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Aging and Everyday Technology

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Abstract

This paper presents a literature review and indicative findings that are part of ongoing research into aging and technology. The review finds that research on older technology users has contributed valuable information on the impact of age-related changes on technology use, as well as older adults' acceptance and adoption of contemporary technologies. However, the majority of the research has been conducted from the perspective of age-related differences in use and performance, or it is medically-focused, examining the potential of technology to improve an individual's quality of life (QoL), for example. Research on older people and technology does not adequately address the integration of technology into the everyday lives of older people. This paper identifies that there is substantial opportunity to examine older users' everyday information and communication technology (ICT) use, and to inform technology design beyond measures of performance, usability and adoption.

Older adults; Technology use; Technology design; Human factors

Most developed nations are simultaneously experiencing two unprecedented transformations; a rapidly aging population running parallel with exceptional advances in information and communication technology (ICT). Declining birth rates and increased life expectancies mean populations worldwide are getting older. Equal to this rapid population shift is the rate of technology's integration into nearly every activity of everyday life (Coughlin, D'Ambrosio, Reimer, & Pratt, 2007). Innovations in design and manufacturing have revolutionised how we access information and have extended our understanding of what it means to communicate and be connected. Interacting with a computer is no longer about sitting in front of a desktop. When calling a taxi or the doctor's office, people are often greeted by

Interactive Voice Response (IVR) systems (Miller, Gagnon, Talbot, & Messier, 2013) and services like Medicare (Australian Government Department of Human Services, 2014) now promote their website as the main point of contact. Private companies have moved to online billing and emergency service organisations are using social media to communicate with the public (Queensland Police Service, 2014). Today many older people are being confronted with technical innovations well beyond an ATM or digital camera; remote healthcare (Coughlin et al., 2007; Mitzner et al., 2010), email (Sayago & Blat, 2010), social networking (Braun, 2013; Lehtinen, Näsänen, & Sarvas, 2009) and smart home technologies (Coughlin et al., 2007) are just a few of these.

There are several fields relevant to understanding older people and technology. This review is therefore multi-disciplinary, but not exhaustive, and forms part of a larger review and on-going research. The 44 papers included here have been analysed by the overall focus of the publication (Figure 1) and by the type of methods used (Figure 2).The social and behavioural sciences, health, business, information technology and human-computer interaction are some of the main contributors to literature in this area. These areas guide the background and focus for much of the related research and commentary (Figure 1).

