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ABSTRACT. Many technologies that are purportedly developed to improve the lives of disabled people reflect an ableist ideology that devalues rather than supports disabled bodyminds. In this paper we attribute this tendency to a neurotypical form of perception that obscures disabled people's *moral visibility*, understood as their visibility as richly expressive and interaction-worthy sense-making individuals. Relying heavily on examples drawn from scholarship on and community with augmentative and alternative communication technology (AAC tech)—that is, communication technology designed for and used by non-speaking people—we take the expressive bodies and voices of disabled people as well as technology's role in forming expressivity and voice as important loci for redressing neurotypical ableist perceptions widely embedded in practices of engineering and science. Through our AAC tech discussion, we map different modes and degrees of moral (in)visibility, offering this mapping as an analytic resource for technologists committed to anti-ableist technology. Additionally, we also trace how technologies can be used and tinkered with in ways that can open up more (neuro)expansive, diversity-embracing ways of perceiving disabled lives. Ultimately, our account aims to motivate technologists to embrace such an expansive approach. We conclude by tentatively indicating some ways in which this approach can be operationalized in engineering and science practices.

1. NEUROTYPICALITY, MORAL VISIBILITY, AND TECHNOABLEIST RESEARCH PRIORITIES

> "Being disabled is as close as you can get to being invisible."
> Billy Golfus (1995)

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How to look at a woman who skillfully, gracefully, and adventurously explores oceanic coral reefs utilizing her wheelchair—a wheelchair that she herself has transformed into a deep-sea diving device? That is the question Sue Austin confronts us with in her video artwork *"Creating the Spectacle!"*[1] As the title of her work indicates, Austin is explicitly targeting her *visibility* as a person who moves through life using a wheelchair. How is she typically seen? How does she want to be, and warrant being, seen? How is her visibility (or lack thereof) tied to the ways in which her body can and cannot move, to the ways in which her body is socially expected to move, and to the artifact she uses to get around? How might altering that artifact and using it in imaginative new ways enable people to look at her bodily life in equally imaginative new ways? A similar set of questions is raised by the late autistic disability activist Mel Baggs (2007), who, in their *YouTube* video "In My Language," puts their body on display as they hum, twirl, rub, and rock in their apartment, engaging everyday-use objects that afford them with immersive, atypical forms of embodied interaction (e.g., stroking their hand on a computer keyboard, rubbing their face on the pages of a book, and flicking a piece of paper). Baggs's neurodivergent interactions with their environment are likely to be perceived as "alien" to the "untrained" ear and eye. Indeed, it is precisely the point of the video to confront neurotypical viewers with their tendency to perceive autistic embodiment as strange, mad, and in the grips of pathological impulses.[2] Using augmentative and alternative communication technology (AAC tech), Baggs educates their viewers midway through the video, explaining, in computerized spoken language that is accessible to neurotypical listeners, that their embodied movements signify a deep, lively, meaningful perceptual communication with their environment; a perceptual communication that *neurotypical* perceivers might be able to learn something from if they weren't so quick to brush it aside as mad or meaningless.[3]

Neurotypicality can mean a number of things. Philosopher and artist Erin Manning (2016) unpacks it as a limiting normative outlook on what it means to relate to the world intelligently and what it means to be (fully) human. To relate to the world intelligently, from the standpoint of neurotypicality, is to have a clear normative sense of the order of things; how they are to be sorted, categorized, individuated, and differentiated. To be human is to be an agent who knows their way around in this neatly and normatively categorized world, someone who is (perceived to be) in control as "the absolute directo[r] of [their] movements" (Manning

2016, 113). To be sure, Manning's definition of neurotypicality doesn't entail a denial of autistic and other neurodivergent people finding joy in categorizing and sorting the world. Rather, her concern, and ours as well, is with the hegemony of neurotypical normativity operative in such sorting and categorization.[4] Manning argues that neurotypicality is a habituated outlook that quietly "frames experience," such that many of us—particularly those of us who function within this frame with seeming automaticity and fluency—"underestimate both its force and pervasiveness" (3). But because it discredits experiences that defy the neatly ordered categories of neurotypical agential functioning—by marginalizing bodyminds that stim, tremble, leak, blush, stumble, and stutter—neurotypicality is an outlook that is ableist and that devalues the bodies, voices, and perspectives of those whose lives are lived outside its narrow bounds.

Manning contrasts neurotypicality with "autistic perception," an expansive concept that polemically celebrates autistic people's nonnormative attunement to perceptual saliences (as exemplified by Baggs) but is emphatically "not meant to describe a group of autistics" (Manning 2016, 112). Rather, entangled with a*r*tistic perception, a*u*tistic perception refers to "the opening, in perception, to the uncategorized, to the unclassified," reflecting "a tendency in perception shared by all that privileges complexity of experience of category" (14, 114).[5] Autistic perception, Manning wagers, can "mak[e] our worlds richer" by "creating techniques and minor gestures that open existence to its perceptual more-than" (14). Baggs and Austin are actively forging such techniques and minor gestures—gestures that celebrate and "inven[t] new modes of life-living" (Manning 2016, 8).[6] In putting their bodies on display, they are demanding to be looked at in radically different ways than we are used to, than technologists are used to. They are inviting viewers to perceive and imagine that there might be different but equally rich and valuable ways of inhabiting the world as an embodied human being. Bodies, lives, in wheelchairs; not walking but rolling. Bodies, lives, lived with AAC devices; less talking, more rocking.

Much like Austin's wheelchair, Baggs's AAC device plays a complicated role in this effort. While it helps to establish communication with a neurotypical context, it can only derivatively convey Baggs's rich embodied communication with their environment. Technologies for disability are often exceptionalized, but they are like other technologies in that they are "neither good nor bad, nor […] neutral," to speak with the words of Melvin Kranzberg, historian of technology. Austin is astutely aware of this nonneutrality. She believes that our ways of "being, seeing, and knowing" are entangled with the technological artifacts that organize our lives, such that changes to those artifacts can contribute to changes in our perceptual and epistemic schemes (Austin 2012b). She aspires for her viewers to shift their perceptual habits away from seeing disabled bodies, movements, and experiences in terms of loss and deficiency and toward an experience of the wheelchair as a source of joy and exhilaration. She wants people to see beyond rigid categories that delineate and devalue certain bodyminds, such that they "*see* the value of difference" (Austin 2012b; our italics).[7]

If Austin is right about the intimate way in which her moral visibility is intertwined with the technological artifacts that surround us, then the notion of moral visibility ought to be front of mind for any technology developer concerned with improving the lives of disabled people. But as it stands, the notion of moral visibility and perception play little to no robust role in R&D processes. The underlying aim of our paper is to rectify this. Doing so serves to counteract a pervasive ableist culture of neurotypicality, which shows up emphatically in *technoableist* interventionist contexts of technological innovation (Shew 2020; 2023). *Interventionism*, as we define it, refers to a technological outlook that frames disability in terms of a problematic lack requiring a technological solution (intervention). *Technoableism* is "a specific type of ableism around hyped and emerging technologies" that "at once talks about empowering disabled people through technologies while at the same time reinforcing ableist tropes about what bodyminds are good to have and who counts as worthy" (Shew 2020, 41, 43).[8] We note that this misalignment between the intention to empower and the outcome to devalue can be understood as a problem of moral misperception and moral invisibility. Technologists' intention to support and empower the lives of disabled people is insufficiently guided by a perceptual attunement to the experiential fullness and the value of disabled people's lives. Beyond diagnosing this as a problem, we offer an analysis of different degrees and modes of moral visibility and perception. This analysis, which emerges from testimonial insights from the lived experiences of disabled people (with a focus on AAC tech and neurodivergent communication contexts) is provided as a heuristic interpretative lens for developing antitechnoableist technologies.

