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Deafblind Technology Use

Final Report

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Background

Mainstream technologies have become largely ubiquitous in areas such as entertainment, enhancement of roles and engagement in social and other areas. However, people who have complex disabilities, including multiple sensory impairments are often excluded from these mainstream technologies. This causes not only a digital divide between people who are deafblind and their peers, but also neglects to harness the potential of the technology to support people to enhance their potential. This project was designed to investigate the potential of mainstream technologies to address this digital divide.

1 Introduction

In the deafblind population the provision of technologies has been poorly documented and evaluated. Deafblindness is a dual sensory disability resulting from the combination of hearing and vision impairment or loss. As the extent of sensory impairment is varied and additional disabilities may also exist, the deafblind population are a heterogeneous group. The unique profile of sensory disability leads to a variable range of communication styles within the population that affects how they express themselves and receive information from others. Mainstream technologies have become largely ubiquitous in areas such as entertainment, enhancement of roles and engagement in social and other areas.

However, as an under researched population, little is known about technology use in deafblind population and to what extent they can access the benefits technologies can provide. Individuals with deafblindness are at significant risk of isolation, and experience increased loneliness, boredom and frustration. To address this, support to participate in everyday life from both humans and technologies is required (Australian Deafblind Council 2011).

To address the heterogeneity of the population, a multiple case study design methodology was adopted, using a mixed methods approach. This involved standardised and non standardised assessment tools, adapted for the population, documentation and reporting of process and qualitative interviews, primarily using an Interpretative Phenomenological Analysis (IPA) approach to detail how participants make sense of their personal and social world. Given the individual nature of each participant, an important part of the project included documenting the process – understanding how decisions were made with regards to technology, where issues occurred, what worked and what did not work.

1.1 Project Aim

The aim of the project was to evaluate the utility and adaptability of mainstream technologies to support people who are deafblind and to understand technology use with people who are deafblind.

1.2 Ethics

This project was approved by Swinburne University of Technology Human Research Ethics Committee on October 27th, 2020.

2 Scoping review

2.1 Aims

A scoping review was undertaken in 2020 and search was repeated in February-March 2023 to establish a broad overview of the current research around deafblindness and technology use, aiming to investigate the current knowledge on the use of technology by individuals with deafblindness and the challenges they experienced. Deafblindness is a condition that has limited available literature, primarily due to a combination of complexity and rarity of the condition. Given this, it is important to undertake a review and report on available research to ensure that the data generated here adds to the field.

2.2 Methodology

The primary aim of this scoping review is to map existing literature to answer the following question:

What is the potential of mainstream technology to assist people with deafblindness to achieve their goals?

Search Strategy

A systematic search was conducted using multiple electronic databases to ensure a broad coverage of relevant literature.

Databases searched included EBSCO, ProQuest, PsychINFO and IEEE, as well as grey literature and specific journals. These were chosen based on their relevance to the field and comprehensive lists of relevant articles.

A preliminary reading of abstracts was undertaken to gain a general understanding of the literature and document MeSH terms. Grey literature was explored through google, peak deafblindness associations and narrative texts

and publications. Abstracts and titles were screened for key terms. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis: extension for Scoping Reviews) Protocol was used to transparently document the review process (Page, MJ, et. al, 2020)

Filters and Limits

Articles that specifically focused on mainstream technology for personal use by individuals with deafblindness, in English language, from 2009 onwards were included. This year was chosen to coincide with the release of the first iPhone with accessibility features. Results were imported into the reference management system Zotero.

Search Terms

deafblind*, deaf-blind, dual sensory impairment, dual sensory loss, mainstream technolog*, assistive technolog*, adaptive technolog*, adaptive features, adults. Searches were undertaken separately in each database. Searches were combined with the AND Boolean term.

2.3 Results

Initial search results comprised of 1489 articles. Duplications (202) were removed, leaving 1287 eligible articles. Following screening, a further 1215 records were excluded. Most excluded articles focused on a pediatric population. Others focused on individuals with deafness or blindness and some on medical interventions. Theses and dissertations were excluded from this review, although scanned or read for other information.

Search outcomes are presented in the PRISMA Checklist (figure 1) for the number of records identified and screened as well as those included and excluded, useful for providing accuracy and transparency when reporting a review. (Page et al., 2021) After final screening, 11 remained for review-see Table 1 for list of included studies.

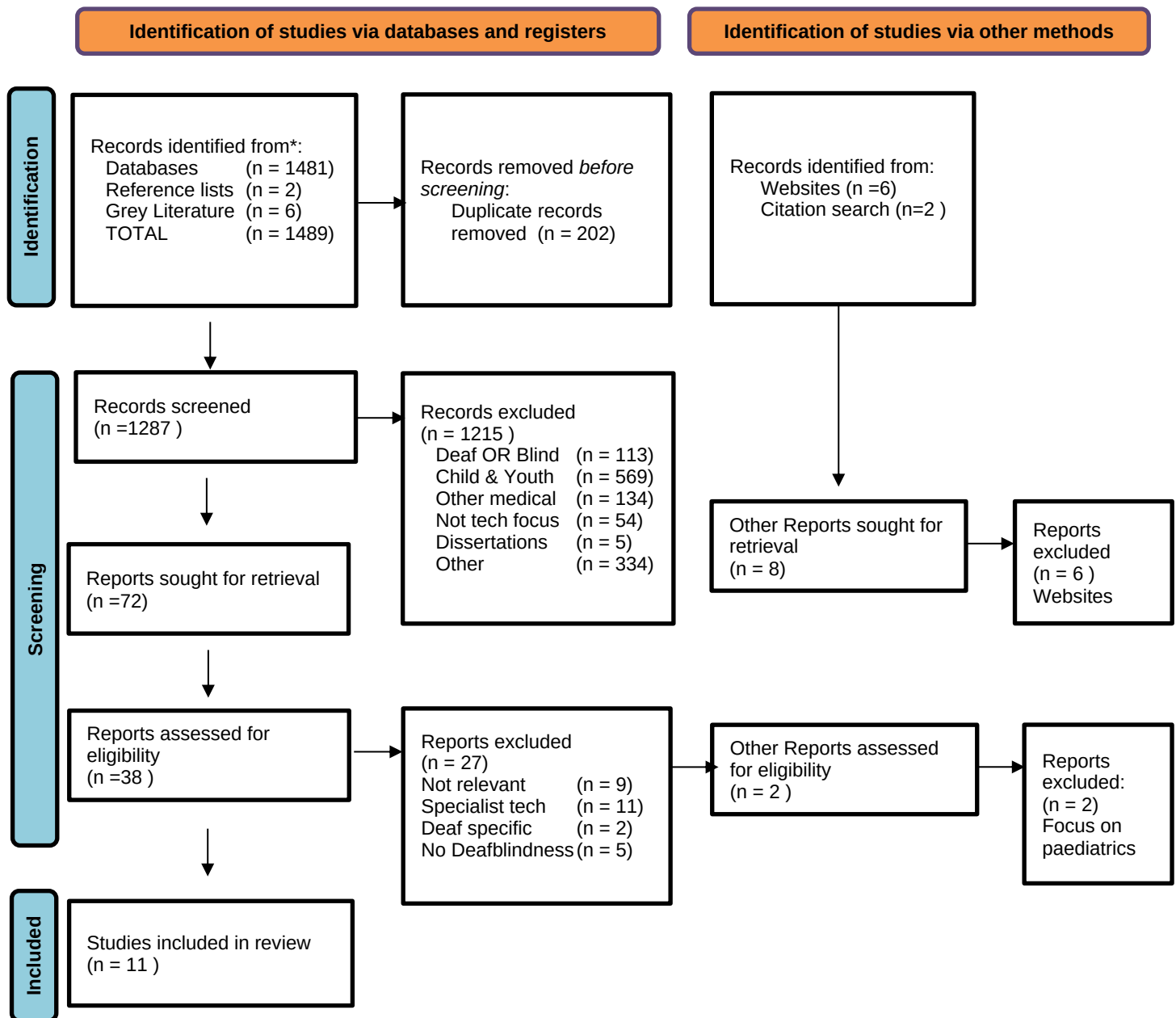


Figure 1. PRISMA 2020 Flow Diagram (Page et al., 2021)

Primary Author	Aim	Location	Sample size	Methods	Key Findings	Key Limitations
Bell, D (2021)	Test MyATOF tool for use in the deafblind population	Africa	n = 17	Qualitative Surveys	Positive feedback from participants	Novel tool and requiring further testing and research.
Cantin, S (2019)	Examine use braille CAD device to communicate in a community setting.	Canada	n = 1	Single case study with user testing	CAD device abandoned; participant created own system	Single case study, results not readily transferrable
Cantin, S (2022)	Examine use braille CAD device to communicate in a community setting.	Canada	n = 1	Single case study with user testing	CAD device abandoned; participant created own system	Single case study, results not readily transferrable
García ,A (2020)	Test usability of smartphone app to access TV subtitles	Spain	n = 9	Case studies with tech prototyping	Potential for device to enable access to subtitles Participants reported more autonomy re. TV access	Tech limited to Europe
Hersh, M (2013)	Explore deafblind experiences of travel and use of communication and mobility assistive devices	Europe	n = 9	Semi-structured interviews	Use of aids was initially stigmatising, but benefits outweighed stigma	Focus on small, specific tech-some used by 1 participant only, limited scope for analysis.
Kassem,K (2022)	Testing a people tracking device via webcam and haptic feedback motors, relayed via a wearable hat.	Scotland	n = 2	Prototyping, workshops	Between 47 and 80% accuracy during testing. Potential for future utilisation.	No f/u interviews data collection.
Luz, T (2022)	User Testing of Caeski keyboard and app	Brazil	n = 11	Prototyping	Potential for wide use in future as is coupled with smartphone.	Based on novel language and keyboard requiring training. User must be familiar with smartphone. Tech already exists for Braille.

Perfect, E (2019)	systematically review published evidence regarding the technologies that enable internet access for individuals who are deafblind.	Canada	n=7 articles	Systematic review	No existing studies evaluating AT and internet use. All tech papers is in early design stage, many with no evidence and data and no use of DB participants.	Inconsistent terminology in literature resulting in articles being missed in searches, evidence of internet use only exists via online blogs and non-academic sources not included in study
Vincent,C (2021)	Deafblind person testing braille display & smartphone in the community to improve face-to-face communication	Canada	n = 1	Case studies with tech prototyping	Using existing tech (braille note-taker and smart phone)-concept may be easily transferrable	DB user not involved in early research phases. Only one DB user and large research team.
Vincent,C (2014)	To test a methodology for assessing the effects of electronic mobility aid devices (EMAD) on the mobility of persons who are deaf-blind in real-life situations.	Canada	n = 4		Using existing tech -findings applicable to other deafblind users. Thorough data collection process	Variance in participants-results may not be transferrable
Wittich, W (2021)	Review of assistive technology use from the perspective of persons living with deafblindness using the ICF framework	UK	n=10 articles	Scoping Review	Most tech used is for single impairment (deaf OR blind) small amount of tactile devices	Small sample size, population inherently heterogenous

Table 1. Included Studies in Preliminary Literature Review

Summary of Findings

All articles included in this review were journal articles on the topics of disability, design, engineering, and technology. Methods included 1 survey, 1 systematic review, 1 scoping review, 5 multiple case studies and 3 single case studies. Case study design appeared most frequently, which is reflective of the population studied. Of the case study papers, 4 investigated technology prototyping with a cohort of deafblind people. All the technology used was intended to improve access to information. The remaining methods were single case studies that explored the use of common mainstream technologies, novel technologies, and tech bundles by an individual. Both the scoping review and systematic review investigated aspects of technology use through The International Classification of Functioning (ICF) framework. The ICF is a framework for measuring health and disability at both individual and community levels, formulated by the World Health Organisation. It provides a standard language and a conceptual basis for the definition and measurement of health and disability and is commonly referred to in health related literature and research (Centre For Disease Control 2015).

