Making Space for Ageing: Embedding Social and Psychological Needs of Older People into Smart Home Technology

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1. Ageing at Home in Europe

Ageing populations present many challenges, both to individuals and to society at large.[1] Ageing itself is, according to the Lund Declaration (Svedin 2009), a major societal challenge of our time, affecting issues of economics and social inclusion. As a result of declining fertility, increasing longevity, and the availability of better healthcare, population ageing is a phenomenon that a growing number of countries worldwide are experiencing. Globally, the number of people aged 60 and over will nearly triple in size, increasing from 894 million in 2010 to 2.43 billion in 2050 (UNPD 2010). In Europe, one quarter of the population will be over the age of 65 by 2020 and the current trend of early retirement is expected to put great strain on spending for pension, as well as health and long term care (McLean, 2011). In 2010, 36 million people worldwide were identified as having dementia, with this number expected to climb to 115 million by 2050 (Mihailidis et al. 2012). Dementia is just one instance of a cognitive or physical ailment associated with ageing, and one of the many challenges that age related technologies and policies must anticipate and address in their support of Europe's ageing population. Regardless of age, however, having a home is undoubtedly one of the most basic of human needs: the right

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to adequate housing is founded and recognised under international law. Described under article 25(1) of the Universal Declaration of Human Rights, the right to adequate housing is one that has also been identified within other major international human rights treaties. Referring to much more than the robustness of a building, "adequate housing" encompasses also the intangible, but no less essential elements of what makes a dwelling into a home. This includes creating a private space that is secure and safe, which encloses and facilitates the formation and maintenance of human relationships and personal bonds. Without proper support, older people experiencing diminishing cognitive or physical capacities may be forced to relocate to a central care centre, such as a care home, regardless of whether they desire to do so or not. Supporting those who wish to remain independent in their own homes as they grow older, who wish to age "in place", should be central to any strategy addressing the challenges presented by ageing populations, both for the benefit of older individuals, and society as a whole. As the term suggests "ageing in place" refers to the ability to grow old in one's home. Supporting this involves the design of ICT-based solutions and structural modifications in a home to meet the resident's needs, thus enabling them to remain in their homes for a greater length of time than would otherwise be possible. Fostering ageing in place is desirable, not only as it can improve the quality of life of those who wish to remain in their homes, but also because it can reduce the cost and the burden that age-related institutional care poses to society. Creating smart solutions and services in the home environment can dramatically improve quality of life for older individuals. The capabilities of the "smart home" concept are still expanding. This is partly due to the rapid advance of ICT and to the fact that a smart home is not a single device, but rather involves the use and integration of many different types of technology, as well as input from service providers. With respect to both housing design and smart homes, there is no "common user" and, to be fully effective in the solution proposed, each design must fully reflect the specific needs of the person. These should address internal factors – such as any mobility or sensory issues they may have –, as well as external factors, for instance the geographic location of the home or the penetration of broadband in the area, which is a crucial element in deciding what solutions are beneficial or even possible in each case. Finally, in deciding the best course of action, it is necessary to consider the physical capabilities of those who live in the house, and the human factors relevant to the design. Effectively supporting ageing in place means addressing many challenges, particularly in designing for the user's capabilities. This means ensuring that both the physical space of the home and the social fabric woven through it

are accessible and open to the user, enhancing their independence and allowing them to live full, happy lives. In addition, older people in particular often live alone. Within the EU, just under half of older people over 65 years old (48.3 per cent) live as a couple, compared to 31.1 per cent living alone (Stula 2012). Although in some cases living alone is a deliberate choice, it can also be the result of the passage of time, such as the death of a spouse or the departure of grown children to homes of their own. Either way, for those for whom living alone is not a deliberate choice, smart and assistive technology can offer a way to carry on with their lifestyle and habits for longer. The home is more than bricks and mortar: it is the sum total of all meaningful social connections belonging to the residents. Considering the home in this manner reminds us that the needs we must address in supporting ageing in place extend beyond making the environment accessible; we must also support the psychological and social needs of the resident in order to maintain their well-being. In ancient Greek the word for the house was *oikos.* However, *oikos* can refer not just to the physical structure, but also to the social elements and the family unit, reflecting the social layer of home life. When understood as representing meaningful connections of people in the home environment, we can imagine the *oikos* of an older person living independently to include not just family members, but also the caregivers and regular visitors; those that interact with the older person on a regular basis and in person. In the case of older adults, the majority of these face-to-face interactions take place in the home, which becomes a social hub as well as a place to return when the day ends.

