Needs assessment for individuals ageing with impairment:
Findings from subject matter expert interviews

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Abstract

Adults with sensory and mobility limitations are living longer and thus likely to experience additional declines related to ageing that can negatively influence their independence and quality of life. Worldwide, millions of individuals with vision impairments (i.e., blind or low vision), hearing impairments (i.e., Deaf or hard of hearing,), or mobility impairments (i.e., using a wheelchair) are ageing into the senior population. These individuals who are ageing with a pre-existing impairment comprise a segment of the population that has received very little attention in the human factors community. The goal of this study was to identify the range of challenges in everyday activities for older adults ageing with pre-existing impairments in vision, hearing, and mobility. We present data from interviews with subject matter experts who represented a range of personal and/or professional roles and experiences with older adults with these specific impairments. Findings inform the development of a comprehensive assessment tool with which to interview members of these target groups. In addition, the results have implications for technology design, instruction, and use—ultimately improving technology interactions for this understudied sector of older adults who are ageing with sensory and mobility impairments.

Introduction

Individuals with impairments are living longer lives than ever before, with many ageing into older adulthood. The result is a growing population of older adults subject to complex difficulties that extend beyond what would be expected with normative ageing – the intersection of both having a pre-existing impairment and being above age 65. In the United States, a recent census report revealed that almost 40% of older adults (aged 65+) reported having one or more disabilities (U.S. Census Bureau, 2014), including vision (19%), hearing (40%), and ambulatory (67%) impairments. Human factor interventions have the potential to support

independence and successful ageing for older adults with vision, hearing, and mobility impairments.

For writing efficiency, we refer to "older adults with vision, hearing, and mobility *impairments*." We certainly recognize that some communities of such individuals reject the framing of their lifelong differences as "impaired," instead viewing them from a "diversity" or socio-cultural community perspective. For example, individuals with lifelong deafness often do not consider themselves impaired and identify instead as a member of Deaf culture. The way that individuals experience and view their sensory/mobility differences will be important especially as we consider the impact of age-related declines, and the acceptance of human factors interventions to mitigate everyday challenges.

Impairments alone do not necessarily lead to disability. The Person-Environment Fit framework suggests that disability is the result of a mismatch between an individual's functional abilities and the demands of their environment (Lawton & Nahemow, 1973). Age-related losses alone, such as declines in vision, hearing, and mobility, can create issues for older adults in maintaining everyday activities (Rogers et al., 1998). For older adults with long-term impairments, the addition of such declines could present compounding environmental difficulties and increased risk of disability (Harrington et al., 2015).

Successful ageing involves three goals: avoid disease and disability; maintain physical and cognitive function; and remain actively engaged in life (Rowe & Kahn, 1997). Goals for people ageing with pre-existing impairments might also include reducing age-related chronic disease, promoting independence, and social participation (LePlante, 2014; Minkler & Fadem, 2002). In addition, the majority of older adults would prefer to age in place, to maintain an independent lifestyle in the home of their choice (AARP, 2010). For many, lack of home accessibility and access to health and community resources inhibits their ability to do so. There is a need for research to identify and address the home and community barriers experienced by people ageing with pre-existing vision, hearing, and mobility impairments.

Technology can provide supportive solutions as individuals navigate age-related declines. Yet, complex issues with technology use and acceptance can arise as both the user and their familiar assistive technologies age (Agree, 2014). An appropriately designed and implemented assistive technology has the potential to alleviate or reduce many challenges and improve the quality of life for people with impairments (Kemp, 1999). However, that technology should also be designed to accommodate the user's additional declines brought on by ageing. For example, older adults with pre-existing impairments are can experience an interaction of sensory and physical impairments that can interfere with their ability to use a familiar device (Harrington et al., 2015).

Little attention has been paid to understanding the additional challenges ageing presents to individuals with a long-term impairment. Interviewing subject matter experts (SMEs) has been demonstrated to be a useful method for acquiring rich information in a variety of domains (e.g., Cullen et al., 2012; Lindgaard et al., 2006;

McBride et al., 2011), and is especially useful at the needs assessment stage. The present study features interviews with SMEs with extensive knowledge about and experience with older adults with vision, hearing, and mobility impairments. SMEs could speak to the range of issues because they interacted with multiple older adults in their respective populations. Through their perspectives, our goal was to identify the range of challenges experienced by these individuals. Specific emphasis was identifying challenges with technology, access to community resources, and housing.

