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EcSAAM: a model studying the acceptance and effect of virtual agents, holograms and robots on loneliness and quality of life, for elderly care in a context of Covid or social isolation

Abstract
We show the key role of the population of informal caregivers, the reason why the situation should worsen in the future, leaving more seniors not receiving enough social care. We show that virtual agents, holograms and robots might be possible complementary agents for human and elderly care. We also propose a reduced glossary for the virtual agents, retaining the clearest term of EVA. Then is introduced Loneliness: its relevance amongst seniors and more in a time of Covid crisis. A novel Service agents acceptance research model is presented, to be tested for elderly-care by a robot for now, and adapted to human care Globally, and overall human interaction in general when social link matters, and for all 3 agents: EVAs, Holograms or Robots.

Key words: embodied virtual agents, holograms, robots, emotions, social link or interaction, loneliness, modeling

Introduction
The objective of this article consists of proposing a more holistic approach of the interaction with people who suffer from a long disease, and need constant and/or repeated care, and to complement the human support by an interactive-machine or interface support. The context of the Covid crisis makes the issue even more relevant; but such issue will become a key problem in our society regardless of the Covid, as explained further on.
We propose a literature review in the literature, to show how much informal caregivers may not totally answer such need. We then show that virtual agents and robots have a real ability to partly bridge the gap. As a consequence, there is a non-fulfilled need and a room for some interactive device such as social virtual agents or robots to answer such needs.
This is particularly true in the case of the elderly. We then propose a model of the care process that emphasizes the role of social connection, adapting a robot interaction model, to the context of any agent (EVA, hologram or robot) interaction model in a medical care process for the elderly, with a focus on loneliness which is a major pitfall in the elderly care.

The elderly population is increasing, as well as the need for caring for them…and free human resource will not grow
Accurate numbers are difficult to find as numbers vary from the sources quoted but still, it is observed that the share of the extreme elderly population, those who need support, is increasing worldwide: those aged 80 years or more was of 1% of the world population in 1950, 4% in 2010, and 10% in 2015 (statistics WHO). Those are the elderly who are most in need for daily care, physical and administrative, but also, emotional care.
If we come to younger-elder people, the World Population Prospects 2019 (United Nations, 2019) tells us that 1 out of 6 people are over the age of 65 in 2019 and they will reach the ratio of 1 out of 6 in 2050 (WHO 2020). Several studies in the OECD and the WHO show that the "*WHO recognizes that long-term care represents a major challenge for all countries in the world, with important implications for economic development and for the health and well-being of older people*", and a need for public health long-term care policies… inexistent ten years ago (Colombo & al. 2011) and still nowadays. As a consequence, we have a growing ageing population, needing care. Can we rely on free or informal carers to continue to do the job in the future?
Caregivers provide a huge job, that our society does not fund, and they will not be enough for the job
The family or "informal" caregiver is a caregiver who is not paid for performing such task. As the American Cancer Society puts it, and the definition is generalizable to any caregiver: "*We define caregiver as the person who most often helps the person with cancer and is not paid to do so (they) may be partners, family members, or close friends. Most often, they're not trained for the caregiver job. Many times, they're the lifeline of the person with cancer*" (https://www.cancer.org/treatment/caregivers/what-a-caregiver-does/who-and-what-are-caregivers.html). A Carer or Caregiver is therefore a person who dedicates a "significant" part of his/her time to take care of a patient suffering from a long-lasting disease or a handicap physical or mental handicap, depression, or simply age.
It is extremely difficult to evaluate the magnitude of the phenomena of caring and of the carers' population. The EUROCARERS association (eurocarers.org) provides very detailed (though uncomplete) data and they recognize the difficulty of finding them: the numbers are, in 2019, of 8.3 M (12.4% of the total population) in France, O.8M (8% of the population) in Belgium, 3.23M (4%) in Germany, 4.035M (7%) in Italy, 3.5M (21.3%) in Holland, to mention only a few of them. The ratio in the EU varies from (non available to) 0.9% to 21.3% of the total population in term

of "official numbers". The non-official estimations of the number of carers, which are the real estimates for EURCARERS, varies from 6.3% to 26.5% of the national population of each state: this is huge. For cancer in France only the estimated population of informal caregivers is estimated at 5M people, who fight, suffer, sometimes fall-down in burn-out and exhaustion, having little or no help from the state, region, and employer (Ligue Nationale contre le Cancer 2013, 2016).

The invisible cost of the care provided by caregivers is huge, and probably unsustainable for most countries.
First the invisible-cost of carers is a little-studied issue. Such valuation is a difficult exercise and several methods are given by EUROCARERS (see e.g. https://eurocarers.org/publications/valuing-informal-care-in-europe/). Second, very few data are available on the subjects as very few countries show interest in its valuation. EUROCARERS shows that in developed countries we can take as a good estimate of the "invisible cost of family caregiving", a ratio of 4% of the GDP! This surprisingly high ratio was confirmed in a phone interview with the EUROCARERS foundation in Brussels. That is, at the present stage the cost of care is extremely high, is going to rocket-up with the ageing population, while the ratio *available carer/cared person* will decrease; the Covid crisis, with the loss of wealth and growth observed in many developed countries, will make the situation even worse. That is, there are many carers, non-paid nor recognized, and the ageing population increasing in size will make it more difficult to meet the needs in the future. If we add to this the huge invisible cost of the care provided by carers we see the situation going towards a dead-end, due to a lack of resources. The situation may also get worse with the financial difficulties generated by the Covid crisis.