We begin in section 2 by introducing the notion of moral visibility in some more detail. Then, in section 3, we highlight how disabled people are routinely rendered invisible in R&D processes, as those processes leave little to no room for bodies, voices, and modes of expression that move beyond the bounds of ableist neurotypicality. In section 4, we ask how we can improve upon this by looking at a specific case—namely, that of AAC technology used by nonspeaking people. What makes AAC particularly illuminating for our discussion is its layered, complex role in affecting the moral visibility of its users. Unpacking this by focusing heavily (though not solely) on the notion of voice, our discussion of AAC tech and nonspeaking users, along with our discussion in section 3, helps to surface different modalities and degrees of moral (in)visibility, an awareness of which, we propose, would be useful for technologists (section 5). We conclude our paper with a brief forward-looking discussion of what it might mean to open up contexts of R&D and technological innovation to Manning's notion of autistic perception, creating new openings and minor gestures with which we can design for rather than against the moral visibility of human embodiment in all its rich diversity.

2. MORAL VISIBILITY: A BRIEF AND INITIAL SKETCH

The desire and the demand for visibility—to be seen, heard, and engaged with, as someone who matters—is a leitmotif running through the testimonials of disabled people (the title of Alice Wong's Disability Visibility Project is not a coincidence).[9] We call the kind of visibility aimed for here *moral visibility*, which we define as the visibility of a person's embodied existence as the site of richly expressive sense-making and lived experience, affording and being worthy of meaningful interaction and responsiveness. This characterization of moral visibility is motivated by insights from the field of enactive embodied cognition, which is a framework in philosophy of cognitive science that offers a capacious non-species-specific account of what it means to relate to the world as an intelligent minded being. All living beings inhabit an irreducibly meaningful perspective on their environment (they make sense of and with their worlds) as they seek to remain viable in their environments as the precariously embodied systems that they are (Thompson 2007). As such, living beings do not stand in a neutral relationship with their world. Rather, as self-moving, perceiving, affective systems, living beings dynamically enact a world that is of existential significance to them, which manifests in the countless embodied ways in which living beings navigate, cope with, and respond to their world.

From this enactive perspective on cognition, the normative criteria for what counts as intelligent and viable forms of environment-responsiveness, or *sense-making*, are, to an important degree, particularistic, in that they are always in part determined by an embodied living being's particular history of sense-making and cannot be reduced to alleged species-specific norms of proper functioning. This means that having and keeping a life in view, as the site of ongoing sense-making, requires an adaptive responsiveness and openness to that life as shaped by its specific morphology, embodied needs and abilities, environmental offerings, and history of ongoing coping. In the human case, an individual's ongoing sense-making is emphatically social: others enable, support, scaffold, and sanction our individual sense-making endeavors precisely by perceiving and engaging with us as embodied sense-makers, and this enables us to jointly enact a shared meaningful world (De Jaegher and Di Paolo 2007). For some of us, our visibility to others as expressive embodied sense-makers is enacted and maintained without much effort, such that we are hardly aware of it as the sort of thing we can lose. We may routinely expect that our expressions (e.g., our laughing, crying, shrieking, shivering) and our actions (e.g., our reaching, approaching, seeking, avoiding) are reliably perceived and responded to appropriately by others (van Grunsven 2022). But for others among us, this visibility is always experienced as tenuous at best, as our embodied, expressive, agential lives are seen (or unseen) through the lens of lack, deficiency, madness, and nonagency in ways that fail to match our lived experiences as sense-makers.[10] The less our bodyminds (appear to) comply with the norms of neurotypicality—the more we stim, blush, sweat, tremble, stumble—the more we may feel our moral visibility is at stake.

Our aim here is not to delve further into the specifics of enactive embodied cognition.[11] Instead, we take its explanatory power for granted while working instead toward a more fine-grained analysis of degrees and modes of moral (in)visibility and moral (mis)perception. Motivating this analysis is the fact that disabled people widely point to a sense of moral invisibility in characterizing the badness of disability. At the same time, it is far from obvious what is entailed by adequate moral perception and full-fledged moral visibility (or "perceivability," to put it in a modally neutral, or non-video-centric, way). As we discuss below, we can, for instance, feel utterly invisible, we can feel partially (in)visible, and we can feel hypervisible. Furthermore, the depth of these modalities of (in) visibility can vary temporally and contextually.

Despite the slippery nature of the notion of moral visibility, we propose that technologists should ask how the R&D practices they engage in, and the technologies that result from those endeavors, might bear on the moral (in)visibility of people whose bodily lives become entwined with their products?' Asking that question is key because the notion of moral visibility is *both appealed to* and *ignored* in contexts of technology development and (participatory) research and design. When that notion is appealed to, it is often done in a manner that exceptionalizes assistive technology, framing it as capable of making visible the formerly invisible. You see this, for instance, in hyped discourse that unequivocally presents AAC tech as capable of "giving voice to the voiceless" such that they are finally heard and seen as people (see Alper [2017] for a critique of this discourse). While the significance of moral visibility is gestured at (or co-opted) in such discourse, what is simultaneously lacking are fine-grained analyses of (1) how moral (in)visibility can be enacted and experienced and (2) the complex ways in which technology can both serve to make visible and render obscure the expressive sense-making lives of users. Such targeted analyses can serve as a resource for those well-intentioned technologists who emphatically take themselves to be in the business of empowering the lives of disabled people, but who are in fact rendering disabled people invisible by sustaining and materializing ableist neurotypical views on what a well-functioning, fully "worthy" human bodymind ought to look like (Shew 2023). Before delving into these fine-grained analyses, we first offer a sketch of current R&D practices, which are premised on what Manning characterizes as neurotypical ways of seeing and often occlude or render invisible disabled people's bodies and lives.

3. THE INVISIBILITY OF DISABLED PEOPLE IN RESEARCH AND DEVELOPMENT

Scientific and engineering research and development are often constructed in ways that see and fail to see disabled people. As investigation into new disability technologies takes many forms, our focus here is in on research and development that occurs quite often in university contexts, where researchers follow standard ethical guidelines for human subjects and posit big ideas for disability technology—AI or CRISPR therapy for neurodivergent people, self-driving cars for blind people, exoskeletons for people with paralysis, souped-up mobility technologies, and so on. Research like this, which tends to be interventionist, hyping a technology's ability to restore lost or absent function and independence, often negatively affects the moral visibility of many disabled people as people who typically live lives that are both full and mundane, even as disabled people are the supposed subjects and beneficiaries of such research. Framing research this way also is contrary to how disabled people actually talk about technology development in the bottom-up tinkering and planning they do for themselves, the hefty burden that maintenance and acquisition of technologies take, and the critical and creative role that "anonymized human subjects" and "patients" actually play in getting various technologies to work (see Herdegen and Shew, forthcoming).

Disability technology projects are often initiated in the absence of deep community understanding and often built upon projections of what researchers think it must be like to be disabled. The continued practice of disability simulation undergirds some of this focus,[12] but also there's a more general attitude of ableism that so many researchers are marinated in—just as we are as a society. There's a basic technoableist assumption that disabled bodyminds are calling out for help—that the proper way to see disabled embodiment is to see it in terms of lack that affords intervention, rather than as sense-making that affords interaction—and that it is good to pursue "humanitarian engineering" that takes disability as a project and problem to solve.

