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Investigating Perceptions Related to Technology Acceptance & Stigma of Wearable Robotic Assistive Devices by Older Adults – Preliminary Findings

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Longevity, and good Quality of Life enhances a positive ageing experience by post-retirement adults. However, physical decline and limitations may affect independence and autonomy to conduct and engage in day to day tasks and social activities. Assistive robots can offer support to assist, and become embodied features that are accepted and worn by older adults. To date, research is limited and little is known about older adults' opinions of assistance by robots in personal and home life. There are a number of Technology Acceptance Models (TAMs) presenting quantitative based questionnaires that attempt to gauge acceptance and usefulness of robots by older adults. This paper presents preliminary findings from a qualitative study with older adults. The findings discussed are from an initial cohort of 8 older adult participants, which are part of a larger, ongoing study. The purpose of the study was to understand older adults' perceptions relating to technologies commonly used and future technologies and their acceptance and usefulness. The preliminary findings are based on a cross section of eight participants, and their perceptions. The findings of the full study will inform and assist the user centred design of a soft robotic exoskeleton.

older adults; assistive robots; stigma; qualitative research

1 Introduction

Baltes refers to lifespan development as an ongoing process of change, from conception to death (Baltes, 1987). It is widely viewed that within a user centred design research project, the user needs, must firstly be identified, and secondly be involved in the process of research and design (Dreyfuss, 2012ed., Papanek 1985; Fisk et al, 2004; Farage et al, 2012; Norman, 2002).

The global population of adults aged over 60 is expected to exceed 2 billion by 2050 (UN, 2015). This demographic in 2013 represented 11.7% of total global population. By 2050 it is predicted to be as high as 21%. This growth, combined with the continuing decline of fertility and birth rates indicates that there will be a greater number of older adults than children aged <15 (UN, 2013).

Older adults are members of a disenfranchised group that collectively experience the 'digital divide' (Newell, 2011). The 'digital divide' refers to the pace of emerging technologies and the ability to use devices by groups such as older adults. It can impact on everyday task application experience, and challenge using technology such as ATM's, mobile phones and computers. Assistive technology should enhance quality of life and support the limitations experienced by the user. It should not be a source of frustration that invokes a reluctance to use a device. This implies the need to pursue and crossover the digital divide by understanding the challenges faced by older adults using technologies.

Graafmans et.al. (1996) calls for a 'lifespan approach' to design that features and emphasises an adaptability and flexibility that matches the needs of the user. They further discuss the influencing factors that can encourage or dissuade older adults from using technology devices. They express that more development is required to define people's acceptance and use of technology beyond their chronological age.

Technology, and its adoption or abandonment has had numerous models developed as a means to measure and identify the factors that optimise its acceptance [i.e. TAMs]. In more recent years such models have been adapted to include older adults, their home environments and social robots or technology devices (Heerink, 2010; Chen & Chan, 2014). These models typically compose of constructs with Likert scales that gauge the potential for acceptance. Generally, they are quantitative measures that do not always accommodate the expression or intimate thoughts of the older adult. TAMs are critiqued and discussed by many authors. Salovaara & Tamminen (2009) detail how TAMs have influenced design, attributing terms such as 'user acceptance' and 'diffusion' and 'adoption'. However, they also share concerns to TAMs as tools that can predict acceptance of technology by people, and discuss the flaws of measures that depend on user self-reporting, and short user exposure to the technology in question.

There is a need to consider alternative ways to understand and evaluate older adult user needs in relation to the acceptance of technology, specifically assistive robots (Shore. et. al. 2018). Consideration is required to the new emerging technology forms and the experiences and opinions of older adults, who are often quite engaged with ICT. Chen and Chan (2014) discuss a qualitative study they undertook that highlighted the positive attitudes older adults in Hong Kong appeared to have, in relation to everyday technology devices. However, other factors influenced more negative attitudes to acceptance and use, i.e. health risks, social problems, environmental and complexity of the technology. Qualitative studies regarding acceptance of wearable assistive robots by older adults is scarce. It was identified by literature review that there was a need to enquire and develop understanding, in relation to the perceptions older adults have to the presence and use of assistive robots.

Robots can be an effective intervention to support a person with mobility limitations. Assistive robots typically are grouped into three categories: manipulation, mobility or cognition (Van der Loos & Reinkensmeyer, 2008). The mobility group of assistive robots includes gait training robots and exoskeletons. ISO 13482 (2014) presents specific safety evaluation criteria for the design of personal care robots, based on three categories or robots: mobile servant robots, physical assistant robots and person carrier robots. Physical assistant robots, in ISO13482 are not defined as medical devices, but devices that can improve quality of life. Under ISO 13482 exoskeletons are classified as physical assistant robots.

Exoskeletons are used typically in rehabilitation, military and industry environments. When we consider the needs requirements of older adults with limited mobility, an exoskeleton could potentially offer enhanced abilities to engage in Activities of Daily Living (ADLs - Katz,1963). This in turn could maintain autonomy and independence as ageing progresses. However, there are relatively few studies that engage researcher with older adult participants in their home and day to day settings. Age UK (2009) found that the majority of studies involving technology and older adults, focussed on internet use and access. Other commentators suggest that, in addition to developing

robots that assist with current needs of a person, there is a need to focus on technologies that can prevent decline and maintain health (Robinson, et al. 2014).
The current authors embarked on a qualitative study involving twenty-four older adult participants in Ireland. The intention was to interact with older adults and understand their experiences of ageing and perceptions of wearable assistive robots. This paper discusses preliminary data based on analysis of eight participants.

2 Purpose of the study

The primary aim of this study was to increase understanding of day to day life and experience of adults aged over 60, and living independently in the community. Specifically, this enquiry would focus on use of technologies, activities such as dressing, and perceived barriers to adoption of technologies.

2.1 Design research and older adults

The design researcher looks beyond what people say, and captures also what people don't (or can't) do, and hearing what people don't say, (Brown, 2009). This focus and skill highlights the importance of quality, over quantity of information gathered during research. Design research can be the most thrilling ride when surprises and discovery happen. However, the designer's role as an impartial moderator (Demirbilek, 1999) also emphasises the responsibility a designer has to the participants involved in the study and their expressions and views.

The ageing global population are a cohort that will continue to grow over the coming years (UNFPA/HelpAge International, 2012). This highlights the need to consider this demographic as a group requiring design led enquiry and new product interventions that can enhance autonomy and independence. This ageing population may hold unprecedented concerns for the future. The European Commission have stated that in the future, young people (>14) and older adults (<65) may become "too heavy a burden on younger working age people (15-64) (EU, 2011)." Concerns are not just economic, and as a consequence of age, our bodies change and decline (Torge, J, 2014). As a result of longer lifespan and medical advances we are now living longer in our own homes, often with some form of functional limitation (Haak, et. al. 2007).