A need for a complementary support for caring the elderly, using new technologies and agents
An experts-interview conducted in a middle-sized European hospital (General Segovia hospital, April 2018) led us to consider situations in which human carers may be difficult to recruit, to maintain in their care-activity, or simply, to get:
- when the caregiver is exhausted and cannot provide more time, more help, or is simply herself in burn-out (to have a deeper view of the life or caregivers in oncology for instance, see the detailed French LNCE report (LNC, 2013);
- when the patient has no more close family alive;
- when the patient has family but has no relationship with them - this is even more painful for the patient when she would like to transmit a memory, a reconciliation, or just souvenirs to her kids, siblings, relatives;
- in poor countries: when the distance between the village or home is too large, and the cost of housing close to the hospital or retirement home, is too high for the relatives.

Those are the main situations in which agents (EVA, hologram or robot) might partly help caring, and for the elderly in particular. We now go more in detail into the types of "agents" that might be a complement to carers and why.

The agents types studied in our reflexion as potential supportive-carers, and their effects
We know that Virtual agents, chatbots, robots, can provide some complementary support; but under which conditions would they be accepted, and with which benefits for the cared user and specifically the senior? We comment the findings, agent after agent, for the three agents we are interested in in this project: the EVA, the hologram, the robot. Please note that a specific conceptual section on EVAs will come further on.
The Embodied virtual agents or EVAs. An EVA positively impacts emotional reactions, the attitude towards the platform, the intention to return and to recommend it (Diesbach 2003, Diesbach & Jeandrain 2005, Diesbach & Midgley 2007, Diesbach, Chandon & al. 2007, Diesbach & Midgley 2008, Diesbach 2010; Bagozzi & Diesbach 2021, forthcoming); It also contributes to creating a social bound (Notebaert 2005, Viot and Bressolles 2012). Exactly as with a real person, an EVA displaying smile and believable emotions (Bartneck 2003) and humour (Nijholt 2002) generates user's enjoyment. Then, joy or pleasure in interaction is key to the will to continue, come back or to keep interacting, and it was found that EVA (and robots) can boost the pleasure of interacting with a system (Heerik & al. 2008a, 2008b), which in turn, increases the willingness of older adults to use it. An EVA also increases the enjoyment of the learning process (Johnson 2000; Lester & al. 1997), which should be key to maintain cognitive faculties in the elderly, slowing cognitive degeneration and isolation, impacting, in turn, quality of life. Amongst the elderly it was observed that an EVA fosters the will to participate in e-forums and social media exchanges, improving quality of life (Noy & al. 2013) and decreasing perceived loneliness.
Participants in conversations appear to trust humans and EVAs equally (Riedl & al. 2011) according to brain imagery. Okonkwo, C., & Vassileva (2001) also observed positive effects of EVAs on trust in a learning process. It is also observed that the positive effect on trust is magnified if the agent is expressive and shows empathy (Lester & al. 1997; Nass & al. 2000). In a way the social connection, the agent's personality seems to strongly matter in building a relationship with the user and in particular with the elderly (Wu & Miller 2005). The feeling of social presence generated by an EVA increases enjoyment and in turn, the will to use the system (Heerink & al. 2008). In general

the feeling that the system displays social behaviors, is able to create a bound with the user, and increases social presence, positively impacting the will to use it (Heerink & al. 2010; Morandell & al. 2008); Takeuchi & Naito 1995). An EVA is an efficient way and accepted character (Bickmore & al. 2005, 2009; Cassell 2000).
Overall, it seems crystal clear that the interaction with an EVA is globally appreciated, at least on a short-term - as in most, if not all cases, users did not interact in such a way for long durations and day after day. Second, it generates positive emotional reactions. It also appears that the social aspect is key: the system is not only appreciated for its skills and efficiency; it seems to confirm the Reeves & Nass approach, that users treat the agent like a person and that the more wealth, the more accepted it is. We will see if such findings are confirmed with robots.
The Holograms. A hologram is a 3D shape projected in the space in front of a user. It is a virtual image, with an increased embodiment level for the user as it seems to be embodied in front of her, and not anymore on a 2D platform, like a normal "platform virtual agent". In a way it is an intermediate position between the EVA and the robot, in term of embodiment (see **figure 1bis. An Embodiment continuum**). The literature on holograms is limited and we found no publication investigating the drivers and modalities of 3D holograms acceptability; the only holograms studied being the use of hologram technology for protecting or improving the design of offered products. Still, the concept of care and companionship being relevant with embodied virtual agents as well as robots, we propose to include the holograms for future applications in our modeling proposal, due to its conceptually "intermediate position" between EVAs and robots. We believe that interactions with holograms should follow the Reeves & Nass paradigm as the EVAs and robots do (machines are often treated and accepted as social actors and not as machines).
Robots. The case of the Japanese robot PARO, developed and used in Japan for providing emotional support to the elderly since the 90s, opens an avenue for elderly care with agents, holograms of robots. Concerning robots, several studies have shown positive effects on human users in a medical context, in particular on acceptance: users perception of an anthropomorphic robot as a companion (vs as a machine) dropped from 47% to 73%, and as a family member (vs a machine) from 20 to 33% after one week only (Fattal & al. 2020), confirming the relevance of adopting a perspective of social companionship construction with a social robot.
Three physical, psychosocial and cognitive areas are identified for assistive robots for elderly care (Caic Odekerken & al. 2018). Wada & Shibata (2007) observed that PARO generated physiological improvements and better inter-human communication. Early in research, it was observed that the elderly were open to using robots in their daily life (Jayawardena et al. 2010); Song & al. (2016) improved rehabilitation in absence of therapists via telerehabilitation training; but acceptability remains an issue: though staff and senior patients were excited about adopting robots, the same staff was reluctant to share their working space with it (Hebesberger et al. (2017); and last, diabetic kids and their human caregivers created a real social relationship with their robot carers (Looije & al. 2017). But the mechanisms of such relationship construction is unknown to date. Interestingly, anthropomorphism in itself does not suffice to predict acceptability (But & al. 2021): a more specified and refined modeling effort is still required; but clearly there exists a sort of "socialization-like process with an EVA", which fosters acceptation, use, well-being. .
Overall, Embodied Virtual Agents, chatbots and robots are estimated to be able to provide an immense support in our daily life in the future, due to their increasing acceptability, versatility, diminishing cost, and efficiency (Purtill 2019; McGausland 2021). It remains key today to study what generates their acceptance. As medical staff (nurses and care auxiliaries) seem to be doomed to be, by far, insufficient in number in the future, it seems key to examine whether EVAs, holograms and robots may play a role as assistant servants via warmth and social bound in a near future. Before going on towards introducing our research model, we now make a point on those 3 agents we chose to study here.

