# Can robotic solutions favor the Ageing Well of the elderly with loss of autonomy?

**Abstract:**

The goal of this paper is to study the perceived benefits of robots in terms of Aging Well for the elderly with loss of autonomy. Through a qualitative study, conducted as part of a co-creation process, a needs analysis is carried out in order to translate the needs expressed into robotic functions. The results make it possible to prioritize the functionalities to be implemented and to guide more generally the technological development of robotic solutions by setting up co-creation meetings. The approach did not take into account the barriers to adoption and possible aspects of destroying value for all stakeholders involved. These could be overcome by defining appropriate services management for the elderly as part of the implementation of a successful ageing marketing.

*Keywords: Ageing-Well, Robotics, Autonomy*

*Track: Innovation Management & New Product Development*

## 1. Introduction

Many countries today face the challenge of an ageing population. The proportion of people of more than 64 years old in the population of the European Union's state members should rise from 18% in 2013 to 28% in 2060 (European Commission, DG ECFIN, 2017) because of the increase in life expectancy and the baby-boom generation growing old. This implies providing care to a growing number of the elderly whose health tends to physically and cognitively decrease while ageing. At the same time, lots of countries cannot face the lack of professional caregivers and of possibilities in appropriate home structures. New issues are emerging around ageing well (Sengès, Guiot and Chandon, 2018), and more specifically with the problem of maintaining the elderly with loss of autonomy in their homes or in non-caring residences. Developing new solutions to help the elderly on a daily basis becomes imperative.

In this context, technical innovations are promising and can help better monitoring the elderly in their everyday life or remotely assist them, especially for those suffering from chronic diseases (Coughlin, Pope, and Leedle, 2016). Robotic solutions can help filling the gap between growing needs in healthcare and services that occidental countries can provide today. Hence many European companies are interested in this market: in France, for instance, the launch of the Silver Economy attests growth opportunities in ageing well (Guérin, 2011).

This reflects a major change, because until now elderly were not considered as an attractive target for robotic solutions which are complex to understand. In addition to a negative perception of some people against technologies, the elderly population can be reluctant and suspicious. This target has been misunderstood both in terms of needs to meet through technological innovations and in terms of environment (stakeholders, living areas) within which these innovations are implemented (Caic et al. 2018).

The goal of this paper is to contribute in assessing the adoption potential of robotic solutions for the target of elderly people with loss of autonomy. Based on a preliminary needs analysis, we have identified potential perceived benefits of using a companion robot in the ageing well perspective and a possible transposition into robotic functions. Within a *co-creation for use/co-creation for others approach* (Humphreys and Grayson, 2008), a qualitative study with phenomenological interviews has been implemented in several countries with elderly people and with professional and informal caregivers who are also taking part in this specific adoption process. Results allow us to prioritize robotic functionalities to be improved. They also make it possible to guide the co-creation process

coupled with an Agile approach towards the adoption of robotic solutions that promote aging well by elderly people with loss of autonomy.

## 2. Theoretical Framework

Elderly and their networks of caregivers' well-being can be enhanced by companion robots. These robots, by having an impact on elderly's life quality, can diminish their feeling of loneliness and isolation (Augusto and al., 2012). Nevertheless, elderly and their caregivers seem to be reluctant to robotic solutions (Broadbent et al., 2009; International Federation of Robotics, 2015). Even if divergences can be noticed in the literature, this reluctance is a key challenge to overcome (Caic, 2018). One of our research question is thus to understand robotic solutions' perceptions for the elderly with loss of autonomy.

The literature globally reveals a rather positive view of technological innovations for people over 50. The role of the acquaintances and of the ecosystem of the elderly can have a huge impact on the technological innovation's adoption process on people who are no longer autonomous in their decisions (Caradec, 2001). However little research has been done on the acceptance of robots by elderly people with loss of autonomy: samples are often composed of young seniors under 65 years of age. However, Peek et al. (2004) show that the more the elderly want to grow old autonomously, the more he or she will be inclined to accept new technologies in order to stay home the longest time possible. The elderly with a loss of autonomy have a positive perception of robotic solutions because they can help them being autonomous and communicate with their relatives and the emergency services (Glende, 2016).