The requirement to involve older adults in the design process has been further discussed by numerous commentators (Fisk, et.al, 2004; Farage, et.al, 2012; Pirkl, 1994; Demirbilek, 1999; Newell, 2011) with Universal, Participatory and Co-design approaches recommended.

2.2 Technology

During literature review, numerous terms were offered when discussing 'new' technology for older adults, for example: assistive social agents, healthcare robots, personal care robots, domestic robots, assistive robots, socially assistive robots, robotic aids and assistive walking technology (Heerink, et.al. 2010; Broadbent, et. al; 2009; ISO, 2014; Smarr, et.al. 2013; Miller, 1998; Wu, et. al. 2014; Van der Loos, 2008; Feil-Seifer & Matarić, 2005 and Tapus et.al, 2007). Generally, the association with each of these authors was the need to understand, evaluate and gauge acceptance and use of these technologies.

With so many terms applying to fundamentally similar technologies, this presents a challenge to designing a study, and its language 'out in the field' to communicate with participants. Language, when used in participatory design research has been shown to optimise user engagement by the spoken behaviour of the design researcher (Luck, 2007).

The purpose of the overall study (n= 24 participants) was to learn from older adults, their perceptions to new technologies, and language, critical to their engagement when they shared stories or experiences. It was considered the familiar assistive devices such as wheelchairs, walking sticks, hearing aids would be helpful to building rapport and receiving commentary from the older adult participants. However, when robotic devices would be mentioned, the term robotic assistive

devices were used in the conversations with the participants. With consideration of exoskeletons and soft robotic trousers, the term 'assistive robots' appears to support the xosoft project outcome of a soft robotic exoskeleton. It correlates with Van der Loos (2008) who defines three areas of assistive robots, as manipulation, mobility and cognitive robots. Mobility assistive robots help a person move from place to place (Miller, 1998, Van der Loos, 2008).

3 Study approach

3.1 Methods

Creswell (2003) refers to the numerous methods that are available to researchers, namely quantitative, qualitative and mixed methods. This study will involve older adult participants and rely on their perceptions and experiences regarding wearable robotic assistive devices. For that reason, a qualitative study was undertaken with grounded theory and ethnographic strategies.

3.1.1 Grounded Theory

Grounded theory has evolved over the years. There are many commentators and authors of numerous articles and books defining grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1994; Birks & Mills, 2015 ed; Charmaz, 2nd ed, 2014). For the purpose of this study a constructivist approach was undertaken. This approach would support the activity, where knowledge would be gained using methods such as coding, memo writing, and theoretical sampling. This in turn would be compared and contrasted to support the build of theory (2014, Charmaz).

3.1.2 3.1.2 Design ethnography

Ethnography is described as an "*integration of both first-hand empirical investigation and the theoretical and comparative interpretation of social organisation and culture*" (Atkinson & Hammersley, 2007). Ethnographic methods have been relied on as a design research tool. They are often recommended as a means to gather knowledge, and immerse researcher with participant in natural settings or environments, and needs to fit the requirements of the design challenge (Blomberg, 1993; Nesta, 2016; Salvador, et. al, 1999). Design ethnography affords the design researcher to understand what their participants do, how they think and what they say. It places the researcher in the context of the participants space or setting. To understand the lives and experiences of the participant, the researcher will enter the participants world with "*an open mind, not an empty head*" (Fetterman, 1998). Using ethnographic methods, the design researcher immerses themselves into the world of people, and discovers the participants desires and opinions of products, meanings and cultures. In addition, Salvador, et. al, note the value of other discipline influences such as anthropology, psychology and sociology (Salvador et. al. 1999).

For this study, the researcher spent time with the older adult participants in their homes. There were visits to social group sessions, and post stroke meetings in two counties. A qualitative approach of observation, audio and image capture, as well as semi-structured interviews were the main forms of knowledge capture during the five-month study period. In addition, opportunity presented to try or experience some products used daily by participants, as a means to deepen understanding e.g. a stair-lift (Figure 1). The audio files for each of the interviews were transcribed verbatim, noting observations of body language, participants tone or demeanour to different experiences or stories they shared.

Figure 1 Researcher experiencing a stair lift in participants home.

3.2 Participants

3.2.1 Recruitment strategy

Twenty-four participants were recruited for the overall study. Participants were sourced through community groups, where membership consists of older adults, e.g. Age Friendly Limerick and The Friendship Club. In addition, snowball sampling was used, where, word of mouth from one participant sharing with another, encouraged other older adults to participate. This afforded a good rapport and trust between researcher and participant. Visits to Post-stroke groups also supported participant recruitment. The full sample of participants varied in age from 60 to 87.

This paper will discuss preliminary findings from the sessions with eight of the participants. There is a gender balance mix of four male and four females, aged between 69 to 87. Four participants were married and four were widowed, and were living in rural and urban areas. Six of the homes they lived in were two-storey, with the remaining two homes classed as bungalows, or with no stairs. As required by ethics committee approval and research planning strategy, each participant was asked to complete the 'mini-cog' test (Borson, 2000). This was done prior to consent form being signed and agreed between researcher and participant.

3.2.2 Ethics

The study was approved by the Research Ethics Committee of the University of Limerick. The submission of the application included strategy and approach to observe, and spend time with older adult participants. It included the information and consent form templates that would be offered to participants to invite them to become involved. In addition, there was a consideration to the cognitive challenges that may present with ageing, and as a means to not unduly infringe or impose, a 'mini cog assessment' (Borson, 2000) was undertaken by each participant prior to consent form being signed. This is an evaluation tool to assess the participant's cognitive ability and their suitability to participate in the study. All participants passed the mini-cog test without stress or challenge. All participants were also advised (and, as stated on the information sheet) that at any time they could stop the session. In addition, image and audio capture was highlighted as tick boxes, that participants would acknowledge if they were happy for this or not, prior to signing the consent

form. Each participant was anonymised, with an agreement that should imagery capture revealing background or personal features, they would not be visible, and would be blurred.

It was explained to each participant how their involvement was of importance to the understanding and development of soft robotic lower limb assistive concept. For the participants, this was described as a soft robotic trousers. It was explained there would be a total of six questions, on various aspects of life and experiences around technology and day to day life. Six questions were developed as conversation guides to the sessions, these questions were developed to optimise the interactions between researcher and participant. The questions are listed and displayed on Table 1:

Table 1 Fieldwork questions:

Question number	
1.	What are your experiences using or helping someone to use assistive devices and/or technologies? –sub a) Glasses or hearing aids; b) Computers or smart phones; c) Rollator or wheelchairs.
2.	Describe any difficulties or barriers to using a technology device?
3.	If you are/were to experience reduced mobility, how does/would it affect your way of life?
4.	When I mention robotic assistive devices, describe what that means to you?
5.	What is your opinion of older adults being supported by robots to do tasks and activities?
6.	How do clothing and dressing options change as we age?

