Building Care Robots that Seniors Actually Care About: Results on Likability from a Survey of American Seniors

Balaji Viswanathan[1], Mahalakshmi Radhakrushnun[1], Arvind Nagaraj[1] and Tim Oates[2]

***Abstract*— Over the past 2 decades, Care robots (CR) have been increasingly used to help seniors with a variety of tasks. The COVID-19 pandemic accelerated the use of CR causing mixed reactions among seniors and caregivers. It is important to understand how to make robots that seniors actually care about. How do we evaluate the kind of features and appearances desired from a care robot? In this paper we first present a likability scale to evaluate robots present and then use that scale to survey of 31 seniors in Texas, USA about their attitude towards CR and the key tasks they expect from a robot. We discuss the results and point to gender and age differences in the responses, as well as categories in which seniors take a stronger position. These seniors with an average age of 82, live in senior living or adult day cares. They have some exposure to robots to provide a more informed judgment. We find that the seniors, especially older ones and women have strong negative attitudes towards medical uses of care robots, while they have a overall positive attitude towards care robots in general. Finally, we use the likability scale to score 6 robots – 5 commercial robots already in use for senior care and 1 non-senior care robot added as a control element. We discuss the results on how particular forms and designs increase likability.**

I. INTRODUCTION

World is aging rapidly. By 2050, the number of seniors above 60 would double from the present figures to reach 2.1 billion people. 426 million of these would be over 80 years old [1]. This puts a strain on the care system across the world. The number of caregivers available to support seniors is decreasing due to a variety of socioeconomic problems that cause a massive drop in the caregiver support ratio as seen in Figure 1.

Care Robots (CR) are expected to fill the care gap and these are piloted across the world [2], [3]. These robots could use the state of the art in video recognition, conversation and autonomous navigation to support the caregivers. If done well, they could both reduce cost and improve quality of care, bringing the power of automation.

There are a number of technical and social challenges in achieving this goal. In our personal experience being in this industry for years, we have seen seniors figuratively and sometimes literally pushing back the robots. Caregivers are nervous if their jobs are in danger, while seniors often worry about being forced to give up human touch.

There is a lack of research on what seniors actually expect and desire from these robots. We are especially interested in the attitudes of seniors over 80 years of age, who are the main demographic of senior care homes. It would be really helpful to the robot designers as well as the various stakeholders (governments, senior living homes, families, caregivers) to understand how to build the right robot experience for the seniors.

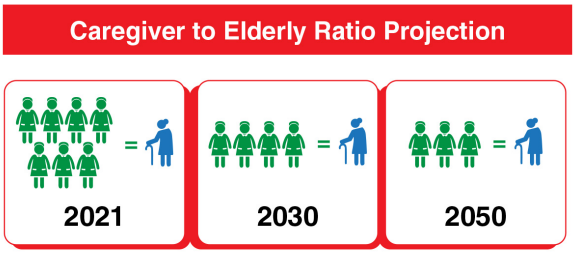


Fig. 1: Caregiver support ratio in the USA. Infographic ©by RIGHT ACCORD

In this paper, we address three key questions:

1) How do the seniors perceive robots, in general?
2) What use cases do they expect from the robots?
3) What kind of robot design do they like?

Our work is a first-of-kind in identifying attitudes toward care robots and evaluating likeability for this particular demographic.

The 31 seniors we picked have some first-hand experience with robots, having observed them in their senior living centers. The survey participants knew that their responses are critical to fine-tune their care. Therefore, you can see strong responses for some of the vital questions. We feel that the finer responses from this survey can help shape the future of human-robot interaction.

II. RELATED WORK

In the recent years, there has been a lot of attention on care robots. [2], [3], [4] provide a survey of recent advances in care robots. There are number of ethical issues in the deployment of these care robots that are covered in [5]. While many of the works believe that the likability of robots need to be seen different from other systems such as tablets and laptops, there are some [6] who argue that such perception differences might be overestimated.

