# Evaluating the Impact on Usability and Acceptance of ECAs in m-Health Applications for Older Adults

Raquel Lacuesta Gilaberte[1][a], Eva Cerezo Bagdasari[2][b] and Javier Navarro-Alamán[3][c]
[1]*Department of Computer Science and Engineering of Systems, I3A (Institute of Engineering Research of Aragon), EUPT/Universidad de Zaragoza, Spain*
[2]*Department of Computer Science and Engineering of Systems, I3A (Institute of Engineering Research of Aragon), EINA/Universidad de Zaragoza, Spain*
[3]*Department of Computer Science and Engineering of Systems, EUPT/Universidad de Zaragoza, Spain*

Keywords: ECAs, Avatars, m-Health, Older Adults.

Abstract: In the context of m-health applications, developing user-friendly interfaces to improve usability and acceptance by older adults has become a prominent research topic. The use of embodied conversational agents (ECAs) seems promising as they allow interacting through natural verbal and nonverbal communication. However, analyses about the design and acceptance of embodied conversational agents embedded in m-health applications for older adults are needed. In this paper, we present a study carried out to analyse the usability and acceptance of ECAs interfaces in m-health applications, compared to traditional tactile text interfaces. The study carried out has involved 23 users over 65 years old with promising results. The ECA interface was positively assessed and its acceptance increased compared to the traditional one, but although the feelings arisen are positive, users still claim for less complexity and a more careful design.

## 1 INTRODUCTION

Digital tools in clinical practice mean new tools for clinicians to deliver care. One is the ability to collect and store information about an individual's condition and care delivery through interoperable online systems. These systems may also be the only way to approach older adults in isolated situations such as the one caused by the COVID pandemic.

Within the technology field, there are different approaches for monitoring older adults. This monitoring can be done through different methodologies such as surveys, interviews, forms, tests… However, new methods are currently being developed through technology, such as chatbots, virtual assistants, or conversational agents. The use of a chatbot could be complex if the older person cannot read the screen because of problems (physical or cognitive) related to age or the existence of illiterate people who cannot write or read but can speak. Virtual assistants allow appointments, messages to be sent, and calls to be made by voice, but they are not designed to monitor people but rather to facilitate specific tasks without the need to write.

ECAs (Embodied Conversational Agents) refer to computer generated life-like characters that interact with human users in face-to-face conversation (Cassell & Bickmore, 2000). They can emulate some human characteristics, using different types of interactions such as speech, gaze, hand gestures, and other nonverbal modalities (Wargnier et al., 2015). This type of interaction, called multimodal communication, is of great utility in healthcare by providing potential personal interfaces to interact with users in healthcare settings (Turunen et al., 2011). Conversational agents using dialogues will therefore be a way to collect follow-up data from users. However, it is worth noting the arousal of conflicts when older adults use of technology, mainly due to the digital exclusion they suffer. Digital exclusion causes them different fears because it is unknown to them, and they may even feel ashamed of not

[a] https://orcid.org/0000-0002-4773-4904
[b] https://orcid.org/0000-0003-4424-0770
[c] https://orcid.org/0000-0002-3843-6796



Gilaberte, R. L., Bagdasari, E. C. and Navarro-Alamán, J.
Evaluating the Impact on Usability and Acceptance of ECAs in m-Health Applications for Older Adults.
DOI: 10.5220/0013216600003938

In *Proceedings of the 11th International Conference on Information and Communication Technologies for Ageing Well and e-Health (ICT4AWE 2025)*, pages 35-45
ISBN: 978-989-758-743-6; ISSN: 2184-4984

knowing how to use it and may be hesitant to ask for help (Nowakowska-Grunt et al., 2021). In addition, there is another major issue, which is trust. Many older people do not want to interact with conversational agents because they do not have confidence in them as they do not know what they can understand. Embodied agents may make the elderly feel more comfortable avoiding the feeling of talking to "a machine". The challenge is to design them so that they best suit the target users and enable seamless interaction.

This paper focuses on the analysis of the use of interfaces based on ECAs in m-health applications to be used by older adults. In these environments, the data collection process is especially critical: a proper m-health app design and the use of well-designed ECAs that generates acceptation may drive to a more natural and accepted data entry. The aim of the study carried out is to know if this kind of interfaces will increase usability and acceptance of the apps, compared to traditional ones.

The structure of the paper follows. First, in section 2, we analyze the related work regarding ECAs and their use in m-health applications. Then, in section 3 we present an initial study carried out to obtain information about the preferences of older adults regarding ECAs design. In section 4 we present the study done to compare an ECA-based interface versus a tactile text interface, in the context of an m-health app developed to retrieve information from older adults in a day-to-day basis. In section 5 results are presented, with special focus on the analysis of the acceptance of the ECA interface. Section 6 is devoted to conclusions.

## 2 RELATED WORK

In the scientific literature, numerous articles referring to virtual agents focus on providing companionship to older adults who suffer from social isolation and loneliness, which harms both their physical and mental health (Bérubé et al., 2021; Bravo et al., 2020; Dai & Pan, 2021; Franco dos Reis Alves et al., 2021). In these works an ECA provides companionship and care by monitoring possible falls or assisting in managing medication intake.