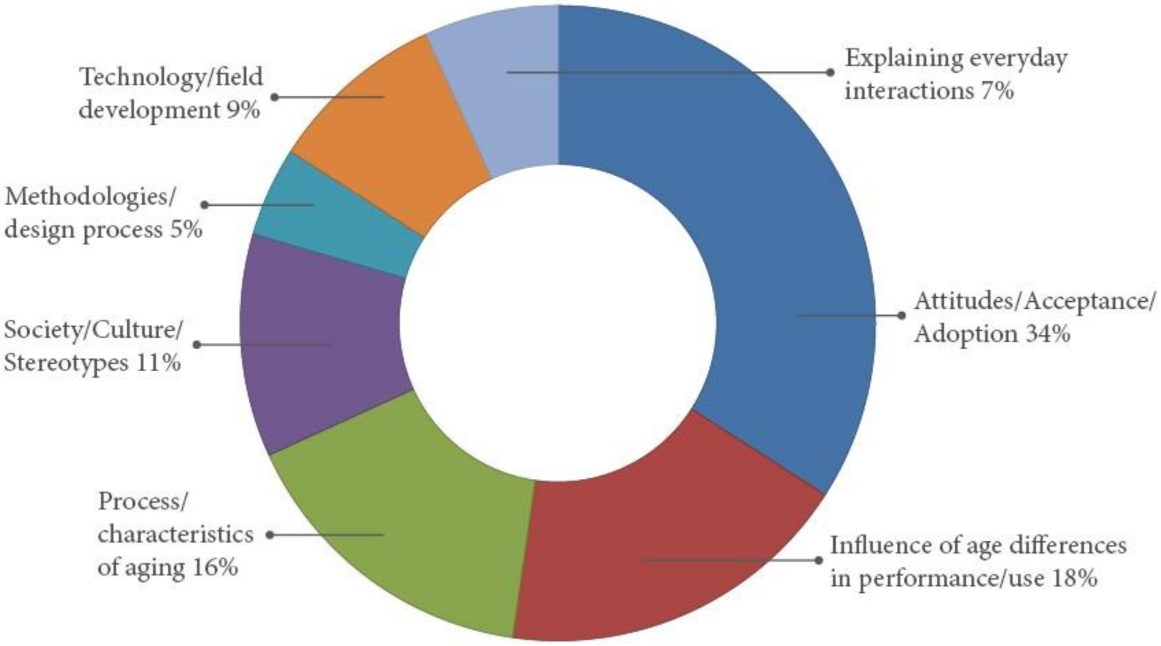

Figure 1 Focus of literature on aging and technology

The social sciences and medicine have provided an in-depth understanding of core aging issues, especially the characteristics of physical, sensory and cognitive decline (Birren & Schaie, 2011) (Process/characteristics of aging in Figure 1). Business and psychology together have established many of the processes and antecedents surrounding older people's perceptions and attitudes towards technology, as well as reasons for and barriers to its adoption and use (34% of literature from review, Figure 1) (Baron, Patterson, & Harris, 2006; Coughlin et al., 2007; Czaja et al., 2006; Melenhorst, Rogers, & Caylor, 2001; Mitzner et al., 2010; O'Brien et al., 2008). Gerontology emerged in the 1940s and 50s as the scientific study of aging when, for the first time, aging started to be considered a serious social issue (Blaikie, 1999). More recently the field of gerontechnology began specifically looking at how technology can support the needs of an aging society (Bouma, Fozard, Bouwhuis, & Taipale, 2007; Plaza, Martín, Martin, & Medrano, 2011).

While there is a significant amount of work translating characteristics of cognitive and physical decline into guidelines for designers (Fisk, Rogers, Charness, Czaja, & Sharit, 2004), research on older people and technology has generally been limited. That which exists is often health-focused, concerned with such things as QoL and health monitoring (see Gaßner & Conrad, 2010 for an extensive insight into technologies related to Ambient Assisted Living). Or, it has been conducted from the perspective of age-related differences in performance, knowledge and experience levels (Blackler, Popovic, Mahar, Reddy, & Lawry, 2012). Other studies break older adults' technology use into categories (Mitzner et al., 2010; Olson, O'Brien, Rogers, & Charness, 2011), providing an extensive amount of information on what types of technologies older people are using, what they are using them for and what they think about them. The goal of an overwhelming majority of the work is to develop an understanding of older adults' technology use in order to increase adoption and effective use.

Figure 2 provides an overview of the types of methods used in the 44 papers contained in this review. Some studies described more than one method; interviews and performance experiments, for example. So in all, 53 instances, of various methods were identified. A substantial number of studies exploring the task performance of older adults employed pre-selected or simulated devices within a lab setting (e.g. Blackler et al., 2012).