Beyond this general outlook, which quietly yet perniciously shapes how disabled people are seen and how tech projects and solutions are envisioned, the rendering of many disabled people and their bodyminds as invisible is a standard practice in scientific research because of how certain bodies are selected, overlooked, and ignored. In most research, disabled people are brought in as testers and users (rather than sense-making collaborators) far too late in the process with many important features—and sometimes even the project itself—determined. In these instances, disabled people are effectively considered as either human research subjects or test pilots for new technologies. It is a great disservice that so many disabled people in the history of technology have been written over by researchers who anonymize our data and use our bodyminds, often without attribution or credit. For a vast swath of our history, the experts about disability have been nondisabled people. Ymous et al. (2020, 1) write about the epistemic violence they've encountered as human-computer interaction researchers and the ways in which they have been treated: "Technology for disabled people is often developed by non-disabled populations, producing an environment where the perspectives of disabled researchers—particularly when they clash with normative ways of approaching accessible technology—are denigrated, dismissed or treated as invalid." This is also emphatically the case in research in psychology that has contributed to the false framing of autistic people as nonempathic. As Caroline Bollen (2023a) has shown, this is the result of myopic research that measures empathy by assuming neurotypical behavioral expressions of empathy and by concluding, on that basis, that autistic people lack (or show deficient) empathy—a move reflecting "neurotypical gatekeeping" (Bollen 2023b). Thus, disabled perspectives, which should be taken seriously in the production of scientific knowledge and valued in the creation of technologies for disabled people, are still often treated as less valuable than the perspectives of nondisabled researchers.

Recent moves toward "coproduction" and participatory research, while valuable, often still anonymize interviewee and participant data: even when interviewees or participants would like to be named and valued, often little option or opportunity for that is given in our current system. This raises a concern about experiential extraction, rather than experience-led collaboration. Though new methods have potential, most disability research is still done in older modes, and Ymous et al. (2020) have highlighted the ways in which disabled researchers themselves can be edged out, discredited, or viewed as biased for being disabled researchers.

There is also a long history of not properly paying or honoring disabled research subjects for the value of their work. Disabled people are often enrolled but not proclaimed as codevelopers who add great value, unless it is as an inspiration rather than as contributors. Liz Jackson tells the story of Betsey Farber of OXO cookware, who is often described as an unnamed arthritic disabled wife who inspired her designer husband to create wider and grippier handles for kitchen implements (Jackson 2018). Even today, the OXO website reads:

> Let's start at the very beginning, in case you haven't heard this story yet. Sam Farber founded OXO when he saw his wife Betsey having trouble holding her peeler due to arthritis. This got Sam thinking: why do ordinary kitchen tools hurt your hands? Sam saw an opportunity to create more thoughtful cooking tools that would benefit all people (with or without arthritis) and promised Betsey he would make a better peeler. (Liston 2017)

Liz Jackson, who tracked Farber down and heard about how active she was as a designer, not just the designed-for, writes, "[D]espite this history of creating elegant solutions for ourselves, our contributions are often overshadowed or misrepresented, favoring instead a story with a savior as its protagonist" (Jackson 2018).

The problem of misrepresentation of disabled people in research is further compounded by the way in which participants get selected as human subjects or test pilots. All too often, to avoid confounding variables, disabled people with only one disability or a narrow type of one disability are recruited and selected. We see this in calls for people like "amputees with single leg amputations below the knee with residual limbs of at least three inches" and "people with autism spectrum disorder, level 1." While it may seem innocuous, or like good scientific practice, to researchers to ask for exactly the subjects you'd like to test something on, this practice quickly narrows possibilities, promotes exclusion of a broader range of relevant subjects, and often narrows the accessibility of testing spaces, forms, and information in ways that bar future participation of more diverse populations of disabled people.

More problematically, most disabled people are multiply disabled or will become multiply disabled more quickly and earlier in their lives. Autistic people are more likely to have Ehlers-Danlos syndrome, postural orthostatic tachycardia syndrome, and mast cell activation syndrome, as well as gut issues; they are also at higher risk for eating disorders (often related to sensory and gut issues), burnout from masking, and more. Diabetic people (both those with type 1 and those with type 2 diabetes) can have complications that result in amputation and blindness. People who get treated for osteosarcoma cancer, like a coauthor on this paper, may require amputations or limb-salvage surgery and may acquire hearing loss/tinnitus, infertility, heart issues, and brain fog from chemotherapy and medical-related PTSD from the whole shebang. Some disabilities correlate with other disabilities, and sometimes the treatment for some disabling conditions leads to more disabilities. What we're saying is that disabilities sometimes come in packs, and the visibility and invisibility of disabled people is often deeply impacted and significantly distorted by researcher choice, hidden norms, and askew expectations. When it comes to disabled participants, it's often important to recognize what science and technology studies scholar Enongo Lumumba-Kasongo sings as Sammus the Rapper: "I am more things than I'm reporting" (2016). To harken back to our earlier sketch of enactive embodied sense-making, the (dis)abilities we have are entangled with our lives as embodied sense-making beings, shaping what is experientially salient to us in ways that bear on how technologies can be meaningfully and desirably interwoven within our existing sense-making lives. This is rendered irrelevant and invisible by the R&D practices described here.

These are no small matters, as the R&D process marks a powerful site of (in)visibility production. It has the potential to enable creativity, joy, fun, and open-mindedness—for seeing different ways of doing things as good and trying out new ways of thinking and being; for embracing and materializing "autistic perception," to use Manning's term. But to fully seize upon this creative potential of the R&D process, disability should be centered and valued beyond assimilation, inclusion, and accommodation. Here the unique ways neurodivergent people perceive, think, value, and make suggests a strength toward creativity, visibility, and knowledge when we challenge normative notions about expertise and disability in the research setting. However, in order to embrace neurodivergent modes of perception and embodiment in R&D processes, neurodivergent people must first be visible within these processes as meaningful sense-makers whose ways of engaging with and looking at the world are to be taken seriously rather than be pathologized and framed as a problem to be solved. This might mean looking for creative new ways of opening up oneself (as a researcher) to "autistic perception" and learning to "listen beyond words" (Van Goidsenhoven and De Schauwer 2020). At the level of data collection, this might mean taking the time to participate in the practices of research participants—for example, as Leni Van Goidsenhoven and Elisabeth De Schauwer (2020) recount, by swinging on a swing alongside a nonspeaking autistic girl so as to gain a gradual sense of her life-world. It might also mean adopting new ways of recording and interpreting data. Both Arseli Dokumaci (2023) and Rachel Chen (2024) speak of the value of video-recording as a way of capturing and honoring significant minor gestures in disabled expressive embodiment—gestures that one might overlook when gathering data through questionnaires or even qualitative interviews.

