To be (Me) or Not to Be? Photorealistic Avatars and Older Adults

Arushi Puri

Interaction Design Lab
School of Computing and Information
Systems
The University of Melbourne
Victoria 3010 Australia
e: <mailto:puri@student.unimelb.edu.au>

Dr Steven Baker

Interaction Design Lab
School of Computing and Information
Systems
The University of Melbourne
Victoria 3010 Australia
e: steven.baker@unimelb.edu.au

Dr Thuong N Hoang

School of Information Technology
Deakin University
Victoria 3125, Australia
e: thuong.hoang@deakin.edu.au

Romina Carrasco Zuffi

Interaction Design Lab
School of Computing and Information
Systems
The University of Melbourne
Victoria 3010 Australia
e: rcarrasco@student.unimelb.edu.au

ABSTRACT

The growth of commercial VR technology has fueled an interest in user embodiment, where a graphical representation of the user, a virtual avatar, enables a more immersive experience and richer interaction. Recent research suggests that older adults are increasingly playing digital games. These factors, combined with the rapidly ageing population, means it is vital that avatar creation software responds to the needs of older adults. Our study seeks to address these needs, by better understanding older adult opinions about virtual avatars that are photorealistic, i.e. bearing likeness to their physical appearances. In our exploratory study, we interviewed six older adults aged between 70 and 80 years and asked them to evaluate 18 photorealistic avatars created with three different commercial avatar creation tools. Results showed that participants were not satisfied with their custom-made avatars due to them missing characteristic features. The results also showed that there was major consensus towards using photorealistic avatars across a range of virtual environments.

CCS CONCEPTS

• Human-centered computing → Virtual reality

KEYWORDS

Avatars, ageing, virtual worlds.

1 INTRODUCTION

Avatars are the representation of a person which provide them an existence in a virtual world [4]. Avatars allow the user to perform activities and have a degree of agency by engaging in interactions for entertainment, commercial and social gatherings [7,9]. Older adults are increasingly adopting technology and gaming. 43% of older adults play video games in Australia [3]. While there has been sustained research interest in the use of avatars in virtual worlds, less attention has been given to the presence of more photorealistic avatars that may enhance interaction and social participation among the older adults [13].

Our study seeks to address this gap by contributing to our understanding of older adult's preferences about photorealistic avatars. We seek to evaluate the suitability of commercial avatar creation tools to create photorealistic older avatars, and explore older adult's views about using photorealistic avatars in various social virtual world scenarios.

The research questions that guided our study were:

RQ1: How do older adults feel about avatars that look similar to them?

RQ2: How do older adults feel about older avatars created using commercial avatar creation tools?

RQ3: What types of avatars do older adults feel are most appropriate across a range of social virtual environments?

2 RELATED RESEARCH

2.1 Avatars

Avatars can be broadly classified into two categories- humanoid avatars and non-humanoid avatars. Humanoid avatars can be defined as avatars which are human like. Non-humanoid avatars can be defined as avatars that do not resemble humans, for example, avatars that resemble animals [6]. A user's choice of avatar has been shown to have an impact on the quality of social interaction in virtual worlds [14]. Another study demonstrated that

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

A. Puri, S. Baker, T. Hoang and R. Carrasco, 2017, To be (Me) or Not to be? Photorealistic Avatars and Older Adults. In Proceedings of the 29th Australian Conference on Human-Computer Interaction, Brisbane, QLD, Australia, November 2017 (OzCHI 2017), 4 pages. <https://doi.org/0000001.0000001>

participants with humanoid avatars had a high level of satisfaction in comparison to those with non-humanoid avatars with respect to social interactions. The participants evaluated 75 characters from animated video games in terms of how human-like they looked. Results showed that humanoid characters were preferred and that the more non-humanoid the avatar became, the more unattractive they appeared to the participant [15].

Though research suggests a preference for these types of avatars, when creating humanoid avatars, users can idealize or explore other identities that do not represent themselves [22]. It is therefore important to conduct research to better understand user preferences in relation to humanoid avatars.

2.2 Avatars and Older Adults

The use of avatars is increasing in various contexts, including health, education and entertainment [16]. With the incorporation of such avatars and the expansion of the aging society, more tech savvy older adults are accessing online and virtual environments to meet their social needs [12].

A study by Siriaraya and colleagues, showed that through the use of avatars older adults sought to strengthen relationships. Avatars also provided anonymity which made the participants feel safe to interact online [14]. The potential strengths of avatars for elderly users in terms of omitting physical limitations and enabling virtual travel through various real life scenarios has prompted calls to investigate further the zone of avatars for elderly [17].

