Why Should I Use This? Identifying Incentives for Using AAL Technologies

Christina Jaschinski[1,2(✉)] and Somaya Ben Allouch[1]

[1] Saxion University of Applied Sciences, Enschede, The Netherlands
{c.jaschinski,s.benallouch}@saxion.nl
[2] University of Twente, Enschede, The Netherlands

Abstract. Ambient Assisted Living (AAL) technologies have the potential to target the challenges of our aging population. However, little is known about what motivates older adults to adopt these new technologies. Most research in this area relies on single cases with a specific AAL application and a limited number of users. To fill this gap, a content analyses of 35 AAL reports was conducted. The aim was to provide a comprehensive overview of potential incentives for using AAL technologies. The data was coded using the Social Cognitive Theory (SCT). In total 13 incentives could be identified, which were grouped into six categories: (1) social incentives, (2) health and safety incentives, (3) activity incentives, (4) novel sensory incentives, (5) status incentives and (6) self-reactive incentives. Within these categories 'social connectedness' and 'health and safety' were the most important incentives. These results provide a comprehensive and theoretically grounded understanding of what motivates older adults to adopt AAL technologies.

Keywords: Ambient Assisted Living (AAL) · Older adults · Technology adoption · Social cognitive theory

1 Introduction

Demographic projections state that by 2050, for the first time in history, the share of older persons (≥60 years) in our population will match the share of younger persons (≤14 years). In the more industrialized regions, such as the EU or the United States, the older population has already outnumbered the younger population [1]. This demographic shift entails major challenges for our society and the healthcare system including more people who suffer from chronic diseases, increasing healthcare costs, a shortage of caregivers and a higher demand on family caregivers [1, 2].

1.1 AAL Technologies

A new generation of assistive technologies, known as 'Ambient Assisted Living' (AAL) technologies, could meet these challenges by facilitating active, healthy and independent aging in place [3]. This is also in the interest of the older adults who prefer to age in their own trusted home environment [4]. AAL technologies are developed in line

Kameas et al. (Eds.): AmI 2015, LNCS 9425, pp. 155–170, 2015.
DOI: 10.1007/978-3-319-26005-1_11

with the ambient intelligence paradigm which aims to create digital environments which are unobtrusive, adaptive and responsive to human needs [2, 5, 6]. AAL is an umbrella term for a variety of innovative technologies including smart homes, robotics and ambient, mobile and wearable sensors. Different algorithms and computational techniques such as activity recognition, context modeling, location identification, planning and anomaly detection enable these technologies to monitor and improve the well-being of older adults [2]. While some AAL technologies focus on the older adults' physical well-being, by monitoring vital signs and activity patterns [7], providing reminders [8] and detecting falls [9]; other AAL technologies target the older adults' emotional well-being, by facilitating communication and interaction with peers and family members [10, 11].

AAL technologies have the potential to facilitate independent and healthy aging and therefore offer a promising solution to the challenges of our aging population. However, many of these technologies are still in the development phase and it is unclear if older adults are ready to adopt and use these technologies. Moreover, compared to younger age groups, older adults are a highly heterogeneous target group in terms of technology experience, activity level, level of social involvement and physical and mental well-being [12, 13]. This translates into highly diverse needs and preferences, making it challenging for developers to design a technology which appeals to the target user.

1.2 Theories of User Acceptance and AAL Technologies

To successfully develop AAL technologies for the older adults we need to understand which factors drive the acceptance process of these technologies. Some of the most influential models to explain the adoption and use of new technologies stem from information systems research (e.g., Technology Acceptance Model (TAM) [13, 14]; Unified Theory of Acceptance and Use of Technology (UTAUT) [15]) and media use research (e.g., Uses and Gratifications Approach (U&G) [16, 17] and Social Cognitive Theory (SCT) [18]). Although these models have their own focus, they all incorporate the expectancy-value principle [19] which has its origin in social psychology e.g., [20]. In essence, expectancy-value theories suggest that future behavior is based on the expected outcomes of the behavior (expectancy or belief) and the affect, positive or negative, attributed to these expected outcomes (evaluation) [21]. Thus, the expected outcomes of using a technology seems to be an important predictor of technology adoption.

Drawing the attention to TAM and UTAUT, both are very influential and widely applied models for investigating the adoption of new technologies. However, in TAM and UTAUT expected outcomes are constructed rather one-dimensional in terms of 'perceived usefulness' and 'performance expectancy' respectively. Originally created in an organizational context, these constructs mainly reflect the instrumental value of a technology. A similar notion was made by Benbasat and Barki [22], who stated with regard to TAM that "study after study has reiterated the importance of PU (Perceived Usefulness), with very little research effort going into investigating what actually makes a system useful" [p. 212]. In our view, TAM and UTAUT are therefore not entirely appropriate to explain the expected outcomes of AAL technologies. Those technologies consist of a wide array of different applications and can entail besides instrumental

values also intrinsic values for the target group. Therefore, we turn to a different approach: Social Cognitive Theory (SCT) that acknowledges the multi-dimensional nature of expected outcomes.