Method

Participants

Interviews from nine SMEs are presented here. They were strategically recruited to represent different areas of expertise and perspectives, three in each group (i.e., vision, hearing, mobility; see Table 1). Each SME had personal and/or professional experience working with older adults in these groups and and were recruited through outreach to relevant ageing and disability organizations and professional societies.

Materials

A semi-structured interview script was developed to explore SME perspectives on challenges in the areas of technology; community and health resources; and ageing in place for individuals ageing with sensory or mobility impairments. Scripts are available from the authors upon request.

The interview script was divided into two main parts: SME background and perceived challenges among older adults with vision, hearing, and mobility impairments. In the first part, participants were asked about their relevant experiences with their respective SME population. The second part assessed their experiences and knowledge of the challenges of the older adults in four domains: (1) technology use and attitudes towards technology; (2) access to community and health resources; (3) housing; and (4) other challenges not encompassed by the first three domains.

Procedure

Three researchers conducted SME interviews for this study; each researcher was assigned to an impairment group and conducted all three interviews for that group. Each interview lasted 45 to 60 minutes; they were recorded and later transcribed.

Thematic Analysis

Transcripts were reviewed twice for emergent themes, first by the interviewer for that group of transcripts, and second by a different interviewer. The four categories of the original interview script were used for the initial organization of emergent themes (see Table 2). The transcript reviewers then conferred and reached agreement on the most salient and prevalent themes within and across transcripts.

Table 1. Description of Subject Matter Expert (SME) Participants

Group	Participant	Description of Expertise and Relevant Experiences
Vision	V1	- Has a visual impairment - Has a parent with a visual impairment - Instructor for computer classes for older adults with visual impairments - Has experience working as a blind/low vision rehabilitation engineer, usability consultant, and researcher
	V2	- Provides care for older adult mother, who is blind (age-related macular degeneration) - Occasionally provides care for another older adult with vision impairment - Licensed certified nursing assistant (CNA)
	V3	- Has a visual impairment (blind) - Leads workshops for people aging with visual impairments for living communities and community centres - Worked as a rehabilitation counsellor for people with visual impairments (typically 55+) - Provided care for legally blind wife (now deceased)
Hearing	H1	- Child of two Deaf parents - Provided care for her older Deaf mother (recently deceased) - Business executive in healthcare industry
	H2	- Provides care for older Deaf father - Sign language interpreter
	H3	- Organizes Deaf senior groups at a Deaf community social service agency - Provides care for older Deaf father
Mobility	M1	- Occupational therapist in a geriatric hospital - Owner of a home accessibility consulting business that helps older adults and their families identify accessibility solutions (e.g., home modifications) that can help them remain at home - Certified aging in place specialist
	M2	- Professional caregiver; working long-term with an older adult with Spinal Cord Injury (SCI) - Family caregiver for her older adult husband who has a mobility impairment - Advocacy Specialist for people with spinal cord and brain injuries
	M3	- Geriatric care manager at a private aging care management service company specializing in senior advocacy, needs analysis, and care coordination - Geriatric social worker in skilled nursing facility-Geriatric Care Manager at a private aging care management service company specializing in senior advocacy, needs analysis, and care coordination - Geriatric Social Worker in skilled nursing facility

Results

Participants

The nine SMEs represented a range of backgrounds. Most worked directly with older adults with vision, hearing, or mobility impairments (e.g., rehabilitation counsellor, sign-language interpreter, occupational therapist). Many also worked as a volunteer or advocate on behalf of those individuals (e.g., instructor for computer classes for older adults with vision impairments, organizer of Deaf senior community events, advocacy specialist for individuals with spinal cord or brain

injuries). In terms of personal experiences, some SMEs had the specific sensory or mobility impairment themselves, and some were caregivers for their ageing parent/spouse who had a sensory or mobility impairment. All were well informed in their respective areas and were able to provide rich accounts of the challenges faced by older adults ageing with sensory or mobility impairments.