4 Results

4.1 Semi-structured interview sessions

Six semi-structured interview sessions – 'conversations' were arranged with the eight participants. Two of these were conjoint; involving, one married couple, and the second involving two friends. One of the single participant interviews involved the participants daughter entering the room at various times and offering commentary with regard to whatever topic being discussed during the conversation. Prior to the session, each participant read the information and consent form. In addition, they completed the mini-cog test and were offered opportunity to ask any questions before beginning to record the session.

To portray activity and commentary during the sessions, the conversations were broad, and facilitated the older adult participant, the freedom to discuss ageing experiences and technology in general; and on their terms. This approach supported a user-led empowerment and the opportunity as a researcher, to see the world through the participants experiences and stories.

4.2 Findings

The preliminary findings were coded using Nvivo software (QSR International). A total of 341 codes were generated from 3,098 referenced comments from the eight participant's interview transcripts using line by line coding and generating open code techniques on Nvivo. From the initial open codes (phase one) [341], eleven categories (phase two) emerged which are displayed on Figure 2:

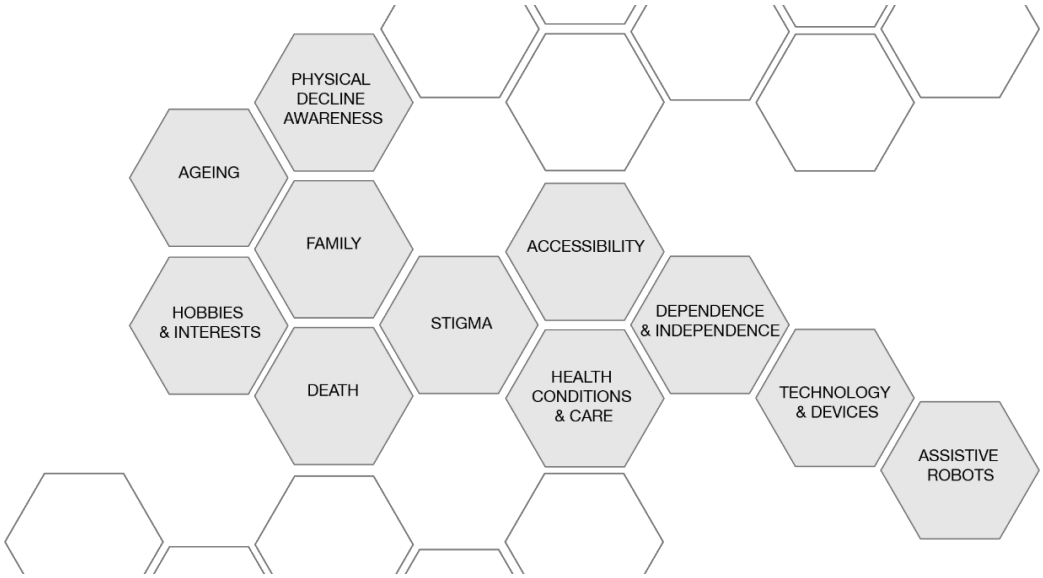

Figure 2 Categories emerged from initial open codes.

The eleven categories displayed have a number of sub categories to each. Each one is displayed and defined in Table 2. The categories were generated from each code and based on the following criteria: a) volume or quantity of the recurring topics; b) quantity of comments to a particular code i.e. wheelchair use. A breakdown of codes to categories, with definitions are displayed in Table 2:

Table 2 Categories, definitions, sub categories.

Category	**Definition**	**Samples of codes generated from transcribed interviews**
Accessibility	How accessibility is experienced to a number of places or settings.	Home; Home adaptation; Bathroom; Stairs; Steps; Stoves & Fires; Kitchen; Doors; Entry & Exit points; Nursing home or life planning; Ramps; Packaging; Furniture; Lifts; Product adaptation; Public Buildings; Road surface; Footpaths; Assistance or grants.
Ageing	The experience of ageing.	Daily activities & tasks; Dressing; Toileting; Travel; Transport; Reminiscence; Career or profession; Retirement; Accidents; Acceptance of ageing; Personal tasks; Trust/trust people; life adaptation; less active
Assistive Robots	How these new technologies are perceived.	User expectation of assistive robots; Barriers to adoption of; Positive perceptions; worn or carried devices; personalised or tailored; unsure of what an assistive robot is; emotional or personal connection.
Death	The effect and thoughts about death, or passing by self and others.	Coping after death of a life partner; Death of others; Death of self.
Family	How we interact and engage with family life and relationships.	Familial stories; non-family stories; Children; infantilising parent; children assisting parent; inherited devices; being a couple; being a burden; family trust; connecting and communicating; older adult parent supporting adult children.
Health Conditions & Care	Experiences using healthcare services, and the assistive devices and health conditions discussed by the eight participants.	Healthcare; Service systems; stories & experiences; dissatisfaction; relationships with health professionals; Hearing aids; challenges with hearing aids; Glasses; challenges with glasses; Experiences using assistive devices; experiences helping someone use an assistive device; wheelchair use; crutches; mobility scooters; personal alarms; shared stories; Health conditions – *Arthritis, Bladder, Blood pressure, Alzheimers, cancer, colostomy, diabetes, sleep apnoea, stroke, varicose veins,*

		vision, hearing, DVT, Diabetes, Heart, leg, feet, spine, overweight, skin, pain, sleep, memory, medication, *IBS.*
Hobbies & Interests	The social hobbies and interests that affect our daily experiences.	Holidays; Walking; Volunteering; Television, Reading; Dancing; Day trips; Tea & Coffee; Clubs & Groups; Cooking & Baking; Music; Being kept busy; Gardening; Keeping pets, Games.
Dependence & Independence	As we age and remain independent or begin to experience times when we can be dependent.	Quality of life; Fear; Anxiety; Loneliness; Being alone; Assistance; Not wanting to be a bother; appreciate help; embarrassment; self-critical; Empowerment; Limitations to independence; Accomplishments. Shopping; Assisted shopping; Costs & expense; Service providers; Bills & Utilities; Online shopping.
Physical Decline Awareness	How self-aware we are to the change that ageing may introduce to our lives.	Resilience; user adaptation with assistive devices; Mobility; Problems with mobility; Task planning because of reduced mobility.
Stigma	Times when experiences can be uncomfortable.	Perceived social barriers; Technology; Stories and experiences shared.
Technology & Devices	The numerous devices we interact with daily, and the technologies that support them.	Technology acceptance; Everyday Devices – Telephones, Mobile phones, computers, iPads, tablets; Internet; Usability & Function, Anxiety, Confidence, Technology Trust, Robot Trust; Social Influence.