Promoting moral visibility means recognizing that the way we tend to view and imagine some people does not map on to their realities. Due to the ways research in science and medicine has often categorized people and described their bodyminds as unruly or problematic in some regard—and here we think of many outdated versions of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) as one example—disabled people have often been systematically misperceived. This misperception is reflected in a "logics of the interventional," which, as Rua Williams (2019) describes, often guides how research proceeds—namely, with an idea that not intervening (defined narrowly) when a bodymind is considered unruly or problematic is equal to harming someone. Williams writes:

> Technologies for autism are dominated by metaeugenics via the logics of the interventional—these normalizing technologies seek to correct aberrant behaviors, shape normative social responses, and remediate deficits and delays. This approach seems natural and necessary from the perspective of the helping professions, guided by a conviction that their role is to deliver health and wellness—a restoration or purification via the "equation of the norm with health" (Edelman, 1974, p. 306). (Williams 2019, 72)

Equally concerned with the logics of the interventional, Erin Manning (2016) warns against neurotypical habits and perceptions that animate R&D processes and funding schemes, working within narrow frameworks of preset problems that show up in clearly categorizable worlds and that can be tackled with clear cut solutions, guided by overly simplistic research questions.[13] She writes:

> The problem is that in this activity of assuming in advance that we know what constitutes knowledge, there is a danger of not hearing the voices that, as […] [Mel] Baggs might say, lurk beneath the words. (Manning 2016, 31)

What can be done to hear those voices better? And how can technology be of (dis)service here? To delve into those questions, we now turn to a case study of AAC tech. What makes AAC tech particularly illuminating for our discussion is its layered complex role in affecting the moral visibility of its neurodivergent users. This helps to reveal different modalities and degrees of moral (in)visibility that, we propose, can be useful to technologists.

4. AAC: PROMISE AND LIMITS

> "Communication aids […] are inherently political, for they make visible or invisible certain people, values, and ideas." – Meryl Alper (2017, 55)

AAC tech is a broad term that refers both to a subset of communication technologies and to the interdisciplinary research field studying these technologies. Understood as a subset of communication technologies, AAC tech encompasses all forms of low and high technology used to support the communication needs of those who are unable or prefer not to use their natural speaking voice due to congenital or acquired disability. Examples of this technology include analogue and digital picture boards, text-to-speech apps, and, more recently, brain-computer interfaces (van Balen, forthcoming). As one of the authors of this article has argued elsewhere, AAC tech has helped to disrupt a specific form of moral invisibility, *categorical moral invisibility*, which occurs when someone is categorically not perceived as the sense-making being that they are (van Grunsven 2022). A paradigmatic example is that of autistic people being seen as "empty shells" who altogether lack self-awareness and empathy and whose stimming and other forms of expression are wholly denied as meaningful ways of engaging the world. Similarly, people who are partially or completely locked-in due to paralysis, and are thus unable to initiate speech and (nearly) unable to perform other forms of bodily movement, often experience being seen and treated by others as mere objects who no longer afford interaction (van Grunsven, van Balen, and Bollen 2024). AAC tech has shown the potential to disrupt the categorical invisibility of these people by opening up new functionalities and modalities for them to outwardly express their lived experiences to others.

That said, how AAC mediates moral visibility is shifty and complex. In an AAC-mediated speech given to AAC tech engineers, the late Colin Portnuff, who held seven patents for products he worked on as a disabled person, recounts how the sight of him in a wheelchair using computerized speech often generated a series of discombobulating perceptual experiences in neurotypical perceivers:

> [I]t is a rare occasion when I meet someone and they see me first, not the wheelchair, and a rare occasion indeed when they talk to me, instead of about me. I wish I had a nickel for every time my companion is asked "Can he hear me?" Or in a restaurant, "What would he like?" If I am alone, the general assumption is that I am deaf or retarded, or both. If I have my laptop on my lap, assumptions change. It seems to act as a badge of authority, somehow creating a bridge of normality, at least until I use it to speak. Then the usual reaction is bewilderment. Just when they thought they could relate to me because they use laptops too, I start using it as a speech generating system, and all bets are off. (Portnuff 2006)

In other words, the ways in which AAC tech can facilitate moral visibility are complex and by no means automatic. One way to unpack this further is by attending to the phenomenon of voice in the context of AAC.

4.1 Voice

When considering voice, we first need to beware of a technoableist hype around technologies described as "voice-giving." In *Giving Voice*, communications scholar Meryl Alper (2017) explains that this rhetoric not only obscures how, for instance, differences in class can greatly affect the extent to which a communications technology, such as an AAC device, can play this empowering role, but also may presuppose a somewhat limited view of what counts as having a voice. In her words:

> [P]arents' ability to mobilize social, economic, and cultural capital shaped the extent to which their children could not only speak but also be heard. In short, physically handing someone a tablet that talks does not in and of itself give that person "a true voice." [...] [V]oice is an overused and imprecise metaphor—one that abstracts, obscures, and oversimplifies the human experience of disability. (Alper 2017, 5)

That said, it seems nearly undeniable that a person's moral visibility, as an expressive sense-making being, is intimately linked to the phenomenon of voice. Voice as a topic has been traversed more often in the area of gender studies than in disability studies, and writers in this area have discussed the ways in which voice is strongly related to how a person is perceived by others in terms of gender and age, as well as things like race and cultural background. For better or worse, voice often serves as a signifier of a person's identity and is often seen as *bringing humanity to a speaker*.[14] Many people who use AAC—and others around them—want a voice that sounds like themselves or like they might have sounded, or some approximation, especially one based on demographic features such as age, race, and gender. Thus, AAC developers must ask themselves whether a young girl can make herself visible as "a fellow Latina in their family" (Alper 2017, 54)? Or whether a young boy's voice is "rendered distinct from members of his family and Jewish community because the software" cannot accommodate the proper pronunciation of certain words commonplace in Jewish communities (53)? As Alper warns, "The traces of certain bodies [...] are rendered invisible through synthetic speech. Engineers, with limited conceptions of what it means to talk and what 'natural' speech sounds like for an 'average' person, whisper beneath every inflection of synthetic voice" (63).

This conversation is notably uncontroversial for other disability technologies, like prosthetic limbs. Kerima Çevic (2020) writes:

> Asking me why would I want an Assistive Augmentative Communication (AAC) device made to serve my son to have the voice of my Black brother is like asking why I would want my son to have a Black prosthetic arm instead of a white one. [...] If my son could use verbal speech, his voice would not sound like any of the voices on his current AAC devices. [...] It matters more than anything that a person has the equivalent of a speech device made for the entirety of who that individual is. And right now, in 2020, that option does not exist for my son and his AAC using Black autistic peers. [...]

> […] It is heartbreaking because asking me this question brings a great deal of pain to me. It forces me to remember that generations of our people have had to justify our right to the same quality of life as white American society.

As an amputee, one of this paper's authors (Ashley) knows personally the wide array of customization permitted for prosthetic sockets to "make it your own," something that is encouraged to help one adjust to a new limb, especially for newer amputees. There is an entire (overly celebrated) industry to make limbs look "like real." Even though an approximation of "the real" is not necessarily what people always choose or want—a young amputee might have the more expansive creative vision for her prosthetic arm to look and function like a glitter shooting unicorn (like the arm created by Jordan Reeves; see Hullinger 2016) instead of a plain old human arm—it should be noted that there is as of yet no equivalent for such wide customization found in AAC technologies. As such, self-expression and presentation that feels authentic is less possible within the confines of more limited options.