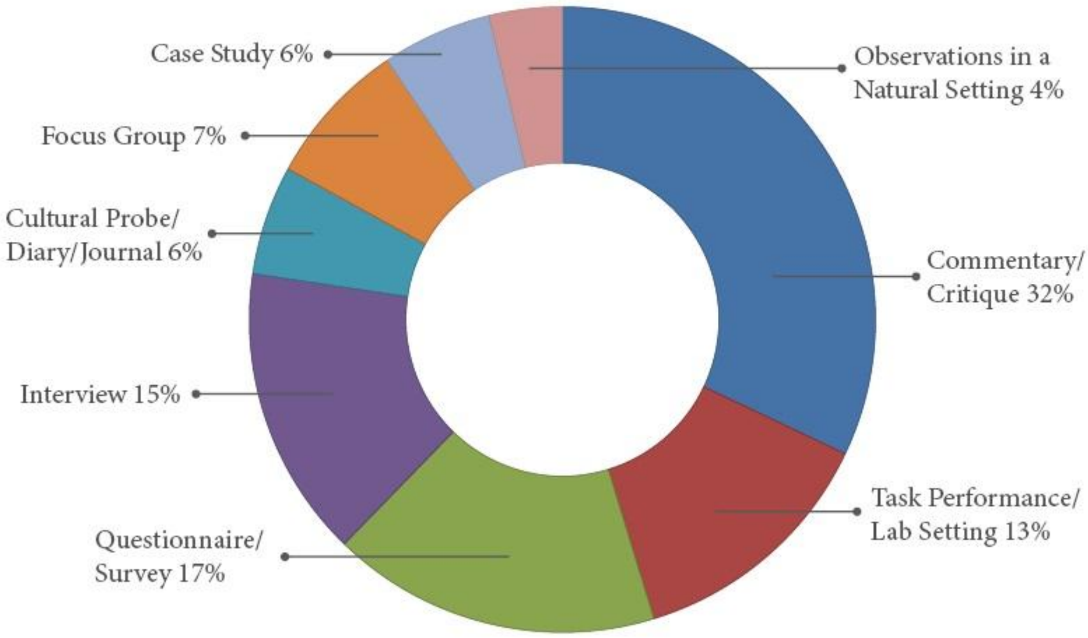

Figure 2 Types of methods used

Others used experience questionnaires (O'Brien et al., 2008; Olson et al., 2011) or self-reporting techniques such as surveys, journals or diaries (O'Brien, Rogers, & Fisk, 2012).With the exception of a few studies (Ames, Go, Kaye, & Spasojevic, 2010; Lawry, Popovic, & Blackler, 2010; Sayago & Blat, 2010), there is a distinct lack of observation of older people's natural technology interactions, of their *actual use behaviour*.

Notwithstanding the importance of current initiatives supporting QoL and independent living, when related to understanding the relationship people have with technology, these types of initiatives have been criticised for being technologically deterministic - much less about real human need and much more about exploiting the capabilities of the software (Bannon, 2011). Computing was once the domain of organisational use, where efficiency and adoption were essential for success. Technology is now so connected to our everyday lives though that usability, efficiency and adoption are no longer sufficient measures of successful design. O'Brien et al (2012) suggest that ethnographic, observational studies are needed to understand older people's technology interactions in greater depth.

This paper will discuss the most salient themes on older people and technology and identify gaps in the literature that form the focus of ongoing research. Some indicative results from the related research are presented and briefly discussed.

Defining Older Adults and Aging

Age brackets and definitions vary in the related literature. Older adults are defined as 60+ (Kurniawan, 2008; Selwyn, Gorard, Furlong, & Madden, 2003), 65+ (Mitzner et al., 2010) and 65-75 (O'Brien et al., 2012). They are older adults, seniors and elderly (Plaza et al., 2011), young-old and old-old (Schaie, 2010). Confusing this conversation even further, are the varying terms used in aging research, and in attempts to interpret what it means to *age well*: active aging, successful aging, healthy aging, positive aging, productive aging and, related to technology, silver surfers, just to name a few.

In 2016 the oldest of the post-war baby boomers will be hitting their seventies. This will have massive economic and societal implications for developed countries. While aging definitions may vary, the view that this next generation is remarkably different from any group that have gone before them does not (Gilleard & Higgs, 2002). This next group of older people are living longer, generally healthier, lives. They are not strangers to technology and they are expected to have an entirely different relationship with it than that of their predecessors. In spite of this, however, some age-related changes are almost inevitable and must be considered by designers in the creation of future ICTs.

Everyday Technologies and Age-Related Changes

Everyday technologies are considered to require minimal training or instruction. They facilitate everyday tasks and activities, even if those activities are not conducted every day (O'Brien & Rogers, 2013). Examples examined in the literature include microwave ovens (Blackler et al., 2012), mobile phones (Kurniawan, 2008), email (Sayago & Blat, 2010), and social networking sites (SNSs) (Braun, 2013) (see O'Brien et al., 2012 for everyday technologies by category). When compared to their younger counterparts, older people generally experience greater difficulty when interacting with these contemporary products and interfaces. They work more slowly, make more errors and show less familiarity (Blackler et al., 2012; O'Brien et al., 2012). These age-related differences are generally discussed in the literature as cognitive, physical and sensory, and attitudinal changes.