1.3 Social Cognitive Theory

Social Cognitive Theory [23] stems from the field of psychology and is an extension to social learning theory. SCT depicts human behavior as reciprocal causation of behavior, cognition and other personal factors and environmental influences. According to SCT a large part of human behavior is purposive and regulated by forethought. Individuals use their forethought to plan actions, set goals and anticipate potential consequences. This means that people anticipate the outcome of their actions and adapt their behavior to achieve desired consequences. Beliefs about the expected outcomes can be either grounded in one's own direct experience or through observing others (observational learning). Thus, one's current beliefs about the expected outcomes of a certain behavior are an important motivator for implementing this behavior [23, 24]. Translating these principles to the context of the current study, the expected outcomes of AAL technology use, will be a leading factor in the older adults' adoption of these technologies.

In contrast to TAM and UTAUT, SCT depicts expected outcomes as a multidimensional construct which are organized around six basic types of behavioral incentives: social (e.g., social interaction), activity (e.g., feel entertained), novel sensory (e.g., obtain new information), status (e.g., get respect from others), self-reactive (e.g., relieve boredom), and monetary (e.g., monetary benefits) [23, pp. 232–240, 25]. These incentives were initially theoretically constructed but have been validated to study the use of innovations such as the internet [25, 26] and social media [27]. However, these studies put the focus on media use, which let us assume that not all of these incentives are equally relevant with regard to AAL technologies. For example, other incentives such as self-preservation incentives are very likely to be important in the context of AAL technologies. Nevertheless, SCT is a broad theory of human behavior that was successfully applied to understand different types of behavioral processes. Therefore, we regard SCT as an adequate approach to get an insight in what could motivate older adults to adopt and use AAL technologies.

The current research uses SCT as theoretical approach to identify potential incentives for using AAL technologies as perceived by the older adults. Thereby, we also allow for additional incentives to surface from the data. Understanding which incentives older adults expect from the use of AAL technologies, can help developers in designing AAL technologies which appeal to the needs and wishes of the user, which in turn aids the likelihood of future adoption.

2 Method

To identify which incentives older adults perceive as important for the use of AAL technologies, we conducted a content analyses of published reports from projects funded by the Ambient Assistant Living Joint Programme (AAL JP).

2.1 AAL Joint Programme

The Ambient Assistant Living Joint Programme (AAL JP) is a funding activity, cofinanced by the European Commission, that aims to promote active and healthy aging in Europe through the use of innovative information and communication technology (ICT). Their goal is to foster result-oriented research projects that deliver concrete solutions for independent aging. In doing so, AAL JP seeks to strengthen the European market for Ambient Assisted Living products and services, and in the long term, reduce costs regarding health and social care [3]. So far six calls with 155 projects have been launched.

2.2 Sample

In June 2014 the AAL JP launched a website containing all public deliverables from their funded projects [28]. During the same month the website was accessed and all uploaded documents were screened, applying the inclusion and exclusion criteria displayed in Table 1. To be included in the sample, deliverables had to contain results of the user-requirement analyses or the pilot testing with older adults directly involved in the testing of the AAL application. In the first round we included 64 documents from 22 projects based on their online availability and title. After scanning the full-text another 28 documents were removed from the selection, leaving us with a selection of 35 document from 17 different AAL projects. This means that in the final sample some projects yielded multiple reports.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Deliverables documenting the results of the user-requirement analyses and the pilot testing	Deliverables that containt no original results (e.g., methodological decription, state of art)
Older adult end-users were involved in the testing of the requirements and the AAL application	Deliverables that neglected user acceptance factors (e.g., only technical requirements)
Online availability	Doubles

2.3 Data Extraction and Coding

To get an overview of the nature of the selected AAL deliverables we extracted data about the project name, call, number of extracted documents, technology category, technology objective, target user characteristics, test countries and the used methodology from the full-text reports (Appendix A), prior to in-depth coding. To identify potential incentives for using AAL technologies we used a mixed-method approach in coding the full–text reports, with some of our codes developed a-priori, using the knowledge from the social cognitive theory (deductive), and other codes emerging from the data (inductive) [29]. During the coding procedure, we especially focused on

the sections describing the user's feedback and evaluation of the tested AAL application. Hereby, we included explicit statements from the involved end-users but also inferred statements from the researchers. We applied a comparative method approach, comparing new codes to previous assigned codes to ensure that codes remain valid [30]. After several rounds of coding, remaining inconsistencies were discussed between two researchers until consensus was reached.

3 Results

3.1 General Characteristics of the Analyzed Projects

With one exception, all of the analyzed project documents originated from the first and second AAL call. This was mainly due to the low online availability of documents originating from later calls. The AAL technologies in these projects were diverse in nature, with eight social networks, three daily life support systems, two communication systems, two robots, and two game applications. The technology objectives defined by the project members were also diverse. Social inclusion was mentioned in most projects as an objective (n = 12), followed by stimulate leisure activities (n = 9), support with activities of daily living (n = 5), safety (n = 5), health and care monitoring (n = 4), information (n = 3), self-confidence (n = 2), physical fitness (n = 2) and improve intergenerational relations (n = 1). User studies were conducted in 13 different European countries with Germany and Spain being represented most often (n = 6). The applied methods were very diverse, including observational methods, surveys, interviews, focus groups and pilot studies in laboratory and natural settings. The age of the older adults included as subjects in these projects ranged from 47 to 96 years. Most subjects still lived independently with some of them receiving care. Some of the analyzed projects specifically focused on subjects with cognitive impairments. The ICT experience among the subject varied from little to solid ICT experience.