The categories were then compared further with existing codes and refined to four distinct Themes (phase three), expressed by the data presented. The four themes namely are: Ageing, Health Conditions & Care; Technology & Devices; Quality of life. This process is visualised on Figure 3.

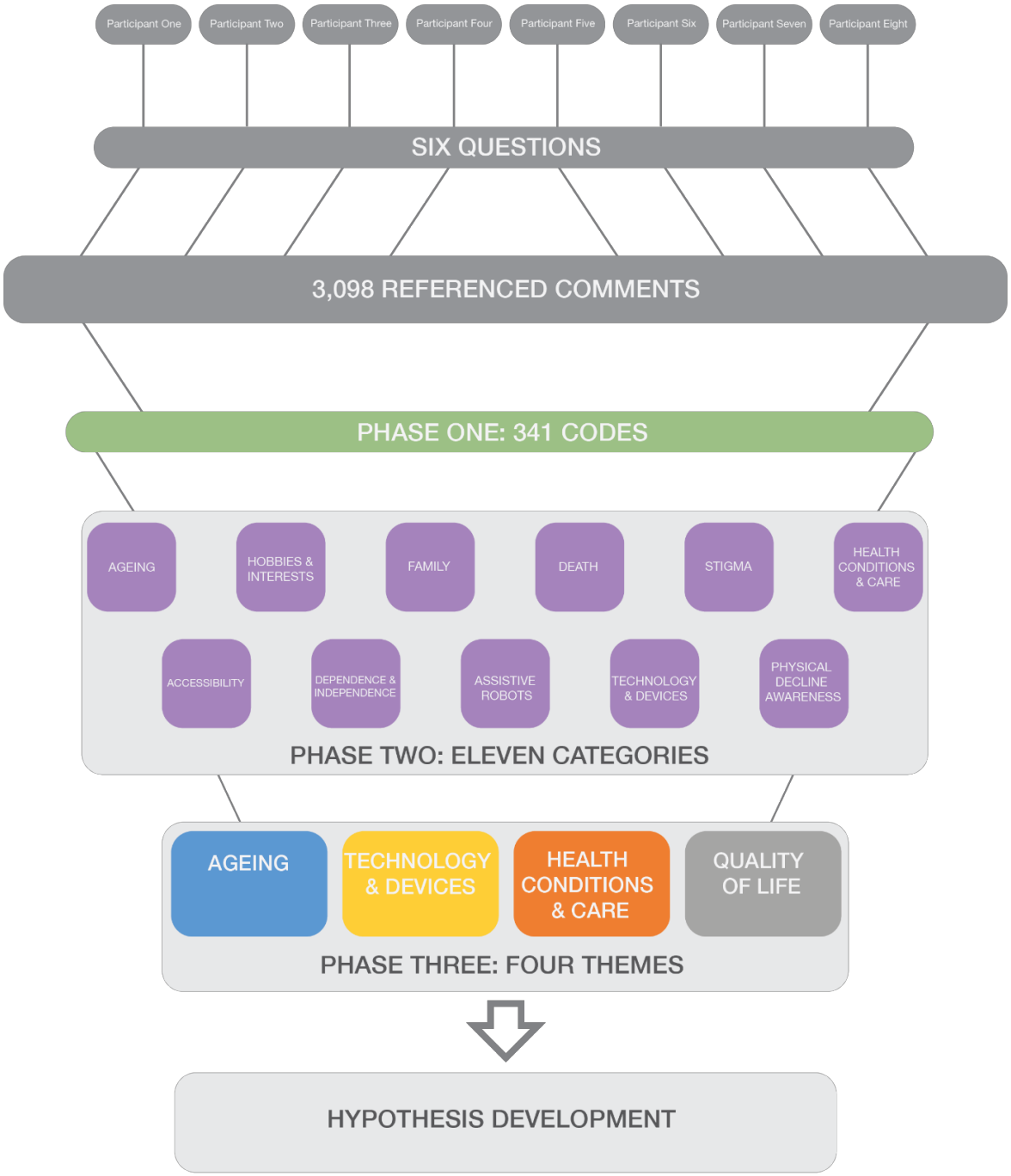

Figure 3 Four themes emerged from data.

As a means to display further the manual construct and endorsement of connections to each category and themes, from the codes, this work was mapped, and is displayed in digitally generated images, (Figures: 4, 5, 6, 7).

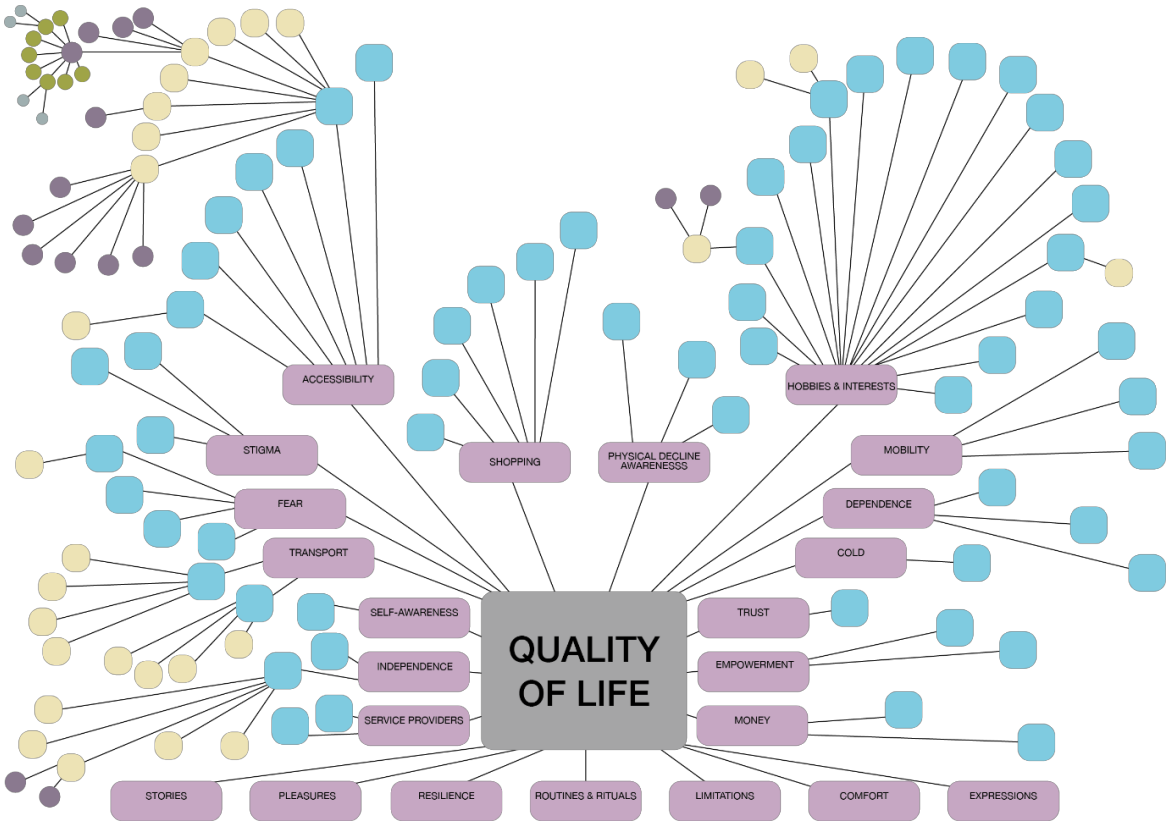

Figure 4 'Quality of Life' theme mapped connections from codes to categories, digital generated version.

