What are the expectations of Dutch young adults in terms of behaviour and appearance of care robots for the elderly?

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ABSTRACT

The following paper describes results of a qualitative study performed at the University of Amsterdam. Previous research has suggested that care-bots for elderly might be a solution to the increasing number of older adults. It has been implied that the acceptance of such robots might vary across different countries as cultural differences influence human attitudes towards robots. In the context of the Dutch culture, companion robots have been proven to be the most likely to get accepted. However, it was noted that user expectations and issues, for instance moral concerns, should be taken into account when designing such robots. In this study, expectations of Dutch young adults towards companion care robots have been investigated. The results show that for Dutch young adults utility is the most important value, that outweighs even ethical issues. The group is driven by pragmatism and expects robot companions to address problems of the elderly and the health-care system. Dutch young adults expect a robot practical in terms of both appearance and behaviour. A robot proposed could be described as a assistive social companion.

1 INTRODUCTION

Over the past decades, the world has experienced a shift in health care needs [31]. The continuous growth of both proportion of older people to children and life expectancy has been a source of challenges for health care systems worldwide [25]. One of the resulting threats is a shortage of care professionals that are able to provide specialised care to the increasing population of older adults. The robotics industry has been seemingly aware of the market needs and a lot of attention has been given to development of care robots for the elderly [9].

This expansion of health care robotics is expected to continue [21]. Although different cultures have shown to have different attitudes towards robots [34], current research shows that in the Netherlands there is a chance for a fast adoption [23]. In fact, it has been proven that robots have the potential of solving some of the problems within the elderly care domain, should expectations of stakeholders be taken into consideration while designing the assistive technology [5, 31]. Results of a study investigating moral considerations, perceptions of utility, and acceptance among Dutch healthcare professionals [31] toward different care robots shown companion robots to be highly useful, most acceptable, and least harmful. The study implies that if successfully introduced, these robots could provide dementia patients and socially isolated seniors with entertainment and daily management [31]. Furthermore, the study suggests that acceptance of robots in healthcare is more associated with the moral considerations of participants than with utility. However, human attitude which is a key factor in Human-Robot Interaction (HRI) was not taken into consideration [13].

Along with providing entertainment and daily management, robot companions are often a social companion [21]. The carebots, i.e. Zora[1], are cuddly, active and playful and have a large number of stored interaction patterns that enable them to engage with the user [21]. Zora is a personal caregiver and a *best friend* for elderly and children and is controlled by a third party, i.e. a healthcare professional [14]. Recent research has produced prototypes of carebots whose actions are driven by artificial intelligence systems and speech control. Such personal caregivers, i.e. Alice[2], an alternate category of robot companions designed to provide social and psychological care to their elderly users. Alice is designed to require less supervision and use its built-in artificial intelligence (AI) systems to come up with independent decisions. Alice's AI systems are also built to give it a more human-like behaviour through, among others, emotion regulation. In addition, unlike Zora, Alice has a human face with unique facial expressions [33].

Some of social robotics experts, such as HRI pioneer Kerstin Dautenhahn[3], argue this quest to make robots human-like is pointless and focus should be on utility instead [27]. Supporting evidence [12, 20] shows that few people want to have a friend robot and while human-like communication are seen as important, human-like behaviour and appearance are not. Furthermore, a culture-specific study [6] implied that while Dutch are generally positive about the robots and HRI, they are not positive about emotions in HRI.

This project aims to examine how the Dutch perceive two carebots described above and what they would expect from a robot companion in general. Their point of view on *helper/fun companion versus friend companion* and *human-like versus utile* is hoped to be obtained. The qualitative study performed in the context of Benelux citizens attempted to answer a question formulated as such: *What are the perceptions of and expectations toward companion care robots among Dutch young adults, in terms of both functionality and appearance?*. A HRI trial involving Zora and a video trial showcasing Alice preceded each interview. Trials were not only used to give participants an idea of both designs, but also ensured that all participants have had a live HRI experience prior to the study. An alike HRI experience decreases individual differences that, along with cultural differences, influence human attitude toward robots [6].

Chapter 2 looks into relevant works of other researchers. Chapter 3 explains an approach taken in the study. Chapter 4 describes all findings. Chapter 5 discusses implications of these findings. Chapter

[0]https://www.youtube.com/watch?v=9TLM6aMV-iE
[2]https://www.dazeddigital.com/artsandculture/article/23905/1/artifical-intelligence-is-here-and-she-s-kinda-cute
[3]https://homepages.herts.ac.uk/ comqkd/

6 summarizes key findings, Finally, chapter 7 provides suggestions for future work.

2 LITERATURE REVIEW

The literature review first looks into human attitude toward robots and influences on that attitude. Then, care robots that this project looks into are discussed. In both sections, a section devoted to the Dutch culture can be found.