Several questions have been raised about attitudes that prevent/limit the adoption of robots. [7], [8], [9] explore the perceptions and attitudes of caregivers and support personnel toward robots.

[1]Balaji Viswnathan, Mahalakshmi Radhakrushnun and Arvind Nagaraj are researchers at Invento Research Inc, Frisco, USA. balaji, mahalakshmi, arvind @ mitrarobot.com

[2]Tim Oates is with the Department of Computer Science and Electrical Engineering, University of Maryland, Baltimore County oates@cs.umbc.edu

(a) Senior playing harmonica with the robot

(b) An expressive senior engaged with the robot

Fig. 2: Some of the seniors working with our robots.

A limited number of works have surveyed the elderly population, usually in a trade fair or an academic setting. These have produced mixed results in terms of acceptance. Among recent works, [10] points to a mostly negative attitude of European seniors towards the adoption of robots. Another survey, done in Switzerland [11] point to a more positive attitude in terms of acceptance. A work done in Canada [12] also points to more positive attitudes among seniors.

The number of surveys are limited in scope and these also have not gone to seniors living in assisted living centers with some exposure to using robots. This could make some of the senior responses more speculative than seeing the robots as something real that could serve them today. More work is needed to understand the senior attitudes towards these robots.

Over the years, several works have looked at developing likability for robots as part of the broader Human-Robot Interaction [13], [14], [15], [16].

There are key differences in how seniors perceive the robots from how younger population see them [17]. This makes it imperative to survey the seniors who would end up using the robots.

III. LIKABILITY INDEX

A. How do you see yourself using a care robot?

This is the first part of the likability index. The goal is to understand the general attitude of seniors to robots towards robots and identify what particular applications they envision for these robots.

We picked a five-point scale, as a larger, finer grained survey might be quite hard for seniors with cognitive ability issues. A 5-point scoring provides reasonable granularity without placing a lot of cognitive load on seniors.

1) Very Strongly Agree
2) Strongly Agree
3) Neutral Agree
4) Strongly Disagree
5) Very Strongly Disagree

We selected eight key areas from our literature analysis where people might require care robots. These were based on our observations working with seniors and their caregivers in senior living homes over the past three years.

1) Bring water
2) Bring medicines
3) Call My Family
4) Entertainment
5) Connect to my Doc
6) Bring Food
7) Get Help
8) Play a Game

Three of these activities – Connect to my Doc, Bring Medicines, Get Help are related to health, two for direct assistance – Bring water, Bring Food while other three are related to engagement. We believe there could be variations in people's attitude towards using robots for healthcare activities versus those for pure engagement.

Those who consistently gave low responses to most of the activities can be considered as more negative towards robots in general and vice versa. This can be used to normalise the likability scores to compare the robots.

B. What kind of robot suit you better?

This is the heart of the likability score. We want to understand how end-users perceive robots and how to build the right kind of robot. We show the seniors pictures of robots, adjusting for similar resolution, picture quality and have them give their first impressions of what they like.

This survey can be given quickly and can become a great resource for designers to objectively evaluate between multiple robot design. The likability scores can also be used by buyers and geriatric researchers.

We picked 12 questions for this survey that primarily deal with perceptions and attitudes.

1) This robot is friendly in appearance
2) This robot looks creepy
3) This robot seems approachable
4) This robot is fun to look at
5) The robot looks to be smart
6) This robot might respond to what I say
7) The robot looks scary
8) I would trust this robot to be in caregiving team
9) I am open to engaging this robot in addition to my caregivers
10) This robot looks dumb
11) The size seems appropriate to me
12) I can see myself using the robot

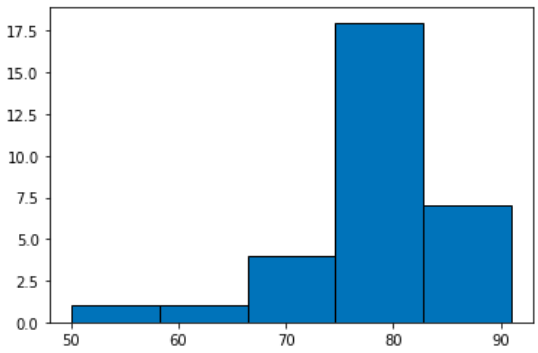


Fig. 3: Age distribution of the seniors in the survey.