Other articles focus on the use of the conversa-3tional agent to register symptoms. Tanaka et al. (Tanaka et al.,2017), focuse on detecting dementia by employing a computer avatar, which performs spoken queries and examines the mental state. The conclusions obtained are that in addition to being able to diagnose accurately, there was a finding that allows more precise detection and reduces effort and time for this diagnostic process. This work (Pacheco-Lorenzo et al., 2021) focuses on whether the use intelligent conversational agents can be used for the detection of neuropsychiatric disorders. The conclusion is that this is an emerging and promising field of research with comprehensive coverage. However, they were not subject to robust psychometric validation processes, so they lacked a more rigorous validity. The last article (Bérubé et al., 2021), focuses on preventing and treating chronic and mental health conditions using conversational agents. The conclusion reached is that it is at a very early stage of research, where its validity cannot yet be fully determined. Nevertheless, it can be said that the results are encouraging in the absence of conclusive evidence.

The following articles focus specifically on the importance of the agents' design and the preferences of older people about them. The article (Shaked, 2017) emphasizes the importance of designing interfaces easy to use, attractive and allowing a smooth interaction, especially for the elderly. Developing avatars for the elderly is a challenge: they review key features to be taken into account that include visual, performance and environmental aspects. as well as trust and entetainment aspects to design helpful and friendly interfaces for the elderly. The work of Salman et al (Salman et al., 2021a) focuses on the addition of empathy in conversational agents. For this purpose, a qualitative analys33is of empathic dialogues in actual calls between a doctor and a patient was carried out. The conclusions reached are that empathic dialog is affected by gender, age, demographics, and even by medical history. The article (Cheong et al., 2011) explores the use of embodied agents as virtual representations of the older adults. After conducting a study with 24 people over 55, they visualized more than 20 avatars, they concluded that elderly participants were unable to identify with them. Nevertheless, results showed a strong trust on child characters and an attraction towards animal and object avatars. The race the avatar appeared to play a role, as well as other characteristics as height, clothing, facial hair, skin tones, or even the brightness of the eyes.

In the articles (Esposito et al., 2018, 2019), in addition to focusing on the agents' design, also studied the preferred technological device for people over 65 years of age based on their experiences. The vast majority share that this is the smartphone since it is the one they find easiest to use. Regarding the agent, in the article (Esposito et al., 2019), an empathic virtual coach is developed to improve the well-being of the elderly. The results showed that

older people tended to prefer the female gender and were more inclined to engage with it. However, it is worth noting that individuals with some experience in technology were not motivated and even perceived the agents as neither captivating, exciting, nor attractive.

The article (Esposito et al., 2018) conducts a study with older adults to validate artificial agents. From a sample of 45 adults over 65 years of age and in good health, four avatars were visualized, 2 of the male gender and 2 of the female gender, with different personality traits (angry, depressed, cheerful and practical). After passing them a questionnaire, the results were the preference for a female agent and a positive, cheerful and practical personality, without considering the voice issue because the videos are played without sound. This article (Thaler et al., 2020) emphasizes the importance of visual appearance, as it influences the perception and acceptance of conversational agents. However, greater humanization of the characters does not necessarily lead to better acceptance, as it often triggers uneasiness and rejection among people. In fact, increased human-likeness correlates with heightened perceived discomfort. These results were consistent across all participants, regardless of gender, age, or sex. This article (Thaler et al., 2020) emphasizes the importance of visual appearance, as it influences the perception and acceptance of conversational agents. However, greater humanization of the characters does not necessarily lead to better acceptance, as it often triggers uneasiness and rejection among people. In fact, increased human-likeness correlates with heightened perceived discomfort. These results were consistent across all participants, regardless of gender, age, or sex.

As we may see there are several studies that point to the potentiality of ECAs in m-health applications as well as to the importance of their design, but no clear design or usability recommendations are given. Therefore, we decided to do an initial study to get direct information about the preference of older adults regarding the design of the ECAs.

# 3 INITIAL ECA STUDY

In order to select the ECAs to be used and to make a first assessment of their acceptance, a first exploratory study was carried out with older adults in a nursing home,

## 3.1 Instruments, Method and Participants

8 possible ECAs (see Figure 1) were generated modifying sex (men/woman) and age (kid, adult, older adult).

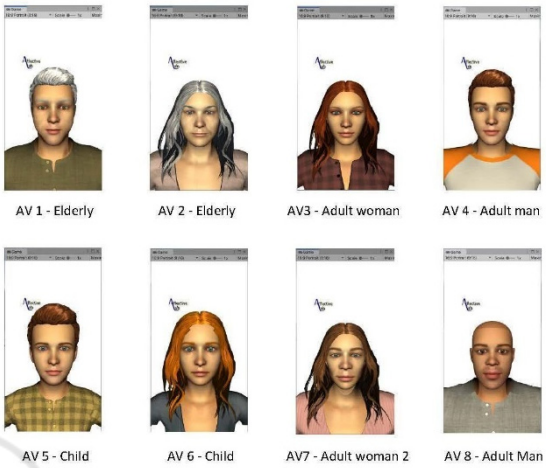



Figure 1: Pool of initial possible ECAs.

First, the users were shown all of them and they had to select just one based only on their appearance. For that agent, a video showing the agent was presented to the user, who was afterwards asked to rate the following aspects:

- Appearance
- Voice
- Social interaction:
    - Naturalness
    - How comfortable/uncomfortable would they feel if they had to interact with him/her
    - Confidence transmitted
    - Credibility
    - Emotion expressed by the agent (Yes/No, positive/negative/neutral).

All of the aspects had to be valued by using a Likert scale (from 1 to 7) except the last one. To facilitate the process no questionnaire was given to the users: the information was collected just talking with them In fact, we were not so interested in the quantitative measurements but in knowing the general preferences of the users as well as their reasons.

