Positive feedback: opportunities for blind and partially sighted individuals to direct spatial navigation using AI

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Abstract

Individuals who are blind or have low vision regularly use assistive technology to navigate spaces on smartphones. These tools affect each person's sense of independence, and this sensibility changes throughout a person's day as they move through environments. Multiple studies document the meaning of independence for blind and low vision people (BLVP) in their homes, neighbourhoods, and unfamiliar locations. Artificial intelligence (AI) is increasingly combined with assistive technology (AT) to strengthen independence. As the technology rapidly evolves, revisiting literature with intimate perspectives on independence may clarify key uses for AI as Generative AI (GenAI) aims to enhance navigation. To address the specific needs of each individual, our project encourages developers to integrate AI so that the end-user can be a programmer. The end-user being the person with a disability, or their support persons. This study contributes longform first-person descriptions of lived experience to literature about AI-powered AT, insight into the types of GPS-navigation functionalities needed by BLVP, emphasizes that more privacy is required, suggests end-user improvements, and contains demonstrations of how people with autism spectrum disorder (ASD) navigate with blindness.

Keywords

Blind, low vision, neurodivergent, autism spectrum disorder, artificial intelligence (AI), generative AI (GenAI), assistive technology, human-computer interaction, spatial

About the font and design

The font selected for this paper is Atkinson Hyperlegible Next. It was designed by the Braille Institute to improve legibility and readability for individuals with sight loss. Quotes from co-designers are printed in medium bold italics. We have chosen to describe information in sentence format or tables to make the work easy to navigate by assistive technologies.

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1. Introduction

1.1 Background and Context

The World Health Organization (WHO) identifies at least 2.2 billion people worldwide to be living with sight loss (*World Report on Vision*, 2019). In Canada, approximately 1.7 million people have sight loss and an estimated 5.59 million more have an eye disease that may result in sight loss (CNIB, 2019). Many organisations are dedicated to supporting independence for blind and low vision people (BLVP), including the Canadian National Institute for the Blind (CNIB), BALANCE for blind adults, The Quebec Foundation for the Blind, and the Canadian Council of the Blind (CCB). The CCB "…advocate[s] for accessibility and independence in all areas of life for people living with vision loss" (*Advocacy – Canadian Council of the Blind*, n.d.). Disability rights advocate, Judith Heumann stated, "Independence is not merely about physical ability it's about having choices and control over your life" (*What Is Independent Living? – Center for Disability Rights*, n.d.). Disability studies emphasize the importance of BLVP having the agency to define what independence means for themselves, and interdependence is often closely linked (Lee et al., 2021).

Navigating an unknown environment carries unique challenges for BLVP, who often prefer to travel using routine routes (Bengtsson et al., 2010). Unexpected changes to a familiar environment can transform known spaces into the unknown. Mobile navigation applications are expected to provide users with safe, timely directions to a destination.

While these assistive technologies (AT) are consistently being refined, the co-designers in this study most often use applications that are not designed specifically for their disability, such as Google Maps and Apple Maps. This project examines suggestions from co-designers for enhancing existing navigation software, rather than creating new applications, as requested by the co-designers and other similar users (Deverell et al., 2022).

For BLVP living in the Western world, they are often positioned as misfits, inhabiting environments designed for people with sight; "abled" people. Dr. Tanya Titchkosky summarizes philosopher Michel Foucoult, "It is through conceptions of disability that places, things, and events are perceived and relations to them organized, even governed" (Foucault, 1980, as cited in Titchkosky, 2011, p.5). Daily life is experienced through disability, reinforced by environments that were not designed to accommodate the basic needs of BLVP.

1.2 Research aim and objectives

This paper begins with a review of the AI-powered assistive tools and the navigation AT being used by the 5 co-designers in this project. As the market for AI-powered AT grows, this project maintains a focus on the tools most used by our co-designers. We take a holistic approach through intersectional depictions of each co-designer's suggestions for the future of AI (Roscoe, Chiou, & Wooldridge, 2019).

Remote sighted assistance (RSA) is used by all 5 participants in this project. In this paradigm, users connect to a remote sighted assistant with a video connection, through their smartphone. The assistant, known as an RSA agent — or agent — “interprets the video feed coming from the user’s smartphone camera, while conversing with the user to provide assistance as needed or requested.” (Lee et al., 2022). There are times, as listed in the discussion section of this paper, when individuals using the software prefer to avoid speaking to a live person, opting to use an AI representative. Speed of use, situational context, privacy concerns, and the type of content, are some of the reasons for choosing the AI option.

Customization of AT applications builds upon early efforts to increase their adoption through do-it-yourself (DIY) approaches (Hurst & Tobias, 2011). It is also important to remember the ableist associations with “doing it yourself.” Disability scholarship has a long history of functioning within DIY culture, illuminating how society is shaped by ableist assumptions (Samuels, 2017; Stewart & Way, 2023). There are parallels between this DIY approach to the many ways people with disabilities increasingly configure digital tools using AI agents. “AI agents are autonomous software tools that perform tasks, make decisions, and interact with their environment intelligently and rationally. They use artificial intelligence to learn, adapt, and act based on real-time feedback and changing conditions” (*What Are AI Agents?*, 2026). How individuals use AI and what they imagine AI agents capable of facilitating for them varies between cultures and income setting (Morrison et al., 2017). In Canada, the most recent recorded number of people living with severe or very severe sight loss make up 22% of all Canadians, compared to 8% of the general population (*CNIB Consultation Response*, 2026). The same report, using data from Statistic Canada's 2017 Canadian Survey on Disability, shows that the average household income for working-age Canadians who are blind or partially sighted in Canada is two-thirds the national average for the general population ($46,000 vs $70,300) (*CNIB Consultation Response*, 2026). AI is a powerful opportunity for low-income disabled individuals to develop applications to benefit their lifestyles. Since 2010, research has revealed different uses, and specific needs, about the design software and devices devoted to improving quality of life for movement across the urban environment for people with disabilities; mobility is increasingly smart (e.g. smartphone) and accessible (Prandi et al., 2021).

Open-Source websites are important hubs for AI development and education. Hugging Face (huggingface.co) is one example, even if the website and all applications are not completely accessible (Murray et al., 2025). As a community project, Hugging Face exemplifies the deep integration that AI can have in the daily lives of people with disabilities, and despite some drawbacks, improvement is ongoing and constant (Murray et al., 2025). The benefits of AI will only be realised if individuals with disabilities can access open repositories like Hugging Face to learn and eventually navigate the website, for users and developers to develop expertise (Ladner, 2015). Hack-a-thons around disability are emerging with a focus on AI, and inclusive pedagogy is becoming known among some AI development communities (#HackDisability, n.d.; Murray et al., 2025). However, there is still a lot to do in improving accessibility for the development of such applications. Research must involve disabled stakeholders. Inclusive design functions in this paper to highlight epistemological anchors in the stories shared by each co-designer, an important part of Critical Disability scholarship in the field of Human-Computer Interaction HCI (Spiel et al., 2020). As a philosophy, inclusive design recognizes the full range of diversity of every person, acknowledges that there is no one-size-fits-all configuration, invites those who are made misfits by current designs to participate in the design process, addressing the needs of individuals on the margins of systems (*Philosophy*, n.d.).

1.3 Assistive technology and misfitting

Siegfried Saerberg (2010, p. 370) describes how "all sounds serve as concrete schemes of interpretation, acoustic images… Sounds signal the what and where, the nature and the locations of objects, persons and actions – for example, voices, footsteps, engines, rustling plastic bags…" Sound plays an important role in this project, used by the author to initiate a dialogue with participants about living with sight loss.