All studies investigated adults with diagnoses including congenital deafblindness, Usher's Syndrome, congenital deafness, and associated vision loss as well as 'partial' vision and/or hearing loss. The literature noted that a mixture of 'mainstream' and 'assistive technology' was utilised by individuals in this population, often in a bundle. Interestingly, all the prototyping research articles described specialist technology paired to a mainstream item-either a smartphone/tablet or TV. Researchers had a variety of backgrounds: design and engineering, audiology, ophthalmology, allied health and computer science.

Several themes emerged within the sources, which are relevant to deafblindness and technology use. Preliminary analysis of articles is grouped into two main themes: Current challenges and future directions.

Current Challenges

Lack of reliable data available on deafblindness

All articles note the difficulty in sourcing reliable data on the prevalence of deafblindness (Bell et al., 2023). Estimates of the worldwide deafblind population range from 15 million (Kassem et al., 2022) to 150 million (Luz et al., 2022) suggesting inconsistent recording due to a lack of a clear, universal definition of deafblindness. In the group of articles for review, 2 cited a Nordic definition of deafblindness and 1 cited the World Federation of deafblindness definition. The remainder of the authors described deafblindness through

variety of terms including severe sensory condition, complex, isolating, unique and 'multi-sensory impairment'. There is obvious difficulty in the formulation of a consistent definition, for example, heterogeneity of the population and low prevalence. This also creates barriers to research and policy. Further, it may lead to a difficulty and lack of consistency when designing appropriate tools to assist in engaging with deafblind individuals.

Lack of technology designed with and for people with deafblindness.

All authors note a lack of appropriate technology for deafblind users. Firstly, technology often used is designed for single sensory impairments i.e. deafness or blindness (Bell et al., 2023; Kassem et al., 2022; Wittich et al., 2021). Wittich (2021) found numerous unforeseen barriers experienced by deafblind people in incorporating their devices into their lives. such as physical design of devices. This includes item weight, and size of buttons and controls. For example, the location of buttons when on the underside of the device made them hard to locate intuitively, making the technology inaccessible. Other barriers included lack of access to external support to both source, learn and use technology; often people are left to their own devices, without supports to guide their ability to learn or access (Wittich et al., 2021). In relation to Usher's syndrome, authors have noted that when their 'remaining sense' deteriorates, products are no longer helpful when used in isolation, but that alternatives are not readily available or adaptable. The study conducted by Kassem (2022) describes the use of aids designed for deafness or blindness used by people with deafblindness in isolation as limited. They speculate that this creates an opportunity to address these challenges through the application of novel cost effective and portable technologies (Kassem et al., 2022). The challenge of formulating technology for people with deafblindness is described as difficult and expensive to develop because of the specific and hard-to-discover nature of these users' needs, subsequently dis-incentivising investment in a relatively small population (Cantin et al., 2022). Although there does exist an opportunity for mainstream products such as the iPhone to be used by deafblind individual, this item seems to be most successfully used when couple with another specific item or items designed for the needs of the deafblind user (Cantin et al., 2022).

Lack of Practice Guidelines for AT provision with deafblind Individuals

The need for a unique approach when considering deafblind individuals may also explain the scarcity of AT practice guidelines for working with this population. In their single case study presented over 2 papers, Cantin et al (2019) described the iterative evolution of the study which saw the participant abandon the initial technology item and formulate a user-made device. This

example suggests the need for the formulation of practice guidelines to promote an understanding of the uniqueness of individuals living with deafblindness and the promotion of evidence-based practice.

Accessibility and deafblindness

Historically, studies on accessibility have tended to focus on physical access, and mobility in physical environments, spaces and indoor premises (García-Crespo et al., 2020; Vincent et al., 2021). When exploring accessibility in the context of deafblindness, communication and access to information are frequently cited as key factors in the literature, specifically, access to information via TV's, phones and computers. However, technology as a means of accessibility remains challenging. In a systematic review investigating internet accessibility in the deafblind population, Perfect (2021) noted that limited consideration has been given to communication technique, that is, braille, fingerspelling, or other, and how this impacts the usability of the assistive technology in the deafblind population. These findings suggest that stronger consultation needs to be undertaken with deafblind individuals to ensure technology is designed with appropriate and useable features.

Communication Considerations

All studies addressed communication challenges for those in the deafblind population in general, detailing a range of different communication requirements and preferences. 'Communication technology' was frequently noted in the studies, emphasizing the importance of communication as a need. One single case study noted that recurring technical difficulties resulted in poor communication outcomes. Challenges such as speed of interaction and exchange when using a smartphone and braille device are suggested to have affected the fluidity of the communication between the deafblind user and a community member (Cantin et al., 2019). While a tactile (braille) communication device paired with a smartphone yields potential as a tech bundle to assist with communication, future research and investment is required to overcome technical issues such as speed and reliability of connection.

Hersh (2013) documents the need for human communication and interaction for people with deafblindness but also documents the expanse of communication approaches, listing seven different communication methods and their subsets. This is an important consideration for technology design and use. Cantin also emphasised the importance of ensuring general community members feel comfortable to interact with someone with deafblindness using technology as an intermediary to enable human interaction (Cantin et al., 2019).

When developing technology, sighted and hearing users' needs should also be considered alongside those of deafblind users to promote transferability across many social scenarios, as communication is a two way process (Vincent et al. 2021).

The Technology Bundle

Over the past decade, there has been a marked increase in the use of mainstream devices (such as smartphones and tablets) utilised by the general population but also incorporate built-in accessibility features for users with diverse needs (Martiniello et al. 2022). Of the 11 articles reviewed, 7 investigated the use of smartphones paired with other technology. The benefit of the smartphone lies in its ubiquity, reliability, powerful programming and ease of access to tech support and upgrades (Cantin et al. 2019). Many smartphones have adaptable features around font size, colour and contrast, voice output and haptic features enabling deafblind users to tailor settings to suit their individual needs and preferences. Further, these discrete features can be set without altering the look or aesthetics of the device. Perhaps because of its frequency of use, it has become that of a social talking point that has the potential to eliminate stigma and promote inclusion (Hersh, 2013). A practical example of smartphone use is noted by Garcio-Grespo et. al (2020) who investigated adaptive devices for television, and the role of the smartphone as a key intermediary in accessing subtitles:

At a social level, Vincent et al., (2014) suggests that the utilization of generally available mainstream technology was key to achieving participation while not emphasising a person's disability. This benefit also extends to the general population who are familiar with this technology and can feel more comfortable engaging with a person with deafblindness, with technology acting as an intermediary. However, the full extent and potential of use regarding smart phones for deafblind users is yet to be realised. Cantin suggests that although the smartphone is in its early use within the deafblind population, as accessibility features improve along with technology literacy of users, access to information and the internet seems to be 'the next step' (Cantin et al. 2019).

Seven articles in the review investigated the use of a deafblind specific communication aid such as a braille device paired with a smartphone via an app. However, some technical challenges did arise in the pairing process between devices such as unstable, lagging or frequent loss of connection. This suggests the need for continued investigation into both technical and functional utility, as

well as continued consultation with deafblind users.

Future innovation

When searching for technology and deafblindness in the literature, a significant amount focused on emerging technology, presented as conference papers. Though these papers did not meet the search criteria, they did offer potential future application for people with deafblindness: Several conference papers describing vibrotactile bracelets, gloves and robotic hands as a braille communication interface, connected to a mobile phone via Bluetooth. Navigation devices for use while walking, providing haptic information to the user. Although these devices would have significant potential to assist a person with deafblindness with navigation, they were investigated in a research context through investigating typically signed and hearing individuals without disability.

It is promising to see the interest in technology development for deafblind users. It is hoped that, as some review articles have attempted to demonstrate, that existing technologies can be repurposed or bundled together to create straight-forward, cost effective solutions. This would enable clinicians and deaf-blind professionals to harness these solutions in a quick and cost-effective way.

2.4 Summary

In summary, literature investigating deafblindness and technology use is limited. Studies are small in scope with only a few participants, due to the heterogeneity of the population – both variability in abilities and capacities, function as well as goals and desires of the people involved. Of the four participants testing a device, each participant used it differently (Vincent et al., 2014). In day-to-day practice, this suggests that people with deafblindness require time to experiment, adapt and make use of devices to suit their needs. The literature suggests that User input is valuable from the outset of a study program to ensure appropriate methodology and inclusion of proper communication modalities such as haptics and braille integration. Wittich (et. al, 2021) suggests that in the coming decades, technology will continue to evolve, presenting opportunities for persons living with deafblindness to be part of this evolution and be partners in the codesign and evaluation of new assistive technologies. Above all, this population requires robust attention and increased supports to access technology and participate in the activities and social interactions that they want and need to do.

3 Research Project to investigate mainstream technology use and people living with deafblindness

Given the complexity of undertaking research within this population, a mixed methods multiple case studies design was undertaken to ensure that as much information as possible was connected to inform future practices. Multiple case study designs are utilised to find “explanatory patterns” within a target population of cases (Greene 1984). Multiple case study research enables the reporting of the how and why information obtained through the case study approach. Moreover, it enables the making of statements around the extent to which conclusions can be generalised. A mixed methods approach was also used whereby qualitative interview and observational data were collected as well as quantitative standardised and non-standardised assessment tools and surveys. This approach was chosen as it enables a more comprehensive understanding of the topic under investigation, and the data can be summarised numerically, adding some credibility to the findings in a traditional sense. However, mixed methods ensures that both qualitative and quantitative information are valued.

3.1 Assessment tools

3.1.1 Unified Theory of Acceptance and Use of Technology 2

The unified theory of acceptance and use of technology 2 (UTAUT-2) (Venkatesh et al. 2012) questionnaire is based on a well-established model of technology and acceptance (Momani 2020). The UTAUT-2 is an adaptation on the original UTAUT developed in 2003 (Venkatesh et al. 2003) which measured 4 determinants of technology: behavioural intention, social influence, effort expectancy and performance expectancy. The UTAUT 2 was modified to include habit, hedonic motivation and price value and had a total of 28 items that were rated on a 5-point Likert scale (Momani 2020). Higher scores are thought to predict greater technology usage and acceptance whereas low scores are associated with low rates of usage and technology abandonment, scores can range between 28 and 140.