After completing the first agent assessment, the user was asked to choose another agent (second favorite) and the process was repeated.

16 users participated in the study, 5 men and 11 women. Regarding their age, there was one user aged between 60 and 69 years, 7 between 70 to 79 years, five from 80 to 89, and 3 from 90 to 99. In terms of their use of technology, less than 15% of them connected to the Internet (once a month at most), and about 45%. of them used it to find out about their loved ones through calls or messages (from one day a week to once a month). Regarding their abilities, they had the typical visual, auditory and motor, reduced abilities due to their age (see Figure 2), but no special physical or cognitive impairment, and they were all able to interact with a tablet (the device used in the study).

### 3.2 Results

In the first election, the clear favorite was the adult man (AV4), followed by the adult woman (AV3) and finally the elderly man (AV1). The other agents were not chosen. In the second vote, the girl (AV6) gets the best vote, and then there are three tied avatars: adult man (AV4), boy (AV5) and adult man 2 (AV8) with the same number of people who have chosen them. After, the elderly (AV1) and the adult woman (AV3); the elderly woman (AV2) and the adult woman 2 (AV8) were not selected in any of the cases. We want to emphasize that, the second selection was affected by the first: if an agent had been voted for the first time, it could not be repeated and many times, it influenced the second choice: "in the first case, I have taken a man, now I select a woman".

It can be concluded that, male characters with young appearance and soft features were the favourites. In general, attention was paid mainly to their (pleasant) physical appearance. These results are not aligned with other studies that reflect preference for female characters (Esposito et al 2018). This may be attributed to the medical context of the videos (medical) and a social-gender issue that may have led the participants prefer a (masculine) doctor character. A similar issue was encountered with the age: the fact of labeling the avatars as "elderly" or "child": a user who did pay attention to this label presented a comment of the type: "a child cannot be my doctor". Therefore our results should be considered within the m-health application context. Other more general issue were found: some users said to choose the agent according to the resemblance to known persons. And considering the emotions generated, the agent that is best valued physically and at a social interaction level is the one that generates the most positive emotions in users.

Besides the selection, additional interesting issues were detected:

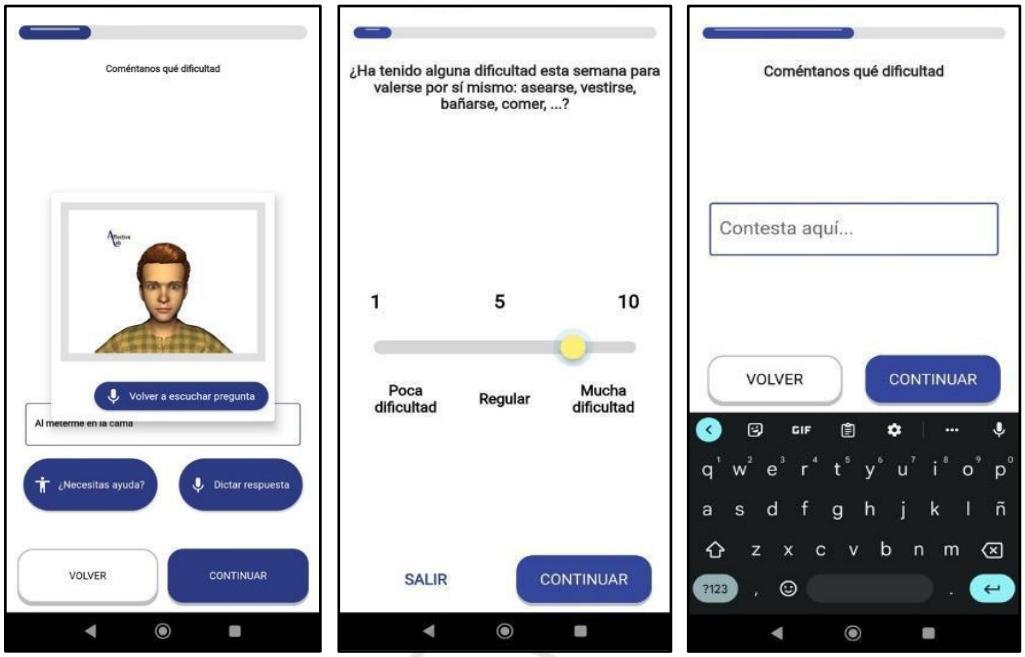
- When we informed users about the study, most users expressed their reluctance to use technology. "I don't know how to do it" was the common comments before even starting to do anything. This highlights the critical point of acceptance when developing apps for the elderly.
- While the videos of the agents were being viewed, except for a couple of users, all of them tried to interact with them (despite the fact that it was just a video): when the agents greeted them, the users answered them, and when they wished them a good day, the users thanked them for those words. This may show positive disposition towards an ECA based interface. Nevertheless, these interactions did not prevent them to give them bad scores in the social interaction questions.
- Participants felt reluctance to say negative things about the agents ("I would not like to give it a bad score") which may point out to some kind of empathy or emotional liaison, although later in the question linked to the emotions they said he/she did not convey any emotion

After this initial study, we decided to continue adding a multimodal interface based on a young male ECA to an m-health application being developed.