This project expands on literature about BLVP as misfits (Alharbi et al., 2024). The label describes the incongruent relationship between people with disabilities and the built environment around them. We focus on the spatial and temporal misfitting that BLVP experience moving through space (Garland-Thomson, 2011). Our paper shapes a narrative from the interviews and co-design sessions to reveal a) the spatial planning that the participants use to map environments, b) the temporal awareness required to navigate with familiarity, and c) how this is challenged by three factors: AI navigation errors, cognitive overload, and the introduction of unexpected events. All three challenges are interconnected and have the potential to create confusion for BLVP. Two of the co-designers identified neurodiversity as being heavily affected by changes listed above (AI navigation errors, cognitive overload, unfamiliar events).

We have collected stories and opinions about the use of AI, with a focus on narratives of travelling. The results of the co-design activities derive from personal experiences and were often recalled anecdotally. The quotes are assembled to follow story structures and facilitate understanding. Quotes in the discussion section may be taken from across all interviews and co-design sessions. The speaker of each quote is indicated with “Cd”, representing “Co-designer,” followed by their assigned number. For example, Co-designer 3 is labelled Cd3. Everyone is anonymous. The paper also stresses each person’s valued contributions by acknowledging all five individuals as co-designers. Working within the discipline of Inclusive Design, all five co-designers are integral to any design work. For this project, the curation of stories is an important element of design. This approach describes information spatially, an approach that will hopefully help readers better understand the people and scenarios that challenge their independence, to find gaps where AI could benefit them.

1.4 List of Assistive Technologies (AT) used by project co-designers for navigation

Figure 1 on page 15 is adapted from the list featured in Herskovitz et al. (2023).

Figure 1 — a list of the assistive technology used by each co-designer.

Type	Name	Description of Uses	Co-designer
Navigation	Apple Maps	Turn-by-turn navigation, traffic, transit information, extra security	Cd1, Cd2, Cd3, Cd4
	Google Maps	Turn-by-turn navigation, traffic, transit information	Cd4, Cd5
	Compass	Virtual compass application	Cd1
	BlindSquare	Accessible turn-by-turn navigation with compass orientation, voiced points of interest, and voice commands	Cd1, Cd5
Human Assistance Navigation	Be My Eyes	Mobile, volunteer-based human assistance	Cd1, Cd2, Cd3, Cd4, Cd5
	GoodMaps	Human created landmark-based, turn-by-turn navigation	Cd1
GenAI & Navigation	Be My AI	Turn-by-turn navigation, traffic, transit information, mobile computer vision for reading text, recognizing colour and light, and describing scenes	Cd1
Hardware & GenAI & Navigation	Meta Glasses	Turn-by-turn navigation, traffic, transit information, mobile computer vision for reading text, recognizing colour and light, and describing scenes	Cd2
Software & Hardware Control	Apple VoiceOver	Communicates navigation on the iPhone, handsfree	Cd1, Cd4
AI Software & Hardware Control	Apple Siri	Controls apps on the iPhone, handsfree	Cd1, Cd2, Cd3
AI Software & Hardware Control	Google Gemini	Controls apps on the iPhone, handsfree	Cd4

1.5 Human-in-the-loop

Assistive technology (AT) is defined by the World Health Organisation (WHO) as helping to, "...maintain or improve an individual's functioning related to cognition, communication, hearing, mobility, self-care and vision, thus enabling their health, well-being, inclusion and participation." (*WHO: Assistive Technology*, n.d.). The degree with which individuals customise how AT functions can be examined as a degree of reciprocity. Following the definition provided by physicist and humanitarian, Ursula Franklin, reciprocity is described foremost as "some manner of give and take"; Franklin emphasizes how newer technologies disallow reciprocity (Franklin, 1989). AI is increasingly integrated into AT, and this project 1) suggests ways for users to work with AI to manage assistive devices, 2) identifies the unique needs that neurodiverse people with sight loss have-specifically individuals with autism—and 3) highlights how privacy and security when using the technology is a priority to support more intimate integration for these individuals. AI provides an opportunity for the end-user to take a hacking, or DIY approach, to pre-existing software. In effect, as Ko et al. (2011) describe that "end-user programmers... write programs to support some goal in their own domains of expertise." Opportunities for individuals with unique needs may now be able to frame their experience using GPS-navigational applications according to lived experience and in-the-moment health concerns.

1.6 Research Questions

How do you define independence?

Instead of defining independence from the position of a software developer and designer, we aim to frame the methodology through the lived experience of blind and low vision individuals.

How does AI support independence for BLVP while navigating daily spaces?

An investigation into how the meaning of independence changes as BLVP move through different spaces.

2. Literature review

Assistive devices for blind and low vision people (BLVP) are specialized high- and low-tech tools designed to access a person's environment and written information, like screen readers, voice feedback, magnification programs and daisy book readers (Presley & D'Andrea, 2008). Most commercially available solutions remain prohibitively expensive, curbing adoption worldwide (Král et al., 2025). Mainstream smartphones and tablets incorporate built-in accessibility features, enabling individuals to avoid pricey, specialized tools (Watanabe et al., 2015). Artificial Intelligence models, mostly trained on images from sighted people, can only provide assistance for limited types of scenarios, assuming 'universal' needs of BLVP (Herskovitz et al., 2023). Herskovitz et al. highlight the concept of Do-It-Yourself (DIY) assistive technologies to address the unique needs of BLVP, pointing out that this approach has largely "referred to low-tech physical assistive devices for people with motor impairments, rather than assistive software." Herskovitz (2024) suggests an end-user programming tool may provide assistance for BLVP by performing such a task as filtering out descriptions of items in a picture which the individual has no interest in. This option can be toggled by the user. Such DIY-approaches are described by the designer, Therese Willkomm (2026), as "specialized rehab engineering," which bridges assistive technology and rehab engineering. Herskovitz et al. (2023) identify three techniques BLVP adapt AT to personal needs: 1) hacking, 2) switching from one application to another, and 3) combining the use of applications. Gamage et al.'s 2023 paper draws a connection between having BLV individuals design projects from the early stages of development, leading to benefits to the BLV community. They indicate a disconnect between the tools being created by designers and the needs of the community. Noted by Gamage (2023) and Choi et al. (2025), BLV individuals benefit greatly and often prefer using conversational agent type interfaces (Choi et al., 2025; Gamage et al., 2023). Conversational interfaces include both verbal and non-verbal cues (e.g. touch screen, shaking phones) (Jung et al., 2024).

This paper illuminates the benefits that BLVP currently experience and envision. Later in the paper, the author provides design recommendations for navigation using mobile devices using on-device AI, defined by the office of the European Data Protection Supervisor as "a model architecture in which AI is implemented and executed directly on end devices, such as smartphones, wearable (e.g. smartwatches), or home appliances" (*On-Device Artificial Intelligence | European Data Protection Supervisor*, 2026). Data is processed locally rather than sending it to the cloud, and the device's reliance on an internet connection is reduced (Narapareddy & Yerramilli, 2025). As such, an internet connection is not required for the AI technology to function.

This study addresses experiences of BLV newcomers to an unfamiliar area, and the ways changing personal health conditions alter navigation, rendering familiar environments as exceedingly challenging. Remedies often include detours, which challenge their mental map. BLVP express having an evolving mental map of familiar locations (Hersh, 2020). Hersh (2020) states that one's ability to understand space and form representations of this space contribute meaningfully to the ability of BLVP to travel independently. In this description, independence means navigating without the accompaniment of another person. Tversky (1991) describes mental maps for BLVP as using hierarchical representations of space, applying landmarks as reference points. Unfamiliar spaces are described as being like collages: "collages are thematic overlays of multimedia from different points of view," and "cognitive collage is often a more appropriate metaphor for environmental knowledge than cognitive map" (Tversky, 1991, p.16). Corazzini et al. (2010) identify a preference for blind people to follow egocentric (based on body coordinates) rather than allocentric (based on frames of reference). In addition to Thinus-Blanc and Gaunet (1997), following a route is more ideal than surveys. A route-like description contains sentences like, 'In front of you are stairs that lead to a door. The door is to your left and opens to your right. To your left is a bus stop. A bench is in front of you, across the lot…'

An example of a survey-type description involves brief sentences. This is preferred by sighted users: 'The stairs slowly descend to a door. When you open the door, you will enter a large parking lot. Turn to your right and you will be facing the bus stop…" (Steyvers & Kooijman, 2009).