C. Qualitative questions

1) Why do you feel positively or negatively about the robot? What makes it likeable or not?
2) Have you ever interacted with robots?
3) How comfortable are you with technology in general?
4) What devices are you most comfortable with?
5) What roles do you think robots can/should play in healthcare settings?

IV. METHOD

We selected 31 seniors, 17 men, and 14 women. Majority of them were in their 80s while some of them were in their 90s. They were in 2 locations – an adult day care center in San Antonio and a memory care center in Westover Hills. Both are in the state of Texas, USA. Their caregivers were present during the interview. Their age distribution can be seen in Figure 3.

Each interview was about 90 minute long, where we first introduced the idea of care robots then asked questions related to their perceptions of robots in general and finally followed up with questions related to likability of particular models. The quantitative questions were followed by qualitative questions.

We picked six robots for this survey: Pepper®, Mitra®, TEMI®, Cruzr®, Atlas®, Mini Mitra®. The selected robots can be seen in Figure 4.

Three of these are humanoids (Pepper, Atlas, Mitra), while the other three are non-humanoids. Two of the robots were about five feet tall (Mitra and Atlas), two about four feet (Cruzr, Pepper), while the other two (Mini Mitra and Temi) were under four feet. Five of these are already used in seniorcare, while Atlas is an outlier. We use Atlas as a baseline to evaluate others. Also, Atlas-like robot design might have been seen in news or movies by seniors. This allows us a chance to explore robot designs that are typically not used for senior care. We have commercial interests in 2 of these robots, but we took adequate care in designing the randomizing the question order to avoid interviewer bias.

For the likability questions, they were shown one picture of a robot and then asked them to rate it with our likability scale. We did the same for all the 5 robots and randomised the order to reduce biases.

Use case	Score (0-5 with 5 being highest)
Play a Game	4.30
Entertainment	3.80
Get Help	3.80
Call My Family	3.63
Bring water	3.43
Bring Food	3.34
Connect to my Doc	3.21
Bring Medicine	2.73
Mean	3.53

TABLE I: Attitudes towards key use cases.

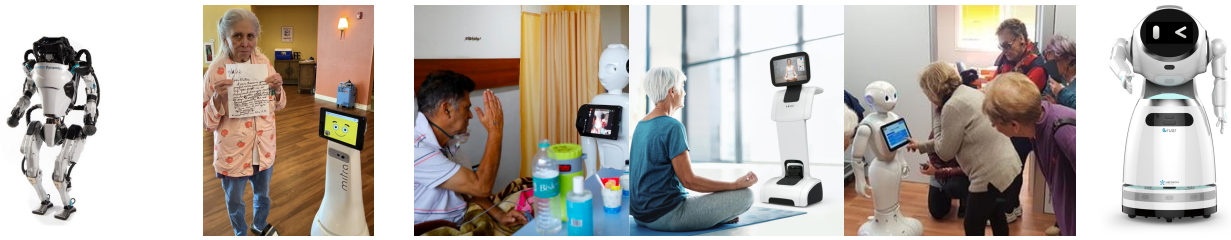
V. RESULTS AND DISCUSSIONS

A. General attitude towards robots

Table I summarizes the senior attitudes towards the key use cases. The key thing we found is that seniors prefer robots more for engagement-related activities (Play a Game or Entertainment) than for healthcare-related activities (Bring Medicine or Connect to my Doc). This result was also corroborated in the qualitative interviews where the seniors were apprehensive about using a novel technology for a critical life and death situation. The seniors preferred the robots to provide additional activities to what they already receive rather than potentially replacing an existing service.