## 4 ECA INTERFACE ASSESSMENT

After the initial study, an ECA based interface was added to an m-health application designed to monitor frail elderly people (Navarro-Alamán et al., 2021). The app is aimed at the elderly population and its main objective is to monitor users through surveys but contains also different physical exercises proposals, games to exercise memory and nutrition advices. The initial interface was a traditional tactile one. We decided to carry out an evaluation to assess the impact of the ECA interface. In particular, we wanted to answer the question:

*Does ECAs help to improve usability and acceptance of m-health applications by older adults?*




(a) (b) (c)

Figure 2: Sample screens of the application without ECA **(a)** numeric insertion screen and **(b)** text insertion screen and of the application with the ECA interface **(c).**

To carry out the assessment we created two versions of the app: one with a traditional tactile interface (Appv1) and other with an ECA-based interface (Appv2) focusing in the daily surveys to be completed by the users. In the first one (see Figure 2), the users read the questions and introduce the answers in a tactile/textual way. In the second version the ECA-based interface allows the user to listen to the questions answer them orally (giving a number, an option or an open text, depending on the question). The user has a button to hear again the question, to ask for help and to dictate the answer.

A questionnaire was designed to carry out the assessment; it is dived into four sections: (0) User characterization, (1) Usability and acceptance, (2) Agent's rating (3) Users' app preference. User characterization questions are aimed to determine gender, use of technology and possible (hearing, visual, mobility) impairing. In Table 1 the rest of the questions are shown.

The test was performed by 23 users all of them over 65 years of age with a mean age of about 72 years, (std deviation of 3.82), 13 participants were female and 10 male. Regarding impairing, the most frequent problems were vision problems, which affect 78% of the respondents, followed by hearing problems and finger mobility with 39% both. All participants had a cell phone, but Tablet ownership drops to less than half (ten respondents). All of them used phones just for making calls. 65% use it for messaging (WhatsApp), and only three of them also use them to view news.

Every user interacted with both versions (half of them in one order and the other half in the reverse order). The sessions were performed at users locations supported by one researcher. First of all the user filled the characterization questions (0) Then, he/she tested (filling a questionnaire) one of the apps (Appv1/Appv2), answered some questions, test the second version (Appv2/Appv1) and answered some questions. Finally, the user answered the preference questions (3) –see Table 2-.

# 5 ASSESSMENT RESULTS

We will discuss the results in terms of agent's rating, general usability and acceptance impact.

## 5.1 Agent's Rating

The agent's physical appearance received an average rating of 6.5 out of 10, while its credibility was rated at 6.8 out of 10. Regarding the emotions conveyed, 70% of users stated that the agent successfully transmitted emotions, and 86% of them described

Table 1: Assessment questionnaire.

| Category | Dimension | Question | Type |
|---|---|---|---|
| **1. Usability/ acceptance** | Perceived ease of use | Q1. The application is effortless to use | Yes/No/Maybe? |
| | Perceived ease of use | Q2. I find this application unnecessarily complex | Yes/No/Maybe? |
| | Perceived ease of use | Q3.I needed to learn a lot of things before I was able to use this app | Yes/No/Maybe? |
| | Perceived ease of use | Q4. I think I would need help from a tech savvy person to be able to use this application | Yes/No/Maybe? |
| | Perceived ease of use | Q5. I imagine that most people would learn how to use this application quickly | Yes/No/Maybe?? |
| | Attitude towards use | Q6. I am satisfied with this application | Yes/No/Maybe?? |
| | Intention of use | Q7. I would like to use this app to report other aspects of my health to my doctor | Yes/No/Maybe?? |
| | Intention of use | Q8. I would recommend that other apps I use be similar to this one | Yes/No/Maybe?? |
| | Attitude towards use | Q9. The app is fun or entertaining to use | Yes/No/Maybe?? |
| | Attitude towards use | Q10. I felt confident in using this app | Yes/No/Maybe?? |
| **2. Agent's rating** | Physical appearance | Q11. Assess its appearance | Likert (1 to 7).<br>1 being not at all appropriate and 7 very appropriate. |
| | Credibility | Q12 How much credibility does the agent give you? | Likert (1 to 7).<br>1 being not at all credible and 7 being very credible. |
| | Emotion expression | Q13. Has the agent transmitted any emotion?<br>If yes, how was the emotion transmitted? | Yes/No<br>Positive, Neutral or Negative |
| **3. Users' app preference** | Easier to use | Q14. Which application do you find easier to use? | Agent/ No agent |
| | Easier to understand | Q15.With what application do you understand the questions better? | Agent/ No agent |
| | Feel better in the interaction process | Q16.With which application did you feel better in the interaction? | Agent/ No agent |
| | Feel more comfortable | Q17.With which application did you feel more comfortable when interacting? | Agent/ No agent |

Table 2: Groups of users and structure of their assessment sessions.

| Users Group | Group Questions | First App | Group Questions | Second App | Group Questions | Group Questions |
|---|---|---|---|---|---|---|
| Group1 | 0 | Appv1 | 1 | Appv2 | 1,2 | 3 |
| Group2 | 0 | Appv2 | 1,2 | Appv1 | 1 | 3 |

these emotions as positive or neutral. Overall, the agents received a fairly positive evaluation, although their physical characteristics could clearly be improved with more time dedicated to their development.

## 5.2 General Usability Analysis

We have divided, for a first general usability analysis, the questions into two groups: those related to positive aspects (Q1, Q5 to Q10) and those related to negative ones (Q2, Q3, Q4).