The use of avatars has been shown to enhance communication between older adults [10]. For instance, a paper determined the effect of an avatar on interaction in ambient intelligent environments with elderly users. Findings suggested that if a task is given to a user by an avatar, the user tends to perform it in a better way than when the task is given to a user in a text form, further strengthening the need to increase our understanding of older adult's use of avatars for communication [10].

Despite the emerging evidence that avatars can strengthen the social participation and communication of older adults, there has been relatively little research aimed at clarifying the type of avatars older adults prefer. In one of the few examples identified by the authors, Cheong and colleagues asked older adults to evaluate 20 avatars using semi-structured interviews [4]. The results showed that the elderly were not able to relate to the older adult avatars. However, there was some attraction shown towards child, animals and object avatars. Both these findings seemingly contradict the results of studies with other user groups as detailed above. Cheong and colleagues report three probable reasons that the elderly did not identify with the older adult avatars. First, the lack of story or plot to provide a context for avatar use may have inhibited bonding with the avatar. Secondly, the authors speculate that the participants educational background may have been a factor influencing their understanding of avatars. A final determinant may have been the limited customization features available for the avatars [4].

Another vital study that dealt with the use of avatars by older people paired 30 young individuals with 30 older participants. In this study, young adults were in their early 20s and 30s whereas older adults were 55 years and above. The paper dealt with perception of age differences in 3D virtual worlds concerning social interaction. This paper concluded that older people had

significantly lower levels of virtual presence in comparison to young people [14]. This leaves an open field of investigation for research. Another study recommended that in order to have more immersion in virtual environments, the user should identify with visual or behavioural characteristics of the virtual avatar [2]. One way of approaching this projection of the self is by creating photorealistic avatars. While these papers focus on older adults and virtual reality, there has not been any research that has looked at older adult preferences with respect to different virtual world scenarios. Therefore, this paper aims to address photorealistic avatar preferences of older adults while giving them a context of social virtual scenarios.

2.3 Photorealistic Avatars

Photorealistic avatars render a realistic (avatar that replicates a user) and animatable whole representation including facial features of an individual [7]. Photorealistic avatars have been shown to be useful in promoting health behaviour changes, by boosting morale and confidence [11]. Moreover, they have been shown to motivate users to think of their health risks [1]. The physical appearance given to individual user's avatar can have an impact on behaviour and attitude, and in turn, affect interactions in both face-to-face as well as avatar based online communities. This phenomenon has been described as the Proteus effect [18]. These studies, however, did not consider user preferences toward their photorealistic avatars. Nor have any studies considered older adult user preferences with respect to photorealistic avatars.

3 METHODOLOGY

Six participants took part in the study, five male and one female. The ages of the participants ranged between 70 and 80 (See Table 1). The participants were recruited from a large study relating to virtual reality and avatars. The first author went to a workshop that was part of the larger Ageing and Avatars project. The first author spoke about this research and asked for volunteers to register. The team contacted them via email and invited them to participate in the study. Ethics approval for the study was granted. (approval number 1647456).

The first author designed three photorealistic avatars for each participant based on pictures of the participants taken from various angles and perspectives. Considering the target of this study are older adults, we aimed at using simple commercially available software so that the software can potentially be used by older adults. Due to the constraints of the study, the first author decided to design the avatars as there are a range of software to choose from. In order to design these avatars, three avatar creation tools were used, MakeHuman, Morph Character System(MCS) and NaturalFront 3D (NF3D).

The first full body avatar was created using MakeHuman, which is an open source software package for designing full body humanoid avatars (<http://www.makehuman.org/>). After starting with a basic human form, the user can manipulate the avatars appearance using a series of adjustments, in the form of a slider between binary characteristics. Age can be adjusted between 1 and 90 years. The age of each avatar was set to correspond to the participants age. Once the age and sex characteristics had been set, the first author spent approximately 1-2 hours creating each avatar likeness. (See Fig. 1 Image 1 & 2)

Table 1: Demographics of Participants

Name of Participants	Age	Highest level of education	Year you first recall using a Computer
Forjador	70	Post-Graduate	1985
Herbert	71	Post-Graduate	1967
Holly	80	Secondary (Incomplete)	1989
Samuel	73	NA	NA
Herb	73	Tafe Certificate	1982
Bob	74	Post- Graduate	1963

The second avatar was created using two plugins - Morph Character System Male and Morph Character System Female in Unity 3D. These plugins can be downloaded from the asset store of Unity 5.6.0f3 – 64bit. Using this, a user can create a full body avatar and modify it with 350+ sliders to adjust different features of the avatar. The first author spent approximately 1-2 hours creating each avatar. (See Fig. 1 Image 1 & 3)