There is also an interesting dynamic that can be seen in Figure 5. We see that the healthcare use cases generate a strong response from the seniors (either 1 or 5) with some very strongly for it and others strongly against. There are very few people who walk in the middle. On other other hand, in engagement related use cases there are some who don't hold very strong opinion in either direction.

The result gives hope to robot designers because the average acceptance score across the eight categories is about 3.5/5. This indicates that the seniors are overall positive about the use of care robots. However, more work is needed to convince seniors that robots can be used in more medical applications. We recommend that industry and government take confidence building activities to prepare seniors to accept medical care from robots when technology matures.



(a) Atlas® (b) Mini Mitra® (c) Mitra® (d) TEMI® (e) Pepper® (f) Cruzr®

Fig. 4: The robots used for this survey.

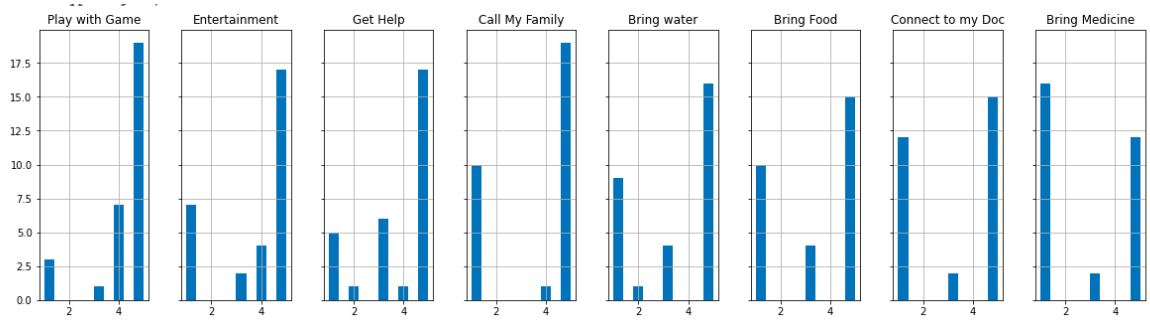


Fig. 5: Score distribution of key use cases.

B. Gender-wise attitude differences

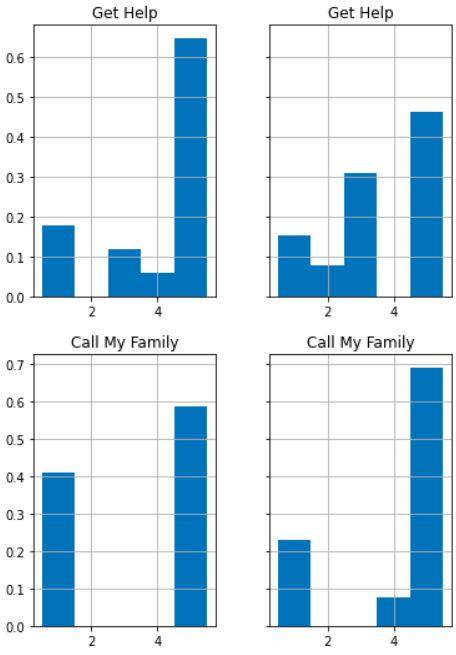


Fig. 6: Gender difference in getting help (men on left, women on right).

We noticed certain attitude differences between males and females, even though their mean attitude is comparable (3.55 for males vs 3.51 for females). For instance, in engagement-related activities and connecting activities there was a substantial difference between the genders. The males were very bullish on engagement activities such as asking the robot to play a game, while the females were more positive on activities such as calling the family.

Use case	Males	Females
Play a Game	4.41	4.15
Entertainment	3.94	3.62
Get Help	4.00	3.54
Call My Family	3.35	4.00
Bring water	3.41	3.46
Bring Food	3.25	3.46
Connect to my Doc	3.12	3.31
Bring Medicine	2.88	2.54
Mean	3.55	3.51

TABLE II: Gender differences in attitudes towards key use cases.