2.1 Human attitude toward robots

As robots are gaining popularity, so is the field of human-robot interaction. The robots are currently being used in health-care [29], education [28], and business [22] changing the world as we know it.

Since robots are now teaching kids [28] and leading companies [22], it should be ensured HRI runs smoothly. Researchers argue that human attitude towards robots is one of the key factors in HRI [13], just like in the context of other information systems (ISs) [36]. The studies [7] also imply that the peoples' attitude towards robots is an area of research that has to be explored more should we want to employ robots as a part of daily life. In order to avoid robot anxiety [6], factors that influence human attitude toward robots should be explored.

2.1.1 Influences on Human Attitude toward robots. In 1999, a group of pioneers in the field of HRI were the first ones to imply that the appearance and behaviour of a robot are just as important as their technical quality in order to gain people's approval [11]. This has been confirmed by more recent studies: human attitude toward robots has shown to be subject to the functionality or appearance of a robot [17], or even the combination of both [10, 19].

2.1.2 Cultural differences. In the past years researchers explored the correlation between individuals' culture and their attitude toward robots [6, 17]. Not only do they suggest there is a dependency, but they also imply that, despite the common beliefs, Westerns are more accepting of robots than Japanese [6]. In contrary to stereotypes, Japanese are concerned about: the impact robots might have on society and the emotional aspects of HRI. On the other hand, the Dutch, for example, have shown to be positive about robots and HRI in particular. However, similarly as the Japanese, they were least positive about emotions in HRI. Researchers suggest that the cultural differences might be tied to religion [7]. For example, the strong Christian influence present in Western cultures might cause people to be less accepting of human-like machines due as having a soul is tied to being human. Since in Buddhism any object can have a spirit, a distinction between natural and artificial is not as important.

In addition to religion, exposure to differing media portrayals of robots might also influence individuals' perception of robots. For example, in Western films and literature a *'Robots will take over the world'* scenario is common; showing robots as evil. In Japanese Manga movies, on the other hand, both robots and humans can be villains [7].

Last, but not least, the frequency of exposure can be of importance. People tend to have extreme opinions about novel technologies in general [19]. Machines unfamiliar to people's culture might evoke negative opinions, but as information about robots spreads, people's perceptions and attitudes might alter. [19] In addition to cultural differences, individual differences including previous exposure to robots may be used to explain differences in attitudes. [7, 19] Along with age and gender, personal HRI experience(s) have been suggested to affect individual's attitude toward robots.

2.1.3 Dutch Attitude towards technology. In the context of the Dutch culture, empirical studies have shown that although less than half of them think robots will have a positive impact on the society overall, the majority of them is optimistic about the future of robotization in health-care domain [5, 23]. However, inconsistencies in the opinions arise as soon as a specific scenario is given. While medical operations being conducted by robots generate positive responses, Dutch are not nearly as enthusiastic about robots acting as care-takers for children or elderly. [23]. Furthermore, the results imply that robots are desired in the health care more than in other domains.

2.2 Care robots

Health care robots are one of the areas of the robotics market. The area has majorly developed at a fast pace over the past years and a future expansion is expected [21]. Nevertheless, it is still a new field and i.e. the terminology used is not consistent. Yet, some suggest to put robots performing medical operations under the term "surgical robots" [31] and care-taking robots can be given an umbrella term "care robots". Within care robots, a few sub-types can be distinguished with a possible division being: service robots, companion robots and mobile presence robots [8, 21]. In this break down, service robots are machines designed to physically assist people in their daily activities through i.e. medication management and feeding [8]. The design of companion robots, on the other hand, is focused around their social capability. They are built to provide users with entertainment and daily management i.e. by leading movement exercises [31] and/or act as social partners [8]. Mobile presence robots employ a completely different approach to the use of robotics, focusing on accommodating interaction between people rather than a person and a robot. Mobile remote presence (MRP) systems are designed to be teleoperated and foster improved communication between individuals [8].

2.2.1 Zora. Zora is a humanoid care robot based on a Nao robot produced by Softbank Robotics [37]. Following the categorization suggested in 2.2, Zora can be classified as a companion robot. Zora is designed to be a personal care-giver for those with special needs, including elderly adults and children. The care-bot Zora has unique selling points of being: friendly, playful, cuddly, patient and active [37]. In the context of elderly, Zora can be used to encourage elderly through movements exercises and other activities requiring user's active engagement. In addition, Zora can be used for entertainment, daily management tasks and productivity. These features make Zora is suitable for use in care facilities [14, 38]. A few institutions in the Netherlands have purchased Zora, a research group *Technology for healthcare innovations* at the Utrecht University of Applied Sciences [30]. The researchers from the group, in co-operation with IVVU, an association of healthcare organizations in the Utrecht region [1], initiated and managed a Zora evaluation project in the Utrecht

region in 2016. Within a period of six months use of Zora was investigated in 15 long-term care facilities for older people [16].