3.2 Incentives for Using AAL Technologies

After thoroughly coding the data, 13 incentives could be identified which were then clustered according to the categories identified by SCT. As expected, a new category related to self-preservation emerged, which we labeled 'health and safety incentives'. However, our data did not show support for outcome expectations in terms of 'monetary incentives'. In fact, we noticed that in the majority of the analyzed projects older adults were afraid that the potential technology could be expensive and unaffordable to them, suggesting that money is rather a disincentive in the context of AAL technologies. Table 2 shows the number of assigned quotes per code as well as the number of source projects in which the codes appear.

Table 2. Number of assigned quotes and source projects per code

Codes	Assigned quotes (n)	Source projects (n)
Social incentives		
Social connectedness	351	16
Involvement	28	8
Health and safety incentives		
Health and safety	103	15
Support with dailly activities	111	12
Connect to care network	8	5
Activity incentives		
Leisure and personal interests	110	13
Enjoyment	51	9
Novel sensory incentives		
Education	44	11
Information	49	9
Status incentives		
Self-expression/self-worth	58	10
Independence	9	4
Status	6	2
Self-reactive incentives		
Relieve boredom	3	2

3.3 Social Incentives

Social Connectedness. The most prevalent incentive for future use of AAL technologies which surfaced from the data is 'social connectedness', with a total quote count of n = 351 and appearance in 16 of the 17 analyzed projects. Social connectedness can be understood in terms of connecting, communicating and interacting with other individuals. These can be either existing connections such as friends and family, or new contacts developed with the help of the AAL technology. For example, during the initial user-requirement assessment of the 3rD-LIFE social network several older adults, who were asked about desired features for 3rD-LIFE, stated that they would appreciate the opportunity to meet new people and talk to them [31]. AAL technologies were also viewed as a valuable tool to combat loneliness. As one older adult indicated after watching a facilitator using the EasyReach social network: "Today, in general elderly people are alone. The system could be a key point for them. It could help elderly people to socialize" [32, p. 34]. In the Domeo project which developed an assistive robot, the technology itself was seen as a possible form of companionship [33]. In sum, older adults recognized that AAL technologies could be an instrument to socialize, feel closer to friends and family and combat loneliness.

Involvement. A second incentive in this category is 'involvement'. Several projects showed that AAL technologies were seen as a way to stay connected and involved with society and making new technologies accessible for older adults, who feel more and

more excluded through the increasing digitalization of our world. One older adult described the EasyReach social network as a "window to the world" [32, p. 34]. Another participant stated "EasyReach is another chance for us, elderly people. It is an innovation and for the first time we are part of it. I could feel part of the network of today" [32, p. 24]. Similar expectations were expressed by older adults in the FoSIBLE project, that developed a TV-based communication system: "I think that it is to make the computer available to all" [34, p. 15]. 'Involvement' as an incentive was somewhat less prevalent, with a total quote count of n = 28, divided among eight projects.

3.4 Health and Safety Incentives

Health and Safety. Besides 'social connectedness', 'health and safety' is the second most important incentive associated with the potential use of AAL technologies. The total quote count was n = 103, with appearance in 15 of the 17 projects. Older adults perceived that AAL technologies could benefit their physical and mental health, for example by finding health-related information or providing games which train their abilities. For instance, in the 3rD-LIFE project older adults said they would like the social network to include videogames with exercises for motor coordination and rehabilitation to maintain their functionality [31]. Another aspect was the increased feeling of safety if AAL technologies would be present in their homes. In the pilot phase of the HOPE system the majority of the end-users who tested this daily life support system that includes different functionalities for monitoring, fall detection and communication in their homes, agreed that it had increased their feeling of safety and security [35].

Support with Daily Activities. Another highly important incentive which was identified from the data is 'support with daily activities'. The older adults recognized that AAL technologies had the potential to support them in their daily life for example with memory and reminder functions or administrative tasks. For example, in the Domeo project, reminders were regarded as a highly important feature for the tested assistive robot [33]. AAL technologies were also viewed as a tool for people that were physically limited as becomes clear by this statement of an older adult in the FoSIBLE project, that developed a TV-based communication system: "It will be very useful for people with reduced mobility" [34, p. 19]. The total quote count was n = 111, extracted from 12 documents.

Connect to Care Network. The final incentive which fits this category is 'connect to care network'. Older adults recognized that AAL technologies could be useful to easily connect with their caregivers. For instance, in the EasyReach project, that developed a social network application, one older adult said: "It would be helpful to connect EasyReach to networks of home care" [32, p. 36]. Moreover, older adults from different projects stated that AAL technologies could provide some peace of mind to family caregivers. However, this incentive was less prevalent, with a total citation count of n = 8, divided among only five projects.