Beginning with the questions on positive aspects (see Figure 3), in all of them the application with ECA is rated higher, both in those related to ease of learning (Q1, Q5) and satisfaction with the application (Q6, Q8, 10). In Q7. ("I would like to use this app to report other aspects of my health to my doctor") the result with and without ECA is similar and very positive (95%) which shows the very positive overall rating of the app and its usefulness. Only in Q9 ("The app is fun or entertaining to use") does it go from 70% (no ECA) to 55% (ECA). This result may be connected with the perceived complexity of the ECA version shown, as we will see in the results of question Q2.

As for the negative questions, (Figure 4) although in question Q2 ECA results are worse than non-ECA ones, in Q3 and Q4, the results are better, i.e. although users find the application with ECA complex they do not think they would need to learn a lot of things or get help to use it. This aspect is analyzed with more detail in the next section when considering acceptance.

## 5.3 Acceptance Analysis

In older adults, technology acceptance is a key factor to be considered. This is why we were interested in comparing the acceptance of both interfaces. The Technology Acceptance Model (TAM) is a commonly utilized paradigm for understanding and predicting technology uptake.

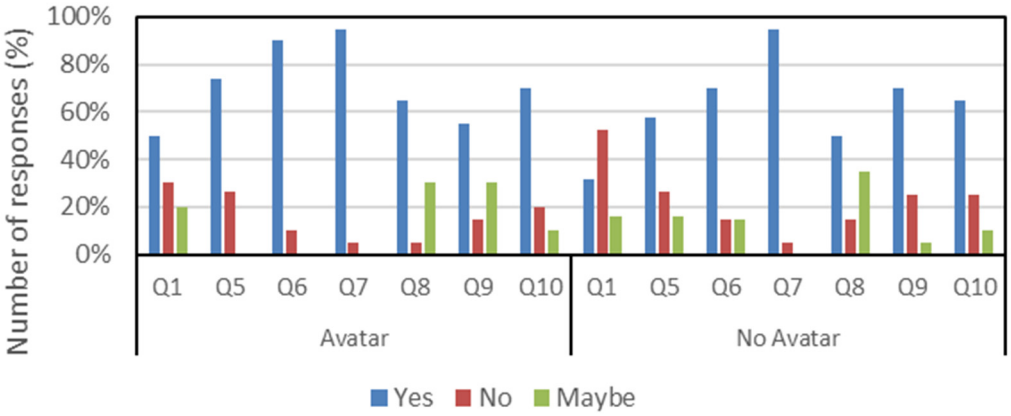



Figure 3: Responses (Avatar/ECA, No avatar/ECA)to usability positive questions (greater affirmative percentage, better result). Questions shown in Table 1.

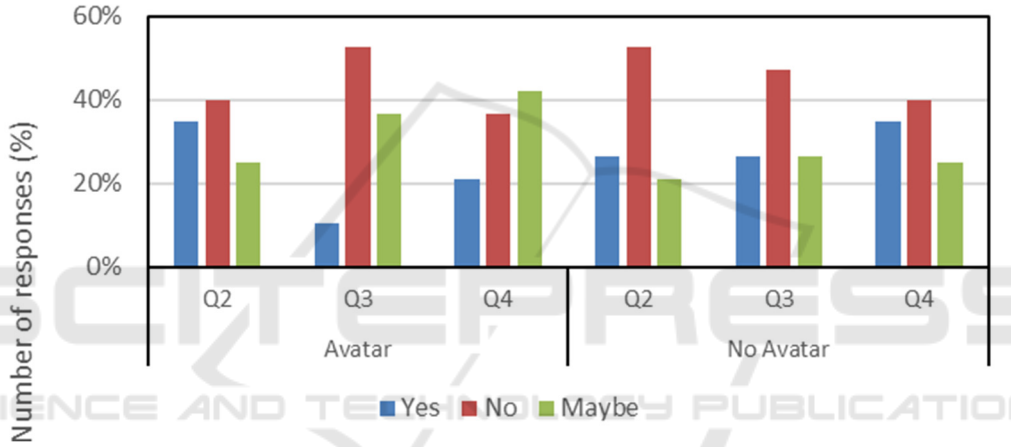



Figure 4: Responses (Avatar/ECA, No avatar/ECA) to usability negative questions (lower affirmative percentage, better result).

TAM was developed in the 1980s by Fred Davis (Davis, 1989) and has since become a prominent conceptual framework in the field of technological adoption research. TAM focuses on four dimensions: perceived utility, perceived ease of use, perceived attitude towards use, and perceived intent to use. As the aim of the evaluation was to compare both interfaces (without and with ECA) we have focused on three of them: perceived ease of use, attitude towards use and intention to use, grouping the questions (Q1 to Q10) around those three dimensions for the acceptance comparative analysis.

**Perceived Ease of Use:** This element is related to the perceived ease of use of the application (see Figure 5). The questions Q1, Q2, Q3, Q4 and Q5 delve into various relayed aspects.

Question Q1, "Using the application is effortless," highlights the importance of usability in the user experience. An application that is perceived as easy to use may generate a more positive and engaging experience for users. On the other hand, an application that is perceived as requiring effort can generate frustration and affect overall user satisfaction. About 50% of users with an ECA and 30% of users without an ECA responded affirmatively, indicating that they perceive that using the application does not require effort. Fifty-five percent of users without an ECA responded negatively, indicating that they find using the application requires effort.