The third avatar was created using NaturalFront 3D Facial Animation Plugin Free (NF3D). NF3D can be downloaded from the asset store of Unity. Using this plugin, a user can create a similar looking avatar to a 2D picture. The third avatar is just the head of the participant. The first author spent approximately 6-8 minutes in creating an avatar head from a 2D picture. (See Fig. 1 Image 1 & 4)

Figure 1: From Left to Right, 1) MakeHuman 2) MCS and 3) NF3D in comparison to 4) the head shot of participant

Once the avatars had been created, an individual interview session was conducted for each participant in which their pictures and printed images of the avatars were shown. In addition, printed images of three virtual world scenarios were shown to each participant. The aim of these images was to understand the types of avatars that participants felt would be most appropriate given three scenarios. The first scenario depicted a lounge where participants were told their avatar would be meeting with family

members. The second consisted of a tennis court environment where participants were told their avatar would be meeting with friends. The third scenario was a library where participants were told their avatar would be meeting with strangers. A series of semi-structured interview questions were asked of each participant to ascertain their views on which avatar they found most photorealistic, what attributes they most liked or disliked about each avatar, and which avatar they would most like to use in the three virtual world scenarios. The interviews were recorded and transcribed verbatim. After transcribing the data, it was coded and subjected to a thematic analysis using both inductive and deductive techniques [21]. Pseudonyms, chosen by the participants, will be used in the findings and discussion sections that follow.

4 FINDINGS

4.1 Avatar Preferences

A consistent theme throughout the research was that four out of six older adults preferred a single photorealistic avatar across all different types of scenarios. Forjador clearly expressed the importance of having a photorealistic avatar by stating that “you still want to belong to your own body”. He further stated that not having a photorealistic appearance would make him feel “detached” whereas a photorealistic avatar would make him “feel that (he is) a part of it (rather than feeling) like “watching a TV show”. Even though this was a major theme, there were also consistent comments that participants wanted to change minor details about their avatars. Although, Forjador mentioned that he preferred an avatar that looks like him in all situations, he also showed interest to see himself in a different manner. For example, Forjador, who described himself as having short fingers, expressed a preference for the avatars long fingers. Similarly, Herbert mentioned, that he wanted the avatar to look just like him, but thinner. Only two participants Herb and Bob, chose different avatars for the three different virtual world scenarios. Herb showed some inclination towards looking younger by stating “if I can be younger that would be wonderful”. Three participants wanted to have a photorealistic avatar, but expressed a preference for an “athletic body” or to look “fitter” if they were to play tennis in the tennis court scenario.

Four out of six participants expressed different opinions in scenarios other than the three used in the research. Holly and Samuel displayed a strong desire to be a non-realistic avatar in certain scenarios such as an “investigation” or places where they “wouldn’t want to go”. Forjador and Herb thought that looking like someone else would help them in a scenario where public speaking is concerned.

Out of six participants, Herbert, Samuel and Bob chose MakeHuman, Forjador chose NF3D and Holly chose MCS as their preference. Holly, Samuel and Herb commented that NF3D “isn’t real”. Herb and Forjador stated that MCS avatar had “fake hair” which did not seem to be realistic. Participants were also asked to describe the most important features in an avatar. Forjador, Holly and Herbert mentioned that face and eyes are the most important features of an avatar. Herbert and Forjador also

found MakeHuman to be feminine because of the distribution of body fat.

Overall, the participants showed mixed feelings towards the avatars designed for them. Most of the participants could identify themselves with the avatars but suggested that they would like some minor changes in it. The type of avatars also varied for participants depending on the social virtual environments given to them. Two of the participants, Samuel and Herb chose different preferences for different scenarios given to them.

4.2 Evaluation of Avatar Creation Tool

Another common theme was that most of the participants perceived that the avatar creation tools made the avatars look younger than their desired age. For instance, Herbert stated that the avatar that was designed to be 70 years old looked like “a hard living 30year old”. Only Herbert and Forjador nominated any of their avatars as being in their 70s. (See [Table 2](#))

Table 2: Participant Estimates of Avatar Age

Name of Participants	Response on Age of MakeHuman Avatar	Response on Age of MCS Avatar	Response on Age of NF3D Avatar
Forjador	50s	30s	71
Herbert	75 or 80	20s	20s
Holly	Late 40s	Early 40s	60
Samuel	40s	20s	50s-60s
Herb	55	35	45
Bob	20s-30s.	20s	50s