You can see the distribution for 2 selected use cases in Figure 6. We can notice that the females were strongly for the ”Call my family” use case, while the males were divided with strong opinions (1 or 5). In the case of the ”Get help” use case, males were strongly bullish, while female opinions were quite distributed even if they were overall more positive for this use case.

C. Age-wise attitude differences

We divided the population into 2 groups, ≤ 80 years old and those over > 80. There were 14 people in the former bucket and 17 people in the latter. There were noticeable differences between the 2 groups.

Seniors below 80 years were far more positive about robots than those over 80 years of age. The biggest difference can be seen in the healthcare use cases, such as ”Bring Medicine”, and engagement cases, such as ”Entertainment”. The one category that bucked this trend is the ”Call my family” where

Use case	Seniors $\leq$ 80 years	Seniors $>$ 80 years
Play a Game	4.43	4.19
Entertainment	4.14	3.50
Get Help	4.14	3.50
Call My Family	3.57	3.69
Bring water	3.50	3.38
Bring Food	3.62	3.12
Connect to my Doc	3.31	3.12
Bring Medicine	3.29	2.25
Mean	3.75	3.34

TABLE III: Age differences in attitudes towards key use cases.

the older populace were slightly more positive than their younger counterparts.

Figure 7 shows the histograms for a couple of use cases. In the "Bring Medicine" use case, the majority of seniors over 80 were giving a strong response (1) while those in the younger cohort were evenly divided. An inverse dynamic is seen for "Get Help" where the younger cohort decided strongly for this, while the older cohort is evenly divided.

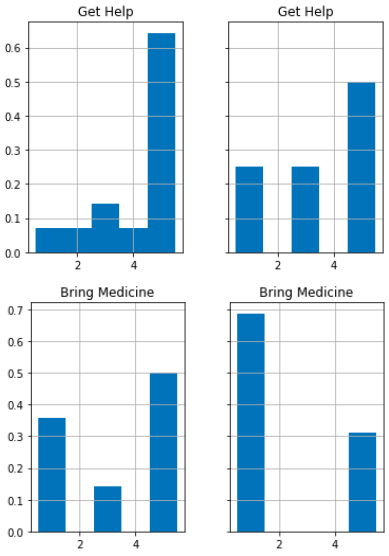


Fig. 7: Age differences in attitudes toward specific activities.

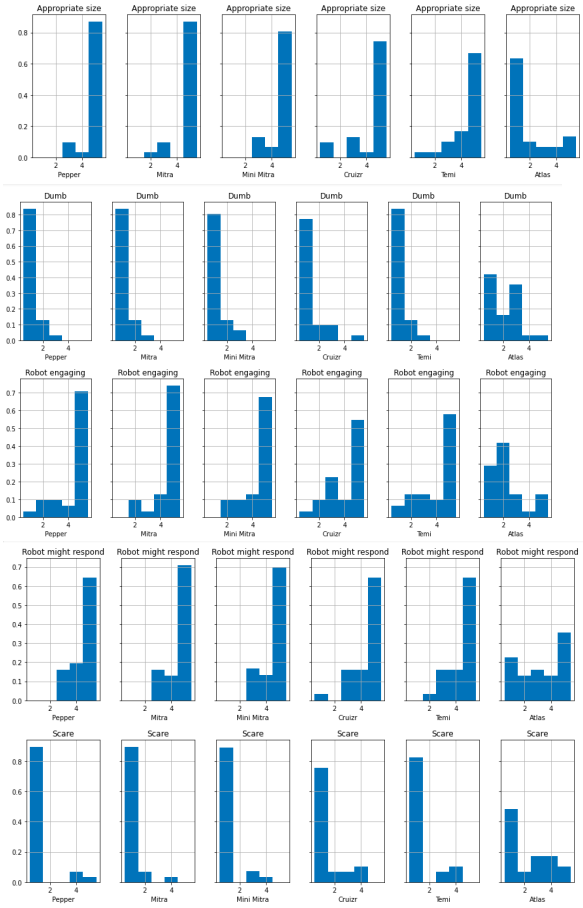


Fig. 8: Likability of various robots.

