Perceived Needs for Assistive Technologies in older adults and their caregivers

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ABSTRACT

There is a growing interest for Assistive Technologies (AT) for aging in place. However, acceptance and adoption of AT in older adults remain problematic. This study investigates the perceived AT needs for three domains (everyday activities, safety and social participation) among 50 community-dwelling older adults and their caregivers. Our results indicate that the perceived AT needs are higher in caregivers than old adults, and both safety and social linking are need domains more critical than that of everyday activities. Importantly, for the first time, we demonstrate that older adults formulate their AT needs irrespective of their cognitive or physical losses while caregivers formulate AT needs according to losses exhibited by an older adult. Precisely, AT needs expressed by caregivers are related to cognitive decline for the domain of everyday activities and to physical decline for the domains of safety and social linking. Overall, this reveals the importance of an peer-evaluation by caregivers or family when evaluating AT need; moreover, we could suggest educational programs on aging-related limitations for older participants and thus enhancing the AT acceptance and adoption.

Categories and Subject Descriptors

K.4.2 [**Computers and Society**]: Social Issues—*Assistive technologies for older adults*; J.4 [**Social and Behavioral Sciences**]: Psychology

Keywords

Assistive technologies, aging in place, technology need

1. INTRODUCTION

Aging in place is a major contemporary societal concern. As digital devices develop to support the independence of community-dwelling older adults [16], the Assistive Technologies (AT) are regarded as one of the most promising ways to meet older adults needs at home, particularly in the three domains sensible in late senescence: everyday activities, safety at home, and social participation [1].

The AT for everyday activities include a large variety of reminding devices such as digital pillbox [14], or management of appointments via electronic organizers [12]. The safety AT are related to the prevention of falls and common domestic accidents. So, lighting path [10], emergency response [15], alarms for caregivers [18], securing of electric appliances are functionalities mostly provided by AT. Similarly, specific social functionalities delivered by AT are designed for elderly people like social gaming [17], simplified mailing [19], video telephoning or digital picture frame (*e.g.*, the *Families In Touch* project by [7]).

Unfortunately, the growing supply of AT for aging in place is not as well accepted by elders than by youngers [6][5]. Technology acceptance, first defined by [8] in the TAM (Technology Acceptance Model), concerns the intention to use or the actual use of a technology. Numerous factors such as the characteristics of old persons (*e.g.*, perceived needs, technological skills) or factors related to his/her social environment (*e.g.*, social support for using AT), but also features of technology (*e.g.*, interface accessibility) are well known barriers of AT acceptance [16].

As perceived needs for AT is a critical variable of AT acceptance; it deserves a deep investigation, notably in light of some findings from aging studies. Indeed, several studies bring the evidence that that older adults are inclined to underestimate their everyday difficulties, while caregivers are accurate in assessing older adults difficulties in everyday functioning [11].This result is explained by studies indicating that the more old adults experience cognitive and/or physical decline, the more they reduce their level of their activities, but without an increased complaint on their everyday functioning (because of the routinization phenomenon [4]). Such evidence is seen as a reflection of psychological coping to gradual losses with aging (see, the Selection Optimization Compensation model by [2]). Consequently, it could be hypothesized that the inaccuracy in estimating everyday difficulties by old adults is also a reason why they do not perceive a need for AT. In this case, the discrepancy between self-reported and peer-reported measures of everyday functioning in older adults should be similarly observed on self-reported and peer-reported measures of perceived AT needs. Logically, it can be also expected that AT needs self-reported by old adults are not related to the extent of their physical or cognitive losses, while those assessed by caregivers are based on the level of losses that they are able to accurately estimate thanks to their observation abilities.

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Consequently, the purpose of this study is to assess for the three domains of AT for aging in place (*i.e.,* everyday activities, safety, and social participation), the relationships between AT needs and the cognitive and physical declines, according to the respondent (older adults *vs.* caregivers).

2. METHODOLOGY

2.1 Participants

72 older adults agreed to participate in the study; they came from three municipalities, randomly selected among several municipalities with an equal distribution for location criteria as follows: urban, semi-urban and rural location. Across two sessions done at the person's home, participants underwent a battery of tests. Twenty-two elders were excluded from the study because of their MMSE (Mini Mental State Examination) score too low (<23; mean score: 26.3 SD: 2.1) to avoid dementia cases. Eventually, the study sample consisted of 50 community-dwelling old adults aged between 60 to 93 years (mean age 81.2 SD: 6.1); 9 males and 41 females; they were still autonomous and without cognitive impairment (marital status: 31 widowed and 19 in couple). The 50 caregiver-women questioned are employed by public services offered by municipalities for supporting independent living in elderly people. Their tasks are mainly to provide support for the realization of administrative tasks, purchases and domestic tasks. They come at the elder's home from twice a month to once a day depending on the elder's difficulties.