How can a smart home meet all of these needs without diminishing the social value of *oikos*? For the remainder of this chapter, we highlight the most pressing psychological and social implications that designers, researchers and policy makers must be aware of when considering the role of ICT in supporting ageing in place, and we will close with some proposed recommendations to assist in addressing the identified issues.

2. Home Rehabilitation and Re-structuring of Space

The concept of *oikos* is represented in the WHO's understanding of housing, as represented in the 2006 report on housing and health regulations in Europe. The report, which examined the relationship between the quality of housing and the health status of residents, identified housing as not just

a building, but the "conjunction of the dwelling, the home, the immediate environment and the community" (WHO 2006: 7). The WHO's "Global Age Friendly Cities" initiative aims to encourage cities and communities around the world to better meet the needs of their older populations The initiative relies on a WHO published document containing guidelines on how to be more open and accessible to older people across all aspects of the community, including outdoor space, transport and in promoting social participation. As part of making housing more accessible to older people, the guidelines make recommendations in nine different areas (WHO 2007): Affordability, Essential services, Design, Modifications, Maintenance, Ageing in place, Community integration, Housing options, and Living environment.

In order to support a person's desire to age in place, it is often necessary to rehabilitate the home, i.e. to adapt the home to account for the physical or cognitive decline of the resident. These guidelines highlight the need for the home to be altered to suit the resident´s needs, such as having hallways and spaces wide enough for a wheelchair, or appropriately designed bathrooms and kitchens. Such physical alterations are intended to increase the accessibility of the home, with special consideration paid to human factors in design, i.e. the characteristics of people and their interactions with their environment to perform specific activities (Fisk et al. 2009). How the home is rehabilitated will depend greatly on the specific capabilities of the person and the age-related changes they experience: such changes can include a decrease or loss of fine motor function or mobility, visual or auditory impairments, and cognitive decline (memory loss, dementia etc.). For older people experiencing mobility difficulties, it may no longer be practical to have to climb stairs to use the bathroom, for example. Depending on the specific context, a chair lift may remove the barrier the stairs pose to the accessibility of the home, although if the resident is unable to operate the device, or if the environment does not allow for its installation, it may then be necessary to move the bedroom or install a bathroom on the ground floor. Ageing often increases the overall fragility of a person, meaning that falls are both more likely and more damaging should they occur (Rockwood et al. 1994; Ambrose et al. 2013). Reducing the risk of a fall may require relatively minor changes to the home: installing handrails or removing trip hazards such as loose rugs are two examples of how this issue may be addressed without major structural changes to the environment. Devices such as wearable or ambient sensors show promise in reliably triggering an alarm should a fall occur, and demonstrate how supporting ageing in place can be achieved

through a combination of physical alterations to the home environment and careful implementation of ICT. Homelabs allow devices or alterations to be assessed in a homelike setting; recent initiatives such as the KUBIK project extend the concept. KUBIK is the product of collaboration between 28 international companies and is designed to allow companies to assess, not only minor alterations or ambient devices, but also light and wall placement, floor materials and many other environmental factors in a rapid and cost effective manner. Such approaches underscore the need to consider the impact of measures to support ageing in place, not just as individual alterations, but as a part of a larger integrated solution that serves the specific needs of the resident. According to the "Age Friendly Cities" guidelines, modifications to the home should not only be available but also affordable, and financial assistance should thus be provided to those that need it. In terms of ageing in place, the guidelines suggest that homes intended for older residents be located near services. In addition, these services should also be affordable and older people should be made aware of them, so that they can benefit from them. Assessing the cost effectiveness of smart homes for ageing in place is a complex task, particularly over longer periods of time (Magnusson/Hanson 2005); however, the cost of such a solution remains a concern for older people (Lê et al. 2012). The cost of smart home technologies (both the initial cost of a device and the ongoing cost of a subscription to a service) or the cost for the physical alteration of a house represent indeed a potentially serious barrier to their adoption. Essential services and suitable housing designs and modifications to support ageing in place need to be accessible to older people and, in this context, accessibility means that services are available, affordable and known.