Technology use and acceptance

Table 2 provides the themes of challenges for older adults with vision, hearing, and mobility impairments. For each domain, the themes were classified as being a crosscutting across impairment groups or unique to older adults with a specific impairment. One crosscutting challenge was the size of technology, particularly concerning cell phones and smart phones (e.g., small keyboards). Similarly, complex interfaces and functions of devices were a shared challenge. SMEs suggested the need for simple, streamlined devices that are easy for older adults to understand and operate. Lack of technology training and support was another challenge that recurred throughout the interviews. As H3 explained "*They get trained one way, and then [it] changes six months later. It can be challenging.*"

Some themes regarding technology use and acceptance were specific to older adults with certain impairments. For example, screen readers were discussed as very difficult for older adults with vision impairments; screen readers have a high learning curve, more functions than desired by most users, and are taxing on memory. SMEs noted that assistive technologies can draw unwanted attention, but that this was alleviated as assistive technologies become more typical in appearance or are integrated into everyday technologies (e.g., iPads). SMEs discussed the benefits of voice recognition software but also discussedconcerns about technologies used in financial transactions.

For Deaf older adults, SMEs explained that technology has a time and a place. For instance, while video remote interpreting (VRI: a videoconferencing technology that brings a remote sign language interpreter into the local situation via laptop and webcam) is useful in most situations, it might not be appropriate in high stress situations, such as the emergency room where *"they're worked up, and they just want a body in front of them to interpret."* SMEs also reported that many technologies (e.g., medication reminders, phones) rely on audio-based cues and do not have an adequate alert system for people who are Deaf. Thus, although technologies were being adopted, additional considerations could make them more useful and usable.

Technology challenges among older adults with mobility impairment were primarily related to privacy concerns. SMEs described how the threat of identity theft and scams discouraged people from using the Internet. Being monitored too closely was another perceived threat among older adults with mobility impairment, especially with many health-monitoring technologies (e.g., activity trackers, medication monitoring systems) imposed on an individual by caregivers and family members. Fear of being spied on and not fully understanding the technology can make people distrust these technologies ("*people don't like to feel like they're under watch*").

Perhaps this concern arose for mobility SMEs because technologies that monitor movement between rooms, and in case of falls notifies help, are likely more prevalent amongst those with mobility impairments. The technologies were typically described as often being designed for the caregiver instead of the user.

Table 2. Themes from Subject Matter Expert Interviews: Challenges Among Older Adults with Vision, Hearing, or Mobility Impairments

| | *Crosscutting Challenges* | *Challenges for Older Adults with Specific Impairments* | | |
	Vision, Hearing, & Mobility	*Vision*	*Hearing*	*Mobility*
Technology Use and Acceptance	- Need for simple, streamlined technologies that are more intuitive	- Assistive technologies for people who are blind/low vision can be large and attract unwanted attention	- Use of video remote interpreting can be inappropriate in high stress situations and is inadequate when the camera/video phone is not in the needed location	- Privacy concerns about using the internet (e.g., identity theft)
	- Size of technologies often too small, creating usability issues	- Screen readers can be difficult for older adults to use; provide an overwhelming amount of information and functions	- Difficult to keep up with frequent changes and updates to technology	- Health technologies often designed for the caregiver instead of the user
	- Technology training and support is insufficient	- Touchscreens without buttons can present issues for people who are blind/low vision because they often rely on tactile cues to make associations; voice recognition software may be a beneficial alternative	- Need for technologies to provide adequate alerts for individuals who are Deaf/hard of hearing, (e.g., vibration, lights)	- Resistance toward sensor/monitoring technologies; concerns about privacy and family members or caregivers spying
	- Older generations tend to be more fearful and resistant to technologies	- Financial transactions can be challenging; difficult to know if they are paying or being charged the correct amount		

Table 2 (continued). Themes from Subject Matter Expert Interviews: Challenges Among Older Adults with Vision, Hearing, or Mobility Impairments