4.3 Ratings based on Resemblance

Older adults were asked to rate the avatars on the basis of resemblance with 0 being the least similar and 10 being the most similar. In general, the ratings of MakeHuman were the highest (average 6.16) and MCS were the lowest (average 4.6). However, the ratings of NF3D were close to MCS (average 4.83). The highest rated avatar by the participants were the one they chose to represent themselves in the virtual worlds. (See [Table 3](#))

Table 3: Summary of Participant’s Avatar Ratings

Name of Participants	Rating for Make-human Avatar	Rating for MCS Avatar	Rating for NF3D Avatar	Preference
Forjador	2	0	6	NF3D
Herbert	7	3	5	MakeHuman
Holly	6	9	2	MCS-Female
Samuel	7	5	7	MakeHuman
Herb	8	7	4	MCS Male
Bob	7	3	5	MakeHuman

5 DISCUSSION

In alignment with the findings from above, older adults were able to identify themselves with their photorealistic avatars. Older adults evaluated avatars on the basis of facial features and body structure in general. However, the emphasis for Holly seemed to be the emotion of the avatar, rather than the level of physical likeness as she stated “The eyes have got a smile in it and the mouth has got a smile in it” for her preferred avatar. Samuel and Herb wanted to change their avatars depending on the interaction scenarios. Samuel stated that “I wanted to be as close to me as possible” when meeting a relative and wanted to look different while doing an “investigation”. Some participants also mentioned that they preferred a non-photorealistic avatar in some situations. Although, Forjador chose the most photorealistic options for all scenarios, in terms of expressing his personality, Forjador believed that having a different looking avatar might help him to “push himself forward” as he is a shy person by nature. There could be various plausible explanations for this. Firstly, previous research has speculated that elderly users are accustomed to watching television soaps, operas and drama television. This can be a reason for the participants to relate to the avatars with emotions and empathy [20]. Secondly, the age and physical similarity of the avatars may not be as important as the perception of creating avatars based on circumstances and personalities as mentioned by the participants [8]. Finally, the participant’s evaluation of their avatars may have been subject to negative stereotypes [19]. For example, Samuel and Forjador perceived the avatars to be more criminal like and lacking personality while Holly thought the avatar was not welcoming and looked unrealistic. This may suggest that the elderly users tend to use personal stereotypes to assess avatars very similar to how they would evaluate others in reality.

The majority of the participants emphasized the facial features being the most important part of the avatar in assessing the avatars. Most of participants based a lot of their feedback on describing how similar or different the eyes, mouth, nose and hair were. In this respect, the results of this study are similar to the results of another study where the participants expressed that the lack of customization in avatar features interfered with their ability to create desirable avatars [4]. This was evident especially in the area of hair customization. For example, many participants felt their hairpiece to be fake and unrealistic and could not relate to as their own.

6 CONCLUSION

Designing avatars for older adults is complex and requires considerable thought and patience. Our findings suggest that the older adults in our study showed appreciable interest in photorealistic avatars. The participants could identify themselves with photorealistic avatars shown to them in most cases. However, it is important to note that the avatars which showed intrinsic human characteristics such as emotions also seemed to be more appealing to some participants. Moreover, the findings also indicate that the virtual world scenarios shown to the participants impacted on how they assessed their preferred avatars. In our

study, the participants thought that the avatars were relatable, but, they suggested that it would be nice to have minor changes to the avatars. The avatars looked younger than what they were designed to look. Facial expressions, hair and features also seemed to play a vital role in choosing avatars, more so than body structure or clothes. In some cases, the preferences of avatars also changed according to the social virtual environment scenarios given to them. Therefore, future research should focus on creating avatars to interact with older adults in different virtual world scenarios and find out which avatar they prefer.

Given that the older adults seem to relate and empathize with avatars which are welcoming and show emotions, it would be interesting to see the preference of the older adults if they used their avatars in the context of a real life story or a plot. We also note that while designing avatars, facial features such as expression, smile and looks outweigh the physique such as body type, height, clothes. Therefore, the skill and creativity to customize these avatars for the older adults requires more in-depth research in creating a more photorealistic avatar they find relatable.