Today, due to developments in machine learning and (affective) computing, we witness a rapidly increasing set of possibilities (different sounding voice options) for voiced AAC devices or "talkers." Still, in the context of computer-generated speech, it's easy to make mistakes about identity, including viewing a voiced speaker as more or less human. Mistakes of identity are a driving topic in literature on transgender experiences of voice, and mistakes about identity where someone is read as less than fully human are a risk in both the case of computer assistants (where people might read too much into a voice and gender a genderless device, for instance) and for AAC users (where people might assume less humanity because of the style and presentation of a voice and its connection to a computer). We stress this to note the ways in which moral visibility is often connected to voice and to emphasize that people often build hefty assumptions about who a person is based on voice.[15]

In addition to being perceivable expressions of identity, voices also steer processes of interpersonal sense-making and human connection through qualitative vocal tones, textures, styles, volume, pitch, intonation, and so forth. Thus, there are many features of a voice relevant to how people are understood that seem harder to accomplish with AAC. Portnuff explains a series of frustrations with current technologies:

> A natural human speaker can vary the pitch and speed of speech without sounding like a machine. […] [M]y wife is hard of hearing, and pitch is an important aspect of intelligibility for her.
>
> Expressiveness would be next. I want a question to sound like a question, and an exclamation to sound like an exclamation. I want to be able to sound sensitive or arrogant, assertive or humble, angry or happy, sarcastic or sincere, matter of fact or suggestive and sexy.
>
> Multilingual capability is next up the pyramid. […] I want to be able to speak other languages than English, and in my selected voice.
>
> […] Setting volume is very difficult. I feel like the Verizon commercial, only instead of, can you hear me now, I'm saying, is this too loud? […] The ability to shout could be life saving for someone with children. […]
>
> I want to talk to animals. […] They do not associate my synthesized voice with me. […] [I]f you use an animal for assistance, it could be critical. (Portnuff 2006)

Having a voice is about far more than the ability to convey propositional content, and being heard is about far more than this content being taken up by others (van Grunsven, van Balen, and Bollen 2024). We must be critically aware, in contexts of AAC development, of conceptions that frame voice as a static "object to find, give, or unlock" through technology (Alper 2017, 62). Instead, voice must be approached as an expansive phenomenon that is interwoven with and at stake in nearly every dimension of our expressive interpersonal sense-making lives.

4.2 Temporality

Voice and *fluency* also play centrally in many narratives about disability, intelligence, and class. Even though it's a movie with otherwise weirdly good disability representation and with authentic casting far ahead of its time, the 1932 film *Freaks* offers up a stuttering character, Roscoe the clown, who is played for laughs and fits cleanly with neither the nondisabled talent acts in the circus nor the group of freaks (Browning 1932). He is read as less smart and somewhat gullible for the way in which he speaks, even when he is among other nonspeaking people in the film. This is not an unusual depiction of stuttering, which has been used in the history of cinema and literature to suggest ineptitude. In a review of *The King's Speech*, Barry Harbaugh (2010) writes:

> [F]ilmmakers have advanced their own unhelpful theories of a stutter's cause and consequence since their earliest opportunity, amounting mostly to cartoon depictions of slapstick ineptitude and a jumble of mistaken assumptions about the disorder: That its sufferers are lily-livered, or "girl shy," or nervously traumatized.

Stuttering, like disability more broadly, has been used to indicate weakness, difference, shyness, or some other negative characteristic or barrier in a character's life.

Joshua St. Pierre (2012), writing about stuttering in the context of disability studies, resituates stuttering in the social environment, rather than presenting it as a personal medical problem (as most literature on stuttering does). He writes:

> [T]he assumed normalcy of hearing hides these possible contributions to the communicative breakdown and shifts the responsibility entirely upon the speaker […] in a dialogical process the hearer and speaker are bound together in the act of communicating and thus "broken" speech is constructed from both the speaker and the hearer […] stuttering as a disability is not necessarily or primarily natural or biological but is a discrimination against "abnormal" communicative variations. (St. Pierre 2012, 10–11)

While not writing about AAC, St Pierre introduces here the vital point that communication is between people and that "problems" of communication—of listening to others—are not reducible to one person's problem. But when neurotypicality frames our perceptual experiences of bodyminds and "proper functioning," thereby valuing control, intentionality, and the clearly categorizable, then mismatches in expressive rhythm can be falsely attributed to alleged deficiencies within a person. This inhibits opportunities for communication across temporal differences and disrupts the moral visibility of those whose expressive bodies rub against the norm.

We know that the neurodiversity umbrella encompasses many types of diagnosis, disability, and ways of being in the world. We as authors here affirm that many different conversational styles and differences are valid. But for people with acquired types of neurodivergence, like chemobrain or ALS or a traumatic brain injury, there is often a significant experienced difference during and after the acquisition. Some people may still be seeking neurotypical conversational norms for pacing and small talk in ways that are no longer possible, and made less so by current technologies. For people who have been neurodivergent for a longer time, there is also a temporal difference in communication that can go unappreciated in the way devices are programmed—sometimes with storytelling as an important relational feature that becomes harder as you are forced to get quickly to a point, or with expressive functions disallowed. This is also culturally relevant: some cultures value storytelling in communication far more than others, and to stray from a main point does not always pose the same communicative frustrations in others. We often use increased speed to express enthusiasm or excitement, too, but "talkers" and similar devices often don't allow one to control the rate of speech. AAC devices are mostly positioned to meet the needs *and values* of neurotypical people, neurotypical communicators.

Temporality is an important feature of technology in the world of disability more broadly. We see the connections between walking and talking again here too: slow walkers are seen as frustrating obstacles to typical ambulators, much like those with atypical speech patterns, and AAC devices are taken as frustrating obstacles at times to those who expect particular timing (and content) in how conversation "flows." Neurotypical sense-makers expect a certain flow of bodies or words. The neurodivergent and disabled are united in crip time. Some of us take less time, some of us take more, and some of us vary in speed in relation to other circumstances. We experience lives out of linear order too. Ellen Samuels (2017) explains that, in disability studies, "disability scholars like Alison [Kafer], Margaret [Price], and I tend to celebrate this idea of crip time, to relish its nonlinear flexibility, to explore its power and its possibility." But then Samuels asks us "to hold on to that celebration, that new way of being, and yet also allow ourselves to feel the pain of crip time, its melancholy, its brokenness." She writes that

> [crip time] requires us to break in our bodies and minds to new rhythms, new patterns of thinking and feeling and moving through the world. It forces us to take breaks, even when we don't want to, even when we want to keep going, to move ahead. It insists that we listen to our bodyminds so closely, so attentively, in a culture that tells us to divide the two and push the body away from us while also pushing it beyond its limits. (Samuels 2017)

While people whose clocks have always been askew through congenital and other early onset conditions may have often navigated that difference as a regular feature of their lives, those with acquired or progressive differences in communication and movement may experience a breaking with earlier frames of the world, conceptions of self, and social existence. Good disability technology does not deny realities of existence or of time and should provide grounds for adaptation, offer flexibility in use to find a first or "new normal," and honor diversity in speed and timing. Doing this may mean making AAC tech that is open to echolalia and other forms of (interactive) stimming (Chen 2024) or that doesn't shut down unexpected uses.

4.3 Use and Content

An awareness of the content for and presumed use of AAC Devices is also significant in understanding user experience. Maxfield Sparrow points out the importance of understanding that neurodivergent people often use their devices and connections *differently* than neurotypical peers, so device bans and other research that prioritizes neurotypical ways of using devices often fail their neurodivergent peers. In "Autistic Screen Time: Swipe Left on Stigma," Sparrow (2023) explains,

> Researchers justify strategies to separate autistic people from their tablets and computers by citing statistics showing autistic youth using their tablets far more for gaming and less for socializing than neurotypical youth, but a systematic review of twenty years of studying internet communication found autistic people talking about having more control over how they communicate with others, feeling more calm during online interactions than in-person socialization, feeling connected to other autistic people, and being able to take part in a global community of others [...]. Whether for socializing, research, work, pursuing personal interests, or unwinding from living in a world designed for people with a different neurology, internet skills are the autistic end run. Don't assume that all screen time is damaging to all people in the same ways.