3. ICT Solutions for Ageing in Place

Smart homes are intelligent environments designed to increase the quality of life of the resident: for older people with diminished cognitive or physical capacity, smart homes have potential to increase their independence. The goal in developing smart homes for older people is twofold: to support their ability to age in place and to control health care costs, which will only increase as the average age of the European population increases (Demiris/Hensel 2008). To meet this goal, smart homes must be equipped to increase the security of the resident and to reduce the risk of falls, stress, fear, iso-

lation and a wide variety of other potential issues (Morris et al. 2013). As such, "smart home devices" refer to a range of technologies that widely vary in both form and function and that can be placed or embedded in the home with the goal of improving the quality of life of the user. Within Europe, the Ambient Assisted Living Joint Programme (AAL JP), a European Commission financed funding activity initiated in 2008, seeks to encourage social, technological and business innovation to achieve:

- New models of service delivery and care that contributes to greater self-reliance for older adults and greater support for informal carers;
- Adapted living spaces that can improve the quality of their everyday lives;
- New ways for older people to remain active, including contributing as volunteers or providing mutual support;
- New ways of mobilising active and trusted networks, both formal and informal, professional and in kind, to provide all types of support.

The projects funded under the AAL JP illustrate the spread of technologies and functions that can be considered under the label of "smart home technologies", as well as the range of needs that technology may address. While some projects looked towards embedded or ambient sensors to assist in fall prevention (CARE, HOPE), others approached the same need addressed by way of wearable sensors (A2E2). Other AAL JP funded projects have directed their attention toward robotics (EXCITE, ALIAS), social networks (JOIN-IN, CVN, AWARE, OSTEOLINK), online services for connecting with care givers, health professionals or community groups (V2ME, SI-SCREEN, NOSTALGIA BITS), and serious games which provide older people with mental and physical exercises (SILVER GAME, GAMEUP, MOB MOTIVATOR). Smart home devices may be employed to address a specific need – for instance, to trigger an alarm in the event of a fall – or they may be part of a network with the broader goal of enhancing the user's quality of life. This can be achieved by increasing the security of the home (for example, sensors which trigger alarms if they detect smoke or water leakage, or which automatically turn off an appliance after a set amount of time), or by enhancing the independence of the user by assisting them in taking the correct medication at the correct time. Smart home technologies also have a commercial presence in Europe. Networked or "smart" devices already proliferate in the home, and each year sees companies push further into health related technologies for the home. Products such as the Nest Thermostat™,

which can be controlled remotely via a smartphone, and the SmarterKey™ lock, a keyless lock which, again, can be controlled via a dedicated smartphone app, represent recent examples of older aspects of the house being re-conceived as modern appliances, with a view toward making home life more energy-efficient or more convenient. In addition to enabling users to better manage home utilities, smart devices are also envisioned as a means to give users more control over their own health. The Aria™ WiFi Smart Scale, for instance, tells the user more than just their weight, it also claims to track the user's body fat percentage and BMI, tracking these data over a period of time and connecting to a computer or smartphone to allow them to track progress and set fitness goals. Such smart devices give a window into the world of the "internet of things", where household objects interact with each other and provide the user with data, or even gamified "objectives" to incentivise certain behaviours (eat more of a certain kind of food, run a certain distance per week, etc.). However, while discrete smart devices are increasingly a commercial normality, the fully integrated smart home concept is yet to appear on a large scale. In addition to initiatives such as the AAL JP, groups such as Smart Homes, a Dutch consultancy which specialises in promoting and assisting in the research of automated or smart home concepts, seek to champion their potential as effective eHealth and energy management tools in the future and help to create an environment where smart homes can become a viable and sustainable aspect of home life in the near future. Smart homes are intended to enhance the independence of the user by providing unobtrusive support systems that can meet their needs (Morris et al. 2013): in the case of older people, this can mean addressing the symptoms of cognitive or physical decline. However, there are other aspects of life that designers and policy makers must be aware of, and the effects of technology in the home can reach far beyond the original or intended goal.