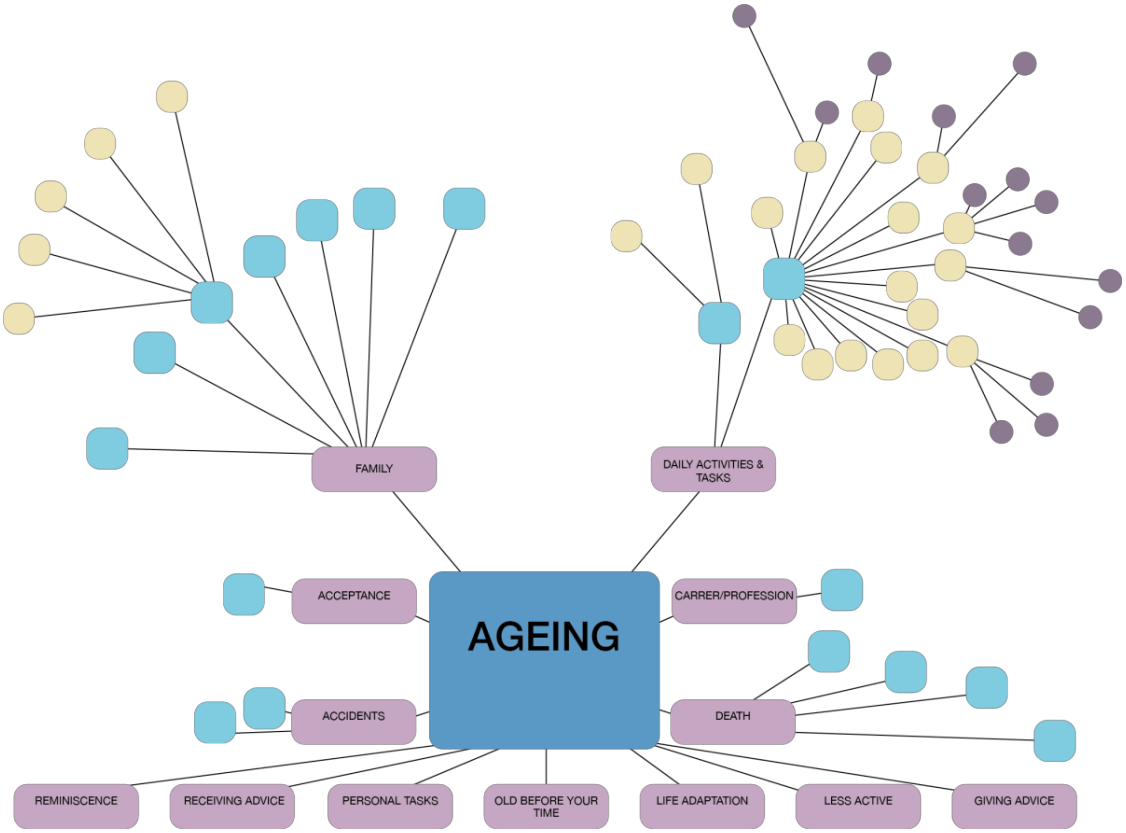

Figure 5 'Ageing' theme mapped connections from codes to categories, digital generated version

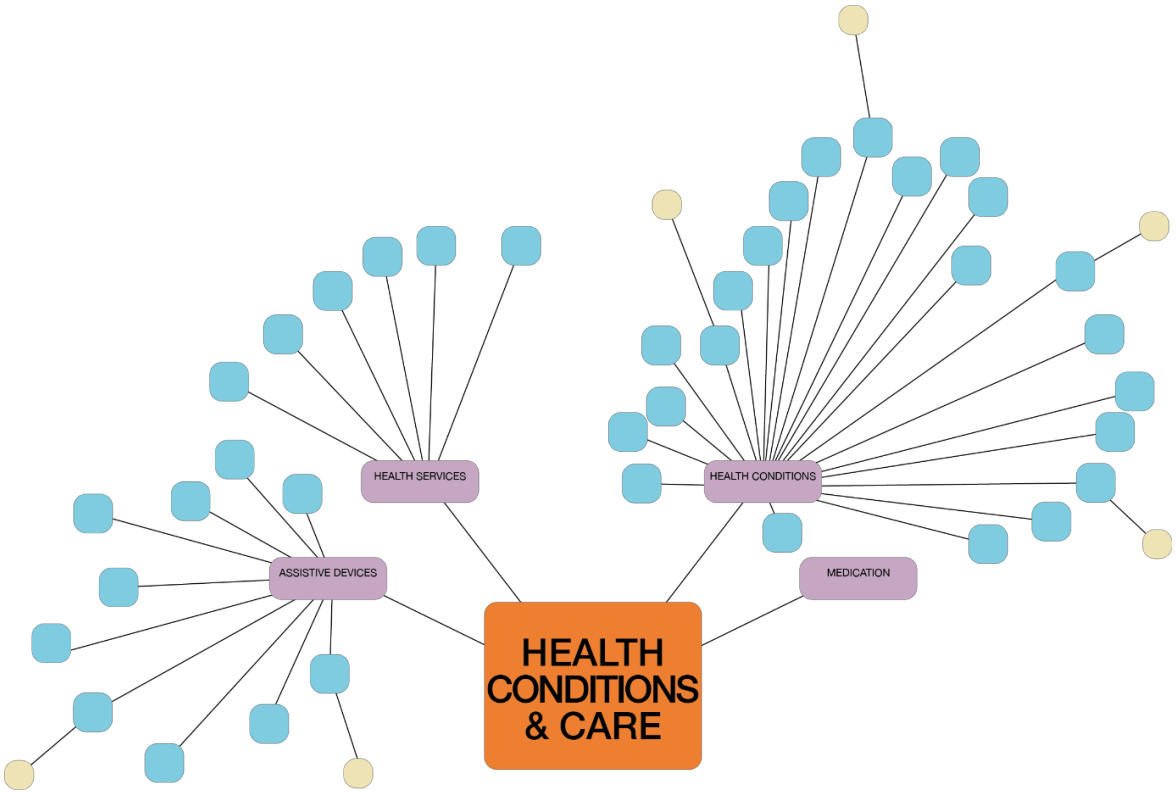

Figure 6 'Health Conditions and Care' theme, mapped connections from codes to categories, digital generated version.