Screentime can allow neurodivergent people to be social and connected in ways researchers and caregivers who value typicality and assimilation fail to recognize. It's not always sentential and can be in the form of play. This neurotypical bias against screens and devices can influence the ways in which therapists, parents, teachers, and colleagues misread and misinterpret neurodivergent people. These devices themselves can constitute one's best means of communication, and prohibiting or restricting them can be a means of silencing, invisibilizing, and disconnecting neurodivergent people.

Content can be neurotypically biased in what is offered, allowed, or anticipated. Most often, parents and therapists are making important decisions for users who are children, deciding what options to allow in early use, and often confining available expressions to a limited set of options.[16] Caregivers who are committed to listening to their kids and providing them the technology to use their voices are in an iterative and ongoing process of anticipating what concepts their child might need, a fine-grained labor of anticipatory empathy. As we change and grow, the language and concepts that we need change and grow with us (and aren't necessarily set up in ways that could be anticipated by age, interest group or other factors, as we are all individuals). If something is not programmed into an AAC device, or is in some way restricted, epistemic and hermeneutic injustices easily arise. This demonstrates the importance of having designs that allow for easy additions and include sufficient in order to make the kinds of communication the user wants achievable and easy. People are not static, and the devices intimately tethered to our expressive lives should not be either.[17] We should note that this point holds true as much, if not more so, for those who play a vital role as hearers and interlocutors within an AAC-user's network. Despite functional improvements in the technology itself, AAC technologies are often used minimally in school settings, where kids sometimes utter just a handful of words each day. This stems in part from a presumption of incompetence, in which people still frequently see AAC users' deficits rather than their competence and communicative potential.

In this analysis of AAC, it's important to note that voice, time, and content all play into whether people are seen or rendered invisible in their attempts at interactions with others. There is a vital difference between interventionist AAC, which seeks to normalize communicative exchange and offer neurotypical content and norms, and neurodiversity-celebrating AAC tech that can capture the ways people want to express themselves (whether that involves communicating propositional content or not) and can be used for the creation of neurodivergent culture. We think nothing of someone humming to themselves and expressing in ways that are nonpropositional: AAC should allow this too. Too often technology is used in assimilationist ways that presume what is best for a disabled or neurodivergent person, or that presume what neurotypical people would like to hear (in a narrow sense) from a neurodivergent person. Additionally, and more generally, technology in contexts of disability too often oscillates between narratives of deficiency and inspiration. Alper (2017, 3) warns, "Such portrayals distract us from seeing [disabled people as] people whose experiences with […] technology can be ordinary and mundane." Moral visibility, we propose, often means being visible precisely in one's ordinary going about one's life, being visible neither as a deficient nor as an exceptional bodymind.

> "Using this technology has made me a better writer because every sentence has to have a succinct purpose. I will both mourn my loss and adapt to my new body because this is what it's like to be disabled in a non-disabled world and non-speaking in a speaking world. And yet, I can still grin devilishly, roll my eyes sarcastically, and my personal favorite, give the middle finger."
> – Alice Wong (2023)

Cal Montgomery (2019) challenges "talkies" ("full-time fluent speakers") to experience the "limits tacitly imposed by communication systems" with an exercise. He asks talkies to take 128 index cards; write important words, phrases, and sentences on each; consider what's important and what's necessary in those choices; and then pick a number from 1 to 5. Based on that number, you then are assigned to write one of the following:

1. a love letter to someone you want to spend your life with
2. a crime report explaining how someone hurt you and giving enough evidence that the crime can be solved and prosecuted
3. a eulogy for a parent or other central figure in your life
4. an essay about the best and worst things that happened to you today and why they matter
5. an account of your dreams for your future (Montgomery 2019)

This must be done with only the words, phrases, and sentences on your index cards, doing your very best. Later, you are told to ask a friend for their opinion on the writing without revealing that you wrote it, and instead saying that someone with a disability wrote it (Montgomery 2019). Doing this step-by-step exercise without looking ahead to the other steps, talkies will likely be extremely frustrated, and rather surprised by how friends might assess the writing they've done with limited choices. Content and use matter. A eulogy, a love letter, and a crime report all require very different sorts of words and phrases, and having an extremely limited and generalized set of options makes writing them much more difficult.[18] The step of having a friend read what the talkie wrote may result in a harsh judgment about the writer's intelligence, competence, and ability—a harsh indictment of how AAC users may be obscured, made less visible and legible to others. The exercise could be a source of pain, perhaps, when the talkie recognizes the ways they were not properly understood in the "tacitly imposed limits" of the technology. AAC technologies have incredible potential for expression, as Alice Wong (2023) alludes to: she has to work to make things more succinct and consider expressive features besides her new voice, in ways that may have been less important to her (and less focal in her experience) when she could speak. She has to be more calculated now in her words.

We should want technology that doesn't exacerbate moral invisibility and, further, that enables moral visibility—this is a moral imperative. Montgomery (2001) writes: "In the disability community, we speak as if some kinds of disability were visible, and others weren't. Let me suggest a different approach: think about the ways different kinds of disability have become more familiar, and more visible, to you as you've gotten to know more disabled people." We limit our shared hermeneutical pool of knowledge if we are unable to see some people as full participants in our world: a world can be articulated and interpreted in so many different ways—this is joyful and generative, and it can be enabled by design. Moral visibility is the grounds for self-determination, respect, and creation. We think here of Montgomery's exercise, and of what can be made joyously when technology enables divergence from a norm in the case of the glitter-shooting arm that amputee Jordan Reeves (Hullinger 2016) created for herself or on the lyrical poetry of DJ Savarese (2017). Sometimes the technologies we have make an implicit expressive claim about which bodies and minds are better to have and operate, especially where technology discourse frames disability as an object to fix or eliminate.

Technologies can be a pervasive catalyst of jeopardizing moral visibility and furthering limited neurotypical forms of perception (per Manning), since technologies set up or reinforce many of our norms. Reinforcing norms through technology spreads misperception, invisibilizes disabled experience, and promotes epistemic injustice. Put differently, technologies can perpetuate epistemic injustice by not letting people represent themselves the way they want to be seen and heard—as the richly expressive sense-making beings that they inevitably are. In an effort to attune technologists to the nuanced ways in which people may be rendered morally (in)visible as sense-making beings and to hint at ways in which technologies can play a role in this, we here offer an analysis of degrees and modalities of moral visibility/invisibility and perception/misperception. We want to emphasize that these degrees and modalities are neither rigidly distinct nor mutually exclusive. For instance, a person can misperceive another due to a combination of "person-reductive" and "deworlding" tendencies, and a person can feel both hypervisible and invisible at the same time. Furthermore, the degree to which one can recover from feeling morally invisible varies across contexts and at different moments in one's life (e.g., one might be able to brush off the sense of exposure and vulnerability that results from excessive blushing in public more easily with age, as is the case for one of the authors of this paper, or one may experience one's hypervisibility as a tester in a research context as a recoverable form of hypervisibility rather than a structurally occurring one that undermines one's visibility as a rich multifaceted sense-making being). Still, we offer this (nonexhaustive) taxonomy as a helpful heuristic device, enabling (self-) scrutiny in ableist contexts of technology development.