In response to poor comprehension and Auslan translation difficulties when conducting the UTAUT-2, two experts in the deafblind field were engaged - one with deafblindness and one Auslan interpreter. The key learnings from this meeting are outlined below:

- Native Auslan users do not use rating scales making it a difficult concept to understand
- Items on the questionnaire that repeat themselves using slight variations

in language with invariably be communicated to the participant using the same signs because Auslan does not have as many synonyms as spoken language

- To increase the utility of the UTAUT to be accessible to people with comorbid cognitive impairment the language needs to be simplified and the scale kept simple.
 - Scale with no greater than 3 options.
 - Use concrete terms.
 - open-ended questions should be avoided.

To address the feedback received on the UTAUT-2 adjustments were made, including:

- When two items addressed the same construct twice, we removed one of those items. This led to 10 items being removed.
- The remaining 18 items were fed into an online tool designed to help edit text to be more accessible based on a selected age. The text was adapted to a 7-year-old reading and comprehension level.
- The numeric scale was adapted from a 5-point Likert scale to a 3-point scale that had two presentation options to facilitate responses; an emotion face (1= sad ☹, 2= neutral 😐 2 = happy 😊) or verbal scale (1 =Yes, 2 = Somewhat, 3 = No).
- Scores in this version ranged between 18 and 54.

See appendix A for a copy of the UTAUT-DB-adapted version that was developed

3.1.2 Canadian Occupational performance measure

The Canadian Occupational Performance Measure (COPM) is an outcome measure designed to detect changes in occupational performance over time (Law et al. 1990; Carswell et al. 2004). This measure is completed using a semi-structured interview following a five-step process for measuring individuals' issues in a client-centered manner in relation to the performance of everyday activity and function. This tool focuses on measuring areas of function in a person's life such as self-care, productivity, and leisure. Once goals are developed the person is asked to rate out of 10 their current performance and satisfaction which may be re-scored later (Law et al. 1990). Any increase greater than 2 is considered significant.

While the validity of the COPM as a measure of occupational performance over time is well established (Carswell 2004) reviews of this tool highlight difficulties in conducting it with people who have intellectual impairment noting difficulties in

comprehending the goal rating. This led us to take a flexible approach when administering the tool by simplifying the language when needed and noting down all responses given by the participants when rating their performance and satisfaction levels.

3.1.3 Interviews

Audio data was collected throughout sessions to document information the standardised measures would not otherwise capture. An informal conversational style interview approach was used to generate verbal data by talking about specified topics, in our case, their technology (Given, 2012). The study employed semi structured interviews to inform and give depth to the information gained during the session. This interview structure was chosen because it allows for a flexible, yet focused exploration of a person's views and experiences, perspectives and insights, triangulating the information. Participants or their proxy were asked open questions pertaining to the participants technology use or their social next works which was guided by Anon's (2023) circle of friends' diagram.

Technology use: The technology section of the interview focused around understanding the technology being used in the participants' life. This was sometimes also paired with a tour of the participant's house to see the technology in their possession. The following prompts were used in the interview:

- What is technology used for?
- How was the technology funded?
- How often is the technology used?
- Do you experience any difficulties when using your technology?

3.1.4 Social Circles

The circle of friend's diagram was designed as a teaching tool to assist children with disability to understand and foster inclusion and peer groups and relationships (Anon 2023a). The diagram was used to facilitate discussion during interviews about the participant social networks, feelings of connectedness and how technology may enable and foster social connectedness within each circle.

3.1.5 Tactile Working Memory Scale

The Tactile Working Memory Scale (TWMS) is an observational based tool designed to be used with individuals with congenital deafblindness. The TWMS

investigates working memory in individuals with deafblindness who engage with the world through a bodily-tactile modality (Nicholas et al., 2019). Observations of tactile behaviour are documented via an itemized rating scale applied to everyday activities and tasks. There are 20 items to rate within the TWMS which cover 3 domains of tactile working memory –encode, maintain and manipulate. Each item is scored as either present, emergent, absent or not applicable based on the observations made. This tool is not designed to be scored as linear relationships are not assumed between each item. Instead, this tool aims to inform on therapeutic interventions and reassessment can be applied to track progress.

3.2 Recruitment of participants

A convenience sample of participants with deafblindness were recruited from Able Australia residential houses and the community via Able Australia client database. Participants had to have dual sensory impairment whereby each sensory impairment significantly impacted their day-to-day living in order to be eligible for the study. Information about the project was distributed by Able Australia to their clients and families. The ability of a person to provide their informed consent was determined by Able Australia who used their clinical reports and knowledge of the individual to inform their decision.

3.3 Procedure

Prior to conducting the first session, researcher established with Able Australia if sessions were able to be directly conducted with the participants or via a proxy such as family member. For participants able to give their direct input Auslan interpreters were present when needed. If a proxy was required Able Australia arranged support workers and in some cases family to act in this role.

This project involved three different phases, the pre-intervention data collection to understand the participant and their technology use, the intervention tech testing phase and then the revisit post-intervention to assess any technology related changes in the participants life. Sessions went for between 30min to 1 hour and were typically run with 2 researchers present, including one qualified in OT. The research took place at the participant's residence or in a location of their choosing. Measures were added and removed over the course of the project's life based on key learnings obtained along the way. See figure 1 for the measures used in each session.

During the pre-intervention data collection, a single session was run with

participants who were self-reporting or their proxy (either in-home support worker or a family member). Demographic and diagnostic information was collected. The following measures changed over the course of the pre-intervention data collection and were not run in any particular order. The UTAUT-2 was conducted then changed to the UTAUT-BD-adapted survey. The TWMS was initially conducted, however was later discontinued. A semi structured interview was run for all sessions during which semi structured questions pertaining to a person's technology and its usage, then later on the social circles construct was introduced as a measure which was treated as part of the interview. Finally, the COPM was always run leading to the formation of 1 to 3 occupational goals. Participants were asked to focus on technology related goals where possible.

The tech testing period varied greatly between participants due to interruptions caused by covid lockdowns with the gap between visits ranging from 4+ months to 12 months. In between sessions, the researchers provided Able Australia staff with a list of goals and technology recommendations for each participant however it was up to the participants, their family and allied health workers whether these goals and technology suggestion were taken on board. Participant's goals, technology aquation, usage and milestones were tracked by Able Australia staff where possible.

During the post-intervention data collection, a single session was conducted with either the participant or a proxy who had daily contact with them. It was not always possible to speak to the same proxy as before due to their availability or because the participants were working on their goals within a different setting such as day program. During this session the COPM goals and UTAUT-DB-adapted were reassessed. Interviews were conducted again to understand changes in a participants' technology use in the context of benefits and barriers experienced. Social circles were also collected if there was time.

Swinburne Research Team	Pre intervention data collection
	Interviews COMP UTAUT-2 later replaced by the UTAUT-DB-adapted Documentation of technology and usage Social circles (late addition) TWMS (early removal)
	Intervention technology testing

Able Australia Staff	Participant's goals, technology aquation, usage and milestones were tracked by Able Australia staff where possible. Length of Phase 2 was impacted by COVID and participant availability. This led to a highly varied gap in between sessions1 and 2 (4-months to 1-year)
Swinburne Research Team	Post intervention data collection COPM UTAUT-DB adapted Interviews Documentation of new technology and usage Social circles

Figure 2. Overview of the project's procedure

3.4 Data analysis

3.4.1 Group analysis of tools

Descriptive analysis at the group level was conducted on the assessment tools to understand how the population typically scored and the range. This section also includes an evaluation of each measure's utility when conducted with people with deafblindness.

Thematic analysis

Each interview was transcribed initially using a transcription service, Otter.AI (Liang and Fu 2016) and then independently reviewed and amended by the researchers to ensure accuracy. Participant names were replaced with ID codes to preserve anonymity. Transcripts were downloaded to a central, secure computer, and uploaded to NVIVO 12.6.1 (QSR International Pty Ltd. 2020) for coding and data management. Pre and post intervention interviews were separated and treated as different data sets in separate NVIVO folders. The data was coded independently by two coders using Braun and Clarke's (2012) six steps thematic analysis framework. This is an iterative process consisting of the following steps: (1) becoming familiar with these data, (2) generating codes, (3) generating themes, (4) reviewing themes, (5) defining and naming themes, and (6) locating exemplars.

Prior to coding these data, researchers agreed that a semantic approach was most suitable due to the multiple forms of communication used within the interview process. A theoretical approach was chosen, as the interview questions did not fit within an inductive framework (Braun and Clarke 2006, 2019, 2021). Themes and codes were regularly reviewed by the research team. Where there was disagreement, the data was reviewed collectively by the research team until consensus was achieved.

Multiple case studies design:

Four representative case studies are reported. These were chosen to represent the diversity which exists in the deafblind population. A cross-case analysis was conducted to identify common patterns and differences that emerge from the multiple case studies. The names and some personal details have been changed to protect participants' identities.

4 Results

4.1 Participants

There were 21 deafblind participants in this study (aged: $M = 52$, $SD = 12$, range 32 - 69; Female $n=11$, Male $n=10$), 11 of those self-reported while for 10 participants proxies were used. As part of the pre-intervention, 7 participants had data collected from multiple proxies to help establish a participant's background and goals resulting in 28 sessions being conducted. While for the post intervention only a singular session was required. The self-reporting participants (11 community, 1 residential) were supported by either family ($n=1$), communication guides ($n=2$) or Auslan interpreters ($n=8$) during the sessions. A house staff proxy was always spoken to during the pre-intervention however for the post intervention there were 5 cases where the proxy used for the data collection changed.

There were 6 reoccurring and 5 unique diagnoses that were reported in this sample. Participants vision and hearing were described as either no vision/hearing or some vision/hearing and then assigned to one of the four possible sensory combinations. No vision was classified as vision that did not extend beyond the perception of light and shadows. All other vision capabilities were categorized as "some vision". For hearing, participants who's hearing was described to have "no hearing", "none" and "profound" in both ears were categorized as having no hearing while all other descriptions were entered as

'some vision'. For expressive and receptive communication 9 different combinations were documented with oral/aural and Auslan/Auslan the most commonly reported. See Table 2 for a summary of the participants demographics and table 3 for a summary of the measures completed during pre and post intervention.

Descriptive	Count
Diagnosis	
Ushers Syndrome	8
Congenital Rubella	5
Autism	2
Cerebral palsy	3
Glaucoma	2
Intellectual Disability	9
Other	5
Sensory profile	
No vision & no hearing	2
No vision & some hearing	6
Some vision & no hearing	3
Some vision and some hearing	10
Expressive/Receptive communication	
Oral/aural	6
Auslan/aural	1
Auslan/Auslan (visual frame & close)	5
Auslan/Auslan (tactile)	3
Oral/Auslan	1
Key word sign/Key word sign (tactile)	1
Key word sign/Key word sign	1
Non formal means/Key word sign	2
Non formal means/ Non formal means	1

Table 1. Characteristics of the participants

Measures	Pre (n)	Post (n)
-----------------	----------------	-----------------

UTAUT	9	0
UTAUT-DB-adapted	12	19
COPM	21	19
Interview	21	21
TWMS	11	0
Social Circles	7	17

Table 2. Measures completed.