The Human-Computer Interaction (HCI) and design community has created a substantial repository of information about navigation for blind and low vision people, while many recent studies examine how AI benefits independence for BLVP (Alharbi et al., 2024; Albouys-Perrois et al., 2018). Despite the growing body of research about HCI and BLVP, "many of these technologies are predicated on normative assumptions that problematize neurodivergent bodies and minds" (Le, 2024, p.1). Literature reflects this normative approach to research, demonstrating a lack of disabled people included in the HCI accessibility practice (Le, 2024; Mack et al., 2021). Participants in this project favour AI that can provide personalised information, and this will be examined throughout the paper. Highly personalised AT leads to more confidence in community interactions, strengthening social skills, thereby facilitating interdependence (Grayson et al., 2020).

Malviya & Rajput (2025) trace the development of AI in assistive technology. To access the benefits of AI, nearly all BLVP have given up much of their privacy (Stangl et al., 2023). While AI has a long history of improving assistive technology, privacy is often traded away with the implementation of GenAI. Camera-based assistive technologies push the limits of what users can accept when relinquishing privacy. The ethical concerns are shared between BLV users and surrounding bystanders (Akter et al., 2022; Alharbi et al., 2025). Another concern with privacy, which detracts from independence, is that information listed on smartphone screens is visible to people nearby, who can also hear audio from the phone and any directions being provided by the user via voice command (Ahmed et al., 2016).

A 2024 literature review by Esquivel et al. about the use of voice assistants among people with disabilities examined confidence related to independence living and community involvement, finding neurodiversity and sight loss to be listed with the most frequently discussed concerns. The authors also noted a persistent prevalence of articles studying neurodiversity, where ADHD and autism were common reasons for the use of VoiceOver assistants. Joseph and Babu (2025) identify opportunities for wearable technology to recognize moments of high stress and direct attention to or away from autistic individuals. Noting the “development, deployment, and validation of technologies for people in the neurodivergent communities,” Joseph and Babu highlight the “revolutionary potential” generative AI has as “a platform for epistemic justice, relational equity, and clinical transformation.”

Research into youth with sight loss (ages 6-25) illustrated increased anxiety from barriers related to education and social activities (Cheng et al., 2025). Substantial literature documents emotional stress among people with sight loss (De Leo et al., 1999; Scott at al., 2001; Thurston, 2010).

Orientation and Mobility (O&M) specialists teach BLVP “safe, efficient and effective travel skills” (‘Orientation & Mobility’, n.d.). This role involves a growing list of responsibilities within this broad description; including training on how to work with guide dogs, how to use assistive technologies, safe use of white canes, and more. O&M specialists increasingly provide support for new assistive technology integrated into smartphones, wearables, tablet computers, screen readers, and other AT hardware (Deverell et al., 2022). Deverell et al. (2022) note how many O&M professionals in Malaysia—where the study took place—wanted more affordable devices instead of new technology, so often too costly for their clients. Nearly half of the individuals who took part in the Australian part of the study wanted better technology training. Improved education about smartphone technology, navigation, and affordability influenced the decision to focus our study on cost-effective responses to ever-present challenges.

3. Methodology

3.1 Research Design

Every BLV individual has their own method of working through the challenges that interrupt their daily navigation. Each meeting used a semi-structured approach, encouraging conversations to be dictated by the lived experiences and topics that came up in discussions. This provided tailored co-design sessions, where soundscapes were created in advance using the experiences described by each person. The project studies how users choose words to communicate with AI, developing a framework for safe access to environments. The soundscapes are co-design activities, acting as creative representations of ideas, and not simulations. Prior to beginning each co-design session, the author explained to co-designers that they would be hearing a “collage-like” construction of soundscapes. Soundscapes were meant to provoke reflection, and not mimic the experiences of participants. Mimicry is an imprecise approach that would be antithetical to the intentions of participatory research (Mankoff et al., 2010).

This study employed a qualitative co-design approach with four phases. Qualitative methods align with the inclusive design philosophy, positioning lived experience at the focal point of the research. The method is ideal for documenting singular experiences of BLVP as they reflect on independent navigation using AI. Co-designs are a data-generating tool which encourage participants to communicate experiences that only they know of, since the sighted researcher cannot presume their lived experience.

The methodology and co-designs use sound as a design tool, documented by Blokland et al. as the most important sensory modality for BLVP, while recognizing that this varies between people (Blokland et al., 2025). The author of this paper also contends with how ocularcentrism dominates communication (Bulk et al., 2020). Cd1 described this overwhelming reality, highlighting how it feels to be surrounded by people, but still feeling alone, a sentiment shared by many blind people (Bulk et al., 2020).

Examining past approaches to studying spatial orientation for BLVP (Spinuzzi, 2005), low-fidelity prototypes of a supportive AI agent and soundscapes elicited honest and constructive data. Co-design sessions were originally planned to take place at Toronto's OCAD University, expanding on low-fi iterative activities using craft supplies (Coppin, et al., 2024). Due to the harsh winter weather, interviews and co-designs were held online to remove travel-related barriers. Each session took place over Microsoft Teams. This change also enabled co-designers located outside of Toronto to participate.

Yoon et al. (2019) have documented their development of an application designed for low vision users, in which VoiceOver (Apple's screen reader) would provide full access, however, users described having trouble using the application when VoiceOver was turned off. How might the user access the application without using their voice? One participant (Cd1) stated a preference for tapping familiar spots on their phone's screen. The speed with which VoiceOver information is delivered was an important question, gauging how comfortable and familiar each participant is with the navigation. Every person felt comfortable with a faster rate of delivery, provided the cognitive strain was minimal (Bragg et al., 2018).

Using thematic analysis, and encouraging co-designers to lead design sessions, conversations provided opportunities to follow the participants' stories, rather than strictly answering a list of questions.

3.2 Recruitment

Recruitment of participants took place between January 2026 and March 2026. We are grateful to the Canadian Council of the Blind (CCB), who volunteered to post an open call for participation in the February 2026 edition of their Visions Newsletter, distributed by email to subscribers. The CCB also posted an open call to their Facebook page. Three out of five co-designers were recruited by responding to the CCB's postings. The other two co-designers were contacted by the author of this paper through OCAD networks, and we are incredibly thankful for everyone's participation.

3.3 Ethics and accessibility

The OCAD University Research Ethics Board (REB) approved this project. There are no conflicts of interest to report. A $350.00 Major Research Project Grant was provided by OCAD University's School of Graduate Studies. Each co-designer received a $25 gift card to either amazon.ca or canadiantire.ca for each phase they participated in. The age of participants ranged from between 20 and 50, with everyone describing different proficiencies, uses, and preferences in how they use AT. Participants were presented with a consent form before beginning each phase of the study. Agreement was required by either signing the form electronically or by verbal consent at the start of each call. Coding took place within 5 days of each interview to anonymise each participant's quotes and all other data.

The co-design soundscapes were built by a sighted individual, and they do not represent the experience of BLVP. As a sighted researcher, mimicking the experience of a person's disability would have been problematic (Siebers, 2008, 28-29). The activity was designed to clarify the author's position as a sighted researcher and encourage the co-designer to demonstrate how they would design an experience where AI assisted in navigation. Working remotely posed challenges, adding an extra barrier to communication between the author and co-designers. Outreach was intended to encourage BLV individuals who live in diverse settings across Canada and the world.

3.4 Questionnaire

An 8-question questionnaire was shared with individuals interested in participating. Information requested included names, email addresses, age, gender, pronouns, primary language, whether they identify as blind or as having low vision, and whether they were diagnosed with a visual impairment in the last two years.