2.2.2 Alice. Alice is a carebot designed to take care of the elderly [33]. Alice is 60cm tall and has a face of a little girl, with unique facial expressions. The social carebot is designed to provide its elderly users with social and psychological care. Alice is the first robot in the world that combines four artificial intelligence systems for (1) reasoning, (2) emotion regulation, (3) recording client's experiences-what the client believes in and knows and (4) independently coming up with intelligent solutions. Alice is not available on the market up to this date, as the researchers are lacking funding [33]. However, the sociobot has been subject of in-situ research. A Dutch documentary *Ik ben Alice*, by Sander Burger, follows an experiment where Alice was put in the homes of three elderly women in order to help them fight depression and loneliness, the burden among elderly [2]. The results of the study surprised even the researchers working on it; despite the initial reluctance of all stakeholders, Alice gained the sympathy of both the elderly and the viewers over the course of the experiment.

2.2.3 Acceptance of Care Robots worldwide. A cross-country literature review [10], provided some suggestions for enhancing the attitudes of stakeholders. They noted that while there are few studies in robotics that have focused on user expectations, identifying these expectations can provide a framework for development guidelines. [10]. The study also suggests that altering user's expectations to match engineering capabilities could be a solution, however, that solution does not align with the principles of a User-Centered Design [4]. Yet, on the other hand, matching the design of a robot to the expectations of an individual, might not be a viable solution due to high length and time of development [10]. Last, but not least it was found that in the context of service robots the cultural factor plays a particularly big role as how people traditionally take care of children and/or elderly is likely to influence their perception of these robots [10].

2.2.4 Adoption of medical innovation in the Netherlands. To confirm the implications of the study [23], adoption of medical innovations in the Netherlands can be investigated. The da Vinci robot, a new surgical device was rapidly and widely adopted in the Netherlands despite its high costs. Empirical study has shown that stakeholder shared believes that (1) the newer technology the better, and (2) a robot is bound to be more foolproof than a human. [5]. Yet, since da Vinci is a remotely-controlled device, the question remains- how would Dutch feel about a robot performing a surgery independently? Would these attitudes change? Unfortunately, little is known about the adoption of assistive robots. All studies found [31] [13] [24] have a number of limitations including (1) having been conducted on a one specific user group i.e. elderly, students or health care professionals, (2) having been conducted in a lab environment, (3) using a quantitative approach, (4) participants only being shown a picture of a robot. Nevertheless, many of the findings reported raise interesting questions and provide cues for future research. In elderly users, the user's attitude along with perceived usefulness of the care robot has shown to influence their willingness to use the robot the most [13], confirming the importance of user attitude in robotics [17]. Within the student population, it was shown that user's emotions should not by any means be neglected when trying to introduce care robots [24]. Within the health care professionals, moral concerns has shown to be a significant factor influencing the human attitude. Furthermore, it was shown that different functionalities of robot, raise different moral concerns, highlighting the dependence between the robot's functionality and user's attitude [31]. Companion robots have shown the highest level of acceptance, they were seen as the least maleficent from the robots investigated (monitoring, assisting and companion) and the most likely to be accepted to collaborate with. What is more, along with assisting robots they were voted the most useful ones. Furthermore, the study [31] have shown that healthcare professionals are starting to have more positive attitudes towards healthcare robots in general and are willing to accept care robots on the work floor provided that the technology does not harm the patient and that patient safety is guaranteed. Van Kemenade [31] concludes that companion robots have the potential to take the lead in the field and pave the way for other care robots.

3 APPROACH

The study design was inspired by results of other researchers [12] [15][20]. In fact, a design of a mixed (qualitative and quantitative) study conducted by Ray [20] was (loosely) replicated in this project. Ray's study was culture-specific and focused on French-speaking citizens of the Geneva region in the center of Europe. The research attempted to answer questions such as: *Is people perception toward robots rather positive or negative and what influences this perception? Do people actually need robots and what for? What sort of appearance and interaction modality is most desirable?* The questions were posed in the context of robots in general and domestic robots. The study reported in this project aims to answer similar questions in the context of the Dutch culture and companion care robots. A qualitative research approach was employed and HRI trials followed by semi-structured interviews were conducted. Details of the design will be discussed in a few sub-sections below.

3.1 HRI trials

Three categories of influences on Human Attitude toward robots are listed and detailed in section 2.1.1: (1) Functionality and Appearance of the robot, (2) Cultural differences, and (3) Individual Differences. The study primarily aims to investigate the dependency of Human Attitude on (1) Functionality and Appearance of the robot. Thus, the other factors had to be controlled. HRI trials were used to decrease individual differences in personal HRI experience(s) and in an attempt to reduce the effect of exposure to media. As previously explained in 2.1.2, Western media often portrays robots as evil, evoking negative human attitudes.