4.2 Analysis of formal tools

4.2.1 COPM

Participants provided either standardised numerical responses or descriptive responses when the scale was too difficult to understand (see Table 4). COPM change scores indicated that participant's goals on average significantly improved (change score of 2 or higher) in level of Performance ($M=2.22$, $SD=3.08$) however did not significantly improve in level of Satisfaction ($M=1.77$, $SD=2.59$). COPM response styles (change scores and descriptive judgments) were combined into 3 aligning groups (positive improvement, no improvement and negative improvement). Across participant's goals they reported in at least one of their goals the following results; Performance (positive improvement = 10/21, no improvement = 13/21, negative improvement = 1/21) and Satisfaction (positive improvement = 11/21, no improvement = 11/21, negative improvement = 1/21). There were 4 goals that had lost relevance over time. This was due to either changes in circumstances or because their goal was achieved via in-person support.

The deafblind participants providing direct input were able to identify goals that they wanted to work on. However, many of the participants who were Auslan communicators had little previous experience with using number rating scales and found it a difficult concept to learn. Auslan speakers instead signed 'good', 'bad', 'poor', 'happy' and 'not happy' when answering.

	% of Goals		Participant n	
	Perf	Sat	Perf	Sat
COPM change scores				
Clinically significant improvement (2 to 10)	44%	40%	n= 7	n= 7
Non-significant improvement (0 to -1)	52%	56%	n= 11	n= 8
Negative improvement (-1 to -10)	4%	4%	n= 1	n= 1
Total change scores reported	n= 27	n= 25	n= 12	n= 11
COPM descriptive judgment				

Positive improvement	33%	36%	n= 3	n= 4
No improvement	22%	27%	n= 2	n= 3
Goal lost its relevance	44%	36%	n= 4	n= 3
Total descriptive reported	n=9	n=11	n=9	n=10

Table 3.COPM reported in terms of total percentage of goals and number of participants, split by method of response style.

4.2.2 UTAUTs

To make the scores between the two UTAUT's comparable, participants percentage scores based on the max total score of each UTAUT (participant raw score / total * 100) was calculated. For the participant's average UTAUT score across both sessions was 71(16) and ranged between 23 – 92. Participant's change scores from session 1 to session 2 were also calculated showing 9 participants decreased in their score while 8 participants increased. The average amount scores changed (in either direction) was 10 points while change scores ranged between (-11 to 29).

Observations on the new UTAUT-DB-adapted measure showed that all self-reporting participants could complete the survey. Participants understood the verbal scale more readily than the face scale. Auslan interpreters noted that only one pair of statements remained in the survey that were communicated using the same Auslan signs with all other repetitions being successfully removed. Language simplification within the survey had reduced the instances of wording clarification being requested. However, there was still a fundamental struggle for Auslan communicators to understand how to apply the survey's statements to the umbrella term technology. To assist these participants, interpreters would resort to specifying a singular item of tech to help them respond to the statements.

4.2.3 TWMS

The TWMS was conducted on 11 out of the 21 participants during session 1 and was withdrawn as a measure after review. The tool was designed for a population who fit a narrow definition of deafblindness only referring to individual with profound dual sensory disability whereas this project collected a sample population of people who exist on a spectrum of sensory disability. As such this tool was only appropriate for 2/11 participants and was frustrating for the others.

While the manual suggests that this tool could be extended to a broader

population such as the people included in this project, there is no clear instruction in the TWMS on how to score items achieved through vision or hearing in the manual that assumes all items will be achieved via the tactile modality. The manual states that the N/A code is to be used “when an item doesn’t apply in the current situation, due to relevant individual factors such as sever motor or physical limitation or other situational factors”.

Results show that behaviours were predominantly present, or not able to be observed during the session resulting in the code NA (see figure 3). The TWMS was found to be insensitive to participants with very separate levels of function, however the tool does state that it is not designed to give a linear score for comparison.

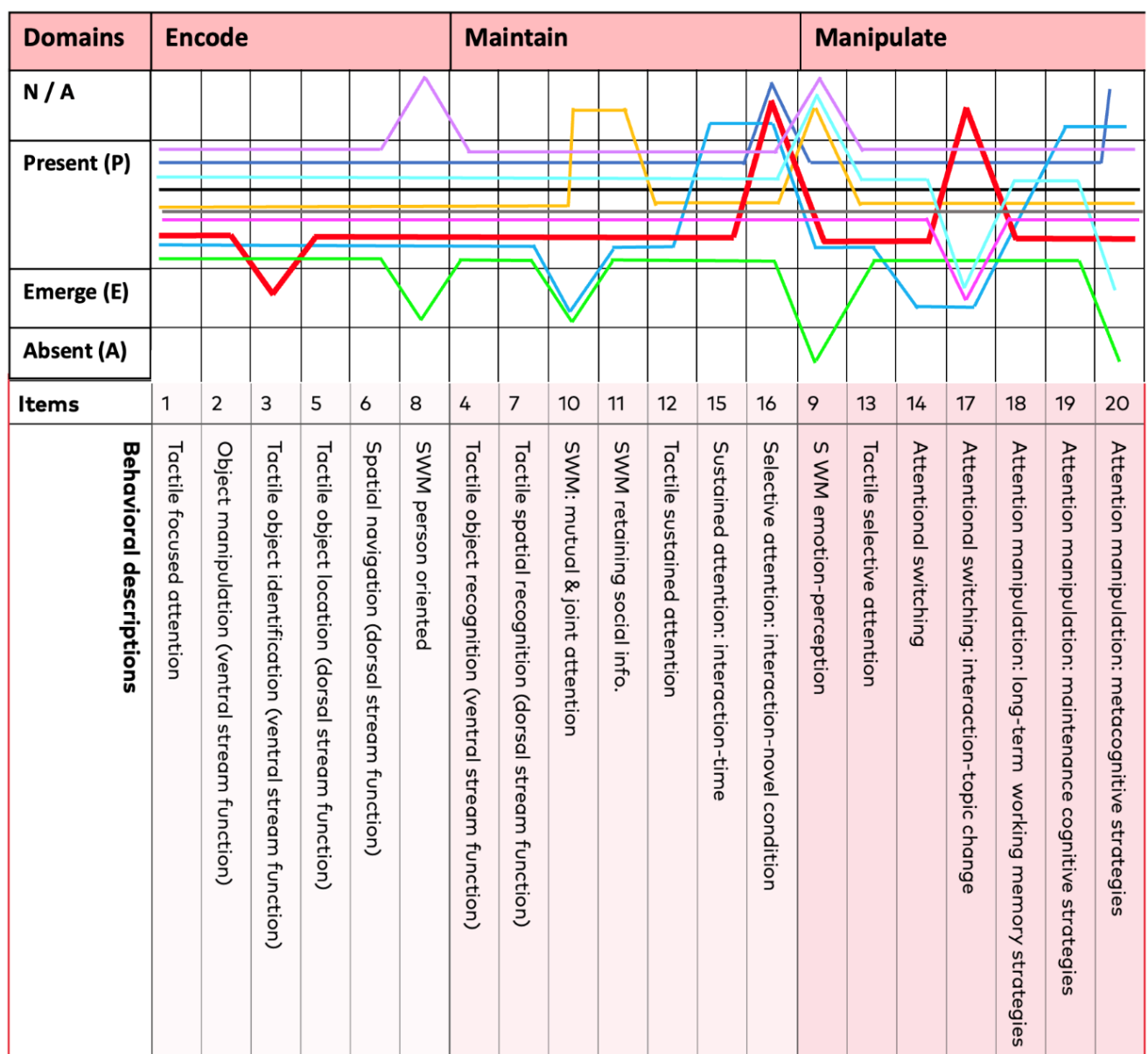


Figure 3. TWMS scores for 11 participants. Each participant is represented by a coloured line which tracks across their results for each item. The thick red line denotes the result for the 1 participant with profound deafblindness

4.3 Technology usage

During the pre-intervention data collection 19/21 participants reported owning some form of technology and 16 of those participants were able to independently navigate some of their functions. A total of 33 different types of technology was documented and noted that 18 participants have at least one item of mainstream technology in their possession.

Post-intervention results saw a total of 8 participants receiving one or more pieces of new technology and 7 participants receiving one or more upgrades to their technology. This increased the number of different types of technology owned to 42. The number of participants owning a piece of technology increased by 1 and 2 additional people gained independent skills navigating some function of their technology.

The documented technology owned by participants is presented in figure 4 has been sorted into categories based on function and the intended population it was designed for. The first category is Mainstream Smart Technology which includes any tech that provides access to or uses web-based functions. Three of these technology categories were based on their intended market –deaf, blind and aging. Finally, there were a few items categorized as generalist assistive tech due to their broad application across different disabilities. The percentage of participants that owned at least one piece of technology in a category at pre and post intervention (Sess 1 and Sess 2 in figure) is displayed in figure 4.