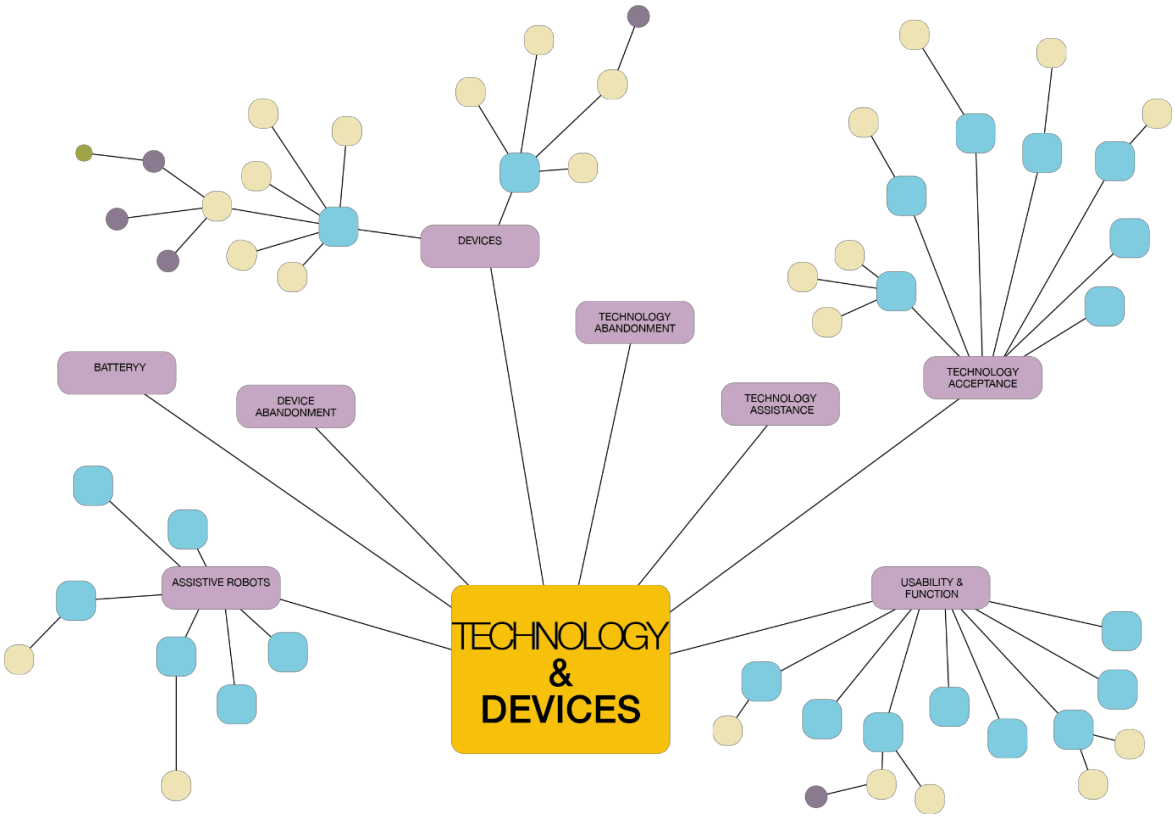

Figure 7 'Technology & Devices' theme, mapped connections from codes to categories, digital generated version.

Figures 8 and 9 detail the development graphically from **codes** (phase one) to **categories** (phase two) to **themes** (phase three). Starting from the outer circle the initial codes generated from transcribed interviews. The middle circle shows how the categories emerge, before finally the inner circle shows the themes. There are a series of one large and six smaller charts, the first showing the overall group and each of the six referring to each of the interview sessions (two were performed with 2 couples together).