3.5 Activity Incentives

Leisure and Personal Interests. The incentive 'leisure and personal interests' was mentioned in 13 projects with a total quote count of n = 110. The fact that AAL technologies could stimulate leisure activities, was highly appreciated by older adults. They were very keen on the idea of personal interest forums or games they could play with other seniors via AAL technologies. For instance, when prioritizing different features of the SeniorEngage social network application, the most popular feature mentioned by the focus group participants was interest groups for hobbies or professions [36].

Enjoyment. Another incentive in this category is the feeling of 'enjoyment'. The first interaction with AAL technology prototypes was often perceived as interesting, fun and entertaining, which in turn motivated future use. For example, one older adult from the Connected Vitality project said after testing the video communication feature of the system in the home: "we really, really enjoyed it" [37, p. 15]. The total quote count was n = 51, divided among nine projects.

3.6 Novel Sensory Incentives

Education. Common stereotypes suggest that older adults have neither the ability, nor the motivation to learn new things. However, our data suggest otherwise. 'Education' was another frequently mentioned incentive for the potential use of AAL technologies, with a total citation count of n = 44, divided among 11 projects. Older adults were excited about potential educational features of AAL technologies which would allow them to acquire new knowledge and skills. For instance, in the 3rD-LIFE project participants found educational applications like lectures, courses or e-learning very attractive potential features for this social network application [31]. Older adults also indicated that they would like to expand their knowledge through the exchange with others, for example in an online discussion group which could be facilitated via AAL technologies.

Information. Another incentive in this category is 'information'. Older adults believed that AAL technologies could provide them with information of their interest such as news, weather or events in their neighborhood. In the SeniorEngage project, the tested social network application was perceived as a platform where older adults could find information and activities at a glance [36, p. 32]. This incentive was mentioned in more than half of the projects with a total quote count of n = 51.

3.7 Status Incentives

Self-expression and Self-worth. The first and most important incentive in this category is 'self-expression and self-worth'. This incentive was identified in 10 projects with a total quote count of n = 58. Older adults perceived AAL technologies as a

potential platform for self-expression, where they could share their values, opinions, experience and knowledge with others, for instance through a discussion group feature. The researchers of the FoSIBLE project concluded that for many participants the motivation to use the groups feature of the TV-based communication system is to display and share their knowledge with others [38]. This in turn gives them the feeling of being capable, being needed and being meaningful to society.

Independence. Surprisingly 'independence' was only mentioned in 4 of the 17 projects as an incentive for the use of AAL technologies, with a total quote count of n = 9. This could be explained by the fact that independence is also implied by other incentives such as 'health and safety' and 'support with daily activities'. Therefore, we still assume that 'independence' is an important incentive for the use of AAL technologies.

Status. The final incentive in this category is 'status'. Some older adults were keen on using AAL technologies in order to earn respect of others, especially there family members as become clear by this statement of an older adult from the FoSIBLE project: "It is also about my grandchildren. I want to impress them, to make them proud perhaps" [34, p. 20]. However, 'status' was only mentioned in two of the projects with a total quote count of n = 6. Thus, we can conclude that status is not an important incentive for older adults to use AAL technologies.

3.8 Self-reactive Incentives

Relieve Boredom. The least prevalent incentive was 'relieve boredom' as it was only mentioned in 2 of the 17 projects with a total quote count of n = 3. Thus, using AAL technology just to pass time is not a major incentive for older adults.

4 Conclusion and Discussions

In this study we conducted a content analyses of 35 AAL project reports extracted from 17 projects to identify potential incentives for older adults to adopt and use AAL technologies. SCT was used as a theoretical approach to identify and group the incentives emerging from the data. However, we also allowed for new categories to surface from the data. In total 13 incentives could be identified, which we grouped into six categories: (1) social incentives, (2) health and safety incentives, (3) activity incentives, (4) novel sensory incentives, (5) status incentives and self-reactive incentives. Except for health and safety incentives (additional category) and monetary incentives (missing category) these categories are identical to the incentive categories used in the SCT. This suggest that expected outcomes indeed should be considered as a multi-dimensional construct rather than as a one-dimensional construct.

Moreover, these results show that the majority of the incentive categories identified by SCT are also applicable in the context of AAL technologies. However, Bandura's original approach [23] does not include a category for self-preservation incentives.

Yet, our results showed that in many of the analyzed project health and safety were important incentives to use AAL technologies. Therefore, this was added as a new category. Bandura's later work applied SCT in the context of health promotion [39]. Within the context of health behavior one of the three essential outcome expectation categories is 'physical' which is defined as "pleasant sensory experiences and physical pleasures in the positive forms, and aversive sensory experiences, pain and physical discomfort in the negative forms" [39, p. 627]. This supports our decision to add "health and safety" as an self-preservation incentive category for AAL technologies. Monetary incentives were not supported by the data, but we assume that monetary matters rather form a disincentive. Earlier case studies of AAL technologies support this assumption, as older adults were often afraid that the tested AAL application is unaffordable to them [e.g., 40, 41]. This is interesting, as the vision of AAL technologies is to reduce the costs of health and social care [42]. However, there seems to be a discrepancy between how AAL is envisioned by the policy makers and how it is perceived by the older adults. Policy makers should therefore carefully think about the financing models and ensure that those technologies are affordable for all seniors.