	Crosscutting Challenges	*Challenges for Older Adults with Specific Impairments*		
	Vision, Hearing, & Mobility	*Vision*	*Hearing*	*Mobility*
Access to Community and Health Resources	- Lack of accessible public transportation; finding and utilizing it requires substantial planning	- Privacy concern in releasing personal information to community resources	- Lack of interpreter services in medical settings; emergency services may be unable to communicate with Deaf older adults	- Lack of awareness about aging and disability resources; many older adults use phone books instead of internet resources
	- Private transportation options are expensive and often unaffordable	- Lack of accessible exercise options	- Need to make events accessible by providing an interpreter	- Difficult to visit doctors and healthcare providers; opportunity for telehealth services with for both patients and staff
	- Resources and services tend to be in major cities; need for satellite resources in suburban and rural areas	- Many people fall into the gap of having just enough money where they do not qualify for aid, but are unable to afford services themselves		- Many people fall into the gap of having just enough money where they do not qualify for aid, but are unable to afford services themselves
				- Lack of accessible exercise options
Housing	- Sensory and mobility impairments are misunderstood by nursing home staff	- Concerns about kitchen safety (e.g., cuts, burns); need for accessible appliances to enable independence	- Limited access to wireless technology needed for communication devices (e.g., in assisted living settings)	- Concerns about telling family members about falls, out of fear they will have to leave their home
	- Affordability of home modifications, technologies, and services are a major barrier to aging in place		- Few homecare providers or caregivers in assisted living facilities know sign language	- More likely to need extensive support with basic activities of daily living (e.g., bathing, toileting), especially if they need assistance with transfers

Accesss to community and health resources

The lack of accessible public transportation was a crosscutting concern across groups. SMEs commented that finding and utilizing accessible public transportation required substantial planning. Para transit options, such as those offering curb to curb service, often required several days' notice. Mass transit options were more readily available but impose a high cognitive load; in addition, issues with walking abilities and fear of being lost were common. Private transportation options, such as taxis, were described as expensive alternatives with ongoing concerns about accessibility (e.g., ease of summoning, risk of injury, complexity of financial transactions). The cost of private transportation is even more profound with wheelchair users in purchasing and maintaining an accessible van. Transportation challenges were discussed as having broad and serious impacts, particularly on one's ability to be an active part in the community and to stay healthy.

Another cross-cutting challenge was that community services and resources – particularly those intended for individuals with vision or mobility impairments – were primarily located in downtown areas of major cities, requiring transportation to reach them. Both vision and mobility SMEs stressed the need for satellite resource centres in suburban and rural areas. In terms of exercise and recreation, SMEs also commented on the lack of exercise options; gym facilities and exercise classes were generally considered inaccessible and inappropriate for older adults with vision or mobility impairment: "*If you're older, there might be an ageing exercise course, but if you're older and you have a vision impairment, there's zero.*" This concern was echoed for older adults with mobility impairments, whose physical capabilities vary widely and for whom exercise would need to be appropriately modified. Across community and health resources, there is a need for better information dissemination for older adults, especially for those with mobility impairments. Many did not know where to look for information about cost, available equipment, and training. As one explained, "*unless you have an advocate for you, you're pretty much on your own.*"

Housing

Most of the challenges elicited involved a need to modify, outfit, or bring services to the home to enable a certain task. The ability to complete kitchen-centred activities independently and safely (i.e., without cuts or burns) was addressed as a challenge for older adults with vision impairments. Accessible appliances that provide audio or tactile cues were mentioned as useful, but expensive options. Having assistive technologies throughout the home was also noted as a need among Deaf older adults. Video relay service (VRS) phones are typically only installed in one room of the house, which can be inconvenient and potentially dangerous for Deaf older adults (i.e., if an emergency arises and the person is in a different room). Finding caregivers for Deaf older adults was described as particularly difficult because most in-home caregivers typically do not know sign language.

The SMEs affirmed that ageing in place is the overwhelming preference of older adults, but challenges remain. Older adults with mobility impairments tend to need

extensive home support, mostly with Activities of Daily Living (ADLs). Older adults may not tell caregivers or family members about falls or injuries in the home out of fear they would be forced to move to long-term care residences.