3.5 Phase 1: Semi-structured 1-on-1 interviews

The author interviewed 5 participants in semi-structured interviews over web calls using Microsoft Teams to learn about how they define the word independence and outline how it changes as they navigate daily spaces. For example, Cd1 said, *"Independence for me is really not feeling like I have to rely on other people and really being able to enjoy… asking somebody for help, not because I can't do it myself, but because… [they are] right there and maybe it's just simply easier."* Interviews began with defining each person's capacity for vision. 2 of the participants define themselves as having low vision. 3 define themselves as blind, while one individual can see images at very close proximity with some clarity. 4 of the participants identified as female, and 1 as male.

Participants provided varied insight into independence. They observed that their sense of independence was most challenged when traveling through unfamiliar spaces. The moments when independence was challenged took place while interacting with unaccounted variants. Examples include task-oriented variables, such as knowing what kind of bus they are entering, the direction of a park's winding walkway, bus numbers, bus seats, bicycle and e-bikes entering their space, unknown changes to the environments, task-oriented variables. Interviews lasted between 60 and 120 minutes. Data from the conversations was used to shape co-design sessions. These interviews set up the co-design session for Phase 2. Descriptions of independence provided structure for the co-design session.

3.6 Phase 2: Co-design 1 with soundscapes

The author hosted co-design sessions for 3 out of the 5 participants from the semi-structured interviews. The sessions were again conducted over Microsoft Teams. For this study, we did not request any information about where the individuals lived. Their descriptions of their day-to-day lives were enough to highlight design gaps for this project. The aim of the co-design sessions was to involve the co-designers in creating iterations on ideal uses for AI. The activity was to first present them with a soundscape created by the author, which they would listen to, then discuss, and offer advice on how to design useful AI. Conversation did not always relate to navigation, therefore only the discussions that relate to this project are included in the Discussion section.

The soundscapes were each approximately one-minute long in length and assembled in advance by the author. It was the author's intention to make each sound in these audio collages easy to pick out of the mix, so that co-designers could select moments to discuss. An epistemological question presented itself: how does a sighted researcher integrate the perception of those who live with sight loss into building a co-design session? The rough collage was partly meant to detract from any feeling that the author was trying to mimic what the scenarios might sound like to a BLV individual. In Figure 2, each soundscape is described as it was designed for each co-designer.

Figure 2 — a list with descriptions of every soundscape used in co-design session 1.

Soundscape Theme	Environmental Changes	Co-designer
Hospital	Hospital hallway, sounds of machines beeping, movement to stairwell lobby, to the parking lot, and into a rideshare car	Cd1
Outdoor Market	Outdoor market with people talking about food, a band begins to play	Cd1, Cd4
Downtown street	Cars pass by, there is construction off in the distance, echoes, a city bus pulls up and stops	Cd1, Cd4
Airport	A crowd near security check-in, a luggage cart drives by, announcers say something inaudible	Cd3
School	Crowd of students walking through the hallway, lockers close, a drill saw from the wood shop buzzes	Cd3
Countryside	Sounds of birds and leaves blowing, walking on gravel and leaves, a horse gallops by on the leaves, then we approach a road where cars zoom by, and we finally walk near an outdoor basketball court	Cd3, Cd4

For example, as described by Cd4, one of the soundscapes featured a bus pulling up to stop in a city during the evening. Cd4 noted how they wanted to know what stop they were at, which bus they were boarding, and remarked on how knowing these elements created a sense of agency. They expressed a wish to know information about the size of the bus, which would allow them to decide whether they need to take a seat that is available to them near the front of the bus, or if they can walk further down to find a comfortable spot in a less crowded area. On a bus, they can see immediately in front of them, provided the lighting is dim. They offered a detailed description of how they manage navigating the bus without the help of smart glasses.

3.7 Phase 3: Co-design 2 with ideal navigation

The third phase was a second co-design session, completed over Microsoft Teams. Only Cd1 participated in this session, proposing a case study for their ideal AI-powered navigation. Some of the aims of this meeting included discussion about personalisation at a technical level. E.g. How fast should directions be presented when they accompany information about an area? Do you have a preferred method for accessing navigation instructions? When do directions help you the most? Cd1 detailed what they consider ideal AI-powered navigation through their mental map of an area in Toronto.

3.8 Phase 4: Triangulation

The fourth and final phase of the study involves triangulation, bridging themes, attitudes towards AI, and follow-up feedback. This was performed throughout the study, verifying the anonymity of all quotes and data.

3.9 Soundscapes as a data collection tool

A soundscape is, "the overall sonic environment of an area, from a room to a region" (Porteous & Mastin, 1985). The soundscapes in the co-design sessions were developed in-part to place emphasis on anything but the visuals, pulling our discussion about AI away from visual dominance, which, as a sighted individual, the author needed to avoid. Since co-design sessions were held remotely, creating an audio-based artefact was intended to spark dialogue between the researcher and co-designers, where participants could understand the aim of the co-design sessions as being creative. The co-design sessions provoked participants to tell the sighted researcher how they experience the world, and what they need from AI. The soundscapes are an ethnographic artifact created by the researcher of this project, demonstrating their perspective. The format was loosely structured, and conversation was honest. Co-designers were enthusiastic about proposing changes to AI and explained their lived experience vividly. It was made clear that the soundscapes were audio-collages, meant to generate ideas and conversation about each co-designer's ethnographic experiences.

Recognizing the creative approaches to navigation, as suggested by co-designers in this project, there remains to be more investigation around creative wayfinding, as research into other benefits of AI for BLVP continues in areas related to extended reality (XR). Literature must continually recognize the many valuable experiences that shape new technology for BLVP, which are built on more than simply not having vision or full vision (Kleege, 2025). As XR blends the physical world with the digital, it can be expected that BLV users will continue to apply the same creativity that they use with media (Zhang et al., 2023).

All 5 participants perceived the world around them as making their ability to navigate with sight loss problematic, and not the other way around. They had suggestions for the handling of any incompatibility between themselves and their environments, like the willingness of other disabled people who take a DIY-approach to shaping their access

(Meissner et al., 2017). DIY approaches to customization of AI-powered assistive technologies (AT) involve disruption, reconfiguring the meaning of the tool, and adapting it to the diverse needs of the individual, all in line with inclusive design, where the user is the designer (Treviranus, 2021).

4. Discussion and results

4.1 Format of the discussion and results

The format of this report values the contributions from each of the 5 co-designers and positions their ideas and opinions within the results and analysis, connecting their intentions to the outcomes of the project. Each subheading in Section 4 describes the scenario that we investigated with co-designers, learning about how AI impacted their independence. Discussions about the semi-structured interviews and co-designs are combined. We attempted to represent the conversation that guided each meeting and maintain the continuity of the discussions.

4.2 Anxiety and cognitive overload

Discussion begins with insight from Cd1 into their experience of cognitive overload.

> Cd1: *"The way that I would kind of want [AI] to behave, is to learn from the pattern. Know that when, you know, when it sees in my calendar… that I'm now on my way home from that appointment to automatically assume that, you*

know, take the least stressful way home… the least sensory overloading way home. But at that time, it can also give me the opportunity to say, hey, no, I'm okay. But to assume the worst kind of idea in that type of a situation."

This description about ideal AI navigation was introduced during CD1's second co-design session, responding to the question, "What would you want on-device AI to do as you leave a doctor's appointment? Do you want it to know that you are leaving the doctor, or do you want to instruct it to take the calm way home since you are leaving the doctor?" Cd1's answer highlights the interdependence between Cd1 and on-device AI, where AI has learned from their lived experience. We came to this design suggestion after discussing the benefits of instructing AI about avoiding busy areas while walking home and taking buses. Cd1 also noted a need to be given opportunities to change course. This method ensures that there is a human-in-the-loop, and could act as a safeguard against errors, inviting exchanges about explainable AI and contestability; matching concerns shared by many other BLVP using AI for navigation and other reasons (Alharbi et al., 2024).