Looking more specifically at the incentives within a category, thereby taking into account the number of different projects in which a code occurs as well as the total quote count, 'social connectedness' and 'health and safety' are the most important incentives in the context of AAL technologies. This implies that older adults are likely to use AAL technologies when they perceive that those technologies can help them to connect with others or when they benefit their health and safety. This is in line with previous case studies of AAL technologies, that also found that "health and safety" [e.g., 43, 44] and "social connectedness" [45, 46] are important incentives of AAL technologies. Other important incentives for the use of AAL technologies include 'support with activities of daily living'; 'leisure and personal interest'; 'education' and 'self-expression and self-worth'. In contrast, 'relieve boredom' and 'status' were the least important incentives. This suggest that older adults are not likely to use AAL technologies just to pass their time or to get respect from other individuals. Surprisingly, the data showed that 'independence' was also one of the least important incentives for the use of AAL technologies. We assume that this can be explained by the fact that the other incentives such as 'health and safety' or 'support with daily activities' also imply independence and the incentive 'independence' can therefore be viewed as an umbrella term for these other incentives. Following this argumentation we still think that 'independence' is a highly important incentive for AAL technologies.

The previously described results should not be interpreted without taking into account several limitations. First, our documents were sampled from a single research framework which is EU based. Therefore, generalizability is somewhat limited by the research focus and the geographical scope. Second, the sample was affected by the online availability of the documents which were mostly sampled from the first and second call, so important data sources might have been missed. Third, we did not have access to the original transcripts of end-users' evaluations. Therefore, the available data already went through a filtering process which in turn could have affected our results.

Future research should take into account more AAL projects from a broader geographical scope, various research frameworks and more recent calls, in order to verify our results and give an outlook on the future trends and direction of the AAL

community. Second, while this research describes several potential incentives for the use of AAL technologies, we cannot make valid predictions about their explanatory power. Thus, future work should apply advanced statistical method to operationalize these incentives and verify their power in explaining AAL technology adoption and use. Third, in this research we specifically focused on potential incentives for using AAL technologies. However, previous research [47, 48] also identified several barriers or disincentives which are likely to play a role in the decision to use AAL technologies. Other potentially relevant factors include personal factors (e.g., technology experience, health status). Future research should distinguish between different types of older adults in terms of health status and technology experience and investigate how their perception of potential AAL incentives might differ.

Despite its limitations, this study provides a comprehensive and theoretically grounded overview of incentives which are likely to motivate older adults to use AAL technologies. Our findings can be used as a starting point by other researchers to further investigate the explanatory power of these incentives and help them to build an empirical model which can predict AAL technology adoption. Developers, policy makers and health care professional can use our insights to further shape the vision of AAL and help them to design technologies which appeal to the need and wishes of the older adults.

Acknowledgements. Part of this research is supported by the AAL Joint Program under contract number AAL-2012-5-187.

Appendix A: General Characteristics of the Analyzed Projects

Project Name	Call	Documents [Reference no.]	Technology Category	Technology Objective[1] (as stated by the consortium)	Test User Characteristics	Test Countries	Applied Method	Identified Incentives (based on the results of the current study)
3rD-LIFE	2	[31]	social network	a, b	60-75 years living independently no specific cognitive/physical impairment ICT experience	Austria Spain	survey interviews focus groups	Social Connectedness Involvement Health and Safety Support with Dailly Activities Leisure and Personal Interests Education Information Self-Expression/Self-worth
Alias	2	[49,50,51,52]	robot	a, b, c, d ,e,	54-84 years **Group 1:** living independently no specific cognitive/physical impairment ICT experience **Group 2:** living in nursing homes cognitive/physical impairment little ICT experience	Germany	survey interviews workshop pilot test in lab setting with pre-scripted use scenarios pilot test at care facilty with pre-scripted use scenarios	Social Connectedness Health and Safety Support with Dailly Activities Leisure and Personal Interests Enjoyment Independence

[1] a = social inclusion, b = leisure, c = health care & monitoring, d = safety, e = support with daily activities, f = information , g = fitness, h = self-confidence, i = improve intergenerational relations