To examine the effects of varying functional and visual designs, HRI trials were conducted with two carebots; Alice (2.2.2) and Zora (2.2.1). The participant information sheet for the study reads "Companion care robots solutions that are currently available on the Dutch market are non-autonomous; they provide an addition to human caretakers and focus on providing their elderly users with entertainment and daily management. However, other types of companion care robots are currently under development. The aim of these developments is to create more autonomous care robots

that provide humans with social and psychological care as well." Zora and Alice were chosen as aides to this material; in this framework Zora is of the non-autonomous, *fun/ helper robot* and Alice is a prototype of the autonomous, *friend robot*. Furthermore, in an alternate conceptualization mentioned at the beginning [27], Zora is a utile robot while Alice is a human-like robot.

Zorarobotics kindly provided the researcher with a month long license for their Zora Software Solution[4] for the NAO robot of Softbank Robotics [5]. Furthermore, members of the Intelligent Robotics Lab [6] were kind enough to lent the researchers one of their NAO robots for the duration of the experiment. Thanks to that live HRI trials with Zora could be performed at University of Amsterdam's Science Park. Alice is a work of Researchers at the VU Amsterdam [7][8] rather than a commercial solution and it proved to be harder to gain access to the prototype. An attempt to contact the researchers resulted in no response and, therefore, the researcher refrained to a video HRI trial. Studies show videotaped trials can be used to test HRI scenarios [35] and are a valuable research tool when used prior to HRI interviews[26].

3.2 Interviews

Interviews are a common tool for better understanding user's attitudes and expectations towards technology [8] and, due to that, they were used in this study. Although a semi-structure interviewing approach was employed to allow for off-script questions, the interviewer has a list of predetermined questions (appendix B) which will be discussed in this section.

Questions were grouped into three main sections:

(A) How do people perceive companion care robots?
  a What does Zora/Alice evoke in human minds?
  b Are people positive or negative towards companion care robots?
(B) What companion care robots should do?
(C) How companion care robots should look like and interact?

As seen in the list above sub-section *a* of section *A* was specific to the carebots introduced in HRI trials. Starting with sub-section *b* of section A questions concerned companion care robots for elderly in general, as defined in 2.2.

In section Aa *What does Zora/Alice evoke in human minds?* participants were asked three detailed questions (Q1) *What are your general thoughts about Zora/Alice after the demonstration?*, (Q2) *What words would you associate with Zora/Alice* and (Q3) *What activity performed by Zora did you like the most?*. Q1 and Q2 were both asked twice, first in the context of Zora and then in the context of Alice. Q3 did not have its equivalent inquiring about Alice's feature as the video trial did not demo all of its capabilities.

In point Ab *Are people positive or negative towards companion care robots?*, each participant was asked a number of in-depth questions, for instance:

(i) Would you consider putting an autonomous robot with more AI like the Alice prototype in their house?
  1 Do you see it more as an addition to social interaction or as a replacement?

Please note that although these questions do not concern a specific robot, Zora and Alice are still referred to as examples of differing types of a companion care robot.

Section B *What companion care robots should do?* examined expectations toward carebots in terms of functionality. Therefore, participants were given a task to arrange six possible features of a companion care robot, from most to least important. That provided quantitative data in form of the order selected and qualitative data consisting of any justifications and comments.

Section C *How companion care robots should look like and interact?* investigated expectations toward robot's appearance and HRI. Once again, participants were asked to arrange their choices and, therefore, both qualitative and quantitative data was recorded. The section was designed as follows:

(a) In your mind, what does a robot look like?
(b) Which design would you choose for a companion robot for your elderly family member? Please arrange cards in the order of least to most important:
  i An android robot i.e. Sophia
  ii A big humanoid robot i.e. Pepper
  iii A small humanoid robot i.e. Nao
  iv A doll i.e. Alice the 60cm tall 'sociobot'
(c) Through what means would you prefer to interact with your care robot? Please arrange the cards from the most to the least acceptable options?
  i speech
  ii touch screen
  iii "totally autonomous"
(d) Artificial Intelligence of the robot
  i To what extent would you feel comfortable with the robot being autonomous?

In question b, pictures of the exemplary robots were provided for participants reference. The pictures are also part of the appendix B.

3.3 Target group

The study was aimed at representatives of Dutch-speaking citizens of the Benelux geographical region. Due to the correlation between individuals' culture and their perception of robots discussed in section 2.1.2, representatives of a single culture were targeted. Dutch culture was chosen not only because the study was performed in the Netherlands, but also because the Dutch have previously shown to be open to the use of robots [7, 23, 31].

As mentioned in section 2.2, companion robots are typically directed towards socially isolated individuals. Social isolation is a problem typically associated with with old age [32]. However, previous research [32] have shown that loneliness in fact demonstrates a "nonlinear" U- shaped distribution with loneliness levels (equally) high for those aged under 25 years and those aged 55 years and over and lower rates for the group in between. The level education have shown to be of no significant influence within the young adults age group.

