ^{F-4} Yeah, we are a bit [William hands ball back to Jason].

Jason: ^{F-5} I think you should try a drop kick [Jason takes ball with two hands then taps on it with right hand. Turns to Sandra and back to William].

William: Ha, I'll try throwing it. [Steps back as Jason hands him the ball. Then takes ball in both hands readying for throw].

Jason: [Steps back, readying for catch] Yeah, alright, do that, do that...

William: [Draws ball back towards him slowly, then throws to Jason, who's standing about 2 meters away].

Jason: [Sound of Jason catching ball] Yes.

William: Go on, try throwing it at me [William holds hands open and out].

Jason: Haha [Nods head to one side and tosses and catches ball gently in his hands as he readies to throw it from one side of his body]. Right, do you want it properly with a bit of spin? [Throws ball in spinning motion as he says spin].

William: Give it a go. [Grasps ball as it reaches him, but it falls between his hands and body. Moves towards fallen ball] Aw.

Jason: Aw, [Jason reaches down to get ball that has rolled towards him] you should have had that.

William: Ok, try again, try again.

[Moments later...]

Jason: That's defeating the point [Throws ball up and catches it twice before throwing towards William]

William: [Catches ball] Yes.

In this transcript, we find William and Jason participate in the exercise by gradually establishing a rhythm. They begin, tentatively, by handing the ball back and forth—signaling their movements with taps of the ball and gross gestures to ready one another (Fig. 1). This back and forth also corresponds to verbal cues such as “are you ready?” and confirmations like “yes” and “oh, that was good”. The passing of the ball is then synchronized with that “simplest” unit familiar to conversation analysts, turn-taking [71], [73]. William and Jason come to first pass the ball to one another,

then throw and catch it, and finally (beyond the short window we present) accomplish a “drop kick”.

It is this turn-by-turn interaction and what emerges as a combined set of capacities between William and Jason that we point to as an interdependency which creates the conditions for access. We find that the capacity to throw and to catch does not reside in any one actor—William or Jason—but comes about through actions that are made mutually intelligible and actionable between the pair. Notably, these are not explicit or crude declarations like “I’m passing the ball now,” but built into the unfolding *interaction*—agencies fluidly shift. Certainly to speak of access here, and to presuppose agency residing in one member of the pair but not the other, would belie what is achieved by William and Jason together. In other words, it would be to elide how they come to be interdependent.

Something that is harder to get a handle on in interchanges like that between Jason and William is that a certain sensibility appears to be at work between them. On viewing the sequence above, what feels abundantly clear is that there is a care between them; they seem not only invested in successfully throwing and catching the ball, but also a concern for how well they are doing together and whether they are achieving the most from their combined capabilities.

Paying closer attention to the video and transcript, we find this affective interchange threading through their acts of connection. A care is made observable in Jason’s hesitation to throw the ball at first; in William’s persistence, and in their voiced compassion, with verbal cues like “aww”; and in a humor, suggesting a drop kick when they aren’t clear how they will accomplish the task at all. The seemingly functional acts of throwing and catching are then entangled with gestures signifying a will, a hope, and the investment to throw and catch a ball well together.

Below, we give closer attention to this presence of care, and its entangled relations with the practical acts of doing things with others. What we consider is how not only agency, but also care continually shifts in these relationships. In so doing, we show how caring can open up moments for another to act, establishing access and care as co-constitutive.

Shifting Care to Build Access Collectively

Below we rejoin William, this time shopping with his long-time, romantic partner-sometimes-guide, Emily. William

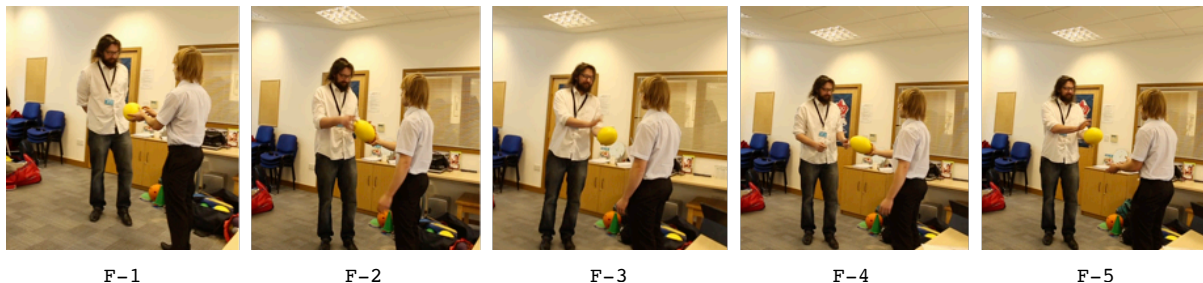


Figure 1. Video frames F-1 to F4 corresponding to spoken turns between William and Jason.

uses his white cane and partial sight to navigate, and Emily, who has had little sight since birth, is accompanied by her guide-dog Jaz. The threesome are in a pharmacy and the transcript captures their search for an exit in a maze of crisscrossing isles.

Emily: You want me to find the door?... William?
 William: Yeah. [Keeps walking]
 Emily: You want me to find the door?
 William: Find the door? [Stops and turns to one side as Emily approaches]
 Emily: Do you want me to find the door?
 William: Yeah, go on then yeah.
 Emily: Where have we gone now? [Emily and Jaz take the lead, and begin to walk right down an isle]
 William: I think we've... Oh, we've headed up to the perfumes.
 Emily: 'Scuse me. [Walks around someone, then walks in silence].
 Emily: [Emily talks to Jaz] Good girl. [Sotto voce, as they continue walking ahead] Where are we going?
 William: [inaudible] lost?
 Emily: Yeah,... errrr... [Turns left] Straight on. Find the door. Good girl, find the door. Find the door, good girl
 Emily: [Emily talks to Jaz] Good girl, find the door [approx. 4 meters in front of door Jazz and then all three stop]. Oh, it [the door] doesn't open.
 William: It's not an automatic door. [Walks around Emily and Jaz and opens a swinging door]
 Emily: Oh isn't it? [Walks through as William holds door open]. Oh, hehehehehehe. We got stumped by a door. Good girl. [Pats Jaz on head].
 William: Hehehehe. [Continues walking].