However, despite these encouraging perspectives, the elderly are distrustful regarding some potential negative consequences of these technologies. Robots can give them the impression of being permanently watched while they do not want to be treated like children and hate being supervised (Rivière & Brugière, 2010). They also need to control the technologies: if the robot helps them interact with their relatives (by sending a picture, for instance), elderly would value the security of their data (Karahasanovic et al., 2009).

At least, even if elderly people are open-minded and have much hope in robotic solutions, they do not forget the downsides: stigmatization, isolation because of the use of the robot and the communication on virtual networks, and dependence to technology (Glende, 2016). Elderly have generally a positive attitude toward robots when they can do the household tasks and remind them to take their medicines. They are way less favorable concerning their social

tasks – conversation, games – and intimate – having a shower: they do not want the robot to interfere too much in their private lives and fear cutting themselves off from the rest of the world socially (Ezer et al., 2009). With the same conclusions, Smarr and al. (2014) indicate that the elderly prefer human to robotic assistance in personal healthcare and relaxation.

Furthermore, tests on robots have shown some elements that are perceived in a non-favorable way. Some elements, which can seem common, are perceived as frightening or irritating by elderly. Thus, a surprising synthetic voice, the endless repetition of a message and the noise of the cooling fan which sounds like human breathing are real brakes for the senior user (Boudet et al., 2012). The role of a third party – caregiver or health professional – can give confidence to the elderly and contribute to a better perception of the robot. However, researchers have shown that elderly's attitude towards robots can sometimes be better than the caregivers' who can feel useless or be afraid to lose their job (Broadbent et al., 2012).

Even if some researchers have shown that robots' functionalities are more important to the elderly than their appearance (Broadbent et al., 2012), this aspect should not be neglected. Broadbent et al (2009) have highlighted the fact that dimensions, head and expression, height, gender, personality, and adaptability are all factors that older people assess when confronted with a robot. Moreover, the elderly are very attached to their home and their environment. A robot can be accepted if it naturally fits their environment without undermining their comfort (McCreade & Tinker, 2005). Hence small-sized robots are often preferred (Wu et al., 2012). Some authors, like Bartneck et al. (2007), raise the question of the cultural background of the elderly, which could influence their attitude toward the robot. Because most of the researches have been conducted in Japan, it is necessary to implement cross-cultural studies to reveal international converging needs.

All the divergences identified in the literature assume needs that are largely unsatisfied with today's robotic solutions. At the same time, the recent introduction of the concept of ageing well in the marketing field (Sengès, Guiot, and Malas, 2014; Sengès, Guiot and Chandon, 2018) let us question how more specifically robotic solutions can contribute to the ageing well of the elderly with a loss of autonomy.

## 3. Methodology

We used a case study approach as the European research project Agile CoCreation of Robots for Aging (ACCRA) was launched. The objective of this research project is to give

robotic solutions to fulfill the needs of elderly coping with a loss of autonomy. By placing the users (dependent elderly and caregivers) in the core of the innovation process, the ACCRA project aims at conceiving a robotic solution and a service offering that can respond efficiently to the needs, expectations and uses of dependent elderly and their caregivers.

The methodology adopted in this project consists in 4 steps: needs analysis, co-creation with Agile development, experimentation and sustainability analysis. In this paper, we will focus on the first phase only. This phase consisted in a cross-cultural study in 3 countries (France, Netherlands, Italy). This study was realized using the robot Buddy, which was under development and was made available by the company Bluefrog Robotics. Due to Buddy's initial functionalities, the ACCRA project focused on 3 main applications (mobility, day-to-day life, and communication) which led, with the literature review, to the construction of baseline scenarios (specific use-cases). These scenarios served as the basis for the interview guide used for the needs analysis. We are developing here only the study led in France and in the Netherlands and was related to the application day-to-day life which aims to help in Ageing Well at home.

For this application, the 3 baseline scenarios were based on Virginia Henderson's nursing need theory (1994) and its classification of needs for day-to-day activities: need for detection, reminders and notification of situation; security need (prevent, detect, alarm in case of danger); communication, entertainment and esteem need.