Cognitive Changes

Cognitive abilities have been identified as significant to successful technology interactions (Blackler et al., 2012). However, cognitive skills like the processing and retrieval of knowledge and information often decline with aging (Rogers, O'Brien, & Fisk, 2013). Age-related cognitive changes, such as smaller working memory, prove problematic during interactions with complex products and interfaces. These characteristics have immense significance given the increasing instance of digital technology interactions in everyday activities. Older adults will be slower at visual information searches and when taking on more than one task at a time. They have difficulty with deep menu structures and layered interfaces, for example.

Auditory and working memory were identified by Miller et al. (2013) as the most influential cognitive factors for success with interactive voice response (IVR) systems. Systems requiring more steps, or where participants (aged 65 and over) were required to remember instructions, proved problematic and a significant number of participants were unable to complete any of the set tasks.

Taha, Czaja, Sharit, and Morrow (2013) also found that declines in cognitive abilities that support reasoning, such as working memory and visuospatial skills, had a negative impact on an older person's ability to perform complex tasks with an online personal health record (PHR). Older adults experienced difficulty navigating a PHR and in interpreting the graphical health-related information it contained.

Other studies have examined age-related differences in the use of experience and knowledge during everyday technology interactions (Blackler et al., 2012; O'Brien et al., 2012; Olson et al., 2011). O'Brien et al., (2012) found that regardless of experience or age, users accessed a variety of prior knowledge during interactions including technical, functional and strategic knowledge. They suggested that understanding the different types of prior knowledge could be used to guide the design of better technologies and systems for older people.

While cognitive abilities are repeatedly identified as having the greatest impact on an older person's technology interactions, some of the most obvious age-related changes are seen in decline to physical and sensory abilities. These too must be given consideration in the design of ICTs.

Physical and Sensory Changes

Essentially all changes associated with aging are governed by the brain and its cognitive systems. Some of these changes, however, have an impact on a person's physical abilities. Some are brought on by injury, illness or stroke but many are present in normal aging as well (Charness & Holley, 2004). While there are many consequences of the physical changes experienced by older adults, changes to posture, balance and gait, for example, the ones discussed here are particularly relevant to interactions with ICTs.

As people age they experience decreases in movement control, speed, coordination, sensation and perception (Ketcham & Stelmach, 2001; Rogers et al., 2013). Decreases in movement control affect both broad and fine motor movement. For some older adults the precise actions involved in using a keyboard or a pointing device, performing *click and drag* motions for example, are not only difficult, but painful (Charness & Holley, 2004).

Sensation and perception is about the immediate processing of information from the environment - touch, vision and hearing (Baddeley, 1999; Rogers et al., 2013). While this information processing is effectively a cognitive ability, the senses allow a person to judge whether their physical interactions have been accurate and effective; applying enough pressure to an icon on a touch screen, adjusting volume appropriately, or the coordination of a mouse and cursor (Rogers et al., 2013). Declines in sensation and perception will have a negative impact on the abilities required to perform double-tapping and pinching interactions on touch-screen devices. Older adults will take longer and will be more inaccurate when performing certain tasks. They will experience particular difficulty with devices that have small elements, controls that are close together, and operations that require speed (Rogers et al., 2013). The use of mobile phones, text messaging (Kurniawan, 2008; Plaza et al., 2011) and IVRs (Miller et al., 2013) are perfect examples of technology interactions requiring these types of skills.

Physical changes to the retina will see most older adults experience some form of visual impairment; a reduction in colour sensitivity, in the ability to identify fine details (e.g. text), as well as an increased sensitivity to glare (Charness & Holley, 2004). It is thought that decline in other areas forces an increased reliance on vision, thereby further slowing physical movement and increasing errors (Ketcham & Stelmach, 2001). Most adults will also be affected by some hearing loss by the age of 70 (Charness & Holley, 2004). As sound is frequently used to provide feedback in technology interactions, changes to hearing must be considered in the design of interfaces and systems. Design implications of sensory decline are reflected in larger keypads, cursor speed and font adjustment, appropriate colour selection and increased contrast. As well as affecting the ability to interact with technology, age-related cognitive and physical changes also have an influence on older adults' attitudes towards technology.