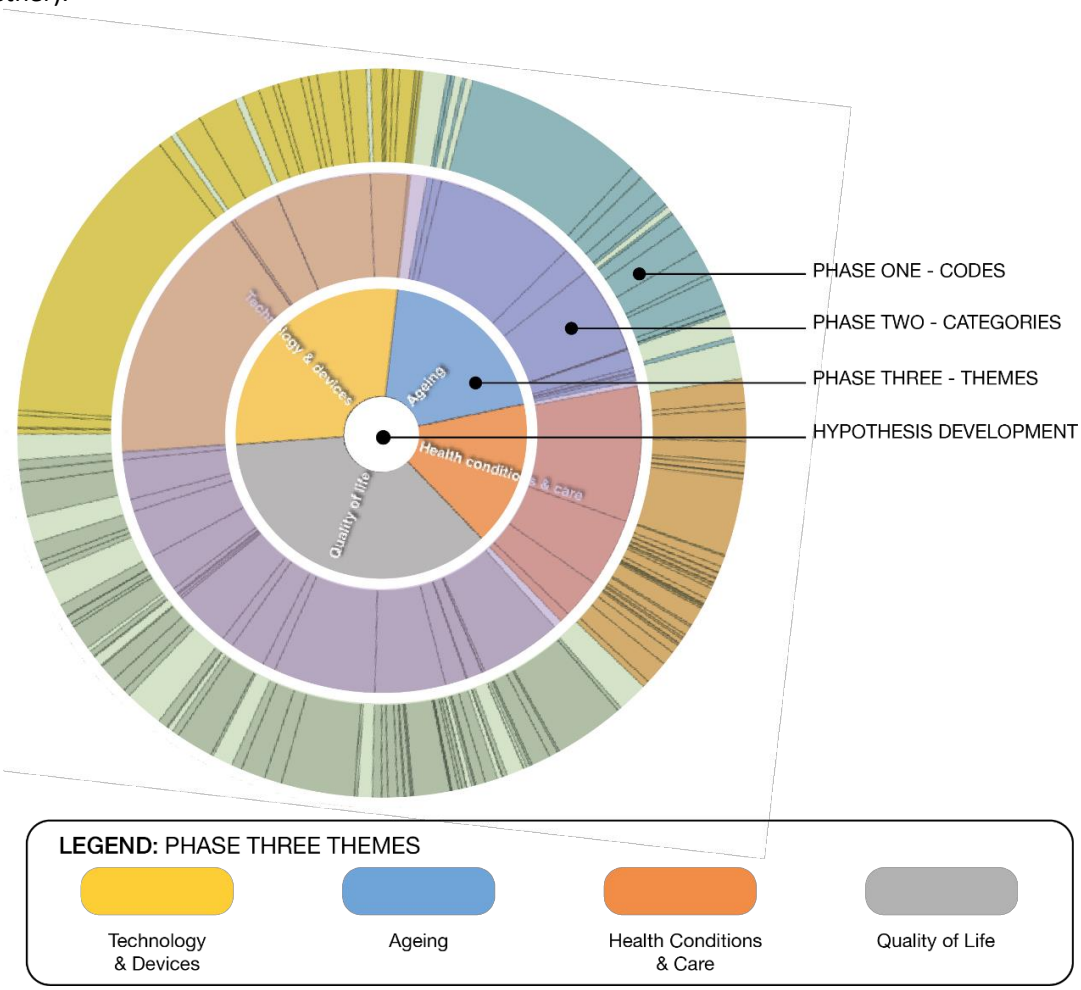

Figure 8 Graphical display of theme development from the overall group of eight participants, generated on Nvivo. Note how the outer circle (phase one) converges into phase two categories, and evolves finally, to the inner circle of themes.

Figure 9 Graphical display of theme development from each of the interview sessions, generated on Nvivo.

4.3 Session snapshots

As a means to share insight and the rich data expressed during the conversations, this section highlights and shares snapshots of responses by the participants (M= male; F= female).

Q1: What are your experiences using or helping someone to use assistive devices and/or technologies? –

Participant Eight (M) – "*He said [Consultant] I was severe sleep apnoea, and the next night was, now, we have to put you on machines and test, to see what strength you require, to tailor it [sleep apnoea machine], for my needs so, I rented it for the first year or two, then I thought, I'm renting this, and the man who supplies it – I asked - and what if I was to buy this? Well he said, I can sell you that machine, look it will do you for another two years, so half the price."*

Participant Three (F) – *"Oh, I have, they're left everywhere!"* [speaking of the numerous walking sticks in different areas of participants home].

Q1 a) Glasses or hearing aids;

Participant Four (F) – *"She [participants sister] takes it out [the hearing aid, when the participant phones her sister] she takes it out! And it's her family have told me what she's doing, but she won't admit it to me."*

Participant Seven (M) – *"I can hear the person beside me alright, if the person …people; if it's a babble of conversation and everyone's talking together, then I'm lost [problems trying to hear layers of conversation with hearing aids]."*

Q1 b) Computers or smart phones;

Participant Five (F) – *No, it's always on ringtone [mobile phone]. It fits in my pocket, it goes everywhere with me."*

Participant Six (M) – *"Another thing about the phone is, you have a line, that you, for medical reasons [or devices like personal alarms]no, but you can actually um, use, um, use other older aids if you like through the landline."*

Participant Two (M) – *"I have a smart phone, it's a hand me down from XXXX [daughter]."*

Q1 c) Rollator or wheelchairs.

Participant Eight (M) – *"I didn't realise how much you needed to know, how to balance a wheelchair, how to get it up and down."*

Participant Four (F) – *"I'll give you an example [helping someone in a wheelchair] about one particular man; he needed it [wheelchair] so badly, um, he got it, we were at a seaside resort and he got into the wheelchair and as he went down, closer to the house normally he would spend his holidays in. It was a B&B, he got out and he said, I don't want her [the landlady of B&B to see me [in a wheelchair] she mightn't take me."*

Q2: Describe any difficulties or barriers to using a technology device?

Participant Eight (M) – *"Doing things that involve money or cash, that mightn't be right, you hear so many things going wrong with that technology, you know what I mean? People scammed or doing this, you know what I mean? I'd be nervous in that sense to go that far, I should maybe, I should push myself more, not to bothering my kids, but they make it so easy for me."*

Participant Five (F) – *"I wouldn't be able to…" [fingers, isn't it Mum –participants daughter]* - participant has difficulty using key pads or any device that requires input with fingers.

Participant Three (F) – *"I don't understand them, and I have no use in … you know?"*

Participant Seven (M) – *"If it operates on a battery it has to be regularly charged."*

Participant Two (M) – *"I suppose the, um, the eh, things are too small. [mobile phone screens] The fingers are too big. The numbers there you know? yeah and you know like, now they're big enough [directed to iPad screen] but if you're writing something, it's [the text] very small."*

Q3: If you are/were to experience reduced mobility, how does/would it affect your way of life?

Participant Eight (M) - *"well there's only … I'd say you'd be trying to hide it more than anything, if you could, maybe that's not the right word 'hide' but sure look, pretend you're not as bad as you are. I wouldn't like to be a burden on my family."*

Participant Five (F) – *"It makes me feel bad that I can't do a lot of things for myself, you know, right now."*

Participant Four (F) – *"Well, I was to learn that very recently, I had, I pulled tendons and ligaments in my foot and eh, for me, it meant I couldn't leave the house without help. I live in the country [rural area] there is no public transport. I would be completely and utterly isolated."*

Q4: When I mention robotic assistive devices, describe what that means to you?

Participant Three (F) – *"It doesn't mean anything. I haven't seen them, I can't ever say I've seen them."*

Participant Seven (M) – *"I feel, well no, I think it's more than that, I think there's, eh, a personal relationship with these robots, unless; when they begin to break down, it's like a serious illness, you know; you almost know you need a new one. It's when your car gives you trouble, you need a new car, you have an attachment to the old car, but, at the same time, it's not as reliable, and you need something reliable."*

Participant Six (M) – *"Take the comparison like, what we were talking about earlier on; you needed to go to the toilet, or whatever it was. I don't think you would have any embarrassment about asking a machine to do it for you [assisting toileting]."*

Q5: What is your opinion of older adults being supported by robots to do tasks and activities?

Participant Eight (M) – *"Yes, to my family, I'd say, I'm with my… my friend [assistive robot] is with me today and they'd [family] say, oh you will be alright today, as I say, my friend is with me today, So, I'd accept it like, and the family would, yea, yea, 'Joe' [assistive robot] is with me, and we'd call him like…"*

Participant Three (F) – *"Sure it would get me to do more. I wouldn't be sitting down in the chair half the day sleeping, I'd love to be able to get around again. I'll never see 16 [again] anyhow."*

Participant Six (M) – *"let the person have that option, let that be one of their options [personalising or customising the robot] if they can take it from a photograph, whatever, and make him look like [for example] my husband, he's now doing things that he never did in his life when he was alive, so, you know, you know; yeah, mental, and physical, to their physical, emotional…"*

Q6: How do clothing and dressing options change as we age?