Question Q2, "I find this application unnecessarily complex," highlights the importance of simplicity in application design and functionality. An app that is considered unnecessarily complex can be confusing and discourage users from adoption and continued use. As commented before, about 35% of users with ECA and 30% of users without ECA

responded affirmatively, indicating that they find the application unnecessarily complex. Fifty-five percent of users without an ECA responded negatively, while only 40% of users with an ECA did so. We think that this result is due to the need in the ECA version to press buttons to hear the content and also to introduce the voice answers, what was found difficult by the Question Q3, "I needed to learn a lot of things before I was able to use this application," provides us with information about the participants' perception of the learning curve required to use the application. Only 10% of users with an ECA and 25% of users without an ECA responded affirmatively, indicating that they perceived that they needed to learn many things before being able to use the application. On the other hand, 50% of users with ECA and 55% of users without ECA responded negatively, indicating that they did not have that perception.

Question Q4, "I think I would need help from a person with technical knowledge to be able to use this application," provides us with information about the participants' perception of the need for technical assistance to use the application. Only 20% of users with an ECA and 25% of users without an ECA responded affirmatively. Forty-five percent of users without an ECA responded negatively, while 40% of users with an ECA responded negatively.

Question Q5, "I imagine most people would learn to use this application quickly," highlights the importance of an application being intuitive and easy to learn for most users. Participants who used the application with ECA, 70 %, considered it easy to use compared to those, 55%, who used the application without ECA. As for the "No" response, there was an equal proportion of 25% in both groups. However, there was a notable difference in the "Maybe" response, with only 5% of participants who used the app with ECA showing doubts about the perceived ease of use, compared to 20% of those who used the app without ECA.

Summarizing, although the percentage of users that found the application complex was a little higher in the ECA case (35% compared to 30% in the non-ECA interface) only 10% of users thought they would have to learn a lot of things before using it (compared to 25% in the tactile version), only 20% (compared to 25%) stated the think they would need help to use it and 70% (compared to 55%) thought most people would learn to use it quickly.

**Attitude Towards Use**: This element is related to participants' attitudes toward application use (see Figure 6). The questions Q6, Q8, Q9 and Q10 delve into various aspects of it.

The question Q6, "I'm satisfied with this application," highlights the significance of the user's satisfaction as a key indicator of the application's quality. The majority of users, both those with ECAs and those without, demonstrated their satisfaction with the application. 70% of users without ECAs and 90% of ECA users said "yes" to the question.

The question Q8, "Recommend that other applications I use be comparable to this one," emphasizes the significance of the application's perceived satisfaction and utility. Over half of users without ECAs (50%) and the majority of ECA-using users (65%) answered "yes." Although both groups shown a willingness to recommend similar applications, users without ECAs displayed a slightly higher proportion of negative responses (15%) compared to users with ECAs (5%).

The question Q9, "The application is fun or entertaining to use," highlights the significance of providing a user experience that is appealing in terms of fun or entertainment. The majority of users, 55% of those with ECAs and 70% of those without, responded positively, indicating that they thought using the application was fun or entertaining. The usability problems commented before may explain these differences.

Question Q10, "I felt confident in using this application," highlights the importance of building user confidence in using the application. A higher percentage of participants who used the application with ECA, 75%, felt confident in its use, compared to 60% of those who used the application without ECA. In addition, a significant difference was observed in the "No" response, with 15% of participants with ECA indicating lack of confidence, in contrast to 30% in the group without ECA. The "Maybe" response was similar in both groups, with 10% of participants selecting this option in both cases.

**Intention to Use**: This aspect refers to the participants' intention to use the application (see Figure 6).

The question Q7, "I would like to use this application to inform my doctor about other aspects of my health," is related to the use-intention factor. It can be shown that in both cases, 95% of participants indicated they intended to use the application to use it in relation to their health's ongoing monitoring, while only 5% indicated they did not want to do so.

As can be seen, the acceptance of the ECA interfaces is higher (in the case of the perceived ease of use an d attitude towards use dimensions) and equal in the intention to use dimension.

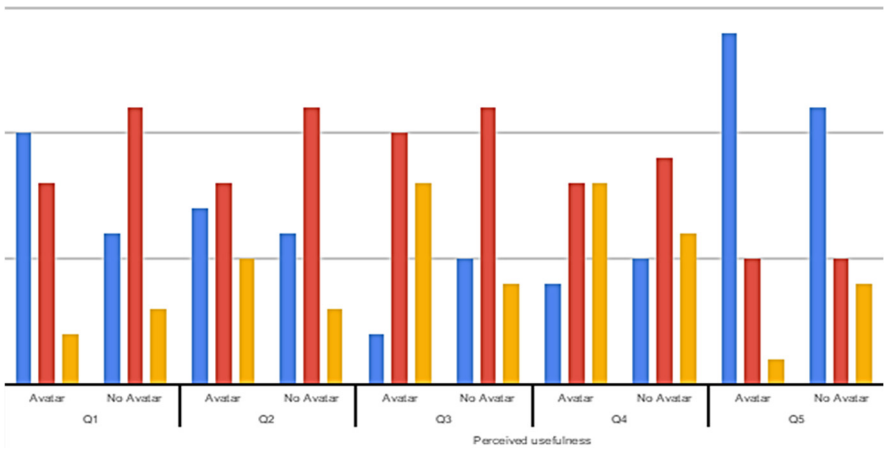



Figure 5: Analysing perceived ease of use (Q1-Q5, Avatar/ECA, No avatar/ECA). Questions shown in Table 1.