6. CONCLUSIONS

We started this paper with a mobility-disability example that moved into a discussion of AAC devices. At their heart, walking and talking—the socially normative ways of moving and of communicating—are merely instrumentally good. Walking is good because you can go places. Talking is good because you can express what you want. But when we don't have that instrumentality in view, "walking, a historically contingent skill, turns into 'walkism': the expectation that everybody can and should walk, and that those who walk have an entitlement to take space and utilize the offerings of the world at the expense of those who do not" (Dokumaci 2023, 78). But walking and talking are not the only ways to meaningfully move and communicate: Sue Austin and Mel Baggs show us (and literally demonstrate with their bodies) movements and forms of communicating that are expansive, creative, joyful, and beyond what walking and talking would allow. Wheelchairs and AAC technologies can be used beautifully and creatively; and we ask for space for technologies in this realm to be led, directed, and reimagined by disabled people themselves—to open themselves up to the minor gestures forged by people like Baggs and Austin, showing us how they can move differently.

Interventionism gets something right: it recognizes the importance of belonging, a desire for our embodied ways of being to coordinate easily with the bodies of others, a desire to be seen but not to stand out too much in our differences. Problematically, though, this then translates in limiting ableist assumptions: "Don't we all want to move through the world and be seen by others as upright?" "Don't we all want to communicate in neurotypically desirable ways?" Thus, well-intentioned (but ultimately problematic) technoableist interventions work with an odd acknowledgment and disavowal of disabled people's bodies as loci of rich and meaningful sense-making: indirectly, the body is acknowledged

TABLE 1. DEGREES AND MODALITIES OF INVISIBILITY[19]

Degrees & modalities of moral (in)visibility	**Categorical** When one's (in) visibility as a sense-making being tout court is (felt as) pervasively entrenched and incontestable	**Particularistic**[20] *When a particular feature (or set of features) of one's expressive sense-making life is reliably misperceived and devalued at the expense of other*s	**Recoverable** *When one can reliably count upon moral visibility and one can recover from moments of moral occlusion with relative ease*
Invisibility *The sense of not being seen in one's fullness as a sense-making, interaction-worthy being*	- Autistic people being categorized as "empty shells" devoid of sense-making - Patients with locked-in syndrome being treated and talked about as if they are pieces of furniture - Colin Portnuff being systematically talked about, not talked to	- AAC-user Colin Portnuff feeling invisible in group conversations or as a humorous sense-maker - Mel Baggs's stimming (rocking, humming) being dismissed as meaningless (whereas their AAC-mediated expressions are recognized as expressions of sense-making) -Neurodivergent users being frowned upon for "inappropriate" screen usage and time	All of us who navigate interpersonal relations, as these inevitably come with moments of miscommunication, breakdown, and misrecognition
Mundane visibility *The everyday experience of being appropriately visible to others as a sense-making being*	One could imagine that a person enjoys moral visibility in a nearly unshakable nonfluctuating way, for instance due to a position of power.	x	- Many of us when we are in the safety of our private inner circles (although many personal testimonies from autistic adults show that moral visibility can be highly precarious even within the intimate sphere of dyadic parent-child interaction) - Most "neurotypical" people (i.e., nondisabled, gender-privileged, nonracialized,) across a range of contexts

Hypervisibility *The sense of being too visible to others*	People put on display as objects of curiosity in freak-shows	- Author (Shew) reentering their workplace after a cancer treatment that involved below the knee leg amputation: "I was […] stared at wherever I went: a bald amputee with crutches tends to draw the abled eye, and I moved slowly enough that I couldn't get away from the stares. […] My bodymind was no longer the type of person who could feel welcome and at home on campus: *every place was unprepared for me*" (Shew 2023, 78). - An AAC-user whose voice makes them stick out in their environment in undesirable ways (e.g., a child whose voice is too adult/ not matching the cultural identity of their family) - A disabled person being tokenized and temporarily highlighted in a research setting as a tester or inspirational source of experience rather than as a sense-making cocreator throughout the process	- Those of us who blush on occasion but bounce back from the experience of social exposure and vulnerability in the face of the other (unlike people with social anxiety caused by idiopathic craniofacial erythema—i.e., excessive blushing)

TABLE 2. DEGREES AND MODALITIES OF MORAL (MIS)PERCEPTION

Degrees & modalities of moral (mis)perception	**Automatic & Rigidified** When a perceiver is rigidified in their ways of perceiving another person and accepts their rigidified perceptions without giving them much thought	**Fluidly Adaptive** When a perceiver is able to see and be adaptively responsive to the expressive sense-making life of another person with relative ease and fluidity	**Tension-Laden & Effortful** When a perceiver experiences challenges in adaptively making sense of the expressive life of another and effortfully tries to perceive the other's sense-making
Person-Reductive When a perceiver reduces a person's full sense-making life either categorically or particularistically (see table 1)	- When a perceiver sees disabled end-users as marked by lack or deficiency - When a perceiver sees people in ways that only cohere with their prior conceptions or defer to medical authority even while reading personal narratives. See Ally Day's (2021) research with HIV narrative reading groups and the significant differences between the group of medical professionals and the group of people with HIV/AIDS - When descriptions of children in scientific studies of autism inadvertently showcase experiences of pain, trauma, and fatigue that the researchers did not notice themselves.[21]	x	Activities of disability simulation

Jointly Embedded When a person’s expressive sense-making life is perceived and responded to in shared contexts of significance	- When teenagers perceive each other (and express themselves) in accordance with a narrow set of expressive norms on social media platforms[22]	- A mundane interaction between two neurotypical people that exhibits ongoing flow in how the other person is perceived, qua expressive being, and responded to. - Interactive stimming, as detailed by autism activist Jim Sinclair (2012): “[W]ith people who shared my language, meaning flowed freely and easily. […] I experienced […] [a] form of natural autistic social behaviour.”	x
World-reductive When the perceiver encounters a person’s sense-making in a perceptual context that doesn’t align with their perceptual habits and preferences	- E.g., a researcher who tries to gather data from research participants (valuing their input and perspectives) while doing so under spatial, temporal, and perceptual conditions that disadvantage the participant and affect how the participant is seen and heard - For example, a researcher trying to recruit “ASD Type 1” participants for a movement study without community involvement and potentially putting some people with undiagnosed EDS or POTS at risk	X	- E.g., a neurotypical and neurodivergent perceiver who are mutually respectful of the other’s lived perspective and invested in shared sense-making yet experience pronounced mismatches due to mismatches in communicative styles and preferences - Colleagues of the author (Shew) mentioned under “particularistic hypervisibility”

as grounding people's meaningful relations to the world and, with that, as something that can also contribute to a disruption in those relationships. It is acknowledged that this disruption can be bad for the person experiencing the disruption and that it is a good thing, perhaps morally imperative, to do something about this. At the same time, there seems to be very little acknowledgment of disabled bodies as the site of ongoing, meaningful adaptive sense-making. Technological solutions are often located at the level of the body, understood as a self-standing machine taken in isolation from its lived meaningful dynamic relations to the environment (Chapman 2023; van Grunsven 2024). We plead for disability tech that contributes to the moral visibility of different ways of embodied being.

Achieving this visibility requires tech that supports neurodivergent interaction and contributes to equally accessible shared environments that facilitate such interaction. As we have hinted, this demands that we critically reflect on narrow ableist theoretical assumptions animating R&D processes (assumptions about the appearance, worthiness, and needs of well-functioning bodyminds), as is done, for instance, in the work of Williams, LouAnne Boyd, and Juan Gilbert (2023) and Ashley Shew (2023). It demands that we critically reflect on practices of data collection and interpretation and how these practices can foreclose or accommodate neurodivergent modes of expressivity and bodily comportment, thus rendering individuals and groups (in)visible (see, e.g., Van Goidsenhoven and De Schauwer 2020; Dokumaci 2023; Chen 2024). And it demands identifying suitable strategies for encouraging designers and technologists to reflect on their own, often implicit, ableist neuro-exclusive assumptions (see, e.g., van Grunsven and IJsselsteijn 2022; van Grunsven et al. 2024) and welcoming disabled people as investigators, paid consultants, and compensated advisors, shifting where expertise lies in the world of disability (see Shew's current work with the DisCoTec Center[23]).