In a flow and intermingling of forces, William, Emily and Jaz work together to navigate obstacles like shelving units, other shoppers, and the larger floorplan to locate the exit. We see a form of access at work; agency and care are distributed across a heterogeneous assortment of actors in order to make exiting the store possible for the group. William, Emily, Jaz, the harness, the shop's floorplan, the isles and so on produce the conditions of access through which all are able to respond to each other.

But importantly, these capacities shift continuously among actors as they progress and work together. Different relationships to another's touch, to lighting, to space, thresholds, words, interactional sequences, open up possibilities for new ways of sensing. But these openings are not only material. While things are getting done, William, Emily, and Jazz notice how things are (or are not) getting done. For example, early on, William follows Emily and Jazz once they have worked out where the exit is, but he steps in to open the door when he realizes something about its operation they do not. There is a sensibility to who is capable of what, and how the flows and shifts can work together.

In acting together, each are caring for how the others are able; their access is thus made possible as much by who can

do what as how one can open an opportunity for someone else to do something. In showing caring and doing as co-constitutive, we point to a sensitivity William, Emily, and Jaz have for one another that makes this intermingling much more than finding the exit or completing the task. To see what is unfolding in purely instrumental terms—as problems of navigating bodies from point A to B, or of mechanically throwing and catching—is to lose all that has gone into how actions and abilities are mutually conducted and shared. Much effort is given to insure everyone can contribute.

From philosopher of science Vinciane Despret, we learn that developing a rapport like this, a sense of each other's capabilities, requires one to give these capabilities “some worth, some affective values” [15] p.55: a sensibility that everyone is aware that William is good at one thing (identifying broken doors), Emily another thing (interpreting Jazz's movements through the guide-dog harness), and Jaz something else (recalling their path entering the store). Much of the access work was in enabling this flow of capacities.

As we have begun to show how care is entangled with building access together, in the next section we establish how care does not presuppose good. We show that some caring is necessitated and upheld through structural inequities that privilege certain abilities like seeing.

Caring Unevenly

To explore in more detail some of the troubles that may arise in building access, let us turn to another video recording we have made, this time in which we see our third pair, Joseph and Gwen, using a trolley to transport some tables they have borrowed from a next door church for an event Joseph is hosting at his workplace. Joseph is completely blind and Gwen is his long-time sighted guide, employed through the same program as Jason. Unsurprisingly, both have come to be close friends over the years. In this example, we skip to the end when Joseph and Gwen are bringing the trolley back to its storage place in the church. Though they no longer have need for the trolley, upon arriving at the church, Joseph and Gwen have loaded some more tables onto it, and they look to be rolling it back outside.

Gwen: I'm just going to open the door here.
 [The couple wheel the trolley into the church.]
 Joseph: OK
 Gwen: Can you just go straight ahead?
 Joseph: Yeah, ish. Hahaha.
 Gwen: ... Leaning to the right...
 Joseph: I am? Or you want me to?
 Gwen: You, hahaha.
 [A few minutes later, they have begun to wheel the trolley back outside, navigating it through two different doors. In the process, they realize their mistake.]
 Gwen: Ok, we're going to swivel it [pause] to your right. [said slowly as if contemplating direction.]
 Joseph: [Inaudible... Both swivel the trolley as Gwen directed.]

Gwen: You ready?
 Joseph: Yeah
 Gwen: [Inaudible...]
 Joseph: [Scratches head. Both move the trolley toward the door, then stop at the door.]
 Gwen: I'm going to push against this door. [Opens door.] Ok, straight ahead.
 Joseph: [Pushes the trolley forward.]
 Joseph: Ok
 Gwen: [inaudible]
 Joseph: Ok
 Gwen: Ok, and turn right. Joseph just stabilize it please. [Gwen lets go of the trolley.]
 Joseph: Ok
 Gwen: [Inaudible] I think, I'm going to unlock the door.
 *Joseph: Yeah [pause] Sorry where... where are we going with this?
 Gwen: Pardon? (laughs) [both laugh and say a few inaudible things].
 Gwen: The trolley goes in the corner.
 Joseph: Yes [More laughing by both]
 Gwen: [inaudible] It could be like Groundhog Day; we could just keep going back and forth.

As Joseph and Gwen walk with the trolley between them, it is at first hard to be sure who is guiding whom. Both are exerting different forces on the trolley, Joseph pushing, Gwen pulling. Joseph momentarily pushes alone, Gwen issues words that help to orientate him. Even when they have realized the mistake (that the trolley is no longer needed) a sensitivity is applied. Joseph's subtlety in action and dialogue: in turning toward the door and in asking "Where are we going with this?" (see *) compassionately makes Gwen aware of their unnecessary efforts. Working together, it seems fair to say there is a care between the two.

Admittedly, this version of care seems to default to positive affect and presuppose care as inevitably good. However, in this reading, we are not complacent about the distributions of authority and power it allows. Gwen and Joseph seem to be very much attuned to one another, and noticeably there is a caring in their voices, pauses, hesitations, and bodily interchanges. And yet the distribution of care leans markedly to one side. As STS scholars Ingunn Moser and John Law [61] describe, good intentions conceal others. They and other scholars [23], [45], [48], [62], [66], [67], [68] are emphatic, and rightly so, that care cannot be outside of 'goods' and 'bads'.

To be sure, Gwen is guiding Joseph here. She exhibits her expertise as a guide, issuing a series of orientating turns to anchor Joseph as they move from outside to inside, through a series of doors. "Straight ahead" indexes the open door, the passing through the doorway, the movement of the trolley. Joseph's "I am? Or you want me to?" is a query to the prior turn, but also a question about the line he has followed or must follow. More precisely, he is reassessing the line he is making with the trolley as he passes through the threshold, moving from before the doorway to after it. This is an

altogether more complex affair than the shall we say 'standard' guiding formation where a sighted person clearly takes lead of a vision impaired person. People, things, spaces are changing, so that what is invited is an active and collective sensing, what we might call a sensing-with, much more than a sensing-for or -of. But this unfolding, as mutual as it may be, also demands recognizing Gwen's placement in front: she moves Joseph's hand, she vocalizes the actions. It is Gwen sensing in a-world-for-the-sighted and giving Joseph the capacity to act in this world. This certainly allows for more to happen; for Joseph to, for example, reorient the pair when plans go awry. But he is being afforded a capability that highlights his absence, that highlights what he cannot 'see'. Care here 'orders disability in a distinctive way' [48], [59]. It is performed *according to norms which prefer a visual recognition of the world*.