A typology of Agents

We will now present a typology of the 3 types of agents that we consider in our research, the EVA, the Hologram and the Robot, before proposing a research model studying the relations between acceptability, loneliness and quality of life in the context of medical care for the elderly with agents, holograms and robots.

A proposal of a new typology of social agents including virtual agents, holograms and robots

Our starting point is the study of the virtual agent considered as "*a program element capable of performing a task for a user, or of helping a user to perform that task*" (Diesbach 2003; Diesbach & Midgley 2007). We propose to study how the different types of virtual agents and robots can bring value to the user in the context of medical support services. Finally we propose a reflection and a simplified nomenclature concerning the agents.
A single term can group together the above agents which, conceptually, represent the same entity, with simply a varying degree of incarnation:
• Platform virtual agent: is synonymous to what the literature commonly calls a Virtual agent, embodied or not (2D or 3D), which is attached to a platform, performs tasks and is attached to a platform or computer screen;

• Hologram: is a virtual agent projected outside the computer screen, and is, in this sense more "embodied". It seems to have a more or less real body and should generate stronger social immersion and interaction.
• Robot: it is also an agent but which loses its virtuality because this time it is complemented in the real world by a physical envelope that we can touch, take in our arms, see moving etc… ;
An abundance of definitions. In the literature several definitions have been given for virtual platform agents. Indeed, we find the terms of IA-Intelligent Agent (Tweedale, Jeffrey & Ichalkaranje, 2006), AA-Autonomous agent (Bösser, 2015), ECA-Embodied Conversational Agent (Cassell, Sullivan & al. 2000), IVA-Intelligent virtual agent (Martin, Albert & al. 2007), AIA-Autonomous intelligent agent (Azvan, Răzvan et al. 2003), and especially EVA-Embodied virtual agent (Diesbach 2003; Diesbach & Midgley 2007, 2008; Noy & al. 2013) to name just a few references, including several in the medical field. The term Avatar: the problem with this term is that it is used in all sorts of virtual agent-use contexts, indifferently, without justifying or explaining its meaning: we therefore prefer to discard it, as inaccurate.
Other nomenclatures not included here have been used. In computer science there is redundancy between AA-Autonomous agent and IA-Intelligent Agent; the terms AIA and IVA bring therefore nothing conceptually and can be discarded (see **figure 1. A typology of "Platform Agents"**). We make now some more detailed points.
The concept of intelligence. We propose to define an Intelligent agent in our holistic approach as "*any entity with a certain degree of autonomy, and endowed with a variable degree of incarnation (embodiment) (from a platform agent, to an hologram, to a robot), capable of perceiving the environment thanks to sensors, to integrate and react to changes in such environment thanks to its "intelligence" (backed-up by, or relying on a strong enough data-base, and on machine learning algorithm(s)), and to perform actions via "actuators" such as moving arms, face, facial features etc.*". This applies to the virtual agent, the hologram, the robot. Of course, in our modeling intent we mostly consider the potential for intelligent agents.
The dialogue. Agents capable of initiating a dialogue with another agent or person are called CAs-Conversational agents (Mott, Bradford & al. 2004). They can communicate "intelligently" through the use of a dialogue module between agents or agents and robots. Its use is known in the medical field through the experiments made with e.g. PEPPER (Sato, Yasuhara & al. 2020) and NAO robots (Maribel, Charlieux & al. 2018).
Finally, if the EVA is equipped with a dialogue module, the agent becomes an ECA-Embodied Conversational Agent. We propose to use the term EVA-*Embodied Virtual Agent* which includes the fundamental concepts to which these different terms refer without providing redundant information. Figure 1 in the appendix underlines the links of kinship and/or redundancy between the different nomenclatures; it also differentiates the different types of agents.
Agents' interaction, whether they are EVAs, holograms or robots, are supposed to compensate for loneliness and improve quality of life, that we introduce now.

Loneliness: the concept, its relevance amongst seniors, its increasing relevance in a time of Covid crisis
Loneliness is not the result of an objective observation, but a subjective, negative feeling related to a perception that one's own social network is insufficient, and it has raised interest in marketing for long (Forman 1991, Vassar and Crosby 2008). It has been identified as a key issue in the context of social and medical care due to the negative effects it has on depression, optimism, cognitive abilities, health status and quality of life among other variables, and several extensive reviews have been conducted on its relevance and effects amongst the elderly (Franck, Molyneux et al. 2016, Gardiner, Geldenhuys et al. 2018). The Covid crisis has put even more pressure on the elderly population, making seniors' quality of life and feeling of loneliness an even more serious issue than it used to be (Filgueiras and Stults-Kolehmainen 2021), ad even more for the seniors (Briguglio, Giorgino et al. 2020, Lekamwasam and Lekamwasam 2020, Filgueiras and Stults-Kolehmainen 2021, Naeim, Rezaeisharif et al. 2021).
The object of our research is to put in some way on the same level, all the kinds of agents imaginable with few words: EVA for embodied virtual agents, holograms, and robots. The EcSAAM research model proposes now to study the effects of these 3 types of agents on the elderly in terms of acceptance, loneliness and quality of life with a focus on the social dimension of the relationship**.**