Finally, we would like to see changes in how people review and fund research on disabled people and disability tech. Worldwide, there is a tendency to fund R&D projects that provide technological fixes to predelineated (alleged) societal problems and that look narrowly at one type of disability and one type of approach. This narrow frame leaves little to no room for open-ended research projects that facilitate genuine creation in which the voices of disabled people take the lead in processes of need-finding and creative exploration and where researchers and technologists have the space to develop new methods based on the different embodied temporal styles of sense-making that exist across the human spectrum. This frame also fails to account for and provide interest or benefit for multiply disabled people (which many disabled people are). When disability is already framed as a societal problem demanding an interventionist solution, the R&D processes serving those "solutions" are prone to foster settings that occlude the moral visibility of disabled people as sense-makers who are integral to uncovering what counts as a problem and a solution in the first place.

As our moral visibility as people is entangled with the ways in which our expressive bodies are perceived by others, technologies that shape our bodily expressivity—for instance, by manipulating, augmenting, or altering expressive, temporal, and spatial dimensions of human embodied interaction—are technologies that play a vital but often overlooked role in the moral visibility and perception of people's embodied lives. As these lives are lived, and should be livable, in a rich diversity of ways, we need an expansive view of technology: a view that aims to *invent (rather than intervene in)* "new modes of life-living."

NOTES

1. We recommend watching her TED talk (Austin 2012b) and viewing the video artwork (Austin 2012a).
2. Impulses that allegedly warrant aggressive therapeutic intervention, or so a dark history of clinical psychology tells us.
3. See also Erin Manning (2016) on the broader value of autistic perception.
4. As Robert Chapman (2023) discusses, this neurotypical normative categorization is exemplified in how signs of "healthy" and "well-functioning" agency and expressivity came to be sorted in nineteenth- and twentieth-century Europe and North America, with the works of statisticians and psychiatrists such as Adolphe Quetelet, Francis Galton, and Emil Kraepelin contributing to the classification of neurodivergent modalities of agency and expressivity as pathological, mad, or even immoral.
5. As such, autistic perception as a concept is certainly not meant to exclude other types of neurodivergent perception.
6. This notion of disabled people creatively inventing new modes of living is also a theme running through Arseli Dokumaci's (2023) *Activist Affordances*.
7. For many nonspeaking autistic people, AAC devices harbor the same potential—the potential to celebrate that there are many different ways to live with language and express oneself.
8. Anti-ableist approaches to disability tech do exist. See "Crip Technoscience Manifesto" by Aimi Hamraie and Kelly Fritsch (2019), "Counterventions"

by Rua M. Williams, LouAnne E. Boyd, and Juan E. Gilbert (2023), and "The Promise of Empathy" by Cynthia Bennett and Daniela Rosner (2019).

9. See the website of the Disability Visibility Project at https://disabilityvisibilityproject.com/.
10. We thank the anonymous reviewer who adds to this that "the concerns here raised about neurodivergent expressions resonate with similar concerns raised in the context of racism and misperceptions of action (see Alisa Bierria's [2014] "Missing in Action" in *Hypatia*)." Similar connections are drawn by Manning (2016).
11. For work on enactive 4E cognition and the notion of moral perception and visibility see van Grunsven (2022; 2024).
12. Disability simulation was once a popular disability awareness activity in which participants would wear blindfolds or use wheelchairs to "experience" what it was like to be disabled, with the thought that this would make people more empathetic. Both sociological research about its outcomes and disability activists' warnings indicate that these practices are less than good, encourage nondisabled people to speak over disabled people, give false impressions about disability, reify existing biases, and make people more afraid to become disabled in the future (Nario-Redmond, Gospodinov, and Cobb 2017; Silverman 2015; Ladau 2014; Riccobono 2017). More recent, but no less worrisome, permutations of disability simulation use virtual reality, "geri-suits" (suits you don to "experience" old age), and computer simulations.
13. Indeed, in these contexts disability itself is often framed precisely as a problem that requires a solution (Shew 2023).
14. These characteristics have also been discussed often in terms of computer-generated voices in the context of AI voice assistants (like Siri; see, e.g., Moran [2021]), GPS mapping programs that voice directions for navigation, and AAC. In writing about the potential for the creation of genderless AI-assistant voices, Cintya Chaves (2021) writes: "One can argue that it is not necessary to lose all the humanity a voice normally brings in order to create a genderless voice. Technology companies are not looking to create voices that sound robotic. On the contrary, they are always aiming for a friendly, human-like voice that connects to the user as an everyday part of human communication."
15. The late physicist Stephen Hawking has one of the most well-heard computerized, and computer-sounding, voices, and he came to identify with a voice made for him, not wanting "upgrades" that were later offered, including a voice that would have been more like his actual original speech-voice with an

English accent. After decades of hearing his own voice in the computerized form some will remember that "Hawking [was] very attached to his voice: in 1988, when Speech Plus gave him the new synthesiser, the voice was different so he asked them to replace it with the original. His voice had been created in the early [']80s by MIT engineer Dennis Klatt, a pioneer of text-to-speech algorithms" (Medieros 2014). People can come to relate to the voice they are given, and Stephen Hawking did learn to use his computer-sounding computerized voice for humor, but this started from a very narrow set of options and was adapted over decades. We should be aware that the voice people want as their own may or may not map on to a perceived "before time" or be "authentic" by demographic or other perceived factors. Options, and having otherwise, matter here.

16. The AAC Company AssistiveWare explicitly aims to tackle some of these concerns. Its newest AAC app, Proloquo, offers a non-changeable baseline of words. Parents and teachers cannot remove words. They can only add new words. (Information derived from in-person dialogue with David Niemeijer on June 18th, 2024.)
17. We should also expect good devices to resist wear and tear and allow for easy systems of maintenance.
18. It's amazing that some people have suggested and tried to prohibit people's use of AAC devices in order to force them to produce mouth words: certainly, the process of using an AAC device presents its own limits, and if it is preferred, its use should be respected without question. The person using the AAC is already working so much harder to be a conversational partner—to be understood and to express—in this context.
19. An "x" in tables 1 and 2 indicates a tension between the two axes.
20. For a discussion of categorical vs. particularistic moral misperception, see also van Grunsven (2022).
21. See the work of Rua Williams (Williams 2019; Williams, Boyd, and Gilbert 2023)
22. See (Malvini Redden and Way 2019)
23. With a grant from the Andrew W. Mellon Foundation, Shew and her team are able to pay disabled community members in her region for their consulting on technology research. The team, which includes co-PIs Damien P. Williams and Keresh Afsari and PhD students Lyndon Frommer, Oliver Shuey, and Venus Azamnia, recruits for diversity of disability and fosters cross-disability discussion about technology on a wide variety of technological research. Consultants are non-anonymized, using their own names, and can be thanked

in acknowledgments and brought on by researchers as advisors (as desired). Disabled people are (and have always been) far more than human subjects or test pilots, and we need to shift that recognition. See more at DisCoTec (2024).

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