We cannot do justice to the troubling and historically contingent complicities that come with care, as others do so richly [23], [48], [62], but it is our proposal that the care work we find enacted between William, Emily and Jaz provide us with another way of approaching access. Between and around them, there are, inescapably, power differentials. On the shop floor, for example, there are: large typefaces marking out isles; regulated levels of illumination; standardized isle widths; and automated doors (or not, as the case may be). All these designed items materialize a structural care for people who can use their vision to find the exit. But still, the threesome provide us with a way to understand caring as part of how they can build access in ways that don't rely on sight or other demarcations which separate and, in their own ways, subvert disabled ways of caring and building access.

Let us think a little more with William, Emily and Jaz to consider this. True, they are making do in a setting designed for sighted people, but conditions for access also seem to come into being through their openness to authorize different types of capacities. Being capable here is much more than a literal 'seeing', it comes through an accessible care that is both resistant and responsive to dominant visual cues. Their care work shows how creating uneven conditions for access does not preclude generative forms of being together. Indeed, they illustrate how an attention to care may help us deepen our understanding of the particular forms of work (smelling, remembering, reorienting, and even stepping back for another to assert their capabilities) on which access depends.

Even in the most ordinary occasions with what may seem the most banal consequences, this care work provides us with an alternative way of complicating how "historically and spatially layered distributions" [62] p.721 of power and capability entangle with access. Understanding access in this way is not to dismiss Gwen's guiding of Joseph's guiding; it is to accept that this difficulty *is* often the way access works, it is the lived conundrum of care. Joseph, William, Emily, and Jaz, come to be able in these always shifting modes of uneven ordering that must be pieced together. The fact that

caring often perpetuates structural inequities does not imply turning away from the trouble. Instead it suggests attending to it closely: making room for multiple and alternate types of sensing that might just resist oppressive norms.

DISCUSSION

We have used the above encounters to begin to complicate a conventional AT focus on tasks. By paying attention to people living with vision impairments, and to the mutual capacities enacted with each other, we've sought to give a greater clarity to the process of creating access. Among each pair, above, we recognized a concern for caring how well partners are doing together, not just for accomplishing the goal at hand. For example, with William and Emily, we noticed care in their patience for everyone to be invested in finding their way. With Joseph and Gwen, we saw this caring attention in their slowness and in Joseph's kindness, asking Gwen where they are going. But we also saw this care unfold in uneven ways that privileged a caring for vision impaired people that can rely on 'seeing for' another. We might thus say Gwen's exacting instructions for moving the trolley enabled Joseph to act in a reduced way, responding to a narrow, verbal interpretation of visual surroundings.

Turning to a feminist and disabilities literature to make sense of these interactions, we also saw how care is entangled in this everyday action—how, as feminist science and technology studies scholar Puig de la Bellacasa writes, care is brought into being through “a hands-on doing connected with neglected everydayness” [67] p. 111. With an attention to care, we made out the difficult-to-identify-in-action but ever-present investment the pairs have in doing well together. This concern helped us articulate the varied forms of work it took to create access while recognizing such work as inseparable from the task completion we had set out to learn from. We saw how the interdependencies produced through and with access worked in distinct and important ways.

In closing, we want to look closer at these emergent relations in the context of interactive system design. Far from suggesting that we 'add care' to AI and forget about human guides, we want to consider what the care work of access means for AI ATs when they become part of the existing relationships of access described above. Our analysis points to how we might widen the emphasis on bounded tasks and achieving discrete outcomes, and place greater importance on the care between people involved in the work of access. It suggests considering specific approaches to AI ATs that are sensitive to the routine work of care access enacting particular (and never entirely innocent) versions of disability and ability.

In the following, we respond to this prompt by thinking through two notable ways in which we saw care work give rise to access: (1) mundane attunement and (2) non-innocent authorization.

Mundane Attunement

Captured above, our interlocutors expose a care knitted into the ordinary course of life events, into continually shifting relationships of things and people mutually sensing in common. Through the collaborative acts of tossing balls, finding exits, and pushing trolleys, we find a routine kind of access being negotiated, but an access that can't be disentangled from care. Such care is not just made a possible or even likely part of access; it is present and acted on because there are relations between actors, human or otherwise. It is constitutive of a world in which access is, too, built through relations [14], [15], [20], [45], [48], [60].

Thus, what we see in these acts is not a preoccupation with the completion of a task *per se* or indeed the necessary steps to achieve it. Instead, there is an investment in establishing what matters and what is meaningful between those involved. What counts as a task done well is, in other words, held open, attuned and negotiated between actors. Whether dropping or dropkicking a ball, it is an unfurling care for such mundane acts that makes moments matter, that gives them worth and the direction for what to do next. Building access [28] is not a goal here, but is, as Lakshmi Piepzn-Samarasinha has written [48], the ordinary, mundane attunement of people's acts, wills and hopes—of how to move on.

In the data driven approaches popular in contemporary AI systems and being introduced into ATs [4], [8], [27], [40], [41], [49], [53], [58], [78], [88], [90], [91], [92], [93], [94], [95] these mundane attunements present a challenge. When what matters in the work of access is open, attuned in response to so many contingencies, how do we find datasets that might afford aggregation in any meaningful sense and that lead to the identification of actionable patterns of interaction that aren't too general? What is it to train a model and evaluate it against goals that are not defined *a priori* or cannot be judged probabilistically?

Salience in the Moment

Mundane attunements point to a different possible avenue where rather than looking to solve defined problems *per se*, the priority could be given to a much more situated training where the user identifies acts that have a *salience in the moment*. These would be necessarily small: a vision system triggered to recognize another's bodily orientation, a gesture, a sound, or a combination of all three. What if on hearing Jason tap the ball, William asks him to do it again, and perhaps again after that. The sound, the associated gesture and the subsequent throwing of the ball are repeated until they become a sequence recognized by the system so it can signal the object's or human's location and orientation the next time. This doesn't solve the throwing and catching between the two, but it may allow the partners to add something more to their repertoire, to invest, mutually, in not only completing a task, but creating something else that adds more to what is possible for them to experience together.