Proposal of a research model to be tested for human-care by a agent: the TAM, sRAM and the EcSAAM
Many theories and models have focused on predicting user acceptance of technology. The best known model is the TAM (Davis et al., 1989) and its various extensions the TAM2 (Venkatesh & Davis, 2000), UTAUT (Venkatesh et al. 2003), UTAUT2 (Venkatesh et al., 2012). This model, inspired by Fishbein and Ajzen's Theory of Reasoned Action (TRA), assumes that perceived usefulness and perceived ease of use are the drivers of the attitude towards using, and ultimately to the use of technology. This very functional model, although derived from the TRA, does not include any social dimension. This will be corrected with TAM2 which includes subjective norm - consistent with TRA - which is the materialization of an internalized social influence, defined as the perception that the technology use behavior would be approved (or not) by people important to the consumer. The UTAUT model will enrich these three basic drivers (perceived usefulness, perceived ease of use, subjective norm) and extend them theoretically.

Built and developed on the basis of perceived usefulness, the UTAUT model will include performance expectancy. Perceived ease of use will be transformed into effort expectancy; and subjective norm will become social influence. The model will add a fourth driver: facilitating conditions, defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003). Finally, the UTAUT2 model adds three new drivers: hedonic motivation, price value and habit.

It is on the basis of the TAM2 model that Wirtz et al. (2018) address the issue of service robots acceptance. The originality of their sRAM model is to go beyond the simple internalization of the social consequences of the use of the technology by the user, and to ask the question of the social function of the use of a technology which is able of interacting, and of simulating human behavior (see the model **sRAM, figure 2**). Wirtz et al. gather "functional" elements from the TAM2 (perceived usefulness, perceived ease of use, subjective norm) and create a category of "social-emotional" elements based on humanness, interactivity and the social presence of a robot. In doing so, they transform the TAM model by structuring it on the basis of the two universal dimensions of social judgment: competence and warmth (Fiske et al., 2006). These two dimensions answer two basic questions: does the "other" (the robot) want to help me (warmth)? Does it have the capacity to do so (competence)? For the authors, even if warmth and competence are separate dimensions, they are often positively correlated, due to a halo effect. In this sRAM model, the social dimension is not limited to the internalization of subjective norms, it is the core of the model by taking into account the social function of the interaction between robot and user.

However, it seems to us that this model can still be improved when we consider that the user is an elderly dependent person, in a care relationship. This can be done at the drivers level, but also at the outcomes level. The particularity of elderly people in a situation of dependence is the decline of their cognitive and physical capacities, which makes them more dependent on their caregivers. Moreover, this decline can cause a decrease in self-esteem and lead to social isolation. This has several implications that need to be considered:

- acceptance must be considered at the level of the user, but also in the close circle of which the elderly user depends (family and caregivers);
- social isolation can lead to a double dynamics: on the one hand, isolation can lead to a fear of other humans (contamination, gaze of others, etc.) and to a feeling of loneliness; on the other hand, because it allows certain tasks to be performed effortlessly, the robot can be considered as part of the extended self (Belk, 2013).

Both of these processes are likely to increase the likelihood that the elements of warmth and competence will cause acceptance of the technology. At the outcome level, acceptance and use cannot be an end in themselves. The use of service robots in an elderly care setting should lead to a reduced feeling of loneliness, a better quality of life and a better hope for the future (resilience). We therefore propose the following model studying the **Elderly care Social Agents Acceptance Model** (**figure 3. EcSAAM model**), which should be tested with EVAs, holograms and robots.

Conclusion

We propose a short conceptualization of a continuum of “agents” who can create a social bound wit a human and play a key role in interacting with her, such agents being part of a sort of continuum, from the less embodied (Virtual agent and then Embodied virtual agent, to the Hologram, and to the robot.

We then propose a synthetic review of some of the characteristics and drivers (or outputs) of the interaction with an EVA or a robot (little literature being available concerning the hologram): they highlight the key importance of not only the functionality and technical outputs of the interaction, but the key role of the social component.

We also demonstrate how important the role of informal caregivers is in our societies: that has been true during the last decades; it will be even more true in the future with the ageing population. If we also take into consideration the dramatic height of the “invisible cost” of the informal care provided by the carers, we observe that at some point: 1. there will not be enough human-carers to support their elderly; 2. the cost is already so high that we can hardly imagine how our societies and healthcare system might wish to pay for more humans to provide more social care. We therefore posit that EVAs, Holograms and Robots might act as a complement - not a substitute - when human carers will not be enough – and more in a context of Covid when the elderly suffer more than in normal time from a lack of human visits and contact. With the fear of contamination, with isolation, our 3 types of “agents” might provide some comfort, support, emotional care, our research takes relevance in a context of Covid pandemia. But its relevance and interest go far beyond: it should apply to all human-agent (EVA, hologram, robot) interaction context where social bound matters, that is, in any human-agent interaction.

This research model will be tested for the elderly-robot interaction context, in a collaboration project of one of the authors. It initiates a collaboration between a French Business School and Robotics research center, and an American Business school and Robotic research center as well, in collaboration with a major European robot-maker. All such institutions are present in the authorship. It will start with a Sabbatical in the USA from January 2022 and will go-on during the next 4 years, proposing a strong focus on the effect of social bond or link on the agent’s acceptation, and on the effect of the agent’s use on loneliness, a tragedy for the elderly’s quality of life, and hope.

BIBLIOGRAPHY

Abushariah, Mohammad & Ainon, Raja & Khalifa, Othman. (2011). Interactive voice response technology for telephony system.

Azvan, Rˇ & Florian, Răzvan. (2003). Autonomous artificial intelligent agents.

Bartneck, C. (2003). Interacting with an embodied emotional character. In Proceedings of the 2003 international conference on designing pleasurable products and interfaces (pp. 55–60). New York: ACM.