4. Addressing the Social and Psychological Dimensions

The goal of the technologies listed above is to improve the quality of life of the user. This goal is often translated into addressing the diminishing capabilities – both physical and cognitive – of the user, enhancing their independence. User specific limitations and needs are taken into account during the design of smart technology through well-known design approaches like

the User-Centered Design and the task based design methodology (Rosson/ Carroll 2002; Fisk et al. 2009). However, there are other dimensions that should be considered when designing technology for ageing in place. Assessments of the quality of life of older people are largely health-focused, with indicators considering functional capacity, health status, psychological wellbeing, social support, morale, dependence, coping and adjustment, all of which are used as "proxies" for Quality of Life (QoL) assessment (Walker 2005). While these indicators cover a broad spectrum of issues relevant to the quality of life of older people living at home, they also limit comprehensive evaluations by not considering the subjective perspective of the older person whose quality of life is under evaluation. The shift toward recognising the quality of life of older people as a multi-dimensional concept means incorporating both objective and subjective aspects alongside expert assessments informed by the opinions and feedback of older people, and is reflected in the development of new assessment tools, such as the Subjective Evaluation of Individual Quality of Life (SEIQoL). With SEIQoL for example, the relative importance of individual factors affecting quality of life is not fixed, but established on a case-by-case basis through the use of interviews and visual aids, such as moveable pie charts (Barnes 2002). Supporting ageing in place is about meeting the needs of older people and enhancing their Quality of Life, and that this is increasingly seen as multifaceted, with more consideration given to subjective assessment. As a result, it is not sufficient to consider only the physical or purely objective health outcomes in the implementation of smart home technologies. The following issues, grouped under the umbrella of psychological and social dimensions of smart home assisted ageing in place, must also be considered and accounted for by all stakeholders involved in the creation of home solutions:

- Social isolation and loneliness
- Sense of identity
- Privacy
- Control
- Sense of identity
- Frustration and abandonment
- Acceptability of measures to support ageing in place.

Social Isolation and Loneliness

One of the greatest challenges to supporting ageing in place is the need to address social isolation and loneliness. A 2010 Eurostat study, "Social Participation and Social Isolation", found that the risk of social isolation increased as people aged (Lelkes 2010). This trend was found to be present to varying degrees across the EU. Half of the countries surveyed reported that at least 10 per cent of respondents over the age of 65 had no contact with friends, either in person or remotely. In Hungary and Lithuania, this figure rose to 25 per cent. With the exception of the Netherlands and Denmark, the study also reported that although the elderly are strongly affected by diminishing interaction with friends or relatives, "in many countries they can still rely on the help of others, to about the same extent as their younger compatriots" (ibid: 33). The findings of the Eurostat survey are valuable in that they provide an image of the pervasiveness of social isolation among older populations across Europe.

Addressing social isolation, particularly on a large scale, poses many difficulties as it can be the result of one, some or all of series of different factors connected to all aspects of the older person's life. Physical frailty, lack of finance, the location of the home, and changes in the older person's social circle (both family and peers) can all contribute to a greater or lesser degree to people being isolated from their community and society at large. Loneliness can be a product of this isolation and is reflective of dissatisfaction with the frequency or closeness of social relationships they have, when compared against what they would like to have (Steptoe et al. 2013). Social isolation has social, psychological and even physical implications for those who experience it, particularly those in need of care and assistance. A person is deemed to be isolated or not based on factors such as contact with other people, or the physical location of the home, while the feeling of loneliness is one of the psychological implications of isolation and has been associated with higher mortality in older men and women. Although it can be a symptom of cognitive or physical decline, loneliness is not in itself an illness: however, it does play a large role in a person's well-being and quality of life. Unlike social isolation, loneliness is largely subjective in that a person may have little contact with others throughout and be perfectly content. In contrast, social isolation can be assessed by evaluating frequency and quality of contact with others, ease of access to services and transport, ability to participate in social events, etc. Recent studies have found that, while loneliness did not have a measurable, direct impact on the mortality of older people (Steptoe et al. 2013), it can in-