4.3 Familiar areas

Participants describe familiar spaces as opportunities to navigate without the use of assistive devices. During our semi-structured interview, Cd4 highlighted how they enjoy walking without headphones over their ears: *"I don't like my… walking to be mediated."* They noted the possibility of benefitting from AI by using its memory to improve navigation. *"Building up a set of points or information that it could build on… it could use a certain framework or lens or angle to analyse something… like a research assistant, I guess. Like a capable research assistant that sometimes you have to doublecheck their work."* The use of AI for navigation is described in a similar way to how Cd4 works with others at their job.

Even when traveling to unfamiliar areas, the experience Cd4 described while commuting as a newcomer involved depending on other people. They travel often, and the following interdependence was provided by other people through their job, *"[I] usually don't go somewhere without a support system, [which] I'll set up in advance."* Still, Cd4 preferred to navigate without GPS navigation, as most of their trips are in familiar areas, often within 10 to 20 minutes from home. Each participant noted a perimeter of 10 to 20 minutes as a comfortable space to navigate without assistance. Bredmose et al. (2023) suggest that a familiar time and its rhythms are parts of the cognitive map. Rhythm and the duration between clues along a route all provide an estimate of the next clue. Predictability and order are highly important to BLVP (Chandler & Worsfold, 2013; Royal National Institute of blind people, 2015).

During the first co-design with Cd2, they describe travelling on busses while, *"Trying to gather as much information as I can… always planning in advance—down to the minute."* The second co-design session with Cd1 started with an unplanned conversation about changes to the city where the co-designer used to shop. The discussion revealed how much easier it is to navigate areas within familiar locations. Studies often refer to familiar landscapes as landmarks. However, at no point did Cd1 use the word “landmarks.” Instead, they recalled memories that made the location identifiable. Cd1 described products that were once sold at a now defunct store, *“They used to have a company that made canvas shoes like the Chuck Taylors, but they were felt instead of laces… being blind, laces are not so easy.”* These memories were discussed alongside existing structures. Landmarks provide a mental map of the surroundings (Chandler and Worsfold (2013); Mortensen (2007)), while Bredmose, et al. (2022) state that people with “practical blindness and severe visual impairment will save a combination of tactile and clear visible elements in their cognitive map.” Accounting for the quote by Cd1, we may also consider other haptic elements beyond landmarks, as they exist in memories.

4.4 Correcting AI

As Cd2 remarked in their interview, *“The thing that I really find frustrating is that a lot of them won't tell you, hey, you're going the wrong way. You know, you might want to turn around now… the place is only 50 metres away and, you know, now it’s 100 metres away.”* Until navigational applications can be completely free of such errors, a problem like this could be addressed by the oversight regulations embedded in the Canadian Accessible Standards Act for AI (*CAN-ASC-6.2:2025- Accessible and Equitable Artificial Intelligence Systems - Accessibility Standards Canada*, n.d.). There may be the possibility of involving BLV users in the process of designing their navigation. The goal of navigation apps is to provide error-free directions. Is there a way to make the navigation more inclusive of the user, who might identify errors before they arise? Cd1 remarked how they would like to increase agency by customizing how accessibility applications correct directions, looping the user into the decision process.

4.5 Access in the classroom

Cd3 was asked how they prefer to navigate their university's campus as someone with low vision. Do they prefer to use their mental map or assistive technology?

> *"Definitely mental map. Definitely memory. I keep reiterating this… I go with what I'm familiar with. And if I know that… my new semester is on the fifth floor, for example, as opposed to the drawing and painting studio on the fourth floor, I'll actually go up there ahead of time. And I'll make sure… So definitely hyper vigilance… I'll even go there a couple of times, maybe a few times, just to make sure."*

They would also prefer to have more information given to them by an AI-powered application prior to visiting the space: *"That would definitely put my mind at ease"* (Cd3).

Before the first class of a semester, they may visit the room 1 to 2 times, to build a mental map, so that when they enter the room on Day 1, they can easily find a chair near the front of the room, knowing how to manoeuvre through the space. Cd3 also reported preparing for job interviews in a similar way, sometimes visiting the room where it is scheduled in advance, *"…just so I know for certain and I'll kind of compartmentalise it and* *stick it in my memory."* For Cd3, navigation and access go beyond moving through a space. At school, it includes positioning within the classroom. Managing sight loss, neurodiversity, and Type 1 Diabetes contribute to access; this involves the ability to listen to the teacher without loud distractions, feeling able to inject insulin from their seat, or eating food and leaving the class when they need to. Jesse Rice-Evans notes that access goes beyond standards compliance, it involves, "inclusive practices that understand accessibility as intersectional praxis" (Rice-Evans, 2020).

Cd1's navigation in a class setting is part of their whole education experience, and it extends beyond campus, into their journey: riding the subway, taking the bus, and walking home. It can be reckless to assume that the route outlined by a navigational app is best for Cd1 because it is the quickest or safest. Safest according to what standards? Hamraie and Fritsch (2019, p. 12) "position the crip politics of interdependence as a technoscientific phenomenon, the weaving of relational circuits between bodies, environments, and tools to create non-innocent, frictional access." By applying this quote to the co-designers' ideas, an opportunity is revealed for blind and low vision people to change their experience of the world around them, by reorganizing the structures of Western civilization, which has been largely designed on vision (Levin, 1993). Using spatial navigation technology in a personalised way reframes ableist networks, resulting in a powerful act of activism against centralised AI. The process is fractioned, which is a way to protest the main directives of a navigational applications that can be designed with ableist intentions, whereas for disabled users, the directives cannot be trusted (Alharbi et al., 2025). Hamraie and Fritsch (2019, p. 14) recount the blind artist Carmen Papalia's art piece, which uses a twenty-foot cane while walking through busy streets, creating a sense of antagonism, "[rendering] access as a frictioned practice." While the act may seem like personalisation, it is a redefining of the time a journey will take, in what Kafer labels, "crip time" (2013, p. 27).

Furthermore, Saerberg's work is built upon autoethnographic fundamentals, which this paper also assumes. For example: while walking in a market, a vendor selling honey continues to remain in the same location as a customer picks up different jars of honey, smelling them, to find the right one. The idealization of sameness contributes to maintaining a sense of unity throughout sensory, temporal, and spatial variation (Saerberg, 2010). The smells, feel, and sounds may be different as the customer goes down the line of products, however over the short distance of space and time between each jar, the difference is minimal from where it began.

4.6 Comfort and shortcuts

Cd3 remarks on the need for GPS-navigational apps to keep them in the loop, since the program does not always know how beneficial a shortcut would be for them.

> Cd3: *"And then there's the walk option. So I have to walk 800 feet, which is only 4 minutes once I'm there at school… It doesn't say, oh, you could, you know, go have a shortcut and go through the [neighbouring building], which I only found that out a couple months into… the first year… it's not the most user-friendly. But it's what I'm accustomed to; what I'm comfortable with."*

In the early months of the school year, Cd3 was directed by Apple Maps to follow a route along streets instead of much easier paths. One of these easier paths provides protection from inclement weather, and integrates them into a popular area for students.

> *"I wouldn't say I'm daft to technology, but I like using what I'm comfortable with. I don't really like going out and experimenting with new things… I'm not 100% efficient with something new, then I panic… I tend to use the same thing, which is just the maps app on my iPhone."*

The act of learning while using an application provides enough cognitive stress to prevent them from adopting another application. While they want to learn about new paths, they only feel comfortable using familiar technology.