Belk R.W. (2013), Extended self in a digital world, Journal of Consumer Research, 40(3), 477-500.

Bickmore, T. W., Caruso, L., & Clough-Gorr, K. (2005). Acceptance and usability of a relational agent interface by urban older adults. In CHI'05 Extended abstracts on human factors in computing systems (pp. 1212–1215). New York: ACM.

Bickmore, T. W., Pfeifer, L. M., & Jack, B. W. (2009). Taking the time to care: Empowering low health literacy hospital patients with virtual nurse agents. In Proceedings of the 27th international conference on human factors in computing systems (pp. 1265–1274). New York: ACM.

Blut, Markus & Wang, Cheng & Wünderlich, Nancy & Brock, Christian. (2021). Understanding anthropomorphism in service provision: a meta-analysis of physical robots, chatbots, and other AI. Journal of the Academy of Marketing Science. 10.1007/s11747-020-00762-y.

Bösser, T.. (2015). Autonomous Agents. 10.1016/B978-0-08-097086-8.43011-

Briguglio, Matteo & Giorgino, Riccardo & Dell'Osso, Bernardo & Cesari, Matteo & Porta, Mauro & Lattanzio, Fabrizia & Banfi, Giuseppe & Peretti, Giuseppe. (2020). Consequences for the Elderly After COVID-19 Isolation: FEaR (Frail Elderly amid Restrictions). Frontiers in Psychology. 11. 10.3389/fpsyg.2020.565052.

Čaić, Martina & Odekerken, Gaby & Mahr, Dominik. (2018). Service robots: Value co-creation and co-destruction in elderly care networks. Journal of Service Management. 29. 10.1108/JOSM-07-2017-0179.

Colombo, F., Llena-Nozal, A., Mercier, J., & Tjadens, F. (2011). Help Wanted?

Cassell, Justine & Sullivan, Joseph & Prevost, Scott & Churchill, Elizabeth. (2000). Embodied Conversational Agents.

Cassell, J. (2000). Nudge nudge wink wink: Elements of face-to-face conversation for embodied conversational agents. In Embodied conversational agents (pp. 1–27). Cambridge, MA: MIT Press.

Davis F.D., Bagozzi R.P., Warshaw P.R. (1989), User acceptance of computer technology: a comparison of two theoretical models, Management Science 35(8), 982–1003.

Diesbach, B. (2003). Virtual agents and stickiness online, proposition of an integrative model. Proceedings of the 8th International Conference on 3D Web Technology, Saint-Malo, France, March.

Diesbach, Pablo. (2010). Embodied Agents, E-SQ and Stickiness: Improving Existing Cognitive and Affective Models. 286-298. 10.1007/978-3-642-13226-1_28.

Diesbach, Pablo & Midgley, David. (2007). Embodied Virtual Agents: An Affective and Attitudinal Approach of the Effects on Man-Machine Stickiness in a Product/Service Discovery. 42-51. 10.1007/978-3-540-73331-7_5.

Diesbach, Pablo & Chandon, Jean-Louis & Galan, Jean-Philippe. (2007). Effets de la présence et la congruence d'un agent virtuel incarné sur le pouvoir de rétention du site web - Effects of the virtual agent Presence and Congruency on the online stickiness power of a branding website.

Diesbach, B. P. d. and A.-C. Jeandrain (2005). "How to Generate Affective Reactions Through Social and Spatial Immersion on a Merchant Website;: Proposal of an Integrative Model." ACR Asia-Pacific Advances.

Diesbach, Pablo & Midgley, David. (2008). Embodied Agents on Commercial Websites: Modeling Their Effects through an Affective Persuasion Route. 283-286. 10.1007/978-3-540-68504-3_32.

Fattal, Charles & Cossin, Isabelle & Pain, Frederique & Haize, Emilie & Marissael, Charline & Schmutz, Sophie & Ocnarescu, Ioana. (2020). Perspectives on usability and accessibility of an autonomous humanoid robot living with elderly people. Disability and Rehabilitation: Assistive Technology. 1-13. 10.1080/17483107.2020.1786732.

Filgueiras, Alberto & Stults-Kolehmainen, Matthew. (2021). Risk Factors for Potential Mental Illness Among Brazilians in Quarantine Due To COVID-19. Psychological Reports. 10.1177/0033294120976628.

Fiske S.T., Cuddy A.J.C., Glick P. (2007), Universal dimensions of social cognition: warmth and competence, Trends in Cognitive Science, 11(2), 77-83.

Forman, A. M. (1991). "The Depersonalization of Retailing: Its Impact on the'Lone." Journal of Retailing 67(2): 226.

Franck, L., et al. (2016). "Systematic review of interventions addressing social isolation and depression in aged care clients." Quality of Life Research 25(6): 1395-1407.

Gardiner, Clare & Geldenhuys, Gideon & Gott, Merryn. (2016). Interventions to reduce social isolation and loneliness among older people: an integrative review. Health & Social Care in the Community. 26. 10.1111/hsc.12367.