Interviews were led in the Netherlands and in France in order to detect the needs. Two types of people were selected. On one side, elderly between 65 and 91 years old, selected according to their degree of loss of autonomy compared to the multidimensional scale AGGIR (levels 4, 5 and 6), half living at home and half in senior residence, and not suffering of any mental problems but needing a punctual or ongoing help for their everyday life and their meals. On the other side, professional and informal caregivers (informal caregivers being the family of elderly) were selected. In each country, 10 elderly people and 10 caregivers were interviewed. At least 40 semi-structured interviews were led.

The interviews were all recorded with a smartphone or an audio device. All of the interviewees signed their agreement and the information extracted from the interviews was anonymized during their analysis. In the Netherlands and in France, participants have watched a video of the robot Buddy and its functionalities. Recorded interviews were fully transcribed and analyzed with a thematic analysis of the content (Gavard-Perret et al., 2008).

The first coding and categorization was presented in a table to have a better understanding within the interviews (progression of the interview in parallel with all the codified themes).

This table was used to help at a vertical analysis of the content. A second coding was set with a table presenting a between-interview analysis (illustration of a theme by all the interviews). This table helped at the horizontal analysis of the content.

Once the information classified, we went through calculating the occurrence frequency of several categories of themes and sub-themes (Jolibert & Jourdan, 2006) based on the evaluation of the number of individuals agreeing with the needs and functionalities suggested. Then, after this calculation and after the results of the qualitative study, we have prioritized elderly's needs and the corresponding functionalities for the robot.

## 3. Results and Implications

Elderly's general level of acceptance and perception of the robot are globally positive. More than 70% of the interviewees of both countries think that Buddy is useful. The elderly think that the robot can be useful to them, even when they are not familiar with that type of technology or when they have little experience with tablets and smartphones. Security and reminder services are much appreciated by the elderly: "*It would be a security for me instead of having this (the respondent shows the teleassistance bracelet) which is currently useless, it would still give me a... a certain confidence, that's it!*". Furthermore, they think that the robot could be a nice companion for their day-to-day life, in particular to alleviate loneliness: "*One feels less lonely, it talks and everything, that's all! That's good. For lonely people like that, isolated, I think it's perfect!*"; "*A little companion for every moment* ".

This point of view is globally shared among the caregivers, even if some of them think that the robot would be more useful for elderly from younger generations: "*Now it's useless but in a few years' time [...]. Not at the moment but it's... if it gets worse and I become less autonomous...*". A few caregivers think that the robot could suppress human contact.

A minority of individuals thinks that they do not need a robotic solution, which they perceive to be a gadget or useless: "*It's interesting the progress we're making... But right now, it's still a keychain! It's a gadget, I mean, I'm not excited about it. Well, it's already taking up space, it would be useless for now*".

The needs analysis led in France and in the Netherlands had for main goal to prioritize the needs and the services of the robots for the three types of respondents (elderly, formal and informal caregivers). In addition to the security needs (risk of fall, call a caregiver in case of emergency, forgetting to drink during warm periods) which are considered as vital, we can

see the importance of companionship needs (especially to communicate with relatives in France) and entertainment need to alleviate loneliness (Table 1). Physical and mental well-being needs are also very important. But meal needs are treated as secondary by the elderly.