4.7 Navigating hospitals

The second co-design session with Cd1 included an extended discussion about how AI could improve travel to and from health care centres. Cd1 noted the stress using public transit to travel to the doctor's office, and its impact on managing their "mental map" of the journey. In the event of construction or another unexpected event along the way, it would become difficult for the individual to imagine what the next step might be. Unlike sighted individuals who could visually scan for new opportunities, "blind individuals must rely on tactile search strategies, memory, or digital assistance tools," (Turkstra et al., 2025), none of which may be optimized for the challenge they have encountered. Navigating hospitals presents equally challenging moments. People and objects move freely and often through hallways, AI cannot always be used to facilitate navigation. Human assistance is the preferred option for assistance. However, for Cd1, BeMyEyes presents a privacy challenge, where connecting to a volunteer through the camera on either a smartphone or smart glasses would be a breach of privacy for individuals sharing the same space. *"I don't like doing it because it's a live camera feed to somebody else in a hospital setting… I find that it's not respectful to the other patients." Leaving the hospital could be made easier with a porter, however this means CD1 needs to "…plan the extra time so that somebody can bring me."*

In designing the ideal AI-powered navigation out of the hospital, Cd1 described that providing directions to their GPS-navigation app before leaving the hospital could direct AT to frame the journey home along more comfortable routes. Again, this would require on-device AI, to protect the privacy of everyone the user encounters. Important to note, Cd1 does not own smart glasses because of the high cost and privacy compromises. The following quote describes the trip home from the hospital.

> Cd1: *"Well, first thing is, I would… want to know where the [restaurant] is on the way out of the hospital [for a snack] … so key… it's one of those things to help… ground you. When leaving the hospital, I might not be able to pay attention to my surroundings as much. I want to know about obstacles… like, where curbs are on the sidewalk... [Or] if there's anything in the way… Where the bus stop is… you have no shelters! It's this stupid little sign on a pole. You're*

blind, you're not going to find that. Especially if you're in a state of personal mental distress. When you get to the bus stop (here would be an amazing one) knowing the [bus] number. And how far away it is. How long until the bus gets there..."

Each item listed by Cd1 in their description of leaving the hospital creates a daunting barrier when the individual is under "mental duress." A lack of bus shelters is a concern shared by Cd2 during their co-design session, remarking, *"… knowing if a bus stop has a shelter… that would just kind of be helpful."* This difficulty in finding public transit pick-up points is a problem documented extensively in a 1997 report by Golledge, Marston & Costanzo, demonstrating how certain accessibility problems have remained constant. Fixing this problem carries what may be considered a prohibitive cost from the standpoint of a city official. However, as Golledge, Marston and Costanzo also documented in a report released in 1998, assistive technology presents an opportunity to fix problems in a low-cost way. AI provides a possible answer, but until it can safeguard peoples' privacy and devices such as smart glasses are produced affordably, the gap will remain.

4.8 Ideal AI-generated directions

In preparation for our second co-design session, Cd1 provided an example of their ideal AI-generated directions for a visit to Toronto, outlined in Figure 3. The directions are based on their mental map of a specific region in Toronto.

Figure 3 — a list of co-designer Cd1's ideal AI navigation steps for a hypothetical walk in Toronto.

Cd1's ideal AI-generated step-by-step navigation
1. When approaching an intersection, at about 50 m away, read out what street I am approaching. For example, "Approaching Queen Street in 50 metres."
2. When approaching an intersection, read out what directions the streets will go. For example, "Spadina Avenue continues ahead, Queen Street goes left, Queen Street goes right."
3. When reaching the intersection, tell me what direction to turn. For example, "Turn right on Queen Street."
4. After completing the turn, have AI tell me how far away the next direction is. For example, "Continue on Spadina Avenue for 25 metres to University Avenue, then turn left."
5. When coming to an intersection that needs to be crossed, especially if it is a large intersection, a) warn me about the size of the intersection—for example, "use caution when crossing intersection, there are four lanes of traffic in each direction."—b) have AI locate and direct me to the button that triggers the signal crossing.
6. When reaching a destination have the AI inform me that the destination is coming up, tell me which side, and direct me to the door. It would even be helpful to have AI tell me what direction the door opens and if it goes in or out. For example, "In 50 metres, your destination will be on your right," then at destination, "your destination is on the right, the door is ahead 3 metres, the door opens to the left, the door opens outwards."

Steps 1 through 3 in Figure 3 outline detailed navigation for a walk along a hypothetical journey through a Toronto neighbourhood. Changes in direction are announced 50 metres in advance, along with the new direction. Such a walk is typical of many GPS maps. The integration with AI-based references to symbols and landmarks, appearing in steps 5 through 6, offer insight into the framing possibilities of AI assistive technologies. Multiple descriptions of the environment include a) navigation across an environment and b) spatial information between the individual and an object, such as the crosswalk button and a door handle. These descriptions identify an idealization of sameness (Saerberg, 2010): the crosswalk involves a button and walking across a set path; opening of a doorknob and swinging the door in a specific direction will lead to a new environment. For Cd1, these steps allow the individual to avoid walking into an unfamiliar environment. It matches their memory of the area and confirms or denies how much they can assume. This preferred AI framework describes high-level planning (Hayes-Roth & Hayes-Roth, 1979). Cd1 has specified an exact route that they want to follow, and they have mentally simulated the process. Cd1 hopes the process will unfold with minimal change, resulting in a less chaotic, easier to understand experience that fits their mental model. The use of a survey approach to delivering the information is an indication of how Cd1 would like to hear navigation from their AI "buddy" (Steyvers & Kooijman, 2009). The directions describe a framework for a non-chaotic, manageable journey, tailored to the needs of someone who identifies as blind and neurodivergent.

4.9 Feeling like a newcomer in familiar environments

Cd1 uses the phrase "visitor mode" to describe losing their sense of familiarity with an area, even in spaces that are within 10 to 20 minutes from home. This unexpected event happens because of a profound change to an environment, rendering their cognitive map incomplete and unapplicable. We discussed the overwhelming experience of how the sounds of construction in an area can ruin their mental map. *"Nothing makes sense anymore. Even if it's a place that I walk all the time, if suddenly they're doing construction…the sound of construction, it will throw you off, and it's like, okay, where am I now? Like, this doesn't make sense."* During our semi-structured interview, Cd1 described an incident where the scaffold from a construction site was protruding 5-feet out into the sidewalk, a familiar area. They could not see it, and walked into a metal beam. The force violently hit them to the ground. After the incident, Cd1 *"…went home. It was literally around the corner from my apartment, and I went home."*

A history of novel options for navigating obstacles without the use of cameras have been studied (Pandelea et al., 2020), yet for everyone contributing to this study, these tools have not caught on. Cd1 remarked at the potential for including LiDAR technology in future versions of Apple smart glasses, which would presumably sense obstacles. A Danish study documented 63.1% of BLVP between age 16-64 choose where to go based on ease of access, compared to 23.7% without disabilities (Bengtsson et al., 2010). It must be stressed that construction along main routes, where navigational applications often direct users, present a severe change to BLVP who consider the environment familiar. Such collisions have a profound effect on day-to-day life for these individuals.

4.10 Shopping for groceries

Cd2 remarks on shopping for groceries alone, *"…if I go to the grocery store, I'll put both [headphones] on noise cancelling to just dim the level of audio, for overstimulation purposes. So I have them kind of on that setting naturally for when I [need] less of the…chaos around me."*

While wearable technology offers opportunities to alleviate cognitive stress, could AI-powered navigational software do the same? Cd2 continues,

> *"I'm just a highly anxious person. So I'm getting better with the comfort of just doing travel and whatever. But I'm always freaking out that I'm going to get on the wrong bus or… do something wrong… they used to have…free bus fare for the blind… I would just get on with my cane and I was so stressed that they weren't gonna see my cane and think [I was] trying to pull one over them… I had been yelled at by bus drivers before... It was worse when I moved to the city, but as… I'm doing the same route so frequently; I get more comfortable with it… even just stressing about people around me and how busy it's going to be… That's me."*

In this co-design, Cd2 listened to a soundscape featuring activities: a) walking through a city and b) riding a bus. The problems we discussed were less about using the bus in a familiar area, and more about riding as a newcomer. The newcomer experience challenges ideas about a familiar bus ride. Multiple stresses compounded, and Cd2 outlined concern about boarding the wrong bus; the threat of being accused of not being blind, and the stress of being surrounded by crowds. While smart glasses could be useful, Cd2 noted how the glasses do not block enough light to be worn during the day; they fall off their nose, and they are not trustworthy for guidance through dangerous situations, like crossing a busy road, or reading traffic signals.