This proposal has a technical basis in work such as that from Rebecca Fiebrink, Marco Gillies and their colleagues [17], [22] who propose more human-centered machine learning in which supervised learning systems are coupled with situated user-generated examples or training. Such efforts towards “reframing machine learning workflows based on situated human working practices, and exploring the co-adaptation of humans and intelligent systems” [19] p.7.1, show that systems can operate in response to limited training samples presented in real-world contexts. Fiebrink, for example, has shown considerable success in building digital music instruments that can be trained and respond to real-time embodied interaction by users [18]. Indeed, we find possible starting points in object recognizers which allow vision impaired users to build their own training sets [41], [49]. How such approaches might be incorporated into the mundane attunements between human actors, and those with different sensory capacities, presents an open question but one that seems in line with the premise of this human-centered machine learning and at least technically feasible.

The broader challenge here—centered on querying the role of AI in these mundane attunements—should stay with what might just be made to matter to an AI AT in a particular moment, and how such capacities for recognition play into the care work of access. Someone might be able to make the pace or rhythm of a friend walking to one side or ahead matter to an AT and it’s imaginable that this particular encounter might come to hold meaning between the couple. For example, someone who is physically separated from their guide might attune an AT to signal their proximity, or the separation of companions might invite exploration, map spatial layouts, or simply enable the practical doings of something else like throwing balls or rolling trolleys. Taking seriously mundane attunements, is to give the ordinary refiguring and renegotiation of bodies the chance to matter in unexpected and meaningful ways.

The non-innocent authorizing of care

Across the vignettes, we see how the work of access is not only continually constituted through mundane attunements, but also shifting and unequal. In doing things together, and in building access through care work, comes the inevitability of producing relationships inflected with moments of awkwardness, hesitation, and dominance. Consider how Gwen and Joseph move between providing access and attuning access; in their unfolding relations they expose small acts that reinforce and get reinforced by uneven rights to care (who should care and when), and skewed capacities to authorize the forms of care that are enacted. For them and the other pairs, the care work of access cannot be “reduced to [the] smoothing out of differences,” but, instead, is a practice of working with differences [68] p. 204, and in some cases these differences are cast by long histories and troubling normative presumptions that disabled people and their ways of going about the world are less valuable and in need of correction [24], [48].

This signals the non-innocence of care that feminist science and technology studies scholar Michelle Murphy writes of in the context of the transnational movements of a vaginal self-exam [62]. To care—even to care for another’s access in a sight-dominant world—is to exert a politics, a politics for example of who has the authority to decide what bodies should guide other bodies, what abilities should be the ones to invite other abilities to act. What we see on occasions like Gwen and Joseph’s is that the authority—the capacity to authorize these politics of bodies and abilities—is entangled in the mundane work of care. To guide and take the lead using a text-book formation, to translate the visual into the audible, etc. are acts that do not point to an absence of care work in access, but rather show how this care, in the very practical ways movements are afforded and authorized, upholds structural inequities.

For AI ATs, the risk here might be to find sway in the increasingly popular responses to bias and ethics in AI. Technical fixes for transparency and explainability are being touted as solutions to the problems of bias in AI datasets and models [1], [84], [85]. The goal of “debiasing” AI systems presupposes that there might be technical approaches and systems themselves that are neutral, somehow outside of the politics of sociotechnical entanglements. Instructive in our work and on the mundane, moment-by-moment interactions between those with and without disabilities, however, is that we cannot assume care comes without a choice, a decision that authorizes a particular version of relationships and events. To care is always to perform a disconnect, “we cannot possibly care for everything, not everything can count in a world” [68] p.204.

The implications for AI in ATs must then be to accept that in making decisions, in choosing to disconnect some worlds from others, in authorising particular versions of the careful work of building access, there must come responsibilities—taking responsibility for the way technologies surveil and, in some cases, taking responsibility to not harness AI when the access it will provide will reinforce structural inequities [35], [47], [74], [75], [87]. Even when the choice is made to use AI, and processes are off-loaded to vision systems and computational models, systems of public education and participation, and regulatory oversight are needed to guide decisions over what worlds we want to act in/for. And included in this must be the voices from critical disability studies [20], [29], [42] and disability justice activism [48], [57], the voices from people and groups who have long fought to counter and rework the structural and intersectional prejudices always already entangled in/with sociotechnical practices.

Records of Access Work

Following work from HCI and media studies scholars [6], [16], [50], [69], [72], one mode of confronting these uneven structures would be to establish a collective memory of the mundane care work of access, with all its pain and misalignments. It could serve to acknowledge the

interdependencies between actors and the worlds such relations come with. Whether such a catalogue of mundane care work has traction in a technical system or for that matter one built on AI we will leave open. However, we maintain that this is a condition that will not merely be solved through top down regulations and system redesigns. Rather, there is a need for a working and re-working of access that affectualizes, politicizes, and historicizes the associated labor to reveal the non-innocent complexities with which we must work [48].

Reckoning with Error States and Outliers

What we also learn from an attention to attunements is the value of “reckoning” [62] p.15 with the byproducts of access-building. In their seemingly unremarkable qualities—non-innocent authorizations are the sites where we continuously learn and adjust what it means to support disabled ways of providing access and care. For example, any technical system should not necessarily induce error states or produce outputs classified as outliers. Rather these should be read as possibilities for being with humans and technologies differently. To expand on the above example, when plans go awry such as with Gwen and Joseph or when guides become physically disconnected, the invitation should be to consider what alternative possibilities there are. As Gwen and Joseph found humor, such moments could spawn unintentional but surprising pursuits, or indeed lead to explicit acts of resistance [87]. The troubles of mundane attunements, might invite us to linger on those moments when care circulates, and where the careful work of building access expands the possibilities for people to be capable together.

CONCLUSION

Broadly, this paper has sought to explore how AI ATs might be designed to widen an emphasis on the bounded task and its capacity to support discrete outcomes and, instead, recognize the importance of the social and affective attunements between people doing things, and wanting to do them well together, through interdependencies. We have considered the ways in which we might approach AI for ATs that take these entangled relations between people seriously, and are sensitive to the ordinary, routine work of care access enacting particular versions of disability and ability.