| **USERS** | **PRIORITY SERVICES** *(Services recommendation based on end-users' needs)* | | |
|---|---|---|---|
| ***E= Elderly F= Formal Caregiver I= Informal Caregiver*** | **Ranking** | **Needs** | **Robot services** |
| **EFI** | **1** *Very high priority* | **1. SAFETY NEEDS**<br>1.1 Risk of fall<br>1.2 Warning a caregiver | ***PROTECTIVE ROBOT***<br>**a) Fall detection and prevention, warning a caregiver** |
| **F** | **1** *Very high priority* | 1.3 Forgetting to drink | **b) Reminder to drink** |
| **EFI** | **2** *High priority* | 1.4 Forgetting medication and appointments | **c) Help with medication and medical appointments** |
| **EFI (EUR) F (Fr)** | **3** *Medium priority* | 1.5 Monitoring the elderly environment for safety (turn off the gas, close the door, etc.) | **d) Monitoring the elderly in their environment** |
| **EFI** | **1** *Very high priority* | **2. COMPANIONSHIP NEEDS**<br>2.1 Loneliness / isolation<br>2.2 Needs for companionship | ***COMPANION ROBOT***<br>Endearing and playful companion that is a daily presence. Interactions between the robot and the user (verbal and physical). |
| **EFI** | **2** *High priority* | **3. COMMUNICATION NEEDS**<br>3.1 Difficulties with the phone<br>3.2 Difficulties with IT communication tools (Skype…)<br>3.3 Far from the relatives | ***COMMUNICATING ROBOT***<br>**a) Phone call**<br>**b) Video call**<br>**c) Sharing media on the robot's screen:** photos, drawings and videos. |
| **EFI** *(controversial for F)* | **2** *High priority* | **4. WELL-BEING NEEDS**<br>4.1 Maintain good well-being<br>4.2 Often anxious or stressed<br>4.3 Strong health concerns<br>4.4 Difficulties with sleeping<br>4.5 Heart rate problems | **BENEFICIENT ROBOT**<br>**a) Zen activity coach**: calming down exercices.<br>**b) Health and mood status**: fun tests to measure the health situation and mood, it can also warn the caregiver.<br>**c) Physical activity coaching** |
| **EFI** | **2** *High priority* | **5. ENTERTAINMENT NEEDS**<br>5.1 Need to entertain | **ENTERTAINMENT ROBOT**<br>**a) Games:** alone or connected with the elderly's network, cognitive games to maintain the memory. |
| **EFI** | **2** *High priority* | 5.2 Difficulties with reading (poor vision) | **b) Reading** books and newspapers. |
| **EF** | **4** *Low priority* | 5.3 Need to learn new things | **c) Learning:** Foreign languages, songs, poetry, etc. |
| **EF** *(controversial for F)* | **4** *Low priority* | **6. MEAL NEEDS** | ***MEAL COACH***<br>Ideas of menu and nutritional advice. |

Table 1. Priority services: service recommendation based on users' needs

The needs analysis helped in orienting the co-creation process with an Agile development. Our goal was to develop and test joint robotic services for two countries to avoid having a too complex project. The synthesis of the identified needs in the Netherlands and in France helped in fostering synergies and preventing the development of too specific services.

As shown by the needs analysis and the resulting priority services (Table 1), companionship functions through several interaction possibilities (verbal and emotional exchanges, games, movements), communication possibilities (audio and video calls, sharing photos and videos, contacting relatives), and well-being possibilities (coaching to help regulate emotional states and moods) constitute the robot's real added value in comparison

with security functions already assumed by today's teleassistance devices, which are considered as basic services according to Llosa's model (1997). On the security aspect, the robot seems to be complementary to traditional teleassistance solutions, in comparison to which it has two advantages. On one side, the robot is more easily accepted than teleassistance products because it is perceived as less stigmatizing; on the other side, the robot can have a complementary role because the elderly tend to forget to wear their teleassistance bracelet.

These first results helped in guiding the evolution of Buddy's programming to the implementation of essential characteristics that Buddy will have in its future interactions with the final user (elderly or caregiver). Some of these characteristics will be "transversal", which means that they will be in common for all of Buddy's applications.

Thus, the needs analysis brought out the importance of several parameters. The price must be affordable. There must be quality voice interaction functionality (voice control and answer). The ergonomics, especially the screen size, must be adapted to the final user. The robot must be easy to use. Companionship, communication and entertainment possibilities (in comparison to rival robotic solutions) are emphasized. Furthermore, the analysis revealed the pitfalls that the robotic solution company has to avoid: Buddy cannot replace the caregiver nor the pharmacist or the physician. It must be tuned off completely at all times and not record any other personal data than the ones controlled by the users.

A this stage of the co-creation project, it is not possible to assess the technical feasibility of the requisite functionalities in terms of new applications to implement, nor to evaluate the potential of the market of elderly in loss of autonomy that we want to conquer. Nevertheless, the research help finding a better definition of Buddy's targets: elderly from new senior generations and whose loss of autonomy would correspond the level 4, 5 and 6 of the AGGIR matrix, living at home or in a senior residence.

All of these results are the ground for the co-creation meeting of the ongoing ACCRA project. Robotic solutions' positive role in Aging Well has been highlighted with cross-cultural studies. We have studied the application day-to-day life in France and in the Netherlands, and the mobility application in Italy and in the Netherlands. This approach, supplemented with a co-creation approach with an Agile development, will help determining the grounds of a 'geronservuction' (services management approach for the elderly) in a marketing perspective of ageing well.

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