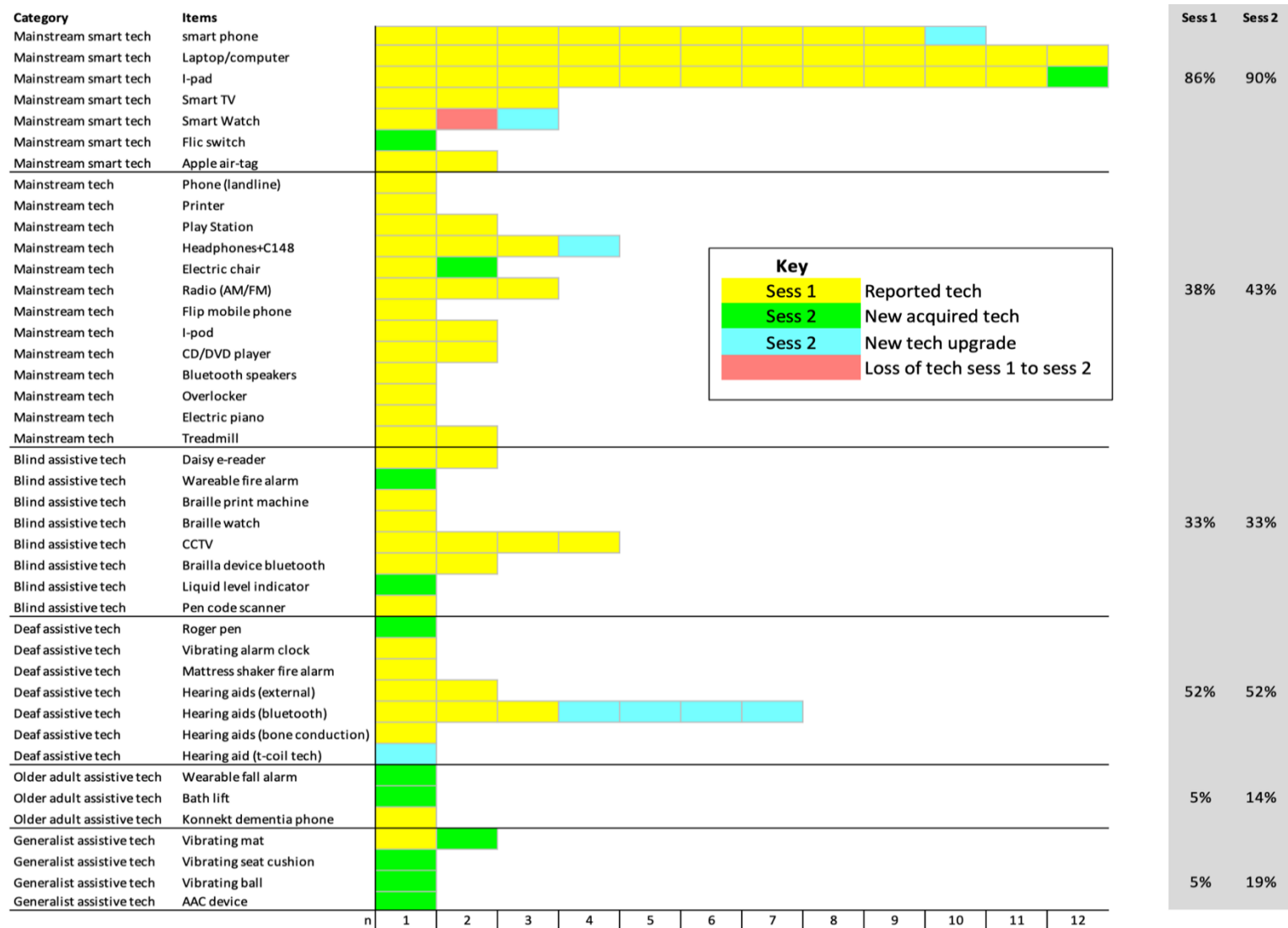


Figure 4. Technology use

4.4 Illustrative Case Studies

The multiple case study design gives rich information – and indeed, there are 21 case studies that could be reported. However, four illustrative cases have been chosen to demonstrate the types of outcomes that are achieved over the process. This then adds to the other information to give a model for the future.

4.4.1 Case Study 1

Background

Polly¹ is a young female with congenital moderate hearing loss and severe (light perception only) acquired vision loss. She is currently living in the community with family. She communicates verbally, receives information aurally using hearing aids, and can read and type in braille. For both sessions, data was collected at their preferred location, a community hub.

Pre- intervention

Polly used an Android smartphone, which they navigated using a text-to-speech screen reader app, the haptics function, and Google Assistant. She could make calls, access the internet, change phone settings, and receive text messages. For social and leisure activities he enjoyed playing video games. A PC screen-reader software, Jaws, was used for work and leisure. Polly score on the UTAUT-2 pre-intervention was higher than other participants in the study, indicating that she was more competent with technology than many of her peers.

Three goals were identified during this session. The first goal was centred around technology and involved sending and receiving text messages via a Braille device linked to their phone. The second two goals involved meal preparation, including safely using cutlery, particularly knives, and making a hot drink safely. Following the assessment, the researchers discussed Polly's priorities with her which were computer access and text messaging, not home living technologies.

Intervention

Polly was able to trial several braille devices with an OT and at home supported by Able Australia's technology library. They set the pace of learning and identified which device was going to be the best fit based on its utility, how well it worked with her phone, and the size, weight, and portability of it.

¹ Pseudonym

Polly encountered several hurdles in the process of purchasing and receiving their device. The device was made by an overseas business without an Australian Business Number (ABN) meaning could not be purchased directly from the retailer through the NDIS. The same product was found locally at a substantially higher cost, moving the product into the NDIS high-cost budget meaning Polly subsequently, had to use their OT funding to have a report written supporting the purchase which extended the process. During this process Polly's chosen device had been discontinued but was able to obtain a demonstration model. She was charged full cost for this product, and it came set in a language other than English. Polly received little support from the supplier to change the language setting and her NDIS support team were unable to help. It took several months for Polly to problem-solve and to find a solution. Further, at the time of receiving the device, she no longer had an OT which made learning to use the device difficult.

Post Intervention

Polly reported using their new device and was happy with the new privacy it afforded her when messaging. Further, she discussed how using the braille device allowed her to use the smartphone more effectively, and that this had the potential to 'open up a new world' for her. Polly's percentage score on the UTAUT-DB was reduced by 10% from her pre-intervention score, possibly due to issues she had with acquisition and adoption of her braille device. Polly's first goal around sending and receiving messages significantly improved in performance and satisfaction thanks to the braille device. No other goals were addressed during this period and their performance and satisfaction scores remained unchanged.

Summary

This case study was chosen to illustrate two key points. Firstly, having a trial of technology means the effective purchase of products. A product that meets individual needs can result in high levels of satisfaction and utility, but also reduces the risk of abandonment. However, there is a second issue, highlighting issues with obtaining suitable technology through inconsistencies in the application of NDIS policies. Further, many technologies required by this population exist in small or 'thin' markets, which are unstable.

4.4.2 Case Study 2

Background

Charlie² is an adult woman living in the community with profound congenital hearing loss and later visual loss resulting in tunnel like vision. Charlie is fluent in reciprocal Auslan and can read and write in English. Interviews were conducted at a community hub at their request and were supported by Auslan Interpreters (2 per session).

Pre Intervention

Charlie owned a NDIS funded tablet device and a smart phone and computer which were self-funded. They reported having a long history of tech use in employment but required support to continue to use technology from both family and paid support workers as her vision deteriorated. Charlie used her smart phone daily to communicate with friends and family through text messaging. The computer and tablet were used as vocational and social tools but reported needing assistance. They also liked to watch TV to relax but could only take part for short periods reporting problems with eye strain. On the UTAUT-DB adapted tool, she scored lower than many other participants in this study, influenced by how stressful they found using technology was.

In the first session, Charlie identified two leisure goals (a) watching the AFL from the stands and (b) watching TV. Charlie found it difficult to watch the AFL game from the stands with binoculars as she was unable to hold them up to their face for the length of the game. They wanted a form of wearable technology that would allow them to watch the game in full. The second goal was to watch TV without straining their eyes to read subtitles. It was recommended that Charlie trial some electronic goggles and glasses to help them watch the AFL and purchase a larger screen TV to reduce eye strain.

Intervention

Several trials with an OT with the goggles and glasses were undertaken, and a suitable solution was found. However, it was difficult to source the glasses, and they ended up not being purchased. In addition, Charlie had a complex home modification assessment by an OT which did not include information about the TV. The NDIA denied the request for a larger screen TV. Charlie did not receive support during this period to assist them in advocating for technology as being reasonable and necessary.

Post intervention

² Pseudonym

A year later, Charlie had not received any of the technology that would have assisted them in their goals. Hence their performance and satisfaction scores remained unchanged. Charlie reported that watching the TV and their sports games still led to physical discomfort. Interestingly, Charlie received an improvement of 22% on the UTAUT from session one. A build up in confidence with their use of technology was possibly due to the wide range of informal and formal support that Charlie reported receiving when using their technology.

Summary

This case study was chosen to illustrate that the NDIS is not always aware of the needs of people with deafblindness. To this end, Charlie continued to experience discomfort and strain when participating in the activities of his choice. To support positive change, greater advocacy is likely required to help people overcome hurdles that they are unable to overcome themselves.

4.4.3 Case study 3

Background

Amir³ is an older gentleman with no vision and a moderate level of hearing in his left ear only. In addition to dual sensory loss, Amir has cerebral palsy, which affects all four limbs. He lives in residential accommodation and has adopted the use of a power wheelchair to mobilise due to a recent decline in mobility. Amir communicates using a mix of signs and receives information aurally. For both sessions, data was collected at Amir's home. A house staff and family member acted as proxy.

Pre-intervention:

Amir was reported that he owned a radio, CD/DVD player, iPad and 3 different pairs of headphones designed to connect and be used with different devices. Only the I-pad was NDIS funded. They primarily use their technology for leisure, to listen to their favourite sport and music and for social connection. Amir's required full assistance when using their technology except for playing CDs. Amir had previously been more independent with their technology, however the I-pad's flat screen was inaccessible, and they had not learnt how to use their current radio which did have tactile buttons. Amir had also lost access to audiobooks since the audio library had become digital. While the audio library could be accessed via Amir's iPad, this is not something that had been explored. Finally, family noted that Amir had previously used a programable speech

³ Pseudonym

device. They were interested in exploring this to increase Amir's opportunities to communicate when out in the community.

Two goals were formulated in consultation with Amir's family and support staff. They were to improve Amir's independence when using their radio and to provide access to and assist in the use of audiobooks and a programmable speech device again. These recommendations were provided to the service provider.

Intervention:

Able Australia provided Amir with a programable speech device that arrived two weeks before the post-intervention session. Staff had programed several phrases into the device having received some support in how to set it up. However, it was apparent that Amir had not been consulted on what he would like to communicate with this device and when he would find the device useful. Amir also received new hearing aids with Bluetooth capabilities, and a new pair of noise-cancelling headphones. All items were funded by the NDIS.

Post-intervention:

Amir's support staff noted that his hearing aids connected directly to the communal living room's smart TV and his iPad. This resulted in improved access to the audio on their devices. Amir's experience of video calls with his family improved as he was able to capture more of the conversation. In the 2 weeks of owning their programmable speech device Amir had not shown interest in using it at home, preferring to communicate with signs. It has not been established whether Amir will use the device when out in the community.

Summary

This case study was chosen based on multitude of technology observations made and the complexity of the issues. Highlighted in this case are the broad benefits that can follow from having the most up-to-date assistive technology and how it has the possibility to increase the relevance and utility of mainstream technologies. The impact of devices changing to interactive flat screens was observed in Amir's reduced independence with their technology.

4.4.4 Case study 4

Background

Aisha⁴ is a young woman living in residential accommodation. She has no vision and moderate hearing loss. Aisha communicates using a limited range of keyword signs and receiving information aurally though their comprehension level is low due to an intellectual disability. Data was collected at Aisha's home for both sessions, with two different staff members acting as proxy for the pre and post intervention session.

Pre-Intervention

Aisha used her iPad regularly with support to access and listen to their personal music playlist saved on their device. She also has an iPod and headphones, but Aisha's support staff were concerned that this device would not be replaceable when it stops working. Aisha maintains her fitness using a treadmill under staff supervision in her home, as she can be unstable when walking on uneven surface outside. Before the pandemic, Aisha swam regularly but due to various issues could not continue. Support staff noted that not swimming was affecting her mental health.