Attitudinal Changes

Beyond physical and cognitive differences, older people are generally slower to engage with and adopt new technologies (Olson et al., 2011). Some older people cite difficulties understanding the terminology and jargon (Sayago & Blat, 2010), while others are simply not interested in using them or have flat out refused almost on principle (Selwyn et al., 2003).

Negative perceptions of technology have been found to create barriers to technology use and adoption (Coughlin et al., 2007; Lehtinen et al., 2009; Melenhorst et al., 2001). Even though older people were now surrounded by “beneficial, empowering and magical new technologies” (Selwyn et al., 2003, p. 25), Selwyn et al reported that many older people found little everyday advantage or pleasure in using them; they were ambivalent to ICT, citing it as irrelevant to their lives. Given the pervasive nature of technology, and its integration with everyday activities, this lack of engagement presents potential issues for older people.

In two case studies using a tablet device with a touchscreen, Barnard, Bradley, Hodgson, and Lloyd (2013) found that older people’s experiences of *learning* a new technology are dependent both on the characteristics of the technology - affordances, transparency, feedback and error recovery, as well as on the perceptions and experiences of the individual - self efficacy, intention to learn and availability of support, for example. Czaja (2006) also found that while cognitive ability is important to everyday activities, it was not enough, and that both attitude and capability predicted computer use.

Social issues of accessibility, isolation and a loss of independence – all of which are exacerbated with age (Haddon, 2000) also influence the ways in which older people interact with technologies. Alongside attitude and capability, a factor such as limited access to technology minimises the features and functions used by older people, restricts their ability to manipulate settings or customise options, and may guide the activities older people use technology for in general (O’Brien et al., 2008; Olson et al., 2011; Selwyn et al., 2003). These types of social issues not only influence older peoples’ perceptions of technology, but their likelihood of adoption as well.

A large majority (34% in Figure 1) of technology research has been focused on the concepts of acceptance and adoption. These concepts stem from the influential Technology Acceptance Model (TAM) (Benbasat & Barki, 2007). TAM finds its origins in psychology and in well-established behavioural theories illustrating that a person’s behaviour is determined by their intentions and beliefs (Ajzen, 1991). TAM evolved from applying these theories to an organisational IT context (Benbasat & Barki, 2007). The enormous amount of work based on TAM has resulted in various models with new constructs including but not limited to; usability, hedonic motivation and self actualisation, perceived need, price value and habit (Conci, Pianesi, & Zancanaro, 2009; Venkatesh & Bala, 2008). Perceived Usefulness (PU), and its antecedent, Perceived Ease of Use (PEoU) have emerged as perhaps the most influential factors to technology acceptance (Benbasat & Barki, 2007).

Heart and Kalderon (2011) found that although adoption of ICT by older people had significantly increased, they were slower to adopt ICTs compared to other digital devices such as DVD players or digital cameras. Barriers to adoption included PU, age and attitude. Without being able to see a need for the technology older people were less likely to use it. The authors noted that, given the increased experience with computers older adults have had over the last few decades, they may be more likely to adopt ICTs in the future. Conci et al. (2009) had similar results. Their study found that while the mobile phone was ultimately considered a utilitarian device, the motivations for use were often influenced by intrinsic needs. Needs such as self-actualisation and enjoyment helped to increase PU and PEoU, thereby reducing cognitive load and increasing the likelihood of adoption. However, Braun (2013) found that ease of use did not influence older adults' use of social networking sites, but that PU, trust in the service and frequency of internet use did.

Research using TAM has traditionally been conducted from an organisational context and therefore predominantly concerned with non-discretionary use – (e.g. *How do we successfully roll out this new software so that our employees will accept it more easily*). Considering technology's integration into everyday activities, however, there seems to be greater discretionary use as well as an increasing lack of choice. In many instances today acceptance and adoption is non-negotiable. In their critique of TAM, Benbasat and Barki (2007) suggest that a broader perspective is required, "one that includes users' adaptation, learning and reinvention behaviours... a more faithful representation of usage activities" (p. 215).