Project Name	Call	Documents [Reference no.]	Technology Category	Technology Objective[1] (as stated by the consortium)	Test User Characteristics	Test Countries	Applied Method	Identified Incentives (based on the results of the current study)
CCE	1	[53,54]	daily life support system	c, d, e	69-78 years living independently or with family member mild cognitive impairment ICT experience and little ICT experience	Germany UK Hungary	observation survey interviews pilot test in lab setting with pre-scripted use scenarios	Social Connectedness Health and Safety Support with Dailly Activities
Connected Vitality	2	[37][55,56,57]	communication system	a, b	55-89 years living independently physical limitations/in need of care ICT experience	Spain Netherlands Sweden	survey interviews workshops pilot test in older adult's homes diary with prompts for tasks	Social Connectedness Connect to Care Network Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth
Domeo	1	[33]	robot	c, d, e	77-85 years mild cognitive impairment	Austria Hungary France	focus groups	Social Connectedness Health and Safety Support with Dailly Activities Leisure and Personal Interests Information
E2C-Express to connect	2	[58,59]	game	a, b	50-80+ years	Finland Sweden	pilot test	Social Connectedness Involvement Health and Safety Support with Dailly Activities Connect to Care Network Leisure and Personal Interests Enjoyment Education Self-Expression/Self- worth Relieve Boredom

Project Name	Call	Documents [Reference no.]	Technology Category	Technology Objective[1] (as stated by the consortium)	Test User Characteristics	Test Countries	Applied Method	Identified Incentives (based on the results of the current study)
EasyReach	2	[32]	social network	a, f	55-80 years	Italy Germany	pilot test in lab setting with pre-scripted use scenarios demostrated by a facilitator use experience was accessed with focus groups, interviews and a survey	Social Connectedness Involvement Health and Safety Support with Dailly Activities Connect to Care Network Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth Relieve Boredom
Elisa	2	[60,61]	social network	a, b	55-75 years ICT experience and little ICT experience	Greece Hungary	focus groups pilot test in lab setting with pre-scripted use scenarios	Social Connectedness Health and Safety Support with Dailly Activities Leisure and Personal Interests Education Information
Elder-Spaces	2	[62,63]	social network	a, b	55+ years little ICT experience	Greece Spain	survey workshops pilot test	Social Connectedness Health and Safety Leisure and Personal Interests Education Self-Expression/Self- worth
FoSIBLE	2	[34][38][64,65,66,67]	communication (and entertainment) system	a, b	50-96 living experience no severe physical/cognitive impairment ICT experience and little ICT experience	Germany France Austria	observation survey interviews focus groups workshops pilot test in lab setting with pre-scripted use scenarios pilot test in older adult's homes with prompts for tasks diary	Social Connectedness Involvement Health and Safety Support with Dailly Activities Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth Independence Status

Project Name	Call	Documents [Reference no.]	Technology Category	Technology Objective[1] (as stated by the consortium)	Test User Characteristics	Test Countries	Applied Method	Identified Incentives (based on the results of the current study)
Go-myLife	2	[68]	social network	a, f	majority 61-65 years ICT experience and little ICT experience	Austria UK	focus groups workshops	Social Connectedness Involvement Health and Safety Support with Dailly Activities Connect to Care Network Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth Independence
HOPE	1	[35]	daily life support system	c, d, e	cognitive impairment living independently, with family member or in nursing home	Italy Spain Greece	survey pilot test in nursing home	Social Connectedness Health and Safety Support with Dailly Activities Independence
JoinIn	2	[69]	game	a, b, g	not available	Germany Hungary Ireland	observation survey interview focus groups workshops	Social Connectedness Involvement Health and Safety Leisure and Personal Interests Enjoyment Education Self-Expression/Self- worth
MyGuardian	4	[70]	daily life support system	d,e	60-83 years living independently with help of caregivers cognitive impairment little ICT experience	Netherlands, France Spain	probe interview	Health and Safety Support with Dailly Activities Connect to Care Network

Project Name	Call	Documents [Reference no.]	Technology Category	Technology Objective[1] (as stated by the consortium)	Test User Characteristics	Test Countries	Applied Method	Identified Incentives (based on the results of the current study)
SeniorEngage	2	[36][71,72]	social network	h	55+	Finnlanda Austria	focus groups pilot test in lab setting with pre-scripted use scenarios	Social Connectedness Involvement Support with Dailly Activities Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth Status
TAO	2	[73,74]	social network	a,b,f, h, i	not available	Switzerland Germany Netherlands	survey interview focus groups workshops pilot test in lab setting with pre-scripted use scenarios	Social Connectedness Involvement Health and Safety Leisure and Personal Interests Enjoyment Education Information Self-Expression/Self- worth
TraiNutri	2	[75]	social network	a,g	47-63 years ICT experience and little ICT experience	Greece Spain Switzerland	survey pilot test in natural setting diary	Social Connectedness Health and Safety