D. *Likability of different robots*

Figures 8 and 9 show the results of the likability survey. We have results in 10 categories. Note that the survey have both positive and negative questions. A score of 1 in an negative category "Dumb" means that the users strongly disagreed with the statement and vice versa.

Pepper®and Mini Mitra®tended to rank highest in many categories, while predictably Atlas came a few spots lower in most categories. Given that the Atlas robot was not designed for senior care use case, such a result was expected before the survey. The presence of Atlas serves as a control group here, enabling us to objectively look at the survey results.

Pepper scored the best in the "Creepy" and "Scary" categories, as nearly everyone agreed that it is neither creepy nor scary, while Mini Mitra topped the category in approachability. Both Mitra and Mini Mitra scored high on Fun metric.

Seniors tended to prefer more well-rounded bodies rather than designs with exposed metal. And there is a bias towards humanoid form factors. Based on the limited sample, we believe that robots of about 4 feet tall suited well for this audience (older Americans). There are likely cultural factors too and the height and humanoid preferences may vary for other demographics.

Overall, the robots used for senior care tended to score above average on all the positive categories, giving hope that

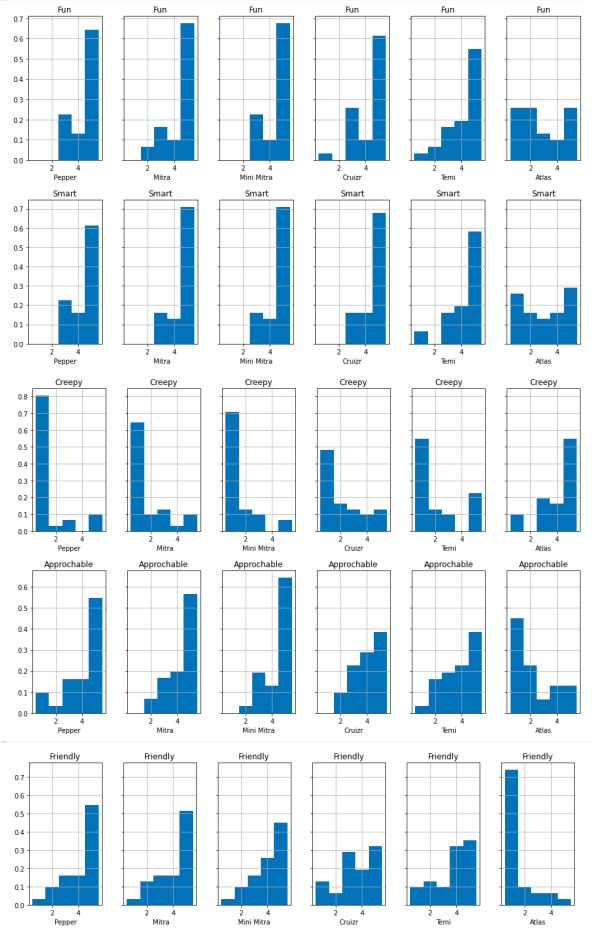


Fig. 9: Likability of various robots (contd).

the designers have taken some care on acceptance.

VI. CONCLUSIONS

For the past 20 years, the industry has been deploying Care Robots (CR). However, we have not had enough usability studies with end users, seniors who would be using robots. We not only need to know their overall attitudes, but also need to have fine-grained details on what kind of use cases they prefer and the kind of designs that suit well for the seniors.

We have presented our likability index that could be used to evaluate a range of robots, and we have also used the index to survey 31 people in senior living homes. The results were very promising for future robot designers and we have also highlighted key areas of improvement – such as in improving confidence that the robots can be used in critical healthcare applications.

Just as we noted patterns based on age and gender, we also believe that there could be critical differences in attitudes based on culture/ethnicity and income levels. We are working on these areas as part of the future plan.

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