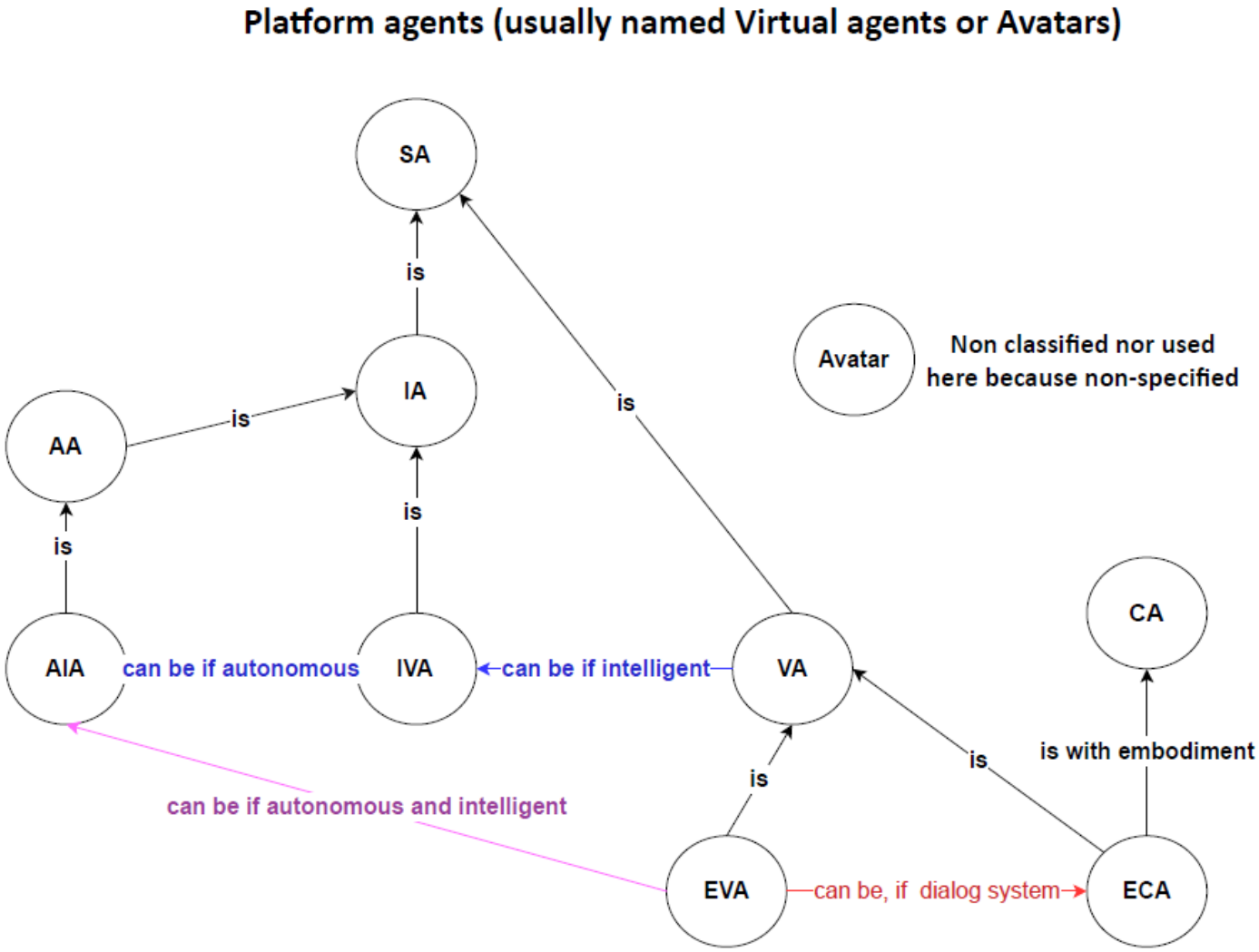
Hebesberger, Denise & Koertner, Tobias & Gisinger, Christoph & Pripfl, Jürgen. (2017). A Long-Term Autonomous Robot at a Care Hospital: A Mixed Methods Study on Social Acceptance and Experiences of Staff and Older Adults. International Journal of Social Robotics. 9. 10.1007/s12369-016-0391-6.