Studies of Actual Use Behaviour

Technology's evolution from task-oriented, organisational environments, to everyday activities involving play and enjoyment has necessitated a change in understanding of both use and user (Kelly & Matthews, 2014). Depending on the academic perspective, *use* is often represented by adoption and acceptance, by functional usability and context of use. *User* is reflected in user testing, user experience, user interface, user-centred design and more recently, user-generated content. However, these concepts often take on a *techno-centric* perspective (Grudin, 1993 in Kelly & Matthews, 2014). Certainly where the older population is concerned, research is often conducted in a laboratory setting, with predetermined tasks or goals measuring performance, speed and errors. These do not adequately explain what people are actually doing with a product or the role that it plays in their lives.

Sayago and Blat (2010) suggest that while a considerable amount of attention has been focused on how age-related changes affect older people's use of ICT, far less has been given to their daily practices with ICT. In a three-year ethnographic study focused on older people's use of email, Sayago and Blat (2010) found that participants often managed their email in a similar manner to how they would have managed their paper mail. While they would use the send, forward and view functions, others, such as saving attachments, message filing and contacts lists were irrelevant. Older people would be more likely to use their glasses rather than the enlarged font option provided. The research also identified distinct patterns of email use for older people, where what was intended and designed as an individual activity became a social one of sharing and intimacy building with close family and friends.

A study by Ames et al. (2010) provides an interesting observation about how families use videochat technologies such as Skype and iChat. Importantly the study is not technically driven. Nor is it concerned with measuring the speed or efficiency of people's task performance. Instead the authors provide a detailed picture of the everyday interactions between people and technology; how the technology is incorporated into the living space, for example, how it guides the way people interact with each other and how it contributes to fundamental family communication. Ames et al. (2010) identified two main categories of work involved with home videochat systems, Technical work and Social work. Technical work represented software, network and hardware issues – poor audio quality and internet connections, for example. Social work represented such things as finding the time and energy to have the conversation, managing the behaviour of children, and maintaining presentation and appearances - both personal appearances and the physical space. Social work was often dictated by the technical equipment, for example parents used the mirrored inset video of themselves to tidy-up both their children and the part of the house that was visible on screen. And the narrow field of view of most web-cameras meant that families often had to squeeze into small spaces and Grandparents on the other end of the call had to be directed back into the frame. Despite the work required, Ames et al. (2010) noted that the technology allowed a group communication that reinforced family identity, and provided benefits for children, parents and grandparents. These benefits, however, were dependent on the success of the technical work and on the system running properly. Ames et al. (2010) suggested that given better Wi-Fi capabilities, and increased physical and social mobility, the need for affordable and reliable communication tools that are appropriate for many generations will only increase.

The study by Ames et al. (2010) is a clear illustration of technology's shift from organisation contexts and further into social ones. This shift means older people are increasingly likely to use, and be required to use, technology in everyday activities. Technology design must therefore be grounded in an understanding of the cognitive, physical and attitudinal changes discussed above. However, everybody ages differently, and the process occurs within a societal setting, influenced by individual culture, history and life course (Blaikie, 1999).

Perceptions of Aging

The baby boomers are the next generation of older people. They are a diverse group that grew up in a time of relative peace and prosperity; they were the first to experience electronic media, were influenced by international events and participated in protest movements. Gilleard and Higgs (2002) point to the importance of recognising this historical influence. With unprecedented changes to work, work environments and technologies, coupled with increased wealth, access to education and leisure time, the baby boomers "broke the mould of the modern life course" (Gilleard & Higgs, 2002, p. 376). This shift completely set them apart from any other birth cohort. Indeed, Gilleard and Higgs (2002) speak of a generational consciousness that comes from being a part of the group whose attitudes and values were formed in the "youth culture of the sixties" (p. 376).

However, society's perceptions of the older population are generally based on views formed in the twentieth century. Perceptions of dependency and medicalisation still exist today, and have been the catalyst for studies, policies and initiatives that tend to focus an exaggerated amount of attention towards decline aspects of aging (Blaikie, 1999). There is growing evidence suggesting that measures of biological decline and chronological age be replaced with alternatives such as functional or social age (Dixon, 2010).

The baby boomers are living longer, healthier, more active lives than any group to go before them. And while they have not grown up with technology in the way that today's children are, most have had significant experience with it in their working life, and later personal lives (Haddon, 2000). On the whole, they are predicted to be a wealthier group that will rely less on the aged pension and will increase demand in lifestyle industries such as travel and leisure during their retirement. Beyond biological, age-related changes, technology design must also take these social and generational differences into account.