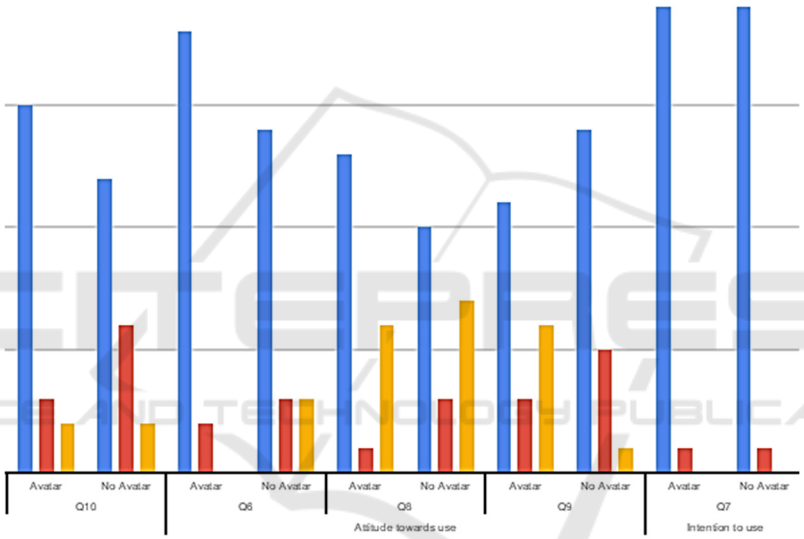



Figure 6: Analysing attitude towards use (Q6, Q8, Q9, Q10) and Intent to use (Q7). Questions shown in Table 1.

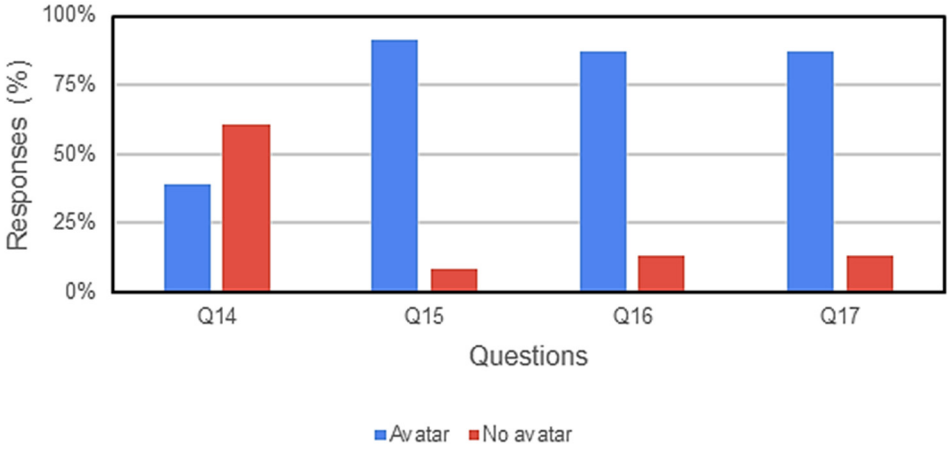



Figure 7: Users' preferences regarding type of interface (Avatar/ECA, No avatar/ECA). Questions shown in Table 1.

The results of this study highlight the advantages of integrating Embodied Conversational Agents (ECAs) into applications aimed at older adults. The ECA interfaces demonstrated higher acceptance in the dimensions of perceived ease of use and attitude towards use, suggesting that the interactive and engaging nature of ECAs contributes positively to user acceptance. Although some participants found the ECA interface slightly more complex to navigate, the majority appreciated its intuitiveness and reported a reduced learning curve compared to the non-ECA interface. Furthermore, the equal levels of intention to use across both interfaces indicate that the perceived utility of the application remains consistent, regardless of interface type.

### 5.4 User App Preference

Questions Q14 to Q17 are intended to detect users' app preference, and their results are shown in Figure 7.

Question Q14, "Which application do you find easier to use?," compares facility of use: 61% of the participant considered the Non-ECA version (tactile) easier to use, only 39% of them thought the ECA interface was easier. This results is consistent with the analysis of complexity done in relation to question Q2.

Question Q15, "With what application do you understand the questions better?" compares facility of use: 91% of the participants selected the ECA version, only 9% the tactile/text interface.

Questions Q16 and Q17 focus on users' feelings during the interaction. In Q16 "With which application did you feel better in the interaction?" the ECA version was clearly favoured, as 87% chose it and only13&% chose the non-ECA interface. Same percentages were obtained in question Q17 "With which application did you feel more comfortable when interacting?".

As it can be seen, the agent helps older adults to feel more comfortable in the use of the applications, during the interaction and led to a better understanding of the questions. Nevertheless, they do not find it easy to use.

## 6 CONCLUSIONS

Due to the aging population and the growing need to closely monitor frail older adults, it becomes essential to integrate technology into their environments and contexts of use. Designing interfaces for this group presents significant challenges, as many older adults are reluctant or, at best, unmotivated to engage with technology. Additionally, a considerable number face vision, hearing, or cognitive impairments, and some experience literacy difficulties.

ECAs interfaces support multimodal interaction, may facilitate the transmission of emotions and at the end may increase confidence and adherence. In this paper, we present a study to analyse the use of this kind of interfaces in m-health applications aimed to older adults focusing in their usability and acceptance by its users.

Our results show that with the use of ECAs, the acceptance of m-health applications increases compared to only tactile text-based interfaces. This is true in two dimensions: perceived ease of use and attitude towards use, being even in the intention to use dimension. Moreover, older adults feel better and more comfortable with the ECA interface (with a preference for male characters with mild appearance) and think they help them to answer the questions. Nevertheless, this kind of interfaces are not seen easier to use or funnier than traditional ones if they are not carefully designed.