Heerink, M., Krose, B., Evers, V., & Wielinga, B. (2008). The influence of social presence on ¨ enjoyment and intention to use of a robot and screen agent by elderly users. In The 17th IEEE international symposium on robot and human interactive communication, 2008. RO-MAN 2008 (pp. 695–700). Piscataway: IEEE.
Heerink, M., Krose, B., Wielinga, B., & Evers, V. (2008). Enjoyment, intention to use and ¨ actual use of a conversational robot by elderly people. In 3rd ACM/IEEE international conference on human-robot interaction (HRI), 2008 (pp. 113–119). Piscataway: IEEE.
Heerink, M., Krose, B., Evers, V., & Wielinga, B. (2010). Assessing acceptance of assistive ¨ social agent technology by older adults: The almere model. International Journal of Social Robotics, 2(4), 361–375.
Jayawardena, Chandimal & Kuo, I-Han & Unger, Ulrike & Igic, Aleksandar & Wong, Richie & Watson, Catherine & Stafford, Rebecca & Broadbent, Elizabeth & Tiwari, Priyesh & Warren, James & Sohn, Joochan & Macdonald, Bruce. (2010). Deployment of a service robot to help older people. IEEE/RSJ 2010 International Conference on Intelligent Robots and Systems, IROS 2010 - Conference Proceedings. 5990-5995. 10.1109/IROS.2010.5649910.
Johnson, W. L., Rickel, J. W., & Lester, J. C. (2000). Animated pedagogical agents: Face-]to-face interaction in interactive learning environments. International Journal of Artificial Intelligence in Education, 11(1), 47–78.
Lekamwasam, Raveen & Lekamwasam, Sarath. (2020). Effects of COVID-19 Pandemic on Health and Wellbeing of Older People: A Comprehensive Review. Annals of Geriatric Medicine and Research. 24. 10.4235/agmr.20.0027.
Lester, J. C., Converse, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., & Bhogal, R. S. (1997). The persona effect: Affective impact of animated pedagogical agents. In: Proceedings of the SIGCHI conference on human factors in computing systems (pp. 359–366). USA: Atlanta, GA.
Lester, J. C., Converse, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., & Bhogal, R. S. (1997). The persona effect: Affective impact of animated pedagogical agents. In: Proceedings of the SIGCHI conference on human factors in computing systems (pp. 359–366). USA: Atlanta, GA.
Ligue Nationale contre le Cancer, P. L. c. (2013). Les proches, ces autres victimes du cancer, Mission Société et politiques de santé (*Caregivers, those additionnal cancer victims, Health policies & Society Mission*). LNC report, National Cancer Observatory, 204 pp.
Ligue nationale contre le cancer, G. J. c. (2016). Les aidants, les combattants silencieux du cancer *(Caregivers: the silent cancer fighters)*, Observatoire sociétal des cancers*)*. 144 pp.
Looije, Rosemarijn & Neerincx, Mark & Peters, Johanna & Blanson Henkemans, Olivier. (2016). Integrating Robot Support Functions into Varied Activities at Returning Hospital Visits: Supporting Child's Self-Management of Diabetes. International Journal of Social Robotics. 8. 10.1007/s12369-016-0365-8.
Martin, Jean-Claude & Jacquemin, Christian & Katz, Brian & Max, A & Pointal, Laurent & Rilliard, Albert. (2007). Intelligent virtual agents.
McCausland T. (2021) News and Analysis of the Global Innovation Scene, Research-Technology Management, 64:1, 2-10, DOI: 10.1080/08956308.2020.1843281
Mende, Martin; Scott, Maura L.; van Doorn, Jenny; Grewal, Dhruv; Shanks, Ilana. *Journal of Marketing Research (JMR).* Aug2019, Vol. 56 Issue 4, p535-556. DOI: 10.1177/0022243718822827.
Morandell, M., Hochgatterer, A., Fagel, S., & Wassertheurer, S. (2008). Avatars in assistive homes for the elderly. In HCI and usability for education and work (pp. 391–402). Berlin: Springer
Mott, Bradford & Lester, James & Branting, Luther. (2004). Conversational Agents. 10.1201/9780203507223.ch10.
Naeim, M., et al. (2021). "COVID-19 Has Made the Elderly Lonelier." Dementia and Geriatric Cognitive Disorders Extra 11(1): 26-28.
Nass, C., Isbister, K., & Lee, E. J. (2000). Truth is beauty: Researching embodied conversational agents. In Embodied conversational agents (pp. 374–402). Cambridge, MA: MIT Press.
Notebaert, Jean-François. (2005). L'interface homme-machine en commerce électronique: Vers une création de lien social comme outil de positionnement stratégique. Revue Française du Marketing.
Noy, Dominic & Ribeiro, Pedro & Iurgel, Ido. (2013). Embodied Virtual Agents as a Means to Foster E-Inclusion of Older People. 10.1007/978-1-4471-5082-4_7.
Okonkwo, C., & Vassileva, J. (2001). Affective pedagogical agents and user persuasion. in: Proceedings of the 9th international conference on human-computer interaction (pp. 397–401). USA: New Orleans, Louisiana
Pino, Maribel & Charlieux, Benoît & Bec, Aurélien & Demange, Manon & Rigaud, Anne-Sophie. (2018). Les robots sociaux : quel impact et quels enjeux dans la maladie d'Alzheimer ?. 10.3917/eres.tisse.2018.02.0147.
Purtill C. (11/4/2019), The Robot Will Help You Now, Time International (South Pacific Edition), 08180628, Vol. 194, Edition 18
Riedl, R., Mohr, P., Kenning, P., Davis, F., & Heekeren, H. (2011, December 6). Trusting humans and avatars: Behavioral and neural evidence. ICIS 2011 Proceedings (Paper 7). Shanghai. http://aisel.aisnet.org/icis2011/proceedings/hci/

Sato, Miki & Yasuhara, Yuko & Osaka, Kyoko & Ito, Hirokazu & Dino, Michael Joseph & Ong, Irvin & Zhao, Yueren & Tanioka, Tetsuya. (2020). Rehabilitation care with Pepper humanoid robot: A qualitative case study of older patients with schizophrenia and/or dementia in Japan. Enfermería Clínica. 30. 32-36. 10.1016/j.enfcli.2019.09.021.
Song, Aiguo & Wu, Changcheng & Ni, Dejing & Li, Huijun & Qin, Hongyun. (2016). One-Therapist to Three-Patient Telerehabilitation Robot System for the Upper Limb after Stroke. International Journal of Social Robotics. 8. 10.1007/s12369-016-0343-1.
Takeuchi, A., & Naito, T. (1995). Situated facial displays: Towards social interaction. In I. Katz, R. Mack, L. Marks, M. B. Rosson, & J. Nielsen (Eds.), Human factors in computing systems: CHIC95 conference proceedings (pp. 450–455). New York: ACM Press
Tweedale, Jeffrey & Ichalkaranje, Nikhil. (2006). Intelligent Agents and Their Applications. 4252. 486-491. 10.1007/11893004_63.
Vassar, Matt & Crosby, James. (2008). A Reliability Generalization Study of Coefficient Alpha for the UCLA Loneliness Scale. Journal of personality assessment. 90. 601-7. 10.1080/00223890802388624.
Venkatesh V., Davis F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186-204.
Venkatesh V., Morris M. G., Davis G. B., Davis F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425-478.
Venkatesh V., Thong J. Y. L., Xu X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157-178.
Viot, Catherine & Bressolles, Grégory. (2012). Les agents virtuels intelligents : quels atouts pour la relation client ?. Décisions Marketing. 65. 45-56. 10.7193/DM.065.45.56.
Wada, K. & Shibata, Takanori. (2007). Living With Seal Robots - Its Sociopsychological and Physiological Influences on the Elderly at a Care House. Robotics, IEEE Transactions on. 23. 972 - 980. 10.1109/TRO.2007.906261.
World Health Organization, (2020). Ageing.
Wirtz J., Patterson P. G., Kunz W.H., Gruber T., Lu V.N., Paluch S., Martins A. (2018), Brave new world: service robots in the frontline, Journal of Service Management, 29(5), 907-931.
Wu, P., & Miller, C. (2005). Results from a field study: The need for an emotional relationship between the elderly and their assistive technologies. In: 1st international conference on augmented cognition, Las Vegas.