7 REFERENCES

- [1] Ahn SJ. Using Virtual exemplars in health promotion advertisements to promote health behavior change: Reducing soft drink consumption. Unpublished manuscript.
- [2] Birk, Max V., Cheralyn Atkins, Jason T. Bowey, and Regan L. Mandryk. 2016, May. Fostering intrinsic motivation through avatar identification in digital games. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 2982-2995). ACM.
- [3] Brand, Jeffrey E., and Stewart Todhunter & Jervis, J. (2017). Digital Australia 2018. Eveleigh, NSW: IGEA.
- [4] Cheong, Wei Lun, Younbo Jung, and Yin-Leng Theng. 2011, December. Avatar: A virtual face for the elderly. In *Proceedings of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry* (pp. 491-498). ACM.
- [5] Ducheneaut, Nicolas, Ming-Hui Wen, Nicholas Yee, and Greg Wadley. 2009, April. Body and mind: a study of avatar personalization in three virtual worlds. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1151-1160). ACM.
- [6] Friedman, Doron, Anthony Steed, and Mel Slater. 2007. Spatial social behavior in second life. In *Intelligent virtual agents* (pp. 252-263). Springer Berlin/Heidelberg.
- [7] Lee, WonSook, Jin Gu, and Nadia Magnenat-Thalmann. 2000, September. Generating animatable 3D virtual humans from photographs. In *Computer Graphics Forum* (Vol. 19, No. 3, pp. 1-10). Blackwell Publishers Ltd.
- [8] Lee, Kwan Min, Younbo Jung, and Clifford Nass. 2011. Can user choice alter experimental findings in human-computer interaction?: Similarity attraction versus cognitive dissonance in social responses to synthetic speech. *Intl. Journal of Human-Computer Interaction*, 27(4), pp.307-322.
- [9] Nimrod, Galit. 2011. The fun culture in seniors' online communities. *The Gerontologist*, 51(2), pp.226-237.
- [10] Ortiz, Amalia, María del Puy Carretero, David Oyarzun, Jose Yanguas, Cristina Buiza, M. Gonzalez, and Igone Etxeberria. 2007. Elderly users in ambient intelligence: Does an avatar improve the interaction?. In *Universal access in ambient intelligence environments* (pp. 99-114). Springer Berlin Heidelberg.
- [11] Peng, Wei, Julia C. Crouse, and Jih-Hsuan Lin. 2013. Using active video games for physical activity promotion: A systematic review of the current state of research. *Health Education & Behavior*. 2013; 40: 171-192.
- [12] Rendon, Abel Angel, Everett B. Lohman, Donna Thorpe, Eric G. Johnson, Ernie Medina, and Bruce Bradley. 2012. The effect of virtual reality gaming on dynamic balance in older adults. *Age and ageing*, 41(4), pp.549-552.
- [13] Siriaraya, Panote, Chee Siang Ang, and Ania Bobrowicz. 2014. Exploring the potential of virtual worlds in engaging older people and supporting healthy aging. *Behaviour & Information Technology*, 33(3), pp.283-294.
- [14] Siriaraya, Panote, and Chee Siang Ang. 2012. Age differences in the perception of social presence in the use of 3D virtual world for social interaction. *Interacting with Computers*, 24(4), pp.280-291.
- [15] Marco Gillies, Brenton, Harry, Daniel Ballin, and David Chatting. 2005. The Uncanny Valley: does it exist and is it related to presence. *Presence Connect*.
- [16] Petrakou, Alexandra. 2010. Interacting through avatars: Virtual worlds as a context for online education. *Computers & Education*, 54(4), pp.1020-1027.
- [17] Steve L. Katsikas, Karavidas, Maria and Nicholas K. Lim. 2005. The effects of computers on older adult users. *Computers in human behavior*, 21(5), pp.697-711.
- [18] Yee, Nick, Jeremy N. Bailenson, and Nicolas Ducheneaut. 2009. The Proteus effect: Implications of transformed digital self-representation on online and offline behavior. *Communication Research*.
- [19] Zebrowitz, Leslie A., Carrie Andreoletti, Mary Ann Collins, So Young Lee, and Jeremy Blumenthal. 1998. Bright, bad, babyfaced boys: appearance stereotypes do not always yield self-fulfilling prophecy effects. *Journal of personality and social psychology*, 75(5), p.1300.
- [20] Zillmann, Dolf. 1995. Mechanisms of emotional involvement with drama. *Poetics*, 23(1-2), pp.33-51.
- [21] Zohar, Manna, and Richard Waldinger. 1980. A deductive approach to program synthesis. *ACM Transactions on Programming Languages and Systems (TOPLAS)*, 2(1), pp.90-121.
- [22] Neustaedter, Carman, and Elena Fedorovskaya. 2009, May. Presenting identity in a virtual world through avatar appearances. In *Proceedings of graphics interface 2009* (pp. 183-190). Canadian Information Processing Society.