In conversation with ideas of interdependence [5], [56], we draw out how care work in access is complicated, becoming a mode that invites ‘more-than’ what any one person is capable of, and thus querying (or indeed *queering* [42]) a deeply entrenched view of specific bodies as intrinsically limited by finite capacities. This mutuality throws into question any idea of what *one* is able to do.

Yet, crucially, our aim has not been to promote an unthinking, uncritical idea of care or that any care is good care. We have sought to show that at one and the same time, care with another is able to slip into generative moments, where capabilities come to be relational and mutual through and responsive to manifold actors’ interdependencies, yet

can also be laden with structural inequities that authorize relations and reinforce ableist ideas of assistance.

We argue that our analysis of the ways people with different disabilities and abilities complete tasks together can impact how AI ATs are designed. We have shown one of undoubtedly numerous ways we might incorporate the technological capacities of AI learning and modelling into the emerging relations between actors, and the continually shifting attunements that shape what to care for and how to care in mundane practicalities of access. This is an approach to AI ATs that reduces the emphasis on compensating for presumed deficits in normatively defined bodies and abilities, and turns towards how capacities are entangled with materially bound acts of care.

We have also argued, however, that there should be no avoiding the responsibilities that come with technologies that are part of people’s choices of how to care, and how to attune abilities to do more together. Through a speculative pause, and staying with the irresolvable, we have tried to make room for a care that just might be, to use Murphy’s phrase, “generatively unsettling” [62] p.722. This, gives us a way of thinking about relations that are articulated differently, that give form to new co-figurings of what access and care might look like together.

In attending to the care work of access, we are in a way making a proposal for an approach to AI and AT design, an approach that at once notices the entangled relations between actors, and is sensitive to the histories and injustices disabilities come with. The challenge this presents is to ask what do we want to make possible? What are the “*conditions of possibility*” for “new existences” [14]. If access comes with multiples of care, how might people work well with technologies that will, to be sure, enable and disable, and that will care-for/with, affect, subvert, and so on. This work beckons HCI scholars to ask what worlds we want to live in and care for.

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REFERENCES

- [1] Ali Abdulrahmani, William B. Easley, Michele A. Williams, Stacy Branham and Amy Hurst. 2017. Embracing Errors: Examining how Context of Use Impacts Blind Individuals’ Acceptance of Navigation Aid Errors. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA, 4158-4169. <https://doi.org/10.1145/3025453.3025528>
- [2] ACM FAT* Conference. Retrieved September 18, 2019 from <https://fatconference.org>

- [3] Tousif Ahmed, Apu Kapadia, Venkatesh Potluri, and Manohar Swaminathan. 2018. Up to a Limit?: Privacy Concerns of Bystanders and Their Willingness to Share Additional Information with Visually Impaired Users of Assistive Technologies. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 3, Article 89 (September 2018), 27 pages. DOI: <https://doi.org/10.1145/3264899>
- [4] Apple. Vision Accessibility: iPhone. Retrieved September 16, 2019 from <https://www.apple.com/accessibility/iphone/vision/>
- [5] 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 (ASSETS '18)*. ACM, New York, NY, USA, 161-173. DOI: <https://doi.org/10.1145/3234695.3236348>
- [6] 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 (DIS '19)*. ACM, New York, NY, USA, 35-47. DOI: <https://doi.org/10.1145/3322276.3322376>
- [7] Andrew B. L. Berry, Catherine Lim, Andrea L. Hartzler, Tad Hirsch, Edward H. Wagner, Evette Ludman, and James D. Ralston. 2017. How Values Shape Collaboration Between Patients with Multiple Chronic Conditions and Spousal Caregivers. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 5257-5270. DOI: <https://doi.org/10.1145/3025453.3025923>
- [8] Jeffrey P Bigham, Chandrika Jayant, Hanjie Ji, Greg Little, Andrew Miller, Robert C Miller, Robin Miller, Aubrey Tatarowicz, Brandyn White, Samuel White, and Tom Yeh. 2010. VizWiz: nearly real-time answers to visual questions. In *Proceedings of the 23rd annual ACM symposium on User interface software and technology*, 333-342.
- [9] Susanne Bodker. 2015. Third-wave HCI, 10 years later-participation and sharing. *interactions* 22, 5 (August 2015): 24-31.
- [10] 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*, 163-171.
- [11] Stacy M. Branham and Shaun K. Kane. 2015. Collaborative accessibility: how blind and sighted companions co-create accessible home spaces. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 2373-2382.
- [12] Clara Caldeira, Matthew Bietz, Marisol Vidauri, and Yunan Chen. 2017. Senior Care for Aging in Place: Balancing Assistance and Independence. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 1605-1617. DOI: <https://doi.org/10.1145/2998181.2998206>
- [13] Lennard J. Davis. 1997. Constructing normalcy. *The disability studies reader* 3 (1997): 3-19.
- [14] Vinciane Despret. 2004. The Body We Care For: Figures of Anthro-zoo-genesis. *Body & Society* 10, 2-3 (June 2004), 111-134.
- [15] Vinciane Despret. 2013. From Secret Agents to Interagency. *History and Theory* 52, 4 (2013): 29-44.
- [16] Kristin N. Dew and Daniela K. Rosner. 2019. Designing with Waste: A Situated Inquiry into the Material Excess of Making. In *Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19)*. ACM, New York, NY, USA, 1307-1319. DOI: <https://doi.org/10.1145/3322276.3322320>
- [17] Rebecca Fiebrink. 2010. Real-time interaction with supervised learning. In *CHI '10 Extended Abstracts on Human Factors in Computing Systems (CHI EA '10)*. ACM, New York, NY, USA, 2935-2938. DOI: <https://doi.org/10.1145/1753846.1753889>
- [18] Rebecca Fiebrink. 2017. Machine learning as meta-instrument: Human-machine partnerships shaping expressive instrumental creation." In *Musical Instruments in the 21st Century*, 137-151. Springer, Singapore.
- [19] Rebecca Fiebrink and Marco Gillies. 2018. Introduction to the Special Issue on Human-Centered Machine Learning. *ACM Trans. Interact. Intell. Syst.* 8, 2, Article 7 (June 2018), 7 pages. DOI: <https://doi.org/10.1145/3205942>
- [20] Kelly Fritsch. 2010. Intimate assemblages: Disability, intercorporeality, and the labour of attendant care. *Critical Disability Discourses/Discours critiques dans le champ du handicap* 2.
- [21] Kelly Fritsch, Clare O'connor, and Andrew Kieran Thompson, eds. 2016. Keywords for radicals: The contested vocabulary of late-capitalist struggle. AK Press.
- [22] Marco Gillies, Rebecca Fiebrink, Atau Tanaka, Jérémie Garcia, Frédéric Bevilacqua, Alexis Heloir, Fabrizio Nunnari, Wendy Mackay, Saleema Amershi, Bongshin Lee, Nicolas d'Alessandro, Joëlle Tilmanne, Todd Kulesza, and Baptiste Caramiaux. 2016. Human-Centred Machine Learning. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*. ACM, New York, NY, USA, 3558-3565. DOI: <https://doi.org/10.1145/2851581.2856492>