When asked about challenges in finding assisted living options, SMEs from both the vision and hearing, groups reported a lack of understanding among staff about sensory impairments. One SME discussed how staff at her mother's assisted living community did not seem to understand the difference between deafness and age-related hearing loss. Thus, employees would scream to try to get her Deaf mother to hear them. Another spoke of a similar misunderstanding, and potential stigmatization, wherein assisted living facilities assigned older adults with visual impairments into higher levels of care than needed. In both cases, SMEs felt broader education for care providers was necessary. The hearing-specific SMEs also described limited access to computers and videoconferencing technologies because of slow adoption in long-term care residences, which in turn could limit access to health and community information as well as result in increased social isolation among residents. In sum, the SMEs did not think that most long-term care residences were ideal (or even satisfactory) communities for older adults with sensory or mobility impairments.

Other: Psyco-social barriers

The interviews yielded a category of challenges not captured by the pre-specified domains; namely, psycho-social barriers. Several SMEs discussed how older adults with impairments are at high risk for isolation and depression. SMEs explained that older adults might self-impose psychosocial barriers (e.g., choosing not to socialize as frequently) or be isolated because of barriers in their environment. For example, one explained that her father's nursing home had group events for residents, but he would not go because they would not hire an interpreter: *"He can't communicate with the people around him."* SMEs suggested that psycho-social barriers are pervasive across all the domains, such as transportation challenges contributing to social isolation or lack of exercise opportunities exacerbating depression.

Discussion

A thematic analysis of the nine SME interviews identified a range of everyday needs for technology, community resources, and housing for individuals aging with vision, hearing, or mobility impairments. Many themes were shared across groups, such as a need for larger technologies; better technology training and support; more accessible and affordable transportation options; a greater understanding of resident needs at assisted living residences; and the potential increase in psychosocial concerns that may result from experiencing barriers in these domains. Nonetheless, some themes were specific to a particular group, with SMEs of older adults with vision impairments describing a need for user-friendly screen readers, exercise options, and privacy concerns. Deaf older adult experts described a need for appropriate use of remote-video compared to in-person sign language interpreters in healthcare, and a general need for sign language accessibility for community resources and events. SMEs for older adults with mobility impairments detailed a need for easy-to-use

technologies, resource information dissemination, and a better method for sharing personal information with their children that allows them to retain some privacy.

Some of the broad challenges revealed in this study aligned with the general ageing literature, but the results revealed details for individuals who are ageing with a pre-existing impairment. For example, a Deaf individual may have not used a medication reminder system prior to ageing. However, due to increased medication use or memory changes with ageing, such a system may now be needed but typical audio alerting tools would not suffice. As another example, technology training is established as a need for older adults (Czaja & Sharit, 2012; Mitzner et al., 2008). However, for Deaf older adults, there is the additional challenge of communication accessibility of such trainings (i.e., needing a sign language interpreter). An understanding of these barriers is the primary contribution of this study.

Similarly, transportation challenges are commonly reported in the ageing literature, brought upon by older adults having to limit or stop driving (Anstey et al., 2005). However, this difficulty is exacerbated for older adults with vision, hearing, or mobility impairments. For instance older adults with vision impairments not only need to rely on others or a service for getting places, but also may be experiencing age-related declines in balance or mobility which could create challenges for getting out of a vehicle. Moreover, they need to be able to identify the location and height of a curb, to prevent a misstep and risk not recovering their balance. Similarly, with age, walking speed can decline, requiring more extensive planning and travel time for older adults with pre-existing vision, hearing, and mobility impairments, many of whom must already arrange accessible transportation days in advance. In all cases, private transportation options are typically too expensive for regular use. If these concerns are echoed in the European population of older adults with sensory and mobility impairments, interventions that alleviate transportation issues may best be piloted in Europe, where the public transportation system as a whole is well-developed.