Taking into account both the lack of access to elderly individuals and a language barrier that could occur, it has been decided to

[4] http://www.zorarobotics.be/index.php/en/who-am-i
[5] https://www.softbankrobotics.com/emea/en/nao
[6] http://www.intelligentroboticslab.nl/
[7] https://research.vu.nl/en/persons/elly-konijn
[8] https://research.vu.nl/en/persons/johan-hoorn

substitute Dutch elderly individuals with representatives of the Dutch young adults population.

3.4 Set-up

Interviews were carried out between the 13th and the 22nd May 2019. The interviews took place at Univesity of Amsterdam's Science Park, at the User Experience (UX) Lab[9]. Participants were recruited from the Amsterdam's student swimming associations-SPONS[10]. Ten participants were recruited via adverts sent out to the association. All interviews were audio-recorded and transcribed.

4 FINDINGS

4.1 Demographics

As explained, the broad target group for the study was Dutch young adults. However, these were not the only criteria used to elicit a final group of participants. There is a wider range of demographic factors that can influence individual's perception of robots and these were carefully considered. The final group consisted of 10 participants and the demographics of the group will be portrayed in this section.

Each participants filled in a demographics form at the beginning of the study. They were inquired about their: (1) age, (2) gender, (3) field of work or study, (4) previous HRI experience (if any), (5) media portrayals of robots encountered, (6) what care robots they have encountered so far (if any), (7) whether robotics is their hobby.

The first variable ensured participant were withing the young adults age group (18-30) and representatives of the whole spectrum were present. In this study, the youngest participant was 19 and the oldest participant was 28. As men and women have shown to differ in their attitudes toward robots [18], an equal number of male and female attendants was chosen. Field of work or study was asked for to ensure that a a variety of backgrounds was represented. Tech experts and scientists in general are more likely to have been exposed to robots and have a technical expertise, thus the group was kept at 50 percent (5 participants). The breakdown of the backgrounds is as follows: two tech experts- one in Data Science and one Information Systems and three other scientists, majoring in: Bio-medical Sciences, Chemistry, and Human Movement Sciences. In addition to that, two humanities students were chosen, of History and of Philosophy. Next to that, there was a participant from the field of Arts- a Motion Graphic Design and a representative of health-care professionals- a Nursing trainee. Question number 4, 6 and 7 relate to one's personal experiences with robots. Participants were inquired about these experiences as studies [7, 18] have shown that personal experiences of robots might influence how individuals' perceive and act toward robots. Nomura et. al [18] suggests that the design of social robots should be considered from the perspective of gender and individuals' experiences and thus, recording both these metrics was highly important. Last, but not least, exposure to media portrayals of robots was inquired about. Research suggests that individuals' perception of robots may differ depending on what media portrayals they were exposed to and, what follows, could cause a potential bias.

[9]http://networkinstitute.org/tech-labs/uxgaming-lab-uva/
[10]https://www.aszvspons.nl/

4.2 Quantitative data

As mentioned in the Approach, a small amount of quantitative data was acquired through the arrangement of choices tasks within the interviews. The numerical data was summarized and will be presented here.

Table 1 ranks tasks to be performed by a companion care robot by importance. Scores in table1 are the average score of each task. The range was 1 to 6 where 1 is the most important and 6 is the least important.

Task	Score
Communication	2.3
Daily management	3.0
Entertainment	3.7
Cuddling	4.0
Entertainment requiring user involvement	4.0
Leading rehabilitation/movement exercises	4.0

Table 1: Features of a robot companion ranked by importance.

Regarding appearances of a robot each participants was asked to choose their one preferred design, as explained in **??**. Table 2 below ranks the different designs by frequency of choice.

Appearance	Percentage of participants
A big humanoid robot i.e. Pepper	70%
A doll i.e. Alice the 60cm tall 'sociobot'	20%
An android robot i.e. Sophia	10%
A small humanoid robot i.e. Nao	0%

Table 2: Appearance of a robot companion ranked by preference.

Lastly participants were asked to arrange the means of controlling the robot according to their preference. As there were three options, when calculating the result each option was given a score of 1-3 where 1 is the most and 3 is the least preferable one. Table 3 shows the averages of scores.

Appearance	Percentage of participants
Speech	1.2
Touch screen	2.2
"Totally autonomous"	2.6

Table 3: Means of controlling a robot companion ranked by preference.

4.3 Qualitative data

Most of the data obtained in the experiments was qualitative, such as interview transcripts. These data sets were analysed and coded to obtain consistent findings. The findings as after two cycles of coding will be presented here.

The interview design made it ineffective to develop section-specific codes for sections *Ab-C* as questions often appeared to interlink. For instance, different participants shared a similar opinion, but expressed it in response to different questions. Furthermore some participants repeated the same thoughts throughout the interview. Due to that coding was applied to sections *Ab-C* as a whole. Only codes developed for section *Aa* as opinions recorded there concern specific robots.