crease the likelihood or rate of cognitive decline, with older people classed as "lonely" more than twice as likely to develop dementia (Wilson et al. 2007). While studies such as those by Eurostat (discussed above) illustrate the need to address social isolation and loneliness as a common need shared by older people across Europe, large scale policy or technological solutions alone cannot effectively address the challenge this need presents. Although older people across Europe may share a common risk of becoming isolated or lonely, it is a destination reached through many roads. That is not to say, however, that there is nothing to be achieved through careful and innovative implementation of ICT and smart home technologies. Services such as email have been available for some time, but the increase in the availability of video conferencing capabilities in home computers, phones and tablets allows for real time communication, with visual as well as auditory feedback to the users. ICT serves a social need by connecting family and friends, but to do so it must be available and accessible to all. It also should be viewed as a tool to enhance, not replace, human contact. In addition, while they may not provide the same level or quality of social interaction, services such as online shopping with delivery do allow older people to retain agency over an important part of daily life, restocking the home. This is, however, not without its own challenges, as it depends on the design of online shopping service being accessible, both to those with physical impairment (e.g. can the text be resized or recoloured for those with visual impairment) and for those with a lower level of digital literacy or less experience accessing services online (e.g. does each listed item have an image so the user can be sure about what s/he is purchasing?; is the service complicated to use without a high degree of digital literacy?). However, to those whose isolation is in part the result of deteriorating financial conditions, cost may prove to be a barrier to accessing technological solutions and, as such, they will not assist those experiencing isolation or loneliness without effective policy measures or innovative social strategies (e.g. a bus service that collects people from their homes and brings them to the town centre or market on specific days, or community groups that actively involve those that may otherwise grow isolated from those around them).

"Successful" implementation of ageing in place strategies requires that social isolation be addressed, and smart home technologies have the potential to be a powerful tool in doing so. Network technologies make it possible to communicate with people in ever more new and varied ways, allowing easier access to information, and to other people. However, addressing needs such as loneliness and social isolation requires a sensitive and deliberate

approach to implementing technology-based solutions in the homes of older people. Although these needs are commonly shared across Europe, the root causes behind it can vary wildly across individual instances and installing smart home technologies may fail to address them or – worse – exacerbate the situation and have a negative impact on the person's quality of life.

Sense of Identity

As people age the amount of time spent in their home increases (Walker 2005): the home is reflective of the individual's experiences and personality, which over time is imbued with its own identity. This identity is drawn from tradition, social cohesion, history, even through deliberate manipulation or alteration of the space to suit the needs and preferences of the occupant. As such, care must be taken when modifying the home to support ageing in place. The importance of a sense of identity in the environment is well studied with respect to care homes and is equally important in maintaining a sense of wellbeing with ageing in place (Robichaud et al. 2006; Oswald et al. 2007). This sense of identity is important, not only since preserving it reduces the risk of frustration and increasing the acceptability of adapting the home, but also because of the numerous positive implications on older people, particularly those with cognitive or physical impairments. Difficulties older people may have with activities of daily living are reduced when performed at home or in spaces they are very familiar with. Familiarity with the environment and its features enables those who are frail or suffering from sensory and physical decline to navigate spaces that would normally require greater effort. People with dementia are also documented to be able to perform tasks otherwise outside of their capabilities when performed within their own home (Mihailidis et al. 2012). Supporting ageing in place can involve modifying the home through physical alterations and the addition of smart home technologies, but attention should be given to retaining the familiarity of the home space for the occupant, preserving the identity they have instilled upon it. Physical modifications – such as replacing steps with ramps or installing support rails in the bathroom – do not alter the layout or function of rooms in the home, yet make it easier to complete daily tasks independently. Considered use of both physical alterations combined with smart home technologies can greatly increase the independence of the resident, allowing them to remain in their homes for longer without drastically altering the layout or physical environment. One of the most valuable aspects