References

1. United Nations: DESA: World Population Ageing: 1950–2050. United Nations Publications, New York (2002)
2. Rashidi, P., Mihailidis, A.: A survey on ambient-assisted living tools for older adults. IEEE J. Biomed. Health Inform. **17**, 579–590 (2013)
3. Ambient Assisted Living Association. http://www.aal-europe.eu/about
4. Eckert, J.K., Morgan, L.A., Swamy, N.: Preferences for receipt of care among community-dwelling adults. J. Aging Soc. Policy **16**, 49–65 (2004)
5. Aarts, E., Marzano, S.: The New Everyday: Views on Ambient Intelligence. 010 Publications, Rotterdam (2003)
6. Kleinberger, T., Becker, M., Ras, E., Holzinger, A., Müller, P.: Ambient intelligence in assisted living: enable elderly people to handle future interfaces. In: Stephanidis, C. (ed.) UAHCI 2007 (Part II). LNCS, vol. 4555, pp. 103–112. Springer, Heidelberg (2007)
7. Choudhury, T., et al.: The mobile sensing platform: an embedded activity recognition system. Pervasive Comput. **7**, 32–41 (2008)
8. Pollack, M.E., et al.: Autominder: an intelligent cognitive orthotic system for people with memory impairment. Robot. Auton. Syst. **44**, 273–282 (2003)
9. Chen, J., Kwong, K., Chang, D., Luk, J., Bajcsy, R.: Wearable sensors for reliable fall detection. In: Proceedings of the 27th IEEE Conference on Engineering in Medicine and Biology, pp. 3551–3554. IEEE Press, New York (2005)
10. Rowan, J., Mynatt, E.D.: Digital family portrait field trial: support for aging in place. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, New York (2005)
11. Gamberini, L., Raya, M.A., Barresi, G., Fabregat, M., Ibanez, F., Prontu, L.: Cognition, technology and games for the elderly: an introduction to ELDERGAMES Project. PsychNology J. **4**, 285–308 (2006)
12. Moschis, G.P.: Marketing to older adults: an updated overview of present knowledge and practice. J Consum. Mark. **20**, 516–525 (2003)
13. Davis, F.D.: A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results (Doctoral dissertation). MIT, Cambridge, MA (1986)
14. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. **13**, 319–340 (1989)
15. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. MIS Q. **27**, 425–478 (2003)

16. Blumlerand, J., Katz, E.: The Uses of Mass Communications. Sage Publications, Beverly Hills, CA (1974)
17. Palmgreen, P., Rayburn, J.D.: An expectancy-value approach to media gratifications. In: Rosengren, K.E., Palmgreen, P., Wenner, L.A. (eds.) Media Gratification Research: Current Perspectives, pp. 61–72. Sage Publications, Beverly Hills, CA (1985)
18. Bandura, A.: Social Foundations of Thought and Action: a Social Cognitive Theory. Prentice Hall, Englewood Cliffs, NJ (1986)
19. Peters, O.: Social Psychological Determinants of Mobile Communication Technology Use and Adoption: a Comparison of Three Models to Explain and Predict Mobile Communication Technology Behavior (Doctoral dissertation). University of Twente, The Netherlands (2007)
20. Fishbein, M.: Attitude and the prediction of behaviour. In: Fishbein, M. (ed.) Readings in Attitude Theory and Measurement. Wiley, New York (1967)
21. Palmgreen, P.: Uses and gratifications: a theoretical perspective. In: Bostrom, R.N. (ed.) Communication Yearbook, vol. 8, pp. 61–72. Sage Publications, Beverly Hills, CA (1984)
22. Benbasat, I., Barki, H.: Quo vadis TAM? J. Assoc. Inf. Syst. **8**, 219–222 (2007)
23. Bandura, A.: Social Foundations of Thought and Action: a Social Cognitive Theory. Prentice Hall, Englewood Cliffs, NJ (1986)
24. Bandura, A.: Social cognitive theory. In: Vasta, R. (ed.) Annals of Child Development. vol. 6, Six Theories of Child Development, pp. 1–60. JAI Press, Greenwich, CT (1989)
25. LaRose, R., Eastin, M.S.: A social cognitive theory of internet uses and gratifications: toward a new model of media attendance. J. Broadcast. Electron. Media **48**, 358–377 (2004)
26. LaRose, R., Mastro, D., Eastin, M.S.: Understanding internet usage a social-cognitive approach to uses and gratifications. Soc. Sci. Comput. Rev. **19**, 395–413 (2001)
27. Khang, H., Han, E., Ki, E.: Exploring influential social cognitive determinants of social media use. Comput. Hum. Behav. **36**, 48–55 (2014)
28. Ambient Assited Living Association. http://deliverables.aal-europe.eu/
29. Ryan, G.W., Bernard, H.R.: Techniques to identify themes. Field Methods **15**, 85–109 (2003)
30. Strauss, A., Corbin, J.: The Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage Publications, Thousand Oaks, CA (1998)
31. 3rD-LIFE Consortium: Report of User Requirements and User Definition of the System. http://deliverables.aal-europe.eu/
32. EasyReach Consortium: Report of the Pilot Results. http://deliverables.aal-europe.eu/
33. Domeo Consortium: Interviews Results Report. http://deliverables.aal-europe.eu/
34. FoSIBLE Consortium: Psychological Impacts of the System Usage. http://deliverables.aal-europe.eu/
35. HOPE Consortium: Assessment and Evaluation Report. http://deliverables.aal-europe.eu/
36. Senior Engange Consortium: Senior's Participation and Roles. http://deliverables.aal-europe.eu/
37. Connected Vitality Consortium: A document with results of the Dutch field test at Sensire - PresenceDisplays (month 27). http://deliverables.aal-europe.eu/
38. FoSIBLE Consortium: Redesigned Use Cases. http://deliverables.aal-europe.eu/
39. Bandura, A.: Health promotion from the perspective of social cognitive theory. Psychol. Health **13**, 623–649 (1998)
40. Sixsmith, A.J.: An evaluation of an intelligent home monitoring system. J. Telemed. Telecare **6**, 63–72 (2000)
41. Steele, R., Lo, A., Secombe, C., Wong, Y.K.: Elderly persons' perception and acceptance of using wireless sensor networks to assist healthcare. Int. J. Med. Inform. **78**, 788–801 (2009)
42. Ambient Assited Living Association. http://www.aal-europe.eu/about/objectives/