In both cases, the first cycle of coding employed values coding; a recognized affective coding method. Assistive methods helps researchers investigate subjective qualities of human experience i.e. judgments and values [3]. Furthermore, values coding is a tool for assessing participant's integrated value, attitude and belief systems [3]. That implied the method would be relevant for a study exploring attitudes, but also expectations thanks to getting an overview of values and beliefs participants adhere to. Code Mapping was used between the First and the second cycle to categorize and organize the codes[3]. In the second cycle, focused coding was applied to condense the vast amount of data according to frequency and significance of codes. The overview of top-level classes are represented in the mind map A.

Results will be reported in a following order: (1) Zora and Alice and (2) Companion care robots in general.

4.3.1 Zora and Alice. In the context of Zora, in Q1 100 % of participants saw the robot as a *a good concept for something helpful*, but not something useful just yet; 90% participants used a future tense when referring to Zora's usefulness *A1: for now Zora is (just) a good concept, that could be helpful in the future*. P2 explains "I mean, it (Zora) is pretty funny. It's really funny to see what it says and does, but it's really more of an interesting idea, that actually usable.. More like a toy. Yeah, it's a fun game, but not anything to be practically used I guess. It doesn't feel like anything that you could use.". Only 1 participant (10%) saw Zora as already helpful. However, even that participant described Zora as mostly a toy in Q2. That was a recurring opinion among participants also in both Q1 and Q2. In Q1, 60% of participants said they saw Zora as a toy. Some said Zora was- *A2: a fun toy but not a companion (yet)*(40%) and/or- *A3: a fun toy but not a care-bot yet* (30%). P9 justified his point of view A2 "She (Zora) feels to me more like a toy I guess than a companion. I think there would be some barriers coming in; I think the people conceptualize of this robot as a companion rather than as a pass-time which is certainly a problem." In Q2, 'toy' was the most common word associated with Zora and was used by 70% of participants. Other popular words included 'funny' 40%, 'entertaining' 40% and 'cool' 30%.

In addition, differing conceptualizations of care robots were recorded. For instance, P8 gives a following explanation for why she does not see Zora as a companion "here the interaction is up to you. You have to decide what you want to do. So it's more like a toy than like something to talk to, cause it doesn't respond back." On the other hand, P3 says Zora does not meet criteria of a care-bot and justifies "For a robot, what I have in mind is that, it doesn't do entertainment, but it gets stuff or cooks stuff, or something like that".

A group of participants (40%) expressed a need to improve Zora's voice recognition. Some provided justification stating that: having to repeat what you said makes communication frustrating (20%) and/or elderly have too little patience to repeat themselves (20%). For instance, P5 pointed out "Especially for elderly people I think they will just tell the machine something and the machine really need to interpret this correctly. Otherwise they will get frustrated I think.".

Last, but not least, problems in Zora's HRI design were pointed out. Participants were worried about whether current interaction design is suitable for elderly (40%). The fact the robot is tablet-operated was brought up particularly often.

In the context of Alice, perceptions recorded in Q1 and Q2 generally fell under one of two top level codes: "creepy" or "realistic". In Q1, 30% of participants were positive about Alice's human looks describing them as "more realistic" and "more relatable". A bigger group of participants (40%) described Alice's doll-like face as "creepy" or "freaky", making movie associations and relating it to "scary dolls in horror movies" (66% of the group) or "the scary movies where robots take over the world" (33%) of the group. Some participants had particularly strong opinions, saying they would be "extremely" freaked out if they were to have Alice as their companion in an older age. Participants also pointed out inconsistencies in Alice's design such as human-face, but robotic body and girl-like face and male voice. In Q1 participants also referred to the Artificial Intelligence (AI) of the robot saying that it "makes the interaction more real" 20% and "more like a carebot, less like a toy" 20%. However, in these statements majority of participants (75%) by AI understood Alice's memorization capabilities; the later recurring expression "extra set of brains" was first used in this context. There was a lack of further justifications in this section. The common concerns about Zora not being a care-bot yet were less prevalent here, only two participants (20%) saw Alice as "just a prototype". In Q2, 40% associated the word "creepy" with Alice, however positive adjectives such as "functional", "smart", or "caring" were used by the same percentage of participants.

4.3.2 Companion care robots in general. After two cycles of coding, all codes elicited were organized into five categories: *PC: positive*, *NC: negative*, *LC: looks*, *CC: control* and *IC: intelligence*. The first two categories are the broadest ones. PC and NC capture participants negative and positive attitudes toward specific features and the findings can be related to the quantitative data obtained 4.2. In addition, PC and NC give an overview of how people conceptualize robot companions and related expectations. Three sub-codes of PC were distinguished: *PC1: social companion*, *PC2: fun companion* and *PC3: helper companion*. NC had two sub-codes: *NC1: social companion*, *NC2: adoption* and *NC3: fun companion*. The remaining three categories describe specific aspects of robots in the eyes of participants: looks, (means of) control and intelligence of a robot. mention how codes were distributed!