of the home is that it creates a distinction between the public and private space: this distinction not only enhances the sense of independence of the occupant, but is also fundamental in promoting a sense of identification in users (De Matteis 2010). This is particularly important when modifying the home and involves the installation of monitoring devices or ambient technologies. Eroding the distinction between public and private spheres may also inadvertently dilute the sense of identity, familiarity and comfort the person has within the home. Even passive technologies, which may not take up much space, can be deemed unacceptable by residents if they view the ability of the devices to monitor or record within the home as intrusive (Guihen 2013). Introducing assistive measures in the home can make life for the resident easier and performing daily tasks less daunting. However, they may also alter the environment in ways that leave the resident feeling uneasy, or less "at home". This concern is particularly valid in the context of smart home technologies, the functions of which may not be immediately clear to the user, causing distrust or suspicion. In particular, care must be taken to ensure that monitoring devices do not erode the distinction between public and private space but instead find a balance between the two, so that the resident feels neither shut away from society nor completely exposed and without privacy. This balance is vital, as it plays directly into the resident's feelings of safety and security in the home, while it affects their acceptance and receptiveness to support measures that enhance independence and allow them to remain in their homes.

Privacy

In Europe, the right to privacy is recognised as fundamental. As technology grows increasingly networked and our data continue to move online, it is vital that this right be safeguarded. Privacy also involves the shielding of people from unnecessary or excessive categorisation, which can have a negative impact on the quality of life of older people (De Hert/Mantovani 2010). All smart home technologies require data to be effective, be it an ambient sensor that can detect when someone is in the room, a wearable device that logs movement, or software which tracks the daily progress made in cognitive or physical exercises. As such, it is vital that privacy issues be assessed from the earliest concept designs and all the process through to implementation. This is especially true in the context of medical health data, which smart home technologies can be used to collect, store or even transmit to other lo-

cations, such as a hospital or doctor's surgery. Improper handling of medical or user data can expose the user to unsolicited contact and potential harm (De Hert/Mantovani 2010). Even though monitoring is a function of smart home technologies and a potential benefit for assisting ageing in place, one must be careful to ensure that the privacy and autonomy of the resident is respected. In assessing the functional capacity of a device to meet the needs of the resident, for instance, questions must be asked with respect to its effect on the privacy of the resident. For example, although cameras may provide a great deal of information in the event of a fall, a study on the attitudes of older people toward smart home technology conducted by the University of Missouri-Columbia found that such a measure was universally felt to be "obtrusive", with concerns raised as to the potential for privacy violations. The same respondents were more favourable to the technology when data could be obscured or "anonymized" (Demiris/Hensel 2008). Smart home technologies are intended to meet the needs of the user, but for them to be deemed acceptable, privacy concerns must be addressed. This study is not alone in earmarking cameras in particular as a barrier to trust and adoption of smart home technologies. More recent reviews continue to highlight such devices as a concern, and privacy as the primary barrier to the adoption of smart home technologies among older adults (Morris et al. 2013).

Control

One of the benefits of AAL technology is that it can act independently of active user input, triggering an alarm in the event of a fall, for example. AAL technology, such as sensors for monitoring motion, heat, electricity usage etc., is designed to operate in the background throughout the day. However, while this may enhance the effectiveness of the technology, it can also have a significant psychological impact on the resident. Smart home technology can be divided into two groups: active and passive (Guihen 2013). Active technology includes devices such as telephones, user triggered alarms and controls for house utilities such as heating. Passive technology does not require the user to actively engage with it and includes, for example, house sensors. The issue of control and the level of control provided to the resident is one of the most important factors influencing user acceptability of smart home technology. While passive technologies have the benefit of working irrespective of the abilities or interest of the user, it is this exact feature that can lead older people to prefer engaging with active technologies, as they