- [23] Eva Giraud , and Gregory Hollin. "Care, Laboratory Beagles and Affective Utopia." *Theory, Culture & Society* 33, no. 4 (July 2016): 27-49.
- [24] Dan Goodley. 2014. Dis/ability studies: Theorising disablism and ableism. Routledge.
- [25] Charles Goodwin, Marjorie H. Goodwin, and David Olsher. Producing Sense with Nonsense Syllables: Turn and Sequence in Conversations with a Man with Severe Aphasia. In *The Language of Turn and Sequence*, edited by Cecilia E. Ford, Barbara A. Fox, and Sandra A. Thompson, 56-80. Oxford: Oxford University Press, 2002.
- [26] Charles Goodwin. 2004. A Competent Speaker Who Can't Speak: The Social Life of Aphasia. *Journal of Linguistic Anthropology* 14, 2 (December 2004) 151-170.
- [27] Google. Lookout. Retrieved September 16, 2019 from https://play.google.com/store/apps/details?id=com.google.android.apps.accessibility.reveal&hl=en_US
- [28] Aimi Hamraie. 2017. *Building Access: Universal Design and the Politics of Disability*. University of Minnesota Press, Minneapolis, MN.
- [29] Aimi Hamraie, and Kelly Fritsch. 2019. Crip technoscience manifesto. *Catalyst: Feminism, Theory, Technoscience* 5, 1 (2019).
- [30] Michael Hardt and Antonio Negri. 2004. *Multitude: War and Empire in the Age of Democracy*. London, Penguin.
- [31] Christian Heath. 1986. *Body movement and speech in medical interaction*. Cambridge University Press.
- [32] Christian Heath. 2011. Embodied action: Video and the analysis of social interaction. *Qualitative research* 3 (2011), 250-270.
- [33] Christian Heath, Jon Hindmarsh, and Paul Luff. 2010. *Video in Qualitative Research*. SAGE.
- [34] Louise Hickman. 2018. Access Workers, Transcription Machines, and Other Intimate Colleagues: Disability, Technology and Labor Practices in the Production of Knowledge (1956-Present). Doctoral Dissertation, University of California San Diego.
- [35] Anna Lauren Hoffmann. (2019) Where fairness fails: Data, algorithms, and the limits of antidiscrimination discourse. *Information, Communication, & Society*, 22, 7 (2019), 900-915.
- [36] Dorothy Howard and Lilly Irani. 2019. Ways of Knowing When Research Subjects Care. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (CHI '19). ACM, New York, NY, USA, Paper 97, 16 pages. DOI: <https://doi.org/10.1145/3290605.3300327>
- [37] Lara Houston and Steven J. Jackson. 2016. Caring for the "next billion" mobile handsets: opening proprietary closures through the work of repair. In *Proceedings of the Eighth International Conference on Information and Communication Technologies and Development* (ICTD '16). ACM, New York, NY, USA, Article 10, 11
- [38] Lara Houston, Steven J. Jackson, Daniela K. Rosner, Syed Ishtiaque Ahmed, Meg Young, and Laewoo Kang. 2016. Values in Repair. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (CHI '16). ACM, New York, NY, USA, 1403-1414. DOI: <https://doi.org/10.1145/2858036.2858470>
- [39] Margaret Jack and Steven J. Jackson. 2016. Logistics as Care and Control: An Investigation into the UNICEF Supply Division. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (CHI '16). ACM, New York, NY, USA, 2209-2219. DOI: <https://doi.org/10.1145/2858036.2858503>
- [40] Chandrika Jayant, Hanjie Ji, Samuel White, and Jeffrey P Bigham. 2011. Supporting blind photography. In *The proceedings of the 13th international ACM SIGACCESS conference on Computers and accessibility*, 203-210.
- [41] Hernisa Kacorri, Kris M. Kitani, Jeffrey P. Bigham, and Chieko Asakawa. 2017. People with Visual Impairment Training Personal Object Recognizers: Feasibility and Challenges. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (CHI '17). ACM, New York, NY, USA, 58395849. DOI: <https://doi.org/10.1145/3025453.3025899>
- [42] Alison Kafer. 2013. *Feminist, queer, crip*. Indiana University Press, Bloomington, IN.
- [43] Naveena Karusala, Aditya Vishwanath, Arkadeep Kumar, Aman Mangal, and Neha Kumar. 2017. Care as a Resource in Underserved Learning Environments. *Proc. ACM Hum.-Comput. Interact.* 1, CSCW, Article 104 (December 2017), 22 pages. DOI: <https://doi.org/10.1145/3134739>
- [44] Elizabeth Kaziunas, Mark S. Ackerman, Silvia Lindtner, and Joyce M. Lee. 2017. Caring through Data: Attending to the Social and Emotional Experiences of Health Datafication. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (CSCW '17). ACM, New York, NY, USA, 2260-2272. DOI: <https://doi.org/10.1145/2998181.2998303>
- [45] Christine Kelly. 2013, Building Bridges With Accessible Care: Disability Studies, Feminist Care Scholarship, and Beyond. *Hypatia* 28, 4 (November 2013) 784-800.
- [46] Christine Kelly. 2011. Making 'care' accessible: Personal assistance for disabled people and the politics of language. *Critical Social Policy* 31, 4 (November 2011): 562-582.
- [47] Os Keyes. 2018. The Misgendering Machines: Trans/HCI Implications of Automatic Gender Recognition. *Proc. ACM Hum.-Comput. Interact.* 2,