Cd4 describes how interdependence enables them to purchase groceries with the use of AI-powered AT:

> *"I don't like walking with headphones on… disrupting my concentration when I'm trying to get somewhere…I just ask for help shopping and I know my way around the…grocery store and they'll help me for 15 minutes and I get the stuff I need… it's not like I'm having to take photos of cans of soup…"*

Cd2 outlines a different approach to grocery shopping, where AI takes the role of a shopping assistant. Here they discuss the use of Meta AI glasses:

> *"… with my family… if we were out, as much as I hate the grocery store, I would go. And so my mom would be like, "I'm going to look for bread. Can you go grab cereal?" ... And again, it's creating opportunities for independence where, if I want to read the fine print on… the sugar-free cereal or the regular Rice Krispies… kind of enforcing that "you can do this independently" mindset."*

Independence for Cd2 is the ability to shop with a family member while using AI-powered AT (Bennett et al., 2018).

4.11 Personalisation and framing navigation

In response to a question about how loud they prefer to receive navigation directions while using headphones during transit, Cd5 said: *"I would say loud enough to hear directions or info, but not so loud so that I just miss the sounds around me. When I'm walking, I keep it—I'll call it medium—so I can still hear traffic or people talking…"* To find the appropriate levels, and to adjust them whenever they wanted, Cd5 memorized the customization menu while working with their sister: *"Customization. I didn't actually do it alone; I did it with my sister, so... I can still remember the steps it took us."* This demonstrates how the act of personalisation can contribute to interdependence between technology and support persons.

Controlling the speed at which directions are delivered by GPS-based navigation systems is also an important personalisation feature, and Cd5 chooses to bring the AI voice, *"down to 75% of normal speed.... so that way, I'm able to, you know, catch up locations clearly without feeling rushed."* When Cd5 requires directions to be repeated, this happens, *"most times... in a noisy area."* Cd5 outlined their use of Blind Square on a trip to a country they had never visited before. They described the benefits of using AI to navigate with low vision: *"If I'm travelling long distance... I try to use a smart scan with obstacle detection and the GPS navigation. So it kind of gives me these alerts to potholes and also if you are approaching the escalator or space."*

4.12 Moving to a new city

During the first interview with Cd2, they discussed moving to a new city and making it their new home.

> Cd2: *"I think now that I've lived in a city that is relatively reliable, it has allowed me to build my toolkit of knowing how to read public transportation in my Maps app... when I moved from my original city... I didn't have that skill of knowing how to figure it out for myself... I was still relying on O&M instructors and*

people to tell me how to figure out the information—versus now, I think I would feel more comfortable with just… knowing how to find that information, knowing that I can find a bus route and when it's coming and how long it's going to take."

By working with O&M instructors and using navigational apps on their phone, Cd2 knows how to find the information they need to navigate. This preference for being able to rely on one's own knowledge of a city instead of navigating by AI-powered AT is a consistent theme across similar literature (Götzelmann & Kreimeier, 2020). Cd2 elaborates on how they familiarize themselves in a new home:

> *"Technology definitely eases the nerves a little bit, but I would be doing the route beforehand... first day kind of thing, to… get in the habit… because I also learned that things obviously differ from city to city. Some bus systems, you have to push the back door to open, and sometimes the driver opens it. And I did not know that was a thing until I went to visit my sister one time."*

4.13 Privacy

All 5 co-designers expressed unique perspectives on privacy and AI. There is a noted difference in everyone's idea of AI's value and how it can help them in their work life, versus how AI can support AT for navigation. Each individual makes choices about withholding information. For example, Cd5 described being *"… very, very selective with the things I share… I don't think I can actually remember sharing deep personal stuff, unless it is* *kind of really needed…to help… like something I really need [for navigation]."* Assistive technology and GPS-based navigation are often chosen as last resort options, aligning with Turkstra et al. (2025), who suggest that future digital AT should focus on remedying problems that cannot be solved effectively or completely. BLVP consistently prefer less interaction with AT during navigation. This is also a common theme in our project, as many of the co-designers describe moments when they choose to either accept help or seek assistance. This decision is a big part of independence. Turkstra et al. (2025) find that, "Whereas sighted individuals can visually assess and adjust tasks in real time, blind individuals must pre-plan, memorize layouts, and develop routines that mitigate unpredictability." For the co-designers in our project, many protect privacy by using AI sparingly, employing it at the beginning of a journey to pre-plan trips, or when something unpredictable happens during the trip. Co-designers preferred to have AI flag possible unpredictable circumstances during a trip to avoid difficult situations altogether, however this is complicated by their preference for protecting privacy.

Some participants are more willing to interact with AI. Cd2 has a slight prescription in their Meta glasses, and they can wear them around the house, which is handy for such tasks as selecting clothes with matching colours; *"I don't want to have to call one of my family members every time."* When asked about their privacy while wearing the glasses and sharing GPS information, they responded anecdotally: *"I have given up, I feel like, a large sense of privacy in my life… given that my phone text can be read from a mile away… even with me holding my phone very close to my face, like still so many people can read it."* This statement highlights a feeling that giving up one's privacy is mandatory to access AI-powered AT, a common perception among BLVP (Stangl et al., 2023). Additionally, this sentiment contributes to safety around strangers being a constant concern among BLVP (Ahmed et al., 2016).

Cd1 and Cd3 both describe an unwillingness to share their information with Google, and instead navigate almost entirely within the Apple ecosystem. As CD1 remarked, *"I'm one of those people who reads the terms of service."* Both Cd1 and Cd3 take every precaution to protect their data from being sold to unknown parties.

4.14 Autistic meltdown

During the second co-design, Cd1 reflected on the way stress builds up to a point where they cannot prevent an autistic meltdown:

> *"When not under stress and anxiety and stuff like that, I can certainly have a lot clearer of a picture. When under pressure… the emotional states and everything like that… nothing really makes sense anymore. Trying to make sense out of it is going to just confuse me even more; and it'll just cause everything to spiral out even faster and it'll just cause more emotional decline to the point where, you know, I'll get go down all the way down into like a meltdown, for instance…"*

Cd1 clearly identifies the moment when they begin to feel overwhelmed and spiral into an autistic meltdown, elicited by sensory and cognitive stressors (Soden et al., 2025).

"An autistic meltdown, there's no control... A meltdown is a sensory overwhelm."

Recognizing that Cd1 identifies how they have no recourse when they are approaching a meltdown, the potential benefits for pre-planning a trip that avoids sensory and cognitive stressors are substantial.

4.15 Adding time

Cd5 outlines how often they are required to add time to their trips as a blind individual, and the reason is often because of how busy an area might be:

> *"10 to 15 minutes if it's a familiar area, my neighbourhood, you know, before needing to try to check back on my route or asking for help. But if it's like in a new or busy place, it's more like 5 minutes…just trying to differentiate if it's an environment I'm familiar with, it won't be that hard for me."*

Time is described as shifting constantly for Cd5. Their mental map of a familiar space is compromised when loud sounds block out familiar sounds used for wayfinding (Saerberg, 2010; Mucci et al., 2020). If they are walking to, *"a place I'm not really familiar with… I would say it may take me like extra 20 minutes… it may take me like extra 15 to 20 minutes… It's kind of double the time I'm supposed to get to a particular place."* Every one of our co-designers adds extra time to compensate for unexpected changes in their route, including unplanned events. Cd3 adds 20 minutes to some trips, and they describe the extra time as compensation for all the waiting they do on subways since they need to way for less-busy trains.