Unanswered Questions and On-going Research

The underlying theme of most research related to aging and technology is the importance of older people's engagement with ICT; that in this *information society* (Selwyn et al., 2003) increased adoption by older people will lead to improved QoL and independence, while a lack of engagement will leave them disadvantaged and isolated. This is a genuine and well-founded position. The perspective, however, tends to consistently understand older people in terms of age-related decline or age-related barriers, typecasting them as less-capable and less-willing users of technology. Here, the potential of technology is understood as something enabling and assistive.

Existing research on older people and technology misses opportunities that would come from an understanding of natural technology use, one less focused on tasks measuring speed or errors. Knowing that a person uses a technology, that they accept it or adopt it, is not the same as understanding what they actually *do* with it. Existing research does not explain the relationship older people have with everyday technologies. How are technologies fitting into the everyday lives of older people? How do they use their devices to perform various tasks? And what can be learned from their typical everyday activities in order to inform better technology experiences? Ongoing research is beginning to explore the everyday technology use of older people and some preliminary findings are discussed below.

An anonymous questionnaire about use of ICT (available both online and on paper) was completed by 168 people aged 60-plus. Just over 70% of participants were from Australia, with the remainder from Canada, the United States, the United Kingdom, India, Mauritius and New Zealand. Preliminary analysis suggests that 92% of respondents use the Internet. Participants were asked to rate on a six-point scale from *Do not use* to *Impossible* how difficult it would be to give up certain devices and services (Figure 3). Just over 50% said they would find it either impossible or very hard to give up their personal computer, about 70% felt the same way about email, while 17% were that attached to social media such as Facebook and Twitter.

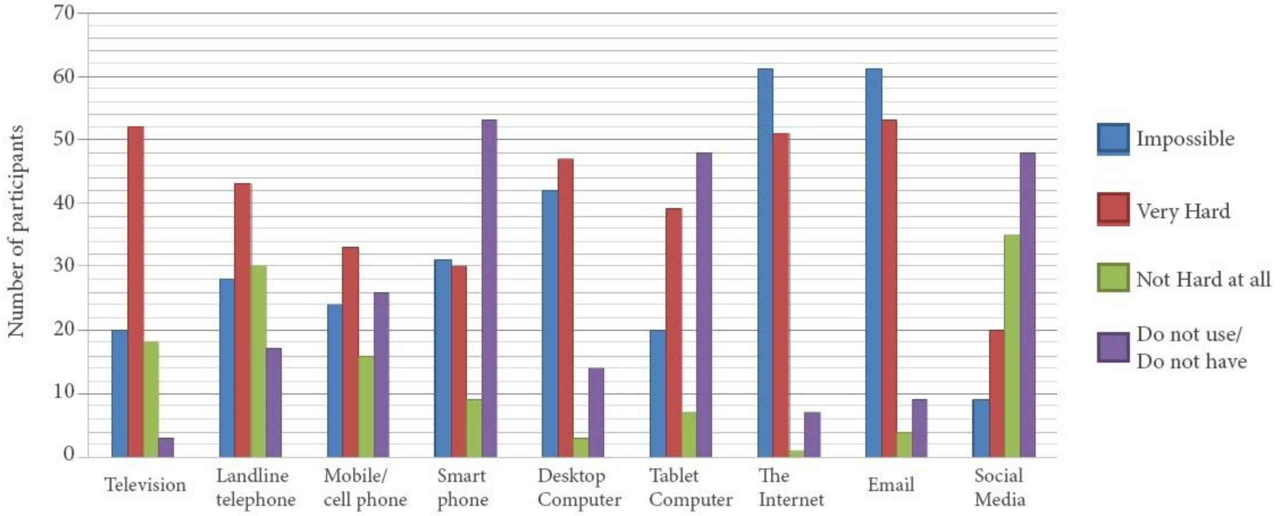

Figure 3 Level of difficulty to give up technologies already used by older people

Follow-up interviews with technology users are revealing that older people appreciate the varying ways technology allows them to communicate. Social media is seen as a platform for public broadcasting or for checking in on younger, geographically dispersed family members. Email is for detailed messages or communicating with groups of with friends and acquaintances. Text messaging is for conversations with the *inner-circle*. The majority of those interviewed disliked the intrusive, demanding aspect of actual phone calls.