For the COPM goals, staff identified that it was important for Aisha to access water for relaxation and leisure. Hence the technology goal was to identify suitable technology to support Aisha in safely accessing water activities at home.

Intervention

It was established that a portable bath lift could assist Aisha in safely accessing the bath at their house which had previously not been possible. The bath lift was assessed and trialed before purchase with an occupational therapist and her regular support staff. The equipment was purchased with NDIS funding, and upon delivery, the OT set up the bath lift with the staff and trained them in its safe use. Aisha received a graded exposure to the device to reduce stress and the OT was on-site.

Post-Intervention

Aisha had been using the bath lift however, in the interim, it had broken resulting in no access to water activities. The supplier had been contacted to replace the bath lift as it was under warranty. When the bath lift was functioning, Aisha enjoyed baths every night. Support staff reported that access to baths had improved Aisha's mental health and in general found Aisha to be more relaxed. A second, technology-based change that staff reported was the purchase of a

⁴ Pseudonym

smart switch through the NDIS on the recommendation of Aisha's OT. The switch was linked to Aisha's pad and programed to facilitate independently control their music. After some training Aisha was now able to control her own music independently.

Summary

While the equipment failed, this case was chosen to illustrate how beneficial receiving the right technology had been. Furthermore, this case study demonstrates the novel technological solutions that are being used to overcome inaccessible flat screens which can bring about autonomous use. The flick switch has great potential to provide people with deafblindness basic control over their smart technology.

4.4.5 Case study Summary

The case studies here demonstrate the benefits people receive when technology was successfully obtained within a supportive context. Technology was seen to provide access to social connection, improved mental health and assist people in participating in their chosen occupations. The scope of available technologies that can assist people with deafblindness in daily life is broad. However, these case studies show how difficult it can be to identify, try and purchase these assistive technologies. They also demonstrate that considerable support, both from support workers, health professionals and others are required to ensure successful use of technology.

4.5 Thematic analysis of interviews

Thematic analysis and coding of the interviews were completed separately for pre and post-interventions. All themes and codes from these discussions will be reported on separately in the results sections, with discussions surrounding changes in themes and inferences from this further explored within the discussion.

4.5.1 Pre-intervention: overarching themes

Within the first interviews conducted, three recurring themes emerged. The first theme covers how technology impacts a person with deafblindness including the general benefits and effects of function and design. The second theme is the impact of support at both system and in person levels. The third theme that emerged was about safety and social isolation. While there was some discrepancy between how participants responded individually to sub-codes, the

overarching themes and codes mentioned were consistent over all participants.

Impact of technology on individuals with deafblindness

As a ubiquitous part of everyday life, technology was reported to be broadly used to the person's benefit, as a central part of them conducting everyday activities. However, technology use and engagement were achieved with varying effectiveness due to technology design and function impacting the level of benefit a person was able to obtain. This theme contained two sub-themes including the benefit of technology experienced and how design and function of technology influences the user.

General benefits of technology

Technologies contributed to meaningful occupations in social, leisure, self-care and work. It was evident that technology helped participants engage in all aspects of daily life, from self-care tasks such as meal preparation, personal safety and maintaining physical fitness to leisure, community access and employment. Technology such as digital water level indicators, which alerted participants when their glass was full, helped to avoid spills and burns, improving participants' safety, confidence, and independence. To maintain fitness, several participants used treadmills. However, the most common area supported by technology was leisure, ranging from simple vibrating devices to smart technology. Technology was also central to many participants' ability to access and participate in the community, including employment. For example, smart technology was used to receive and reply to work emails, write, and apply for grants, catch public transport, and promote their work on social media applications. An example of this was a family member noting how technology supported participant employment, e.g.;

"what she does all day like, her job. Technology is a big part of that as well".

Family Proxy

The ability to access and maintain social connections in the deafblind participants was heavily reliant on technology and was seen to increase their opportunity to engage socially with friends and family. All participants within the population regardless of their technology literacy and ability were motivated to learn how to use and adapt their technology to enable them to be independent when communicating with others. Social media, email, video conferencing and messaging tools such as WhatsApp, were discussed, both as a way for maintaining contact, but also as a means for engaging with the greater population. Examples included participants promoting their own work or even

attending a funeral remotely. Technology for people in supported accommodation provided opportunities to maintain social connections with their families who lived regionally or in a different city that otherwise would not be possible. This activity was often facilitated by house staff members, who reported that contact with family was a highlight in the participants' weekly routine.

"During the COVID time, I tried to call the phone, it does not work out, but I put dad have Skype. Yeah, I installed Skype everything they talk to each other".

House Staff Proxy

Lastly, technology was used to facilitate training formal support staff in getting to know, understand and care for the person. Typically, smart devices were used to store and play videos informing support people on how to communicate with and understand the person's behaviour, care needs and preferences. Examples include parents and allied health support developing videos to educate and assist formal and informal support to understand the personal nuance of a client's disability and needs.

Experience of design and function of technology

While accessibility functions are being used to good effect, participants still reported significant barriers in accessing and engaging with technology. This was typically due to technology not fitting the needs of the individual based on problems encountered with function and physical design. Problems such as these reduced the potential benefits participants could gain from their technology and made items of technology undesirable or unusable. The barriers documented differed depending on a person's style of communication and their unique sensory profile. One participant noted the challenges in integrating assistive technology (braille device) and smart technology (mobile phone).

The iOS is challenging. It makes the Braille system quite confused with the iOS software in the Apple. Sometimes we have a good connection, sometimes not. So the Braille struggles a little bit with the iOS software.

Community participant

There was an apparent relationship between participants' level of sensory impairment and their level of interaction with technology, as many technologies are about delivering visual and audio information. Hence, for participants with combined profound hearing and vision impairment, many technologies did not meet a need, and as such, they did not typically engage with them. We did

observe, however, the use of vibrating sensory assistive technology and simple cause-and-effect appliances in the home like toasters and kettles in this sub-group of the population.

When assessing the physical design of technology, people with deafblindness have found it challenging to adapt to technologies that have changed from having physical buttons to becoming flat. Participants with no vision who once independently used CDs and iPods to access music and books reported no longer being able to participate in these activities without support or having lost access altogether. Participants with low vision typically liked their iPads because of the larger screen size. However, the community participants still used a phone when out in the community due to how much easier it was to manage the size and weight. One participant said,

"I find the iPad very heavy to carry even though it's meant to be light, it is still a bit heavy for me"

Community Participant

The inbuilt functions of smart technologies were reported to have many positive, accessible functions that facilitated their usability for participants. Screen settings that reduced glare and increased text size were commonly utilised by people with low vision to navigate their technology. Audio text descriptives and smart voice command applications were used when vision impairment was profound, but participants' hearing loss was moderate to severe. However, participants still reported encountering issues daily using these smart technologies. For example, some accessibility settings were not applied to all applications, resulting in access issues. Other participants indicated accessibility settings were applied in inappropriate contexts, such as where an inverse screen setting was applied to the pictures taken on their phone camera. Other examples included participants who used braille devices with their phones reporting that emojis had no simple braille translation, and that some mainstream applications for transport, particularly Uber, were too difficult for them to independently use.

A second topic discussed was the impact of changing technology, particularly operating system updates, which participants reported as stressful and causing significant confusion. This included when changes may have been perceived as minor changes in the general population. System updates could change the function of applications that participants had spent a long time learning to use and could override their accessibility settings. While there were some participants who reported operating system updates as an inconvenience, many reported

that it presented an almost insurmountable barrier. For example, one participant stressed that,

"I just have to learn whenever there are those updates. I don't like it, but I can do it."

Community Participant

The impact of support

The second theme to be identified was around the impact of support. Support was seen as central to participant's ability to engage with technology. Receiving the right kind of support was identified as important as not all styles of support led to positive outcomes for the participants. While a lack of technology support had only negative effects on a participant's ability to engage in their occupations. This theme contained two sub-themes including support received at the systemic level (such as the NDIS) and support received via in-person formal and informal support.

System level support

At a system level, the advent of the NDIS has seen increased support, including facilitating technology acquisition and use. However, participants noted insufficient understanding of deafblindness within the NDIS. An example is when the NDIS denied a participant request for technology to reduce eyestrain. The process of acquiring technology through the NDIS was reported to be a lengthy experience that impacted participants' ability to engage in their chosen occupations. For example, support workers for one participant noted they had been waiting for as long as two years for an iPad to support the participant, e.g;

"We ordered an iPad, but still, we are waiting for it. I don't know what happened with delivery.... NDIS one we ordered, but I'm not sure it's (been a) long time now. Two years or something? We (have been) waiting, but I don't know what's going on... (participants) OT says she's going to follow up, but nothing happening."

House Staff Proxy

However, it is prudent to mention that many initial interviews were conducted when COVID-19 still significantly impacted people's lives. As such, some delays and the experience of reduced support resulted from these COVID disruptions. The funding of allied health through the NDIS to assist with the setup and use of technology received was seen to have significant benefits. For example, a speech therapist exploring the using an iPad to support communication. However,

people often reported that they were finding it difficult to find allied health support, noting a lack of people in the healthcare system to draw on. For example one family member noted;

"I've tried to get occupational therapists to come, which I've got the upgrade from NDIS for that. But there's just nobody around."

Family proxy

In-person support needs

Most participants reported having some ability to navigate and use their technology independently. However, they still required support to achieve what they had set out to do. For example, one participant could independently use their talking books device however needed support downloading books. This was a common reflection where participants noted that with in-person support they could simply achieve more. Technology was seen by participants as a tool to be used in partnership with support people to build their ability.

"Like I said before, I rely on touch. That's the human communication. You know, and I need both. I need the technology as well. Depending on what I'm doing and where I'm going, I need access to both."

Community Participant

Finally, how a person was supported by others around their use of technology and the skills and digital literacy of the people supporting them significantly impacted participant's technology use. Participants reported the most beneficial outcomes in engaging with technology when their supports facilitated technology use, with adequate trialing, training, and follow-up. Participants talked about appreciating when their support people understood that learning technology was a, fatiguing, and time-consuming process. Conversely, it was noted that there was also the potential for support to limit an individual's ability to engage with technology. This occurred when support actively did everything for the participant. The result of this approach led to the complete dependence on the support person to access and use technology, including where participants have previously shown aptitude. The second limitation noted by researchers was when support staff did not have adequate digital literacy skills or understanding of the current technology landscape. A lack of awareness of what technologies and applications were available was a key factor limiting people with deafblindness, particularly those living in residential accommodations. For example, when the audiobook library changed from CDs

to a digital catalogue, support staff could not help participants transition, as they were unaware of the digital catalogue, and that it was available through the participants iPad.

Safety and social isolation

The third theme to come out of the data was around safety and social isolation concerns. While discussing technology, participants frequently discussed having various safety concerns both in the community and at home and felt an increased sense of social isolation brought on by the covid pandemic. Safety and social isolation formed the sub-themes.