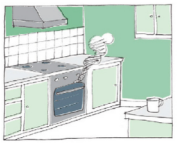
2.2 Assessment of technological need

In order to assess AT needs on the three domains of assistance (*i.e.* everyday activities, safety, and social participation), we have built scenarios of use cases classically provided by marketed or research AT products. The selection of use cases is based on both the examination of products provided to elderly people by *www.abledata.com* and the analysis of reviews on gerontechnologies [3]. The four more frequent functionalities of existing AT devices [3][16] has been identified for each one of the three needs domains as follows:

- *AT functionalities for Everyday activities:* 1) medication adherence, 2) meal preparation, 3) appointment reminders and 4) notification about local events;
- *AT functionalities for Safety:* 1) a light path for night displacement; 2) emergency response system for critical situations; 3) supervising of electric appliances and 4) alerting a caregiver
- *AT functionalities for Social participation:* 1) simplified mailing system, 2) video telephoning system, 3) sharing of digital pictures with family and 4) social games with peers

To understand each AT functionality, a use case is scripted in several steps describing a situation for which the AT functionality is expected efficient enough to meet a need according to the three domains (figure 1). For each use case, the old participant or caregiver had to decide whether the provided assistive functionality matches a AT need for aging in place. Each of the four use cases in each of the domains was scored 1 if the participant answered Yes, and 0 otherwise, inducing three scores ranged from 0 to 4, a higher score indicating a more important AT need.

Figure 1: Item of our questionnaire about AT need, presenting one case usage from the safety domain



Step 1. You (your recipient) put(s) a dish in the oven and leave the kitchen.

Step 2. One hour later, an alarm sounds and a message appears on your AT device (smartphone, touch pad, etc.): «Your oven is on for more than one hour. Do you want to turn it off? »

Step 3. You press on « yes » or « no ». In case no answer is provided, the oven is automatically turned off.

2.3 Assessment of cognitive and physical functioning

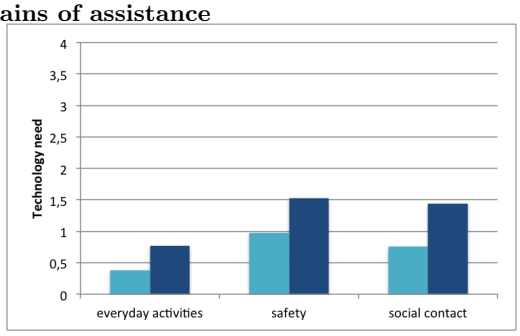
Scales were selected from widely used clinical and research scales for probing elders' cognitive or physical functioning:
General cognitive functioning - It includes the following two scales: 1) The Dementia Rating Scale-2 (DRS-2) [13] assesses five basic cognitive domains (attention, initiation- perseveration, abstraction, visual-constructional abilities and verbal as well as non-verbal memory) ; this scale gives a score between 0 and 144 (where 144 is the best score) ; 2) The Frontal Assessment Battery (FAB) [9] probes several high cognitive domains including conceptualization, mental flexibility, motor programming, resistance to interference, self-regulation, inhibitory control, and environmental autonomy; FAB gives a score ranging from 0 to 18 (where 18 is the maximum score). The cognitive functioning measure refers to the sum of scores obtained on each scale (with a maximum score of 167; mean score of our older participants: 146.19 SD:9.36).
Physical functioning assessment - It includes the following tests: 1) mobility measures (Five Chair Stands test, assessing lower body strength, Static Balance Testing, Timed Get Up and Go Test assessing agility and dynamic, Gait Speed Test), scored from 0 to 13, with higher values indicating greater mobility function; 2) body mass corresponding to the sum of two indices including the standard Body Mass Index [BMI=mass (kg)/(height (m))^2] and the lean mass scored from brachial and calf perimeters. The body mass score provides a score from 0 to 5, with a higher score indicating a better body mass; and 3) sensory measures (visual acuity and hearing) assessed with a four-point Likert-type scale, providing score ranged from 0 to 6 with higher scores indicating better sensory functions. Aggregating all tests, the resulting scores range from 0 to 24 with higher values indicating greater physical functioning (mean score of our older participants: 15.44 SD:3.94).

3. RESULTS

3.1 Technology need for older adults and their caregivers

According to mixed ANOVA [2 (Respondent: old *vs.* caregiver) x 3 (domain of aging in place: everyday activities *vs.* Safety *vs.* Social participation)], the main results are as follows: first, the caregivers reported higher AT needs than the old adults for the three domains conditions ($F(1,98)=19.21$, $P<.001$); second, AT needs are lower for everyday activities compared to both safety and social participation conditions ($F(1,98)=11.22$, $P<.001$). The interaction effect did not reach the significance. In other words, elderly people expressed globally fewer AT needs than their caregivers

Figure 2: Scores of technology need on the three domains of assistance



Elders' answers are in pale blue, and caregivers' answers are in dark blue

for each domain of assistance. Furthermore, AT needs are higher for both safety and social participation domains compared to everyday activities domain (Figure 2).

Now, let us identify how two cognitive and physical functionings can influence the AT needs according to the respondent (older adult *vs.* caregiver).