Implications for design

Our results highlight a variety of barriers faced by older adults with sensory and mobility impairments. With respect to technology, these findings suggest the need for participation of SMEs as well as individuals with sensory and mobility impairments in technology design. By including user groups who have a diverse set of capabilities and limitations early in the design process, technologies are likely to be more usable for all users. Indeed, several challenges identified in this study were cross-cutting among the vision, hearing, and mobility impairment groups, suggesting that designers should consider the interaction of multiple impairments, which can create compounding difficulties for a user. Taken together, these findings further support the potential value of universal design, in which environments and products are designed to be usable regardless of the age or limitations of the user (Sanford & Stark, 2014). Thus, human factors considerations should not just include ageing *or* sensory/mobility impairments, but also those who are *both* ageing and have a sensory or mobility impairment. As a general guideline, technologies should be developed such that the loss of one sense will not disable the user from utilizing a

beneficial technology. For example, technology training should be available through multiple media (not just user manuals, but also audio support for individuals with visual impairments and help-lines should have VRS access). Similarly, small, flat buttons that are difficult for individuals with vision impairments to differentiate, might also be difficult for individuals with limited motor control to accurately press. Alternative inputs could help with this issue (as voice commands have helped older adults with vision impairments use communication technology).

For individuals ageing with an impairment, universal design could improve their ability to fully participate in the community (Sanford, 2012). The design of public transportation, buildings, and services should consider and accommodate needs of a wide range of users. By determining the challenges faced by older adults with sensory and mobility impairments, interventions can be developed. For example, equipping taxis with money readers may alleviate payment concerns for older adults with visual impairments. In other cases, it may simply be the laggard adoption of people who are not older adults with impairments that can be changed. For example, if assisted living facilitates adopted VRI and computers for residents in the same way they adopted board games and telephones, information and communication could be much more accessible to Deaf older adults. In such cases, interventions would require the involvement of a greater range of stakeholders. When designing universally or specifically for older adults with impairments similar interventions could ideally be implemented based on a taxonomy of everyday support needs for older adults with sensory and mobility impairments. A taxonomy could also guide the development of technologies and systems not just for older adults with impairments, but for older adults in general, who may later experience age-related sensory and mobility declines.

Limitations and future directions

As in all research studies, limitations must be considered in interpreting the data. First, there is a need to recruit SMEs from a greater range of experiences, particularly professional caregivers in assisted living communities. Such individuals are very difficult to recruit, perhaps because they have a heavy workload and high turn over, and possibly because those who care for multiple older adults with a sensory or mobility impairment are rare. In either case, given the difficulty the researchers had in finding such individuals, it follows that it may also be difficult for those seeking care to find those individuals. Additionally, these data revealed that not all challenges faced by older adults with sensory or mobility impairments are barriers to functional needs. Social challenges and psychosocial challenges are also substantial. Further, technological advances may modify some of the challenges reported here. For example, as VRI and voice-activation input become more standard in technology, some challenges reported by SMEs might decrease. However, if VRI and voice-activation continue to become popular, but not procedurally standard across the technologies that use them, training may become a greater burden with users having to distinguish how to access the feature on one product versus another product. Likewise, the increased use of flat buttons might make technologies less accessible for users with vision and mobility impairments. Additional investigation into the specifics of challenges and how older adults with

sensory and mobility impairments respond to them is necessary to provide additional human factors guidance.

Strengths of the study

The design and results of this study provide useful guidecance. First, the results demonstrate the need for involvement of older adults with sensory and physical impairments, as well as their advocates, caregivers, family members, and relevant professionals in the design process. Knowledge gained from SMEs can be used to guide further investigation with target user groups. The SME interviews allowed for a comparison across three common impairments (vision, hearing, mobility), while still capturing a broad range of experiences. SMEs will be vital points of contact for future work with user groups because they can facilitate the recruitment of a diverse sample and can help to assure potential participants of the credibility of the researchers.

Conclusion

The goal of this study was to identify the range of challenges experienced in everyday activities for older adults ageing with pre-existing impairments in vision, hearing, or mobility. Interviews with SMEs with personal and/or professional experience with these individuals revealed challenges that were unique to each population as well as shared across impairment groups. By better understanding these challenges, the human factors community, alongside key stakeholders (e.g., physicians, community groups), can jointly provide solutions that promote successful ageing for individuals with sensory and mobility impairments.

Acknowledgements

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