43. Wild, K., Boise, L., Lundell, J., Foucek, A.: Unobtrusive in-home monitoring of cognitive and physical health: reactions and perceptions of older adults. J. Appl. Gerontol. **27**, 181–200 (2008)
44. Van Hoof, J., Kort, H.S.M., Rutten, P.G.S., Duijnstee, M.S.H.: Ageing-in-place with the use of ambient intelligence technology: perspectives of older users. Int. J. Med. Inform. **80**, 310–331 (2011)
45. Huber, L.L., et al.: How in-home technologies mediate caregiving relationships in later life. Int. J. Hum.-Comput. Int. **29**, 441–455 (2013)
46. Beer, J.M., Takayama, L.: Mobile remote presence systems for older adults: acceptance, benefits, and concerns. In: Proceedings of the 6th International Conference on Human-Robot Interaction, HRI 2011, pp. 19–26. ACM, New York (2011)
47. Jaschinski, C., Ben Allouch, S.: An extended view on benefits and barriers of ambient assisted living solutions. Int. J. Adv. Life Sci. **7**, 40–53 (2015)
48. Peek, S.T., Wouters, E.J., van Hoof, J., Luijkx, K.G., Boeije, H.R., Vrijhoef, H.J.: Factors influencing acceptance of technology for aging in place: a systematic review. Int. J. Med. Inform. **83**, 235–248 (2014)
49. ALIAS Consortium: Requirements list regarding the needs and preferences of the user groups. http://deliverables.aal-europe.eu/
50. ALIAS Consortium: Analysis of pilot's first test-run. http://deliverables.aal-europe.eu/
51. ALIAS Consortium: Analysis of pilot's second test-run with qualitative advice on how to improve specific functions/usability of the robot. http://deliverables.aal-europe.eu/
52. ALIAS Consortium: Final report on the requirements list. http://deliverables.aal-europe.eu/
53. CCE Consortium: Guidance Document Summarising User Requirements and Potential Barriers. http://deliverables.aal-europe.eu/
54. CCE Consortium: Summary of pilot results. http://deliverables.aal-europe.eu/
55. Connected Vitality Consortium: A document with the results of the Spanish field test. http://deliverables.aal-europe.eu/
56. Connected Vitality Consortium: A document with the results of the Dutch field test at Sensire. http://deliverables.aal-europe.eu/
57. Connected Vitality Consortium: A document with the results of the Swedish field test. http://deliverables.aal-europe.eu/
58. Express to Connect Consortium: Impact Assessment: Final field tests. http://deliverables.aal-europe.eu/
59. Express to Connect Consortium: Impact Evaluation: Summary of all the studies. http://deliverables.aal-europe.eu/
60. Elisa Consortium: End User Requirements. http://deliverables.aal-europe.eu/
61. Elisa Consortium: Usability study (III). Usability test results according to SIMPLIT methodology. http://deliverables.aal-europe.eu/
62. Elder-Spaces Consortium: End-User Requirements. http://deliverables.aal-europe.eu/
63. Elder-Spaces Consortium: Report on user trials. http://deliverables.aal-europe.eu/
64. FoSIBLE Consortium: Report on user requirements as with respect to the addressed applications. http://deliverables.aal-europe.eu/
65. FoSIBLE Consortium: Report on inHaus lab evaluation results. http://deliverables.aal-europe.eu/
66. FoSIBLE Consortium: Report on usability tests. http://deliverables.aal-europe.eu/
67. FoSIBLE Consortium: Test Results (in the form of problems to be solved in update packs). http://deliverables.aal-europe.eu/
68. Go-myLife Consortium: Synthesis Report on target group analysis and user needs and requirements. http://deliverables.aal-europe.eu/
69. Join-In Consortium: Report on User Requirement Analysis. http://deliverables.aal-europe.eu/

70. MyGuardian Consortium: User Requirements Report. http://deliverables.aal-europe.eu/
71. SeniorEngange Consortium: Usability and Ergonomics Report. http://deliverables.aal-europe.eu/
72. SeniorEngange Consortium: E-Participation for senior citizens best practices. http://deliverables.aal-europe.eu/
73. TAO Consortium: Overall research project final report. http://deliverables.aal-europe.eu/
74. TAO Consortium: Exploratory Studies: Beginning Users 60 plus & Volunteers. http://deliverables.aal-europe.eu/
75. TraiNutri Consortium: Test user report of Usability and Acceptance. http://deliverables.aal-europe.eu/