Cd3: *"There's too many people down in the station... I'll wait for the next train… I don't like being so close with so many people. And then I feel that if I have the cane and escalator or the elevators are out, then people kind of treat me like a priority. She's got her cane… she must be fully blind, so I'll give up my seat. I don't like that."*

Additionally, Cd4 states how they, *"… would tap and drag and use [a black cane instead of white cane] … it was effective in that, less people would just assume I needed help and try to help me and cross that personal space boundary."* This preference to avoid others was also described by Cd4 spatially, *"If I walk on the side streets, like nobody's talking to me… maybe people aren't looking out for each other as much as on the main street or I don't know… it's cultural now, like where we see this thing, we see this person in this situation who might need help."* AI affords the opportunity to avoid interactions with strangers (Holly, 2019).

Cd1 summarizes planning for a day as a blind person, *"It makes it impossible to get anything done… You're allowed to have one appointment per day… any more than that, and you won't have the time to do it, or you have to have a sighted guide that can be with you."* While this rule may not apply to everyone, it summarises how challenges often compile to an unmanageable level and can sabotage an entire day.

Contributions

- Highlights the interdependence between BLV individuals, the people who support them, and the assistive technology (AT) they use.

- An example of how soundscapes remove access barriers in co-design sessions for remote participants.
- The preference for BLVP to navigate familiar environments on their own, without AT.
- Opportunities for including the user at different points while using GPS-navigation applications.
- Descriptions of preferred routes for BLVP with autism spectrum disorder (ASD) and other cognitive differences.
- An examination of how cognitive overload can cause individuals to lose access to their mental map, making them feel like newcomers in familiar areas.
- Suggestions by BLVP for ideal navigation.
- Identification of privacy concerns while using GenAI-powered AT
- A recommendation for on-device AI to improve AT for BLV users who prioritise security and resist extractive technology.

Limitations

Data from 3 unused semi-structured interviews was discarded. The meetings were conducted over Microsoft Teams. The author noted that responses were extraordinarily similar. A possible explanation is that the interviewees may have been using translation tools powered by GenAI. In future studies, translation tools could continue to result in inadmissible data. The 3 interviewees also made sure to keep their interviews short, at around the 1-hour mark, which was between 30 to 60 minutes shorter than others. As highlighted by Chandler and Poalachi (2017), surveys are becoming targets for fraud, where the participants are attempting to earn money from the exercise. This author is not accusing anyone of fraud, but the interview results were similar enough that they could not be trusted data. 3 other people were recruited to participate. The sample size of this study is small, with 5 individuals being profiled. Not every co-designer participated in each phase of the project. Consequently, the findings of this research do not equate to a generalized conclusion about all blind and low vision individuals. As the project progressed, Cd1 become a prominent participant, requesting to take part in one more co-design session than everyone else.

Conclusion

This project started with the question: how does AI support independence for blind and low vision people (BLVP) in their daily spaces? Six BLV individuals examined what the word independence means to them. Through semi-structured interviews and co-design sessions, we came to understand how personalisation capabilities within GPS-based navigation applications do not offer the support required by some BLVP living with autism and other neurodiverse conditions. Two of the participants in this project identify as neurodiverse, while the other three noted how stress and anxiety management could be better supported by GPS-navigational apps. Independence is most often described as having agency, which was described as falling away when each person's sense of a) familiarity, and b) their mental map, were made inaccessible by loud sounds, unexpected physical challenges, and the removal of landmarks.

AI is described in these interviews as a powerful mediation tool for neurodivergent individuals with sight loss, potentially helping people easily navigate mobile applications and instruct AT to support independence. The project demonstrated that without protecting privacy, our participants do not feel safe using the software, therefore AI could not support independence. The results question if local AI, or on-device AI, might be a viable option.

After examining multiple scenarios using activities involving soundscapes, we noted where AI succeeds and fails to support BLVP. Specifically, we observed that trips to and from the doctor's office caused anxiety that could render support from AI useless in navigational situations. Additionally, two participants highlighted how neurodiversity posed unique challenges in combination with blindness and low vision. One individual faces unique barriers with autism, elevating the chance that excessive sound may cause unmanageable stress, thereby producing what they described as autistic meltdown, which renders the individual's mental map inaccessible and makes a familiar setting seem unfamiliar.

Multiple co-designers stated that they prioritise familiar tools. During co-designs, they stated that they would like to be able to customize trips in advance, to avoid loud areas and bumpy routes if they are in pain or experiencing stress. Due to privacy barriers in Google Maps and Apple Maps, the co-designers and researcher were unable to find workarounds by developing AI agents to suggest comfortable routes using these familiar applications.

More research is recommended to understand the types of pre-planning that BLV individuals who have autism might benefit from, and how studies that involve interacting with this type of technology could expand knowledge. As local and on-device AI becomes increasingly feasible on smartphones, additional work could focus on bridging privacy and functionality to bring much-needed capabilities to BLVP. The push to include AI in more AT is speeding up. Introducing opportunities for reciprocity, where people can act as end-user programmers, may keep individuals who are traditionally pushed to the margins of targeted user groups in the loop. Meaningful AI-powered navigation that supports independence for blind and low vision individuals depends on privacy, personalization, and shared control rather than automation alone.

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Appendices

Appendix A: One-on-one semi-structured interview questions

1. Can you outline your capacity for vision? Do you identify as blind or as low vision?
2. What visual assistive technologies (VATs) do you use regularly?
3. Please reflect on experiences navigating your home and daily spaces, such as job sites, public transit, and parks, without the aid of AI.
4. How would you describe your sense of independence using VATs?
5. What's your sense of time like using devices? And its link to independence?
6. How do you define independence? And in general, how does this definition shift throughout the day for you?
7. How does AI support your independence when using VATs?
8. How has AI contributed to your mental map of the environments you frequent?
9. Are there instances where you wished AI could address a need that it cannot already? And how does this need factor into your sense of independence?
10. Overall, would you describe AI VATs in a positive or negative light?
11. What are some negatives you've experienced in using AI and how have they affected your independence?
12. How has using AI in VATs affected your sense of privacy?
13. How has your sense of independence been altered by your sense of privacy in the home and daily spaces?

14. Which VAT capabilities do you feel are most improved by the integration of AI?
15. How does AI affect your independence during interactions with other people? What about pets and nature?
16. Has AI changed the way you think about navigation throughout the city?
17. What new technologies do you want to use through the help of AI? What about Augmented Reality (AR), does AI make this technology more useful?
18. Does AI empower a sense of creativity?
19. How has your opinion of AI changed by the different controversies around generative AI? How familiar are you with generative AI and traditional AI? (definitions available upon request)
20. Finally, lets return to your definition of independence. As our conversation concludes, has this definition changed?
21. What would you like people to know about your experience with AI as it relates to visual assistive technologies?

Appendix B: Co-design session 1 semi-structured questions

1. What would have helped your independence in this situation?
2. Do you think about this situation in advance?
3. Can you describe your mental map of this space? (acknowledging how challenging this might be)
4. Does language support come in handy?
5. What technologies would you typically use in this setting?
6. How about taking into account other disabilities that you must cope with on a daily basis?
7. When would you need to switch apps?
8. Do you think meta glasses would be a big help?
9. How do the sounds make you feel?
10. What would you have liked to know about going into this setting?
11. Would you be using a white cane?
12. Let's talk about cognitive load.
13. Let's talk about the mental/emotional aspects of this experience.
14. What technologies would you be using?
15. How automatic do you want AI to work?
16. When do you want to contribute?
17. When does you want to customize the information and not just the interface/experience?

18. Does it help to think about disability in spatial terms?
19. Does it help to think about accessibility in spatial terms?
20. How do other ailments, disabilities/impairments hinge on your blindness or low vision? - How do they depend? And how does this factor into independence?
21. Social aspects?
22. Misfit feelings?
23. Could these other health conditions/barriers be points where the individual can and should contribute creatively to their care? Does non-visual disability + visual disability = spatial challenge?
24. Would you be inclined to use AI for navigation in daily spaces to support specific health needs that pop up–changing needs?
25. How safe is AI for you in travelling.
26. Do you want more spaces where you don't have to use AI and tech for help?
27. What are transitions between environments like?
28. Are you often building mental maps in new spaces?