Safety Concerns

Regarding personal safety, participants expressed concerns about accessing the community without support and conducting household tasks without inflicting injury to themselves. In the home, participants did not feel comfortable safely handling hot food, drink or appliances in their kitchen, fearing they would inflict burn injuries. One participant stated;

"Yeah. Cooking... is high risk for me. Yes. So I don't touch it"

Community participant

When accessing the community, participants noted both environmental and social concerns. For example, when going somewhere new that was unfamiliar to them or a place with uneven terrain participants were fearful of falling, resulting in injury. One participant discussed a fall withing the community that was still affecting their confidence when out and about, reporting,

Yeah, I had a nasty fall, I think it was last year ...I missed, the brick tiling, because steps looked the same, and I thought we reached the bottom and, it was about 8 steps, and I went, well, flying ... I was in a bad way, lots of blood and I had to lie there for two hours for the ambulance to come... That was my first scare and that's why I get petrified like, in the shower or I'd rather take the lift in the gallery, I'd rather take the lift, I fear falling over"

Community participant

Social isolation

Covid had a significant impact on participants' ability to engage with their community and their access to in-person support. While technology had supported participants in maintaining social connection, they reported strong

feelings of social isolation and a slowness in returning to post covid social activities. Social isolation was also discussed in reference to sensory changes as participants conveyed a sense of anxiety around further social isolation when their hearing or vision deteriorates further.

"my contact with the other deafblind community members was, you know, getting less and less. And the communication-guides who I used for support to go out and travel and visit people also became less and less"

Community participant

4.5.2 Post Intervention themes

The post-intervention themes captured some significant changes that participants underwent during the intervention period, but there was overlap with the themes identified in the pre-interviews. Four main themes were identified. Firstly, there was increased engagement in occupations by the participants, and with greater frequency post the intervention. The second theme discusses the remaining gaps in the technology that participants were experiencing. The third theme discusses the significant impact that in-person support has on technology use. The fourth theme discusses the experience of isolation and the impact of being a part of a diverse population. Again, these themes were evident across all post-intervention interviews.

Changes post intervention

The first theme identified was that, facilitated by technology, participants reported engaging in a greater range of meaningful occupations with greater frequency. This was influenced by several factors, including the new technologies that had entered their lives, and the way participants were reporting that they used their technology. This theme contained two sub-themes, including the positive impacts of the uptake of smart technology and how in-built accessibility functions and applications are being used to greater effect.

Impact of the uptake of smart technology

Access to up-to-date mainstream and assistive technology products supported participants with an increasing range of occupations. Examples include Apple air tags used with smartphones to locate essential items, and a smart switch designed for 'smart homes' was programmed to enable a person with no vision

to control their music on their iPad. Between visits, several participants received hearing aid upgrades. This saw them switch from old hearing device technology to updated models with blue-tooth functionally and improved filtering abilities. The new hearing aids supported participants to engage in face-to-face conversations and social situations in environments that had previously been difficult to engage in. Their new hearing devices were also being integrated with other Bluetooth-capable devices. The improved connection between devices improved some participant's experience. For example, some participants highlighted the improved sound quality led to more accessible social interaction with family when engaging in phone or video conferencing calls

"He can hear everything more. He loves that"

House staff proxy

Ways participants are taking advantage of their technology.

The ways participants used their technology varied greatly based on their unique requirements and personal goals. Interestingly, the range of accessibility functions now available within smartphones meant this item was being used by all community-based participants as well as several of the participants in residential houses. The most common accessibility settings applied to participants' phones were larger font size and dark mode which reduces glare for people with low vision. Less common settings utilised were programmed quick keys and motion reduction. Participants who used these functions attested to how helpful they found them. One participant noted how a programmed quick key helped them access the weather app which they used to inform them on their clothing choice for the day. Participants also discussed taking advantage of a range of applications that helped them navigate and use their phones but also helped them in their day-to-day lives. For example, a magnifier app to visually enlarge objects and text and a photo audio describer app that takes images and audio describes the content. Finally, technology was being used to enable social connection which was seen as a central motivator to own and use technology independently.

"So WhatsApp, that's really good. I'll show you, that's how I contact my family and friends. So, for example, I have a group called family. My sister is here, so I have all my family on WhatsApp contact"

Community participant

Gap in the availability of suitable technology

While the first theme captures where technology was reported to have improved in its utility, this second theme covers the remaining gaps in the technology as experienced by the people we interviewed. Participants were increasingly aware that there was a potential for technology to support them to actively engage in meaningful occupations. However, technological solutions that fit the participants' needs were often challenging to come by. This theme contained two sub-themes, including the general issues surrounding having a gap in the market and issues that impact a person's safety.

The issues surrounding the market gap.

Participants knew what they needed from their technology in terms of design and functionality, but frequently could not find the solutions they required. Many participants reported needing technology to be simple to interact with, and when it came to smart technology, easy access to the functions the participant required.

"I feel like I just need something more simple . . . So it's confusing, right? There are so many bells and whistles. There's just too much. Where do I put them all?"

Community participant

Technologies that did not meet participants' needs led to frustration, reduced engagement and in many cases technology abandonment.

Due to the general absence of technology designed specifically for this population, participants were required to engage with complex systems of technology or devices poorly suited to them. For example, participants reported using multiple products simultaneously to support them in a singular task, as there was no suitable singular product available. Participants reported finding these systems complex and overwhelming to use and typically not portable. For example, to communicate through text messages one participant was using a CCTV device to enlarge the text on their phone so it was big enough for them to read. This meant they could only access and reply to messages independently when at home. In terms of function, several participants noted the voice recognition technology was unable to understand their speech. This excluded them from voice-activated virtual assistants. This participant noted during the interview:

"She does try on her phone because they've got the Google assistants and

everything like that. But just won't recognise what she's saying."

House Staff Proxy

Sourcing accessible technologies was noted by the participants to be an arduous process. Products that met their needs were typically part of niche markets, which made them difficult to find out about, and sometimes were not available within the Australian market. This could cause delays in sourcing technology for trial and purchasing. Participants reported that acquiring technology was frustratingly slow.

Technology based safety concerns.

Home safety devices were either not owned or deemed as ineffective by many participants in their ability to alert them to danger. Several participants in residential settings have been waiting on bed shaker alarms, though no one had acquired this device throughout the project, although some were reported to be abandoned. The abandoning of safety devices was commonly reported. Poor design factors such as weight and hard-to-open clips accounted for some of the abandonment. A fall device was found to be too sensitive to movement and wrongly notified family of falls. Participants also reported that devices had failed to alert them of a potential or actual issue or threat. For example, one participant reported that her pet notified them of the fire alarm as the notification that was supposed to come through on their phone had not worked.

"the (fire department) had left a note for me, so my comm guide ended up pulling the smoke detector down from the ceiling and calling the CFA and explaining the situation. Yeah, so the phone didn't tell me at all. I don't know how we can improve that".

Community Participant

The second safety concern appearing in several discussions was around digital safety. Participants were aware that they were not online safety literate and risked falling victim to scams and data breaches. These concerns were voiced by family and support workers and the participants themselves. Formal and informal support people discussed their desire to protect people seeing distressing content or acquiring a computer virus. However, support people were unsure how to improve safety without impinging on the participants' rights for privacy and freedom of use. While participants themselves wanted to understand how to protect themselves and have software that would provide anti-virus protections.

Technology outcomes are influenced by how people are supported.

How people were supported significantly impacted technology and quality of life. When participants were actively supported to become more independent with their technology, they reported more satisfaction and greater benefits from engaging with their technology. For active support to be successful, the person providing it needed to have good digital literacy and understand the person's learning requirements, which make up the first two sub-themes. The third sub-theme is related to support practices that limit a person's choice and control.

Digital literacy of formal and informal supports

Participants reported having higher device satisfaction and device utility when active support and training were provided with their technology. For example, one participant noted how the person they supported trusted them in supporting their device use, despite their own misgivings,

"A lot of the time, she'll just bring her tech straight to me. Me and (participant) we've got the same phones. So I can try, and I'm probably best to try and fix it when she messes it up."

House staff proxy

However, participants reported that receiving professional technology support was rare. Subsequently, many participants relied on the digital literacy of formal and informal supports, which was less successful when the digital literacy of the support person was low. A related issue was that at times there was insufficient support from allied health when technology was prescribed. One participant discussed being unable to link their new t-coil hearing aids with other devices which use electromagnetic technology and not blue tooth to connect with other devices. Their audiologist had not explained to the participant or her support people how to achieve connections with other devices. As a result, they reported not being able to listen to their smart TV since the upgrade.

Methods of active technology support

The second factor that influenced the success of active support was how the support was enacted. Most participants preferred a slow and empathic approach where their needs were listed too, and expressed gratitude when the time was taken to support them in trialing different technologies to find the best fit. Many participants indicated they felt more likely to use their technology when this initial support was provided. Conversely, participants reported lower satisfaction and higher rates of technology abandonment when support was not

provided initially. Further, after acquiring technology, participants reported needing ongoing support to improve their technology use that was sympathetic to their learning style and needs. Namely, to be mindful that the learning process could be stressful and needed to be slow. Based on shared lived experience, participants indicated enjoying peer support.

"at (Deafblind Victoria) it's always about this kind of peer support, helping each other, deafblind people who are knowledgeable, help others and then they exchange, and they're all building their skills."

Community participant

However, there was still a need to match peers with the right people and be mindful of different learning needs.

Technology works predominantly when paired with in-person support.

The need for human interaction within formal support was seen as essential when engaging with technology. Participants stressed that while technology supported them in their occupations, it did not eliminate the need for active human support. Indeed, combined with in-person support, technology grew the capacity of participants to engage with the world in an increasingly active and meaningful way. For example, one participant liked to use their phone to take photos. While they could not see photographs, they would have their support person describe the photos, triggering their memories of past events.

"I don't really use photos. I asked people to take them for me. But it's more in my memory. I'll ask someone to explain it to me what the 14th photo is, and I'll keep that in my mind. I went on holiday, and took a lot of photos and sort of tried to imagine the beautiful view and that kind of thing. It was hard to see what colour, but it didn't matter because the guy had explained everything to me and what was around so I could sort of look at it and try and picture it at the same time."

Community participant

Restrictions on choice and control

Finally, participants experienced restrictions around the choice and control of their technology, either by restricting their access to a device or underestimating participant abilities. Accounts from the experiences of residential participants detailed restrictive allied health practices over their choice and control. For example, one participant enjoyed using their iPad for leisure, particularly watching YouTube, but was locked out of their leisure applications by an allied

health professional. While the intent was to support participant communication through using the iPad as a therapeutic tool, this limited the individuals' control to use their technology as they saw fit.

Another issue noted throughout these discussions was that many participants were highly capable and often surpassed the expectations of those around them, but only if they were given the opportunity and support in the first place. Lowered expectations surrounding individuals' abilities were noted to have significant consequences on what opportunities that person was given. For example, one participant indicated frustration when her formal support undermined her desire to explore audiobook devices due to the potential cost, despite the participant having regular work, to which the participant noted;

"I don't know why she says that. That's a bit rude, I've got plenty of money"

Residential participant

Isolation and understanding a diverse community.