Participant Eight (M) – *"But, I mean if I don't, if I was I need something [shopping] I need milk or I think I need butter… If I have to buy another shopping bag, it'll kill me, so I got into the habit, I stick one [shopping bag] in the back pocket [of trousers]."*

Participant Five (F) – *"I know, yeah, going to the loo, trying to [remove tights] everything hurts [participant has arthritis in her hands]"*

Participant Four (F) – *"Well, things, you are trying to conceal, the bulges I suppose because they are there, and but eh, in addition to that you know, you don't have the curves that you had before so therefore you kind of tend to wear things that maybe are 'boxy' on you or maybe a little bulgy in the wrong places."*

Participant Six (M) – *"But, I think, colours express your mood as well. I think more so, again, with ladies, going… but you know, if you see someone in black all of the time, you can bet your bottom dollar that person's very down."*

The snapshots are brief insights to the descriptive answers by the participants, to initial six questions. Each session lasted between 40 mins and 1.5hours.

This study reveals many expressions and perceptions the older adult participants shared in relation to technology and its acceptance or abandonment. The participants expressed at times a sense of stigma, self; or observed, and likewise a dependence at times on others to support technology use and acceptance.

The participants expressed commentary on various technology devices and service systems. In relation to robotic assistive devices, there was a range of opinion, from not knowing or showing interest in the potential of robot assistance, to visualising an emotional connection and personalisation of them e.g. giving the robot a name. In relation to stigma, it appears that there is an attempt by some people to cover up or disguise a condition (e.g. poor hearing). However, becoming a burden is a worry and cause of anxiety among some of the participants. At times, some of the participants referred to older adults in a way that deflected from their ageing (e.g referring to 'granny shoes' they wouldn't wear; other older adult friends of a similar age, that needed their help). Personal appearance was perceived and expressed as a determinant sometimes of someone's mood (e.g. the colours they wore) and a conscious effort to feel comfortable.

5 Discussion

The preliminary findings presented in this paper offer insights to the rich content by contextual enquiry, that can be undertaken with a relatively small group of participants. It offers expression of an intimate nature at times. This requires the build of trust and rapport between researcher and participant. The stories and share are a valuable commodity to draw on throughout the process of design. They are to be valued and captured with both respect and concern that the participant is heard, and their experiences voiced, with relevance to product or service system development. Participants can identify challenge or problems of use and experience with products or service systems. Designers' define and develop solutions that attempt to address the participants expressed problems. In addition, design research adds rigour by observing the unspoken, creatively logging and delivering insight that informs products and service system development that can enhance quality of life.

This study asked the older adult participants, what their perceptions were to newer technologies, by mentioning and discussing robots and exoskeletons. This introduction at times was challenging to visualise, and also insightful, with topics such as personalisation, colour, function and user-expectation being discussed. Existing TAMs that are designed to gauge acceptance and use of robots or technology devices by older adults afford some enquiry to constructs such as adaptability and trust, however the nature of a wearable exoskeleton (e.g. xosoft) may become, in effect an item of clothing with various features that require understanding and use potential & optimisation.

Examples of some of the questions raised by the participants in this study:

- How to put it on and take it off?
- Would it be noisy?
- How fast would it go?
- What would it cost?
- How would it operate (e.g. battery) – does it need to be charged? And remembered to?
- Wearability – People wearing the same item and other people noticing or knowing, it's the 'same trousers'
- Aesthetics – what it would look like, and look like when wearing?
- Human Factors concerns – e.g. Diabetes, arthritic hands/joints etc.
- Collision detection/falls would it know or protect you?

To date there does not appear to be a TAM or tool that can effectively capture exoskeleton or robotic assistive device acceptance and use, studies such as the one discussed in this paper, could provide the basis for such a tool.

5.1 Research limitations

This paper discusses preliminary findings from a cross section of eight participants involved in a larger study that involved twenty-four older adult participants. Due to the rigour of the process and time constraints, a cross section of the study was analysed to highlight the insights and experiences shared during the interview sessions. In addition, it can be a caution to interview two people together in a conjoint interview setting. There is a risk that one participant may feel less inclined to openly be expressive and commit commentary to the session. However, it can also be an empowering and rich experience where stories can have heightened perspectives shared and discussed collectively.

It was acknowledged that despite the older adult participants being independent, and living in their own homes in the community, that in some instances, 'gatekeepers', i.e. family members may be aware of the research and visits to homes of participants. It was envisaged that should this present as a problem, that there would be an openness and an effort to build trust between the gatekeeper and researcher. During the study, an episode was encountered where the daughter of one of the participants spoke on the phone to enquire more about what would happen during the session. The participant in question lived with her daughter, and family. It was important that everyone was comfortable in this scenario, and the researcher successfully overcame this challenge by building rapport with the daughter and inviting the daughter to feel free to sit in on the session if participant was happy with this. The session was conducted comfortably for all.

6 Conclusions

This study was an endeavour that facilitated freefall contextual enquiry by the researcher with older adult participants. The accommodation and openness shared by the participants revealed intimate share of the world through their eyes. In addition, opportunity presented to see and engage with devices typically associated with ageing, and support by assistive devices, i.e. walking sticks, stair lifts and sleep apnoea mask. These devices have become part of day to day life for some of the participants. Insights such as, the participant with sleep apnoea having to ensure the device is packed as part of holiday luggage to ensure a pleasant and healthy holiday.

The methods presented here display rigour and application of work collected and gathered out in the field and driven by real commentary and perceptions by the older adult participants. Older adults have a tacit understanding, and experience of life that is new – ageing happens only once - we are alive until we die. The older adult participants discussed, what can be conceived as 'sensitive' topics such as death, the loss of a partner, the feelings of being a burden. Tasks such as dressing or needing assistance were on occasion empowering but also acknowledged as an aspect of physical decline awareness. The recollection of one participant (aged 81) arriving to an interview carrying a 'dashcam' that they would fit themselves, highlights the embrace of technology, yet conversely another participant preferring the assistance of family, to new technology or technology tasks (i.e. updates on computers, shopping online). This diversity of technology adoption by the older adult participants endorses this study and the potential for support tools development that assist understanding to technology acceptance.

It is clear from the experiences shared by the older adult participants that there are many pleasures, and causes of frustration, or anxiety to the use and acceptance of technology as we age. Likewise, the presence and potential of robots and robotic assistive devices is an area yet to present measurement or acuity by older adults. As an emerging technology, there is a need to enquire and express further the needs requirements of the ageing population and the acceptance and use of these devices in day to day activities and tasks.

The findings of this study require further analysis and build to incorporate the findings of the remaining 16 participants insights. When this work is completed, it will be compared and contrasted separately and collectively to understand and define a hypothesis that directs the build potential of a Technology Acceptance Model that is not currently available, namely an evaluation tool to gauge technology acceptance by older adults to assistive robots, and specifically exoskeletons.

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