offer a more tangible sense of control (Guihen 2013). Unlike an ambient sensor placed discreetly in the corner, active technologies provide a sense of agency to the users, as they are the ones directing how and when it is used and – crucially – not used. The issue of control is strongly connected to that of privacy and personal space. The user wants to be in control of their environment, making the technology work for them and toward their preferences rather than living in an environment where devices monitor or record their movements and actions without any active feedback for the user. As a result, implementing smart or ambient technologies must be done in a manner that does not remove the users' sense of autonomy and control over their own home. Identifying the appropriate level of control is particularly difficult in cases where the resident suffers from dementia or Alzheimer's disease. During the interviews conducted as part of the VALUE AGEING project, Rafael Capurro, suggested that "In case of degenerative diseases such as Alzheimer's the balance goes towards taking the place of the other by others and/or by technology" (Guihen 2013: 58). In such instances, it may reduce the capability of the technology if too much is asked of the user, and a higher level of automation may be necessary. However, such decisions must be made on a case-by-case basis, with the enhanced autonomy and safety of the older person in the forefront of the decision-making process. The divide between automated and directly controlled is not impermeable and there may be instances where the hybrid of both approaches is most appropriate. For instance, while ambient sensors can monitor the environment and react to changes within it based on preset parameters; they need not necessarily actuate another element of the smart home platform. Instead of raising an alarm or flagging the attention of a caregiver, the device may prompt the user to take action directly. Another interviewee, Alex Mihailidis, is optimistic about such approaches: "I think the technologies that are able to monitor older adults during common activities, provide them with prompts and reminders of things they need to do, systems that can monitor the health and safety of older adults, such as fall detection systems or ones that collect some very basic, high-level physiological health data to the person and make that available to the older adults themselves and their caregivers; those are the main classes that I would see as the most promising in the short term right now." (Guihen 2013: 40) The COACH[2] project is indicative of this approach.

2 | Cognitive Orthosis for Assisting with aCtivities in the Home, a prototype of an intelligent environment designed to assist people with dementia manage activ-

It developed a Cognitive Assistive Technology (CAT) designed to remind and assist older people in washing their hands before they leave the bathroom. CATs leverage smart home technologies to increase the independence of older adults by alerting the user that an action is required. However, the autonomy of the user and their sense of control over the home environment are preserved by prompting the user to act rather than completing tasks independently. This is particularly beneficial in instances where the resident is suffering from mild cognitive decline and may forget to perform basic tasks around the house (Mihailidis 2008). Providing the resident with greater control over their environment while still providing the assistance necessary to enhance their independence can be a difficult balance to achieve. However, such a balance is necessary to ensure that the resident feels at ease in their own home, that is, supported by the technology rather than controlled by it.

Frustration and Abandonment

Even as the capabilities of smart home technologies continue to advance, older users may not be enthusiastic to adopt them into their lives. There is also the possibility that the user may abandon the technology, completely removing any potential benefit it may have had. One of the greatest reasons for user abandonment is frustration (Guihen 2013): frustration occurs when the device or service fails to meet user expectations, or is found to be difficult to use. Such frustrations are of particular concern with emerging technologies, where the user may have no prior experience with a device and no initial comfort can be assumed. The inability of the user to adapt the device to their specific needs – either as a result of inflexible design or poor training – increases the risk of the user growing frustrated with the technology either actively choosing to abandon it or using it with less frequency as time goes on. Frustration with a technology can also be the result of discomfort felt by the user, either as it is uncomfortable to use (such as a bulky wearable sensor, or a device with a confusing user interface) or because the user experiences an alienating effect, such as can happen when they do not feel in control of devices in their own home. Frustration is also not limited to ICT based solutions: for instance, a ramp installed in place of the front step to reduce the risk of fall may be uncomfortably steep for the user or a metal handrail too

ities of daily living in their homes with greater independence, managed by the Intelligent Assistive Technology and Systems Lab at the University of Toronto.

cold for comfortable use in the winter. Such discomforts may also contribute to frustration felt by the resident and, while one cannot switch off a front step, this frustration can contribute to diminishing the comfort felt by the resident in their own home.