- CSCW, Article 88 (November 2018), 22 pages. DOI: <https://doi.org/10.1145/3274357>
- [48] Leah Lakshmi Piepzna-Samarasinha. 2018. *Care Work: Dreaming Disability Justice*. Arsenal Pulp Press.
- [49] Kyungjun Lee, Jonggi Hong, Simone Pimento, Ebrima Jarju, and Hernisa Kacori. 2019. Revisiting Blind Photography in the context of Teachable Object Recognizers. In *Proceedings of the 21th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '19)*. ACM, New York, NY, USA, to appear.
- [50] Kristina Lindström and Åsa Ståhl. 2016. Becoming response-able stakeholders: participatory design in times of uncertainties. In *Proceedings of the 14th Participatory Design Conference: Short Papers, Interactive Exhibitions, Workshops - Volume 2 (PDC '16)*, Claus Bossen, Rachel Charlotte Smith, Anne Marie Kanstrup, Janet McDonnell, Maurizio Teli, and Keld Bødker (Eds.), Vol. 2. ACM, New York, NY, USA, 41-44. DOI: <https://doi.org/10.1145/2948076.2948086>
- [51] Kiel Long, Lyndsey L. Bakewell, Roisin C. McNaney, Konstantina Vasileiou, Mark Atkinson, Manuela Barreto, Julie Barnett, Michael Wilson, Shaun Lawson, and John Vines. 2017. Connecting Those That Care: Designing for Transitioning, Talking, Belonging and Escaping. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 1339-1351. DOI: <https://doi.org/10.1145/3025453.3025715>
- [52] Paul Luff, Jon Hindmarsh, and Christian Heath, eds. 2000. *Workplace studies: Recovering work practice and informing system design*. Cambridge university press.
- [53] Haley MacLeod, Cynthia L. Bennett, Meredith Ringel Morris, and Edward Cutrell. 2017. Understanding Blind People's Experiences with Computer-Generated Captions of Social Media Images. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 5988-5999. DOI: <https://doi.org/10.1145/3025453.3025814>
- [54] Laura Mauldin. 2017. A Feminist Technoscientific Approach to Disability and Caregiving in the Family. In *Disabling Domesticity*. Springer, 139-161.
- [55] Microsoft. Seeing AI: Talking Camera App for Those with a Visual Impairment. Retrieved September 16, 2019 from <https://www.microsoft.com/en-us/ai/seeing-ai>
- [56] Jennie Middleton, and Hari Byles. 2019. Interdependent temporalities and the everyday mobilities of visually impaired young people. *Geoforum* 102 (2019), 76-85.
- [57] Mia Mingus. 2010. Reflections on an Opening: Disability Justice and Creating Collective Access in Detroit. *Leaving Evidence*. Retrieved September 17, 2019 from <https://leavingevidence.wordpress.com/tag/collective-access/>
- [58] 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 (ASSETS '17)*. ACM, New York, NY, USA, 81-90. DOI: <https://doi.org/10.1145/3132525.3132530>
- [59] Ingunn Moser. 2005. On Becoming Disabled and Articulating Alternatives: The Multiple Modes of Ordering Disability and Their Interferences. *Cultural Studies* 19, 6 (November 2005) 667-700.
- [60] Ingunn Moser. 2011. Dementia and The Limits To Life: Anthropological Sensibilities, STS Interferences, and Possibilities For Action In Care. *Science, Technology, & Human Values* 36, 5 (September 2011): 704-722.
- [61] Ingunn Moser and John Law. 1999. Good Passages, Bad Passages. *The Sociological Review* 47, S1 (May 1999): 196-219.
- [62] Michelle Murphy. 2015. Unsettling Care: Troubling Transnational Itineraries of Care In Feminist Health Practices. *Social Studies of Science* 45, 5 (October 2015), 717-737.
- [63] Francisco Nunes, Nervo Verdezoto, Geraldine Fitzpatrick, Morten Kyng, Erik Grönvall, and Cristiano Storni. 2015. Self-Care Technologies in HCI: Trends, Tensions, and Opportunities. *ACM Trans. Comput.-Hum. Interact.* 22, 6, Article 33 (December 2015), 45 pages. DOI: <https://doi.org/10.1145/2803173>
- [64] Francisco Nunes and Geraldine Fitzpatrick. 2018. Understanding the Mundane Nature of Self-care: Ethnographic Accounts of People Living with Parkinson's. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Paper 402, 15 pages. DOI: <https://doi.org/10.1145/3173574.3173976>
- [65] Halley Profita, Reem Albaghli, Leah Findlater, Paul Jaeger, and Shaun K. Kane. 2016. The AT effect: how disability affects the perceived social acceptability of head-mounted display use. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 4884-4895.
- [66] Maria Puig de la Bellacasa. 2011. Matters of Care in Technoscience: Assembling Neglected Things. *Social Studies of Science* 41, 1 (January 2011) 85-106.
- [67] Maria Puig de La Bellacasa. 2017. *Matters of care: Speculative ethics in more than human worlds*. U of Minnesota Press.
- [68] Maria Puig de la Bellacasa. 2012. "Nothing Comes Without Its World": Thinking With Care. *The Sociological Review* 60, 2 May (2012) 197-216.
- [69] Daniela K. Rosner, Samantha Shorey, Brock R. Craft, and Helen Remick. 2018. Making Core Memory:

- Design Inquiry into Gendered Legacies of Engineering and Craftwork. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). ACM, New York, NY, USA, Paper 531, 13 pages. DOI: <https://doi.org/10.1145/3173574.3174105>
- [70] Karen Ruhleder and Brigitte Jordan. 1999. Meaning-making across remote sites: How delays in transmission affect interaction. In *ECSCW'99*, 411-429. Springer, Dordrecht.
- [71] Harvey Sacks, Emanuel A. Schegloff, and Gail Jefferson. 1978. A Simplest Systematics for the Organization of Turn-Taking for Conversation. *Studies in the Organization of Conversation Interaction*, 50, 4 (January 1978) 7-55.
- [72] Jentery Sayers. 2015. Prototyping the Past. *Visible Language* 49, 3.
- [73] Emanuel A. Schegloff, and Harvey Sacks. 1978. Opening Up Closings. *Semiotica* 8, 4 (1973) 289-327.
- [74] Morgan Klaus Scheuerman, Jacob M. Paul, and Jed R. Brubaker. 2019. How Computers See Gender: An Evaluation of Gender Classification in Commercial Facial Analysis and Image Labeling Services. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 144 (November 2019), 33 pages.
- [75] Ari Schlesinger, Kenton P. O'Hara, and Alex S. Taylor. 2018. Let's Talk About Race: Identity, Chatbots, and AI. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). ACM, New York, NY, USA, Paper 315, 14 pages. DOI: <https://doi.org/10.1145/3173574.3173889>
- [76] Kristen Shinohara and Jacob O. Wobbrock. 2011. In the shadow of misperception: assistive technology use and social interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 705-714.
- [77] Kristen Shinohara and Jacob O. Wobbrock. 2016. Self-conscious or self-confident? A diary study. conceptualizing the social accessibility of assistive technology. *ACM Transactions on Accessible Computing (TACCESS)* 8, 2: 5.
- [78] Lee Stearns and Anja Thieme. 2018. Automated Person Detection in Dynamic Scenes to Assist People with Vision Impairments: An Initial Investigation. In Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '18). ACM, New York, NY, USA, 391-394. DOI: <https://doi.org/10.1145/3234695.3241017>
- [79] Sarit Szpiro, Yuhang Zhao, and Shiri Azenkot. 2016. Finding a store, searching for a product: a study of daily challenges of Low Vision people. In Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '16). ACM, New York, NY, USA, 61-72. DOI: <http://dx.doi.org/10.1145/2971648.2971723>
- [80] Anja Thieme, Cynthia L. Bennett, Cecily Morrison, Edward Cutrell, and Alex S. Taylor. 2018. 'I can do everything but see!' -- How People with Vision Impairments Negotiate their Abilities in Social Contexts. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). ACM, New York, NY, USA, Paper 203, 14 pages. DOI: <https://doi.org/10.1145/3173574.3173777>
- [81] Tanya Titchkosky. 2011. The question of access: Disability, space, meaning. University of Toronto Press.
- [82] Austin Toombs, Laura Devendorf, Patrick Shih, Elizabeth Kaziunas, David Nemer, Helena Mentis, and Laura Forlano. 2018. Sociotechnical Systems of Care. In Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '18). ACM, New York, NY, USA, 479-485. DOI: <https://doi.org/10.1145/3272973.3273010>
- [83] Austin L. Toombs, Shaowen Bardzell, and Jeffrey Bardzell. 2015. The Proper Care and Feeding of Hackerspaces: Care Ethics and Cultures of Making. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15). ACM, New York, NY, USA, 629-638. DOI: <https://doi.org/10.1145/2702123.2702522>
- [84] Shari Trewin. 2018. AI fairness for people with disabilities: Point of view. arXiv preprint arXiv:1811.10670 (2018).
- [85] Shari Trewin, Meredith Ringel Morris, Shiri Azenkot, Stacy Branham, Nicole Bleuel, Phill Jenkins, Jeffrey Biggam, Walter S. Lasecki. 2019. Workshop: AI Fairness for People with Disabilities. Retrieved September 18, 2019 from https://assets19.sigaccess.org/ai_fairness_workshop.html
- [86] 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*, 217-224.
- [87] Rua M. Williams and Juan E. Gilbert. 2019. Cyborg Perspectives on Computing Research Reform. In *Proceedings of CHI '19: CHI Conference on Human Factors in Computing Systems (CHI '19), May 04, 2019, Glasgow, Scotland UK*. ACM, New York, NY, USA, <https://doi.org/10.1145/3290607.3310421>
- [88] Shaomei Wu, Jeffrey Wieland, Omid Farivar, and Julie Schiller. 2017. Automatic Alt-text: Computergenerated Image Descriptions for Blind Users on a Social Network Service. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17). ACM, New York, NY, USA, 1180-1192. DOI: <https://doi.org/10.1145/2998181>

2998364

- [89] Ellen Zegura, Carl DiSalvo, and Amanda Meng. 2018. Care and the Practice of Data Science for Social Good. In *Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS '18)*. ACM, New York, NY, USA, Article 34, 9 pages. DOI: <https://doi.org/10.1145/3209811.3209877>
- [90] Yuhang Zhao, Sarit Szpiro, Jonathan Knighten, and Shiri Azenkot. 2016. CueSee: exploring visual cues for people with low vision to facilitate a visual search task. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '16)*. ACM, New York, NY, USA, 73-84. DOI: <https://doi.org/10.1145/2971648.2971730>
- [91] Yuhang Zhao, Shaomei Wu, Lindsay Reynolds, and Shiri Azenkot. 2017. The Effect of Computer-Generated Descriptions on Photo-Sharing Experiences of People with Visual Impairments. *Proc. ACM Hum.-Comput. Interact.* 1, CSCW, Article 121 (December 2017), 22 pages. DOI: <https://doi.org/10.1145/3134756>
- [92] Yuhang Zhao, Shaomei Wu, Lindsay Reynolds, and Shiri Azenkot. 2018. A Face Recognition Application for People with Visual Impairments: Understanding Use Beyond the Lab. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Paper 215, 14 pages. DOI: <https://doi.org/10.1145/3173574.3173789>
- [93] Yu Zhong, Pierre J. Garrigues, and Jeffrey P. Bigham. 2013. Real time object scanning using a mobile phone and cloud-based visual search engine. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '13)*. ACM, New York, NY, USA, , Article 20 , 8 pages. DOI: <http://dx.doi.org/10.1145/2513383.2513443>
- [94] Yu Zhong, Walter S Lasecki, Erin Brady, and Jeffrey P Bigham. 2015. Regionspeak: Quick comprehensive spatial descriptions of complex images for blind users. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 2353-2362.
- [95] Annuska Zolyomi, Anushree Shukla, and Jaime Snyder. 2017. Technology-Mediated Sight: A Case Study of Early Adopters of a Low Vision Assistive Technology. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility*, 220-229.