Code *PC1: social companion* was recorded in answers of all participants (100%). The key drivers for the use of it were found to be values of *PV1: fighting loneliness* (90% of participants; used >1 by

63% of the group) and *PV2: pragmatism* (90% of participants, used >1 by 1 participant). Common beliefs associated with *PV1: fighting loneliness* include *B1: having a two-way conversation communication makes people less lonely* expressed by 7 participants (70%) and related attitudes: *PA1: a robot is "someone to talk to"* and *PA2: a robot companion would be a good addition to a person's social interaction*, both expressed by 80% of participants. For example P3 explained "I think I would give Alice to my grandma over Zora, because I think Alice is more someone you can talk to. (...) Then it would be like an addition. Like the days when I can't be there or someone else, so that she would have someone else to talk to; like the robot." Regarding PA2, most participants stressed that they see a robot as an 'extra' and that interaction with other humans is preferred. P5 explained "I think it should be preferred that the social interactions comes from other humans. (...) But I can already see that a lot of elderly already are pretty isolated. So then if a robot can provide some relief in this or some comfort; that they can like socially interact with them, I think that's a good thing." Only one participant, P9, saw social HRI as a potential replacement of social interaction *PA3: In given circumstances, a companion robot could replace human social interaction*. Furthermore, attitude PA2 appeared to be tightly linked to *PV2: pragmatism* and beliefs associated with it. Over half of the participants (60%) saw Zora as a pragmatic solution- *PA4: a robot companion is a pragmatic solution for elderly*. These individuals explained that *PA5: family members have "their own life" and the time that they can spend care for their elderly is limited.* A big part of that group (83%) stressed that *PA5: family members should use the time they do have to socially interact with their elderly.* Both attitudes are illustrated in P5's utterance "And of course.. they have all the time in the world and they're sitting at home. And younger people like for example me- I'm in the middle of study and moving and finding a job. And so yeah.. I think of course I think it's better to give them all the social interaction you can. But if maybe that's not enough then maybe robots can add some more social interactions for them.". The belief that younger adults should care for the elderly within the extent that fits the schedule rather than make the time for that cause, was prevalent among participants.

Code *PC2: helper companion* was found in answers to all question categories of 90% of participants. Two popular values motivating the use of the code were: *PV1: supporting the user* (70%) and *PV2: reducing healthcare overload* (90%). In PV1 support was seen mainly in the terms of daily management, for instance P7 explains: "maybe for people who live at home and are feeling a bit lonely.. and like yeah, they might need some help with remembering to take their pills or something, then I think that's already a great idea.". P9 shared that very view and conceptualized a companion as.. *PB1: a companion is also someone that supports you in everyday life.* Moreover, a similar conceptualization was implied by five more participants (70% all together) who shared a belief *PA1: productivity/daily management features add value to a robot.* Reminding the user about taking their pills was a common example of such feature listed, so was providing the user about an address of a (i.e.) relative as shown in the video trial and reading the news. In general, features related to memory and reminders as such, were seen as useful by the biggest group of participants. The majority of part-takers (70%) manifested attitude *PA2: an "extra set of brains" is nice.* Regarding *PV2: reducing healthcare overload*, users shared belief *PB2: healthcare system is overloaded and workers are overworked* (% ?). The opinion led them to position *PA2: robots could lighten the workload for human care-takers*(% ?). P5 states "I think it can be a really good thing to like give health-care employees some additional robots to help them out.", similarly P7 declares "I think it's a good idea to well not replace but partially replace some care-giving people". Although, these statements adhere to PV2 and PB2, attitude recurrent in PC1 - "robot is an addition not a replacement" seems to be relevant here as well.

Last sub-code of PC distinguished was *PC3: fun companion* used by 40% of participants. Participants referred to two values PV1: providing amusement (40%) and PV2: fighting boredom (20%). These values together with common opinion that *PB1: a robot is entertaining* (40%) led them to the mindset *PA1: A companion robot would keep the elderly entertained.* (40%).