While interviews are still on-going, of the technology users interviewed so far, nearly all have said they switch on a device first thing in the morning. The device varied, and so too did the reason for its use - reading the newspaper, email, checking the stock market - but consistently ICT has become part of the everyday routine. Older adults appreciate the connection to friends and information that ICT allows, but this connecting is done in their own time. Many prefer to keep the technology at arm's length, and make conscious, deliberate decisions to *disconnect* from time to time. While older people are still frustrated by the lack of attention given to fundamental age-related differences in design, they recognise that there are characteristics of technology that they will not understand –in maintenance and troubleshooting, for example. But these limitations are not a deterrent to use, rather they are something that is simply accepted.

The various and continually changing requirements for login details and service sign-ups are a regular source of frustration for older users. Older couples, for example, are forced to create false email accounts in order to gain access to services they would rather share because signup procedures only recognise one user, or one IP address or one email per account. Login details, passwords and pin numbers were identified as a significant point of frustration by nearly all of the older technology users interviewed in this research so far.

There also appears to be two distinct streams of use; that which is accepted as necessary, unavoidable, perhaps even mundane – online banking for example, and that influenced by personal interests and hobbies: studying through MOOC platforms, preparing digital scrapbooks, managing their own websites, organising tutorial slides for adult education, buying and selling on EBay.

Two other broad themes seem to be emerging that are not strictly related to personal use of technology, but rather take a bigger-picture perspective. Older adults regularly express concern for the next generation, particularly that of their grand-children's generation. This concern relates to the long-term impact technology use may have on fundamental skills such as writing and arithmetic, as well as personal communication and social skills. On the other hand, however, technology is seen as having the potential for greater good. That open access to such a wealth of information will only, in time, serve to breakdown barriers - something perhaps that as a generation they have been striving to do since the Sixties. These studies are revealing an enormous space for design inspired by the older population, design that looks beyond measures of performance and functional independence, and sees older people as active, engaged users of technology.

Implications for Research and Design

Research relating to technology and design for older people identifies age-related changes as influential factors in successful ICT use. Inspired by concepts like QoL and through assistive technology initiatives, substantial improvements have been made to the well-being of older adults. Now, with reduced costs and increased internet access, GPS tracking, fall detection and telehealth services are all available. Additionally, many of the fundamental interaction issues, such as poor contrast, font and screen size (Kurniawan, 2008), have been addressed in the customisable displays and interfaces of contemporary devices.

However, it seems one set of usability issues has been replaced with another. The complex design of many technologies still contributes to increased error and frustration for older people. While personalisation options are available on devices such as mobile phones, they are often buried deep within complex menu structures.

The focus of existing research has provided valuable information on the impact that age-related changes have on technology interactions, and this fundamental knowledge will still be relevant in the design of future systems. This next generation though, are expected to be considerably different to any group of older people to go before them. At least initially, they will have less interest in health-driven assistive devices. Few could have predicted just how rapidly ICT has become integrated into the everyday. Baby boomers have been firmly a part of that evolution. In order to envision the future technology space that this group will want to live in there needs to be a broadening of the perspective the design community has on older people. Designing for this space is not solely about supporting functional independence, but about living – reading, listening, creating, playing, communicating and sharing.

Conclusion

The literature presented in this paper, particularly that on age-related changes, is not new, especially to those involved in the related research. However, its incorporation into design still seems to lack effective interpretation. New devices and systems are often just as complex as the last, while those specifically intended for older adults are generally lacking in any considered design or are just over-simplified.

The information discussed here forms the basis for ongoing research exploring how older people use ICTs. The design of future systems has to stretch beyond the narrow focus of age-related decline. In order to design technology that is not only useful and usable for this next generation of older adults, but appropriate, engaging and meaningful, it is essential to understand the relationship that this diverse group of people have with technology now. Research needs to move beyond measures of performance, functionality and adoption and towards a deeper understanding of this user-technology relationship.

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