APPENDIX

Figure 1. A typology of "Platform Agents" (traditionally named virtual agents)



Glossary: an arrow with the mention "is" from A to B means: "A is a sub-category of B". Sub-categories are pointing to bigger categories.

Figure 1.bis. An Agent Embodiment continuum

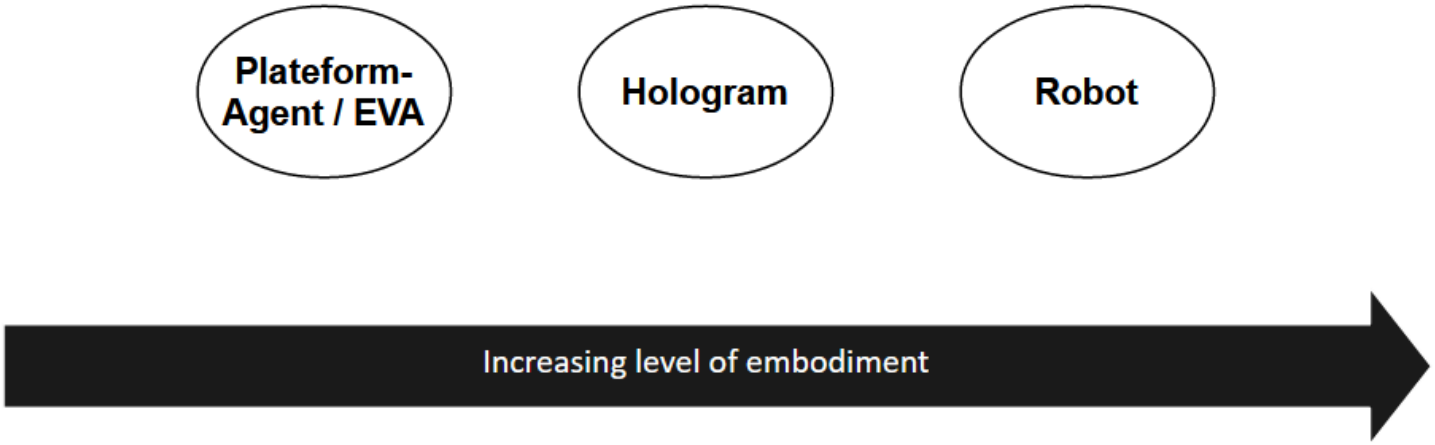


Figure 2. The sRAM or Service Robot Acceptance Model

Figure 2, Original sRAM-SOCIAL ROBOTS ACCEPTANCE Model; by Wirtz & al. (2018), drivers of robot acceptance

Figure 5. Service Robot Acceptance Model (sRAM).
This is the model which inspires our research

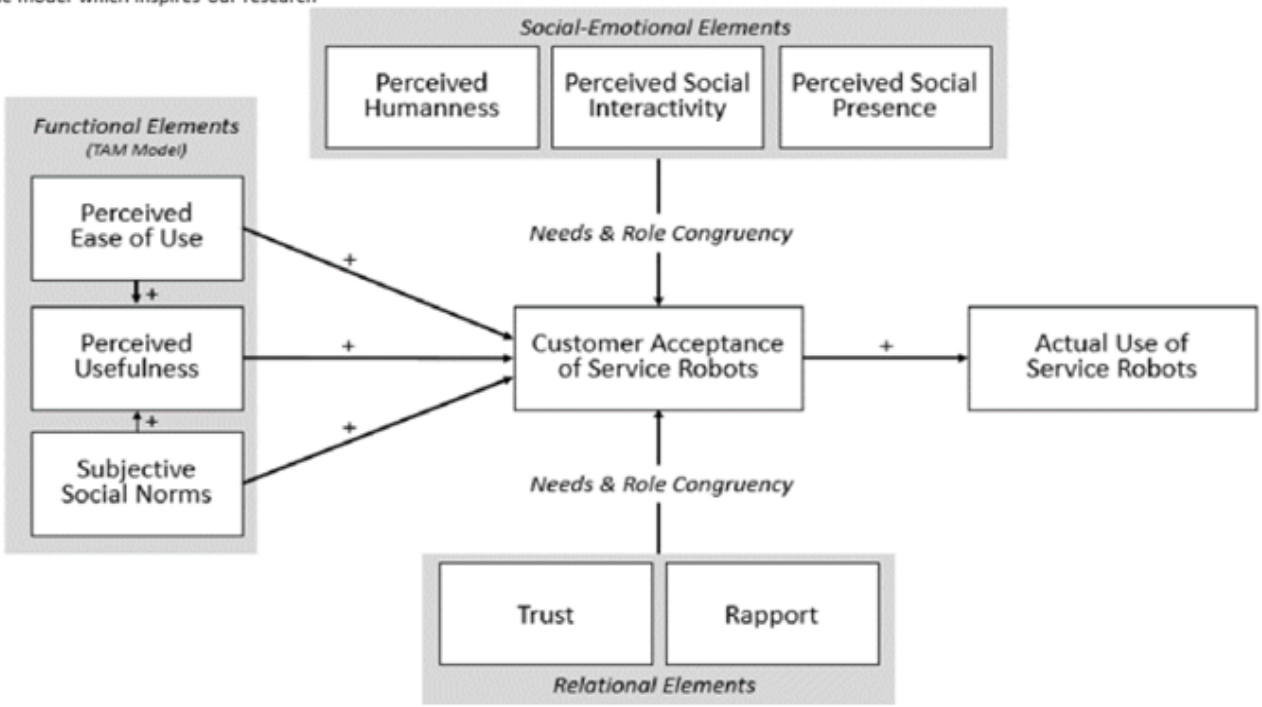


Figure 3: The EcSAAM research model of Agent acceptance in ederly care
Model also adapted to the context of any human-agent interaction