After the promising results obtained in this initial work, other issues such as the study of agent's credibility, trustworthiness and its impact on user's adherence to the app have to be studied in next works.

## ACKNOWLEDGEMENTS

Partially funded by the Spanish Ministry of Science and Innovation through contract PID2022-136779OB-C31. T60_23R Research Group in Advanced Interfaces (AffectiveLab), Government of Aragón. Research grant program 2024.

## REFERENCES

Bérubé C, Schachner T, Keller R, Fleisch E, V Wangenheim F, Barata F, Kowatsch T. (2021). Voice-Based Conversational Agents for the Prevention and Management of Chronic and Mental Health Conditions: Systematic Literature Review. *J Med Internet Res. Vol 23(3):e25933. doi: 10.2196/25933*.

Bravo, S.L., Herrera, C. J., Valdez, E. C., Poliquit, K. J. Ureta, J., Cu, J., Azcarraga, J.J., Rivera, J.P. *(2020).* CATE: An Embodied Conversational Agent for the Elderly. *In Proc. of the 12th International Conference on Agents and Artificial Intelligence (ICAART 2020)*, vol 2, pp.941-948, doi: 10.5220/0009174009410948.

Cassell, J., & Bickmore, T. (2000). External manifestations of trustworthiness in the interface. *Communications of the ACM, 43, pp. 50–56 http://dx.doi.org/10.1145/355112.355123.*

Cheong, W. L., Jung, Y. and Theng, Y.L. (2011) Avatar: a virtual face for the elderly. *In Proc. of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry, pp. 491-498. doi: 10.1145/2087756.2087850.*

Dai, R. & Pan, Z. (2021). A virtual companion empty-nest elderly dining system based on virtual avatars. *In Proc. IEEE 7th International Conference on Virtual Reality (ICVR), pp. 446-451, doi: 10.1109/ICVR51878.2021.9483852.*

Davis, F. D. (1989). Technology acceptance model: TAM. *Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption, pp. 205, 219.*

Esposito, A. et al. (2019). Seniors' Acceptance of Virtual Humanoid Agents. *In Ambient Assisted Living, Cham, pp. 429-443*.

Esposito, A. et al. (2018) .Seniors' sensing of agents' personality from facial expressions. *In Computers Helping People with Special Needs, Cham, pp. 438-442*.

Franco dos Reis Alves, S. , Uribe Quevedo, A., Chen, D., Morris, J. and Radmard, S. (2021). Leveraging Simulation and Virtual Reality for a Long Term Care Facility Service Robot During COVID-19. *In Proc. Symposium on Virtual and Augmented Reality*, pp. 187-191. doi: 10.1145/3488162.3488185.

Navarro-Alamán, J., Gilaberte, R. L., & Bagdasari, E. C. (2021). A proposal for the initial characterization of the elderly to develop adaptive interfaces (in Spanish). *Revista de la Asociación Interacción Persona Ordenador (AIPO), vol. 2(2), pp.34-41.*

Nowakowska-Grunt, J., Dziadkiewicz, M., Olejniczak-Szuster, K. & Starostka-Patyk, M.(2021). Quality of service in local government units and digital exclusion of elderly people - example from implementing the avatar project. *Pol. J. Manag. Stud., vol. 23, pp. 335-352, doi: 10.17512/pjms.2021.23.2.20.*

Pacheco-Lorenzo, M. R., Valladares-Rodríguez, S. M., Anido-Rifón, L. E. and Fernández-Iglesias, M. J. (2021). Smart conversational agents for the detection of neuropsychiatric disorders: A systematic review. *J. Biomed. Inform, vol. 113, p. 103632, doi: 10.1016/j.jbi.2020.103632.*

Salman, S., Richards, D. and Caldwell, P. (2021). Analysis of empathic dialogue in actual doctor-patient calls and implications for design of embodied conversational agents, *IJCoL Ital. J. Comput. Linguist., vol. 7 (1|2), doi: 10.4000/ijcol.862*.

Shaked, N. A. (2017). Avatars and virtual agents – relationship interfaces for the elderly. *Healthc. Technol. Lett., vol. 4(3), pp. 83-87, doi: 10.1049/htl.2017.0009*.

Tanaka, H., et al. (2017). Detecting dementia through interactive computer avatars. *IEEE J. Transl. Eng. Health Med., vol. 5, pp. 1-11, doi: 10.1109/JTEHM.2017.2752152.*

Thaler, M., Schlögl, S., and Groth, A. (2020) Agent vs. Avatar: comparing embodied conversational agents concerning characteristics of the Uncanny Valley. *In Proc. IEEE International Conference on Human-Machine Systems (ICHMS 2020*), *pp. 1-6. doi:* 10.1109/ICHMS49158.2020.9209539.

Turunen, M., Hakulinen, J., Ståhl, O., Gambäck, B., Hansen, P., Rodríguez-Gancedo, M.C., Santos de la Cámara, R., Smith, C., Charlton, D., Cavazza, M.(2011). Multimodal and Mobile Conversational Health and Fitness Companions. *Comput. Speech Lang., vol. 25 (2), pp. 192-209, abr. 2011, doi: 10.1016/j.csl.2010.04.004.*

Wargnier, P. et al.(2015). Towards attention monitoring of older adults with cognitive impairment during interaction with an Embodied Conversational Agent. I*n Proc. IEEE VR International Workshop on Virtual and Augmented Assistive Technology (VAAT 2015)*, pp. 23-28, doi: 10.1109/VAAT.2015.7155406.