Acceptability of Measures to Support Ageing in Place

There is currently no formal ethical framework for assistive technologies (Tiwari et al. 2010): however, work has been carried out to develop guidelines and conditions for the successful and ethical development of assistive technologies. The SENIOR project, a 24 month European Commission funded project tasked with assessing social, ethical and privacy issues associated with ICT and ageing, identified several conditions that should be addressed when developing technologies to support older people: these conditions influence not just individual acceptance of a technology, but also societal acceptance. SENIOR highlighted the needs for user freedom of choice to be respected, as well as their autonomy and privacy. It also recommended that any solution implemented safeguard the dignity and self-esteem of the user, while emphasising safety (Wright 2009). Carefully assessing needs and matching these to the provided technology can result in higher acceptance rates. In an attempt to study elderly needs toward the adoption of assistive technologies, Forlizzi, DiSalvo and Gemperle (2004) conducted an ethnographic study of ageing adults who lived independently in their homes (seventeen elders aged 60 through 90 were interviewed and observed in their homes). Self-awareness and self-perception of the user's own needs have been showed to affect the way they feel towards assistive technology, increasing the likelihood that they will use technology once they identify or understand the potential benefits of the proposed device. Older people may recognise the utility of a technology, but may not feel that it could assist them specifically, nor do they desire to use a technology that they feel exaggerates or draws attention to their needs (Guihen 2013). The relationship of older adults with technology cannot be compared with the relationship that younger adults experience: they may not be as familiar with ICT terminology, in particular with "interface metaphors". While younger adults are familiar with terms such as mice, folders, and desktops, as they relate to technology, these concepts may be unfamiliar to older users, who are then required to acquire a new lexicon of ICT related vocabulary (Guihen 2013). Such examples are illustrative of how the barrier to entry with technology may inadvertently be raised, even

from the early design phase. Care must be taken to be aware of such issues and to address them from an early stage to minimise the risk of reducing the acceptability of smart home technologies in the eyes of the end user.

5. Looking to the Future of Ageing in Place in Europe

Europe's ageing population is a social reality: however, that does not mean we cannot take steps to address the issues this presents to us. Supporting ageing in place with smart technology and home rehabilitation has the potential not only to reduce the societal cost of long term institutional care, but also to empower older members of our communities to remain independent in their homes for longer and with a higher quality of life. However, the potential for technology to address the needs of older people in this context also brings with it the temptation to see these devices and services as a panacea to the challenges of fulfilling the desire of older people to remain in their homes. This chapter has highlighted needs which fall outside the traditional understanding of physical and cognitive challenges associated with ageing: social isolation and loneliness, privacy, control, sense of identity, frustration and abandonment, and the acceptability of measures to support ageing in place. To conclude, we will suggest some recommendations intended to ensure that these social and psychological needs are addressed, increasing the acceptability of smart home technologies for ageing as well as the overall quality of life of those that choose to use them. Within Europe, our core values are enshrined in the European Charter of Fundamental rights. We recognise the vital importance of ensuring that the dignity, privacy and security of every person are preserved. We need to identify the values we wish to see embedded in housing design and smart homes: these values are not simply abstract concepts and should inform guidelines to which we adhere when addressing societal challenges. As such, we should develop tools to help us ensure these values are embedded effectively and to assist us in assessing the implications so that further refinements can be made as time moves on. The WHO Guidelines, the Riga Declaration and Digital Agenda for Europe are examples of how values can be operationalised and translated into policy goals. Identifying stakeholders is a vital part of addressing the needs of all involved in supporting ageing in place, including designers, formal and informal caregivers, policy makers and the users themselves. However, it is not

enough to identify them; efforts should be made to facilitate communication between them and to increase the impact of dissemination efforts. The AAL JP, for instance, brings stakeholders together and incentivises efforts focused on specific identified societal needs, such as ageing in place or assisted navigation in public spaces. It is also a platform for dissemination, both of best practice efforts and new technological innovations. The barriers to proposed solutions must be identified and mitigating strategies proposed. In particular, we must ensure that the benefits of smart home technologies are shared by all and that issues such as cost or the location of the home do not become insurmountable barriers, keeping new technology and design innovations from benefiting the most vulnerable in society. Finally, we need to be aware that new practices, norms and technologies will emerge which will challenge existing knowledge. Much as we should not only be receptive to but also seek out cross-stakeholder collaborations and end user feedback, we must also be willing to revisit and reevaluate existing best practice norms in the face of shifting societal paradigms. The needs and responsibilities identified in this paper should be placed in the context of the European Charter of Fundamental Rights and the Values of the European Community applied to address them. If appropriate measures are taken to ensure that the needs of older people and their associated *oikos* are at the centre of the development of new policies and smart home related technologies, their potential for societal and individual good may yet be met.

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