3.2 Impact of cognitive and physical functioning on AT needs

To assess the role of cognitive and physical functioning the self-reported AT needs for the three domains (dependent variables), we performed ANCOVA with the following statistical design: respondent as ordinal independent factor, cognitive score (or physical score) as continuous covariant factor, and respondent* cognitive score (or physical score) as interaction factor (table 1). Then, to observe how these characteristics mediate the technology need for our two groups of respondent (*i.e.* older adults and professional caregivers), we performed inter- correlations between physical and cognitive scores and AT needs (table 2).

Table 1: ANCOVAs results controlling for cognitive or physical functioning scores

	Cognitive funct.	*Interaction Resp*Cog funct*
Everyday act.	**F(1,98) = 6.29****	ns
Safety	ns	ns
Social part.	ns	ns
	Physical funct.	*Interaction Resp*Phy funct*
Everyday act.	ns	ns
Safety	ns	**F(1,98) = 4.56***
Social part.	ns	**F(1,98) = 3.27 ‡**

*ANCOVAs=analysis of covariance; * $p < .05$, ** $p < .01$, *** $p < .001$; ‡p=0.07; ns=non significant.*

The results show the level of cognitive functioning of old adults is only related to the AT needs for everyday activities ($F(1,98) = 6.29$; p=.01). The inter-correlations between cognitive functioning and AT need scores revealed the following results: AT needs self-reported by old adults for everyday activities are not related to their cognitive functioning, but conversely, those expressed by caregivers are positively related to cognitive functioning of old adults (r=.38; p<.01)(table 2). In other words, caregivers considered that the AT for everyday activities are less appropriate for old adults with high cognitive decline.

Table 2: Inter-correlations between measures of technology need and cognitive and physical measures for older adults and their caregivers

	Everyday activities	Safety	Social participation
	AT Needs by Older Adults		
Cognitive functioning	ns	ns	ns
Physical functioning	ns	ns	ns
	AT Needs by Caregivers		
Cognitive functioning	**.38****	ns	ns
Physical functioning	ns	**-.32***	**-.29***

** $p < .05$, ** $p < .01$, *** $p < .001$; ns=non significant.*

The physical functioning is significantly related to AT needs for both safety and social linking domains. The inter-correlations between physical functioning and AT need scores revealed the following results: AT needs self-reported by old adults for safety and social linking are not related to their physical functioning, but conversely, those expressed by caregivers are negatively related to physical functioning of old adults (respectively, r=-32; p=.02 ; r=-.29; p=.04)(table 2). In other words, caregivers considered that the AT for safety and social linking domains are particularly appropriate for old adults with high physical declines.

4. DISCUSSION

The aim of our study was to evaluate the need for AT that support aging in place according to the three main need domain well identified in the aging field: everyday activities, safety and social participation [1]. For this purpose, 50 cognitively healthy elders and their caregivers were questioned regarding to functionalities frequently provided by AT within a need domain. Also, measures on cognitive and physical functioning of each old participant have been collected to evaluate if they influence the measures of AT need reported by old participants or estimated by their caregivers. A first result is the discrepancy between older adults and their caregivers concerning perceived AT needs. Elders requested less AT needs than their caregivers. This discrepancy mirrors results observed for estimations of everyday functioning difficulties [11]. This is in accordance with the SOC model [2] that highlights the role of psychological coping in minimizing of the age-related losses exhibited by old adults. Thus, our results highlight the importance of a peer-evaluation to assess AT needs, as Gold [11] proposed for Instrumental Activities of Daily Living assessment. Most importantly, we provide results indicating that AT needs perceived by old participants are not related to their cognitive or physical difficulties. By contrast, AT needs estimated by caregivers are in adequation to cognitive and physical limitations exhibited by old participants. Precisely, caregivers perceive AT as appropriate within the domain of everyday activities if old participants have high cognitive functioning. So, it is likely that caregivers estimate that an elder with low cognitive resources may not succeed to use AT for

complex tasks of daily living like preparing meal or taking medicine. This fits the study by [6] reporting a positive relation between cognitive abilities and technology uses in a large sample of old adults. By contrast, caregivers estimate AT as an increased need for the elders with low physical functioning, notably for both domains of safety and social participation. It is well known that low physical functioning (decreased vision, hearing and mobility) increases risks of domestic or falling accidents, but also risks of social isolation, explaining thus caregiver's interests for AT promoting social participation. Our results indicate that cognitive and physical functioning of elders have an important impact on AT need. Nonetheless, this work also presents some limitations. Indeed, our measure of AT need is done using use cases of device functionality depicted in several steps. Perhaps, demonstrations with richer visual media such as videos might be more appropriate to ensure the well understandingof the technology's assistive function by the elderly.

5. CONCLUSIONS AND PERSPECTIVES

Overall, we can conclude that the perceived AT needs are more accurate in caregivers than in older adults. This highlights the importance of a peer-evaluation when assessing AT needs among older adults: caregivers and family appear more often aware of cognitive and physical limitations that affect the independent living of old recipient or old parent, respectively. Therefore, this conclusion pinpoints the necessity of the awareness of own cognitive and physical limitations as a prerequisite of accurate AT need in old participants.

As a fruitful line of future work, HCI researchers should address educational programs dedicated to aging-related limitations as leverage of improving self-perceived AT needs and thus, as promoting means of AT acceptance and adoption among old adults.

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