The final theme is not specific to technology but is essential in how it connects to technology use and to understanding to support technology use for people who are deafblind. This theme covers the fact that the deafblind population is highly diverse, and that skilled communication is needed as part of the human experience, as described by people who are deafblind. This connects to the potential for isolation within the deafblind community and the impact of communication breakdown in general and concerning technology.

The deafblind population is diverse.

The participants were diverse in their disability and communication. This was reflected in their reported experiences of in-person support, technology and community participation. Not all participants engaged with the deafblind community as they felt their disability was not represented and, as such, felt excluded. It was also noted that systemic support structures, such as the NDIS, did not have an adequate understanding of the diversity within the population, which impacted how both support and technology were provided.

"The only criticism about the NDIS is their lack of knowledge about deafblindness. I find that frustrating. They've now got a specified section that they now have with deafblindness like they consider it a unique disability instead of letting the two (vision impairment and hearing impairment), but they're still quite not dumb but probably ridiculously low knowledge about it."

Communication and connection, how this relates to safety.

Communication breakdowns between participants, their peers, formal support, and the general population were noted throughout all follow-up interviews. Participants indicated that breakdowns in communication had an impact not only on participants' ability to engage with technology and meaningful occupation successfully but also significantly impacted quality of life and safety, as previously discussed. As noted, participants in this study were diverse, with complex and varied communication needs. As a result, formal support was required to develop high-level communication skills when working with participants. For example, one support person noted:

"The casual who work here for more than six, seven months? They can talk (participant) properly. The first time is pretty hard."

House staff proxy

Further to difficulties communicating with formal support, participants noted that it was challenging to communicate with people in the greater community, irrespective of their communication methods. While Auslan creates communication barriers, participants who used speech reported that members of the public avoided interacting with them and reported feeling frustrated when strangers responded to their support workers despite initiating direct communication. Subsequently, many participants, particularly community-based participants, noted the risk of social isolation. The theme of social isolation and safety was highlighted when participants frequently expressed not feeling safe when on their own in the community. This was often linked to an inability to communicate their needs and pick up on environmental changes. The role of communication guides within the community was notably invaluable.

"he can't go on his own to that because we've not trained people to work within. They don't know any of the true extent of his disabilities. They know he's vision and hearing-impaired. But when one of us goes with him, it's myself, my husband or his (communication guide). But we're also looking at getting another support worker going with him to that so that he can be independent, but safe."

Family proxy

5 Summary

This project aimed to evaluate the utility, adaptability, and individual experiences of technologies for people with deafblindness through a longitudinal observational study. The study utilised a pre-post design, as well as existing infrastructure to implement intervention in between these two data collection points. This design was chosen to enable robust data collection and analysis in a highly individualised and diverse population. A second outcome was to identify in real world research what the common barriers and enablers to receiving technology were, and to see whether these were common across people with different needs and preferences. Information surrounding technology use, acceptance and goals was collected with the persons themselves or by a proxy when this was unavoidable.

Over the course of this project an increase in technology use for most participants was observed as well as an increase in how useful participants perceived it to be. Access to newer mainstream and accessibly technologies brought about significant improvements to participants' lives. The biggest improvements were upgrades to hearing aids, which improved people's ability to hear people, but their ability to listen to sound on their smart devices thanks to the inbuilt Bluetooth function.

The use of technology in the deafblind population is not a linear progression, nor is it a simple solution. For example, developments in technology such as devices with physical buttons changing to flat screens caused a decline in independent use of technology for some people. Flat screen technology has therefore some drawbacks, but positively, the continued development of inbuilt and external accessibility options in these technologies led to successful adoption of that technology amongst some participants. Successful acquisition and use of technology by a person with deafblindness was dependent on several factors. The first part was funding for the purchase and funding for people to support and facilitate the end user be present to facilitate its use. Without this type of support, people's technology engagement can stagnate as evidenced by the continued lack of access to a device when the NDIS denies its request.

The assistance provided by in-person support played a vital role in technology use. Several qualities of in-person support were identified as key predictors of its success. Digital literacy was central to firstly, identifying and recommending technology solutions that met the person's needs. Furthermore, the level of digital literacy affected how successfully a support person could assist with technology. The way people approached support was also found to be important. People benefited most from receiving initial support when receiving a device, which led to a more positive technology experience and reduced the

instances of abandonment. On-going support with technology was seen as necessary, and active engagement with technology was critical in assuring some independence in using their technology was gained.

Participants reported experiencing significant gaps between what was available and what they needed. Previous research alludes to the fact that poor experiences of technology because it is never designed with a person with a dual-sensory disability in mind (Bell, Prain, and Layton 2023; Kassem et al. 2022; Wittich et al. 2021). As such participants reported using multiple artifacts together to reverse engineer solutions to varying effect.

While not related to technology, the frequency that participants reported feeling socially isolated and unsafe in the community on their own warranted a mention. Their disability and communication affected their ability to socially connect, including with other people who are deafblind. The in-person support was central to providing access to social outlets.

This project showed that when certain adjustments are made to tools they can increase its accessibility. Having changed the scale and language of the UTAUT we found that it was able to successfully inform on a person's level of technology engagement. The COPM we left unchanged throughout and while participants again struggled with the numerical scale and some of the language, the self-reporting participants had all been able to identify 1 - 3 goals that they wanted to work on. The TWMS, like the tool suggested, was not an effective comparative tool and was only applicable to people with profound hearing and vision loss. General observations during the sessions were that fatigue was a significant factor particularly for people who use tactile Auslan to communicate. We suspect that the skill level of the Auslan interpreter also affected the data recorded as information from one session to the next could conflict. Lastly when a proxy was required speaking to multiple people led to better informed interventions.

6 Recommendations

This project has highlighted that mainstream technology with adaptations can support people who are deafblind to participate in daily life, and improve quality of life, achieve their self-identified goals, and achieve the things that they want and need to do. There are several recommendations emerging from the findings.

1. Systemic Advocacy.

The first recommendation involves advocacy at a systemic level. As stated in the report, the use of technology in the deafblind population is not a linear or simple process, and the population is diverse; yet, there needs to be an acknowledgement from people providing services (such as the NDIA or other agencies) that this population always experiences complexity, and therefore always requires more time and support to identify meaningful goals, and to source the ways that goals can be achieved. Further, an acknowledgement that some technologies that are seen as ubiquitous (i.e., a larger television) is not just a luxury item, but a means to participate in an activity that is otherwise denied, or causes harm (i.e., eye strain).

Further, this group should have access to supports and health professionals who are familiar with the challenges of a dual sensory impairment and can therefore make appropriate recommendations. This is one group for whom the next cab off the rank approach is entirely unsuitable.

2. Personal level advocacy

At a personal level, people who are deafblind are often underestimated, partly as there are (a) not always the tools or supports available to correctly understand the communication or goals required and (b) not given the time that is required to identify and work on various goals or tasks. At a personal level, advocating for extra time, or even time over an extended period to address fatigue should be encouraged. This may be written into someone's NDIS plan for example.

3. The right supports at the right time

Developing a package of support that includes not only the technology, but also supports required for use of that technology is essential. This takes several forms:

- The right technology – not only identification of the technology, but access to trialing the technology, and modifications as necessary. This may take several attempts.
- The right training -ensuring that time for learning and training for both the person and their support staff is built into any package including technology
- The right people support – understanding of the person and their needs together with understanding the technology and how to use it is essential in supporting the person.

4. Help with navigating support systems.

The support and funding systems, including the NDIS are complex, and isolating. Ensuring that people are able to access, for example, advocacy for home modifications that include all that is required (i.e. a television that has a larger

screen to prevent yet strain) means that people can get what they need. Local Area Coordinators (LAC's) and Support Coordinators should be able to support this, and match people to ensure that the complex health and social support systems can be navigated. It may be that specific technologies (ie apps) are developed for this purpose into the future.

5. Development of a technology assessment protocol

It is important to understand that off the shelf tools useful for other populations are not suitable for persons with deafblindness. A specific protocol that includes potential suitable tools, but also taking into consideration factors such as fatigue, which necessitates either longer time, different assessments or multiple visits should be identified up front. Other factors included in a protocol should be funding for interpreters or other forms of communication support, as well as ways to ensure that the voice of the person is heard.

6. Tools and measurement instruments

Not all assessments utilised in the project were found to be helpful, and the development or adaptations of different tools specifically for people with deafblindness is recommended.

In terms of tools used in this project:

- Gather an understanding of a person's current and previous use of technology for context. This conversation can be integrated into the COPM where the participant is supported to establish their personal goals.
- The modified UTAUT is a useful tool to quantify a person's technology use, and should be integrated into assessment protocols in the future
- With any tool use - Allow participants an opportunity to finish early or split conversations over multiple sessions to manage fatigue. This may even include other people taking the assessments that are then passed to the relevant person/professional

7. Development of people with specialised skills in working with people who are deafblind

Participants need access to people with good digital literacy including people who also have specialised knowledge in the assistive technology space. Currently technology use varied not just due to differing needs but due to differing access to people with high levels of digital literacy. Improved access to people with relevant digital literacy skills would benefit the deafblind population.

This includes support workers but also health professionals who can adapt their processes because they have specialised knowledge of the population and the technology. Much technology has been adapted for 'intuitive use', but this intuitive use often involves either vision or hearing or both – usually not tactile. It is also important that new developments – such as haptics for iPad are shared with the end-user, and this requires the person supporting them to understand how to apply new developments.

8. Access to persons to reassess or adapt technology when systems change

Technology systems change regularly – smart phone, iOS, or android updates for example. When these systems change, often the person loses their ability to utilise the technology that they are dependent on. Therefore, written into any protocol should be an allowance for updating technology and assessment when things change.

9. An acknowledgement of concerns regarding safety and social isolation.

This is very important to consider into the future. All our deafblind participants expressed concerns for their safety and experienced social isolation. Whilst technology can be an enabler of social interaction, it must be remembered that technology can also be further isolating. Thus, technology cannot be considered in a void, but as a part of a person's rich and self-directed life.

7 Appendix:

7.1 Appendix A: UTAUT-DB-adapted

UTAUT Survey Deafblind adapted ID_____ Date_____

UTAUT: Revised and refined version for the Deafblind population

	No	Some What	Yes
I find technology useful in my daily life.			
Using technology increases my chances of achieving daily tasks.			
Learning how to use new technology is easy for me.			
Learning how to use new technology is a fast process			
People around me think that I should use technology.			
Technology allows for more opportunity to be social			
I have the right assistive tools in place to use my technology.			
I have the knowledge/skills needed to use technology.			

My technologies are compatible with each other.   

I have the help I need from people around me to use technology.   

Using technology is fun.   

I use technology to relax.   

The technology I use is good value for the money.   

The cost of technology that I would like to buy is affordable.   

I use technology most days.   

I find technology addictive   

I will to continue using technology in the future.   

I will always try to use technology in my daily life.   

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