Code *NC1: social companion* captures attitudes opposing to: *PC1: social companion* and was found in responses of 50% of participants. Values adhered to here include *NV1: sincereness of interaction* (40%), *NV2: bond* (30%) and *NV3: family* (30%). However, none of the related beliefs or attitudes were prevalent. The most common belief linked to the sincereness of interaction was *NB1: conversing with a machine is insincere* (30%) and led to attitude *NA1: a conversation can be held only between humans.* Yet only one participant, P7, elaborated on that further by saying "But the fact that it's still a robot and it doesn't have any feelings or still.. You know, it's not really listening or something.. it's all implemented I guess.". Other participants believed that- *NB2: A mutual bond is an important part of an interaction* (30%). A participant, P6, elaborated by adding "And what elderly missed most when they're lonely it's like the context that you're really close with someone you love or a brother or very close friends. And that's when people tend to feel lonely; when they don't have those contacts anymore. Yeah I don't think it (social HRI) would really help with the loneliness, because it's true you can talk to it but it can not relate to your problems and you cannot like open up like you can to someone who you're really close to." The statement directly argues with the popular belief from PC1 *B1: two-way conversations reduce loneliness.*Interestingly, upon another question "But then do you think when your parents get older you would be able to commit a lot of time to hang out with them?", the participant got less definite in his opinion and added "It can be an addition but I don't think it will fulfill all the purposes..". The shift of views was recorded across a few participants, as mentioned before. P6, however, still argued that loneliness is a "societal problem" that should not necessarily be solved with the use of robots. P4 also relates to bonding with robots in her answer- "I think that is a very dangerous idea and also unhealthy, but it also reminds me of a movie "Her" where a guy falls in love with his computer system. (...) Cause at the end of the day, it's still a robot. So you fall in love with it, but it cannot love you back, or give you anything back." In his opinion, P6 assumed a person cannot build a bond with a robot while P4 assumed only a one-side bond is possible. As can be seen, in her answer P4 made a movie reference, yet she did not explain how a one-sided bond is dangerous. Furthermore, the participant finished her monologue by saying "And I think if you have an elderly lady who just wants to be friends with a robot.. I mean maybe, if she needs a sense of fulfillment and she can get it there then that's great, but it's dangerous as well, cause at the

end of the day it's just a robot and you're gonna count on a robot.". Similarly as P6, P4 has shown to be prone to changing her opinion about social HRI.

NC2: adoption (70%), the second sub-code of NC reflects participants' doubts about whether companion robots could be successfully introduced to the current generation of elderly. There was no obvious link between the individual reflections and specific values, therefore only beliefs and attitudes will be mentioned. Four participants (40%) assumed *NB1: elderly tend to be skeptical about technology* which led them to conclusion(s) *NA1: companion robots are a solution for the next generation* (30%) and/or *NA2: some elderly might be open for the use of robots* (40%). Both the attitudes are illustrated in a fragment of P2's monologue "There's a suspendable leap of sorts. It's the same when you're watching a movie and you're sort of accepting the new reality and you do the same thing with the robot (...) I don't see my grandpa, my grandpa is 92 or something, I don't see him doing this cause.. Cause like, it's too much. It's too weird, it's too far from what he's used to. But my other grandparents are 80-something now, so it's a 10-year difference.. So i'd see them.. I'd see them going "oh that's pretty cute, we'll give it a go", they'd be interested in it. I can particularly imagine that if my parents then get older. They've seen this kind of thing so if you, if you think 10 years in the future or so, then things are different.. Cause these people are used to these things more and then it makes more sense to them and then it's not as weird." There was one participant whose attitude did not fall under either of the codes- P6; that participant exhibited reluctance towards robots throughout the whole interview. When inquired whether he sees companion robots at least as a solution for the future he replied "I think robots in a sense like a Google home or.. social robots; for me that is currently hard to imagine. But yeah, for daily management for sure.". The attitude was shared by P8. However, these opinions mainly concern social companion robots rather than robot companions as a whole. In the context of adoption, participants also noted that *NB2: elderly struggle to use technology* (40%). Interestingly, some saw this as a 'no-go' while others suggested there would be a learning curve. For example, P3 noticed "I wonder if my gran would understand how to use it.. Because she can't even work an iPhone. She has a NOKIA phone and she barely even knows how to use it. So not sure if she would know how to use it, but maybe after a while she would get it. And then it would be really good.". On the other hand, P8 thought "also the fact that it's through the computer and not through talking.. my grandpa doesn't even understand the iPhone. So how will that work, you know. That's the part that is still.. Yeah I don't think that works. Like with speech, I think that elderly people understand. But through the computer.. I think that would be something for the next generation like our generation that's becoming older, like my dad or my mom. But the gap for our grandparents now is just too big."

Lastly, *NC3: fun companion* (70%) represents downsides of toy-like robots expressed by participants. Again, it is not clear what values participants had in mind when making their statements. Common attitude was that *NA1: entertainment is good, but not enough to buy a robot* (50%) and *NA2: "Why not", but it is not a priority* (30%). Some people justified their attitude with a belief that *NB1: people get bored with entertainment quickly.* (30%) or that *NB2: entertainment is not the most beneficial feature* (20%).

In LC, *LC: looks* user preferences for the appearance of a robot companion are summarized. User preferences generally fell under three classes *LC1: human-like*, *LC2: machine-like* and *LC3: cute*.

Participants who preferred human-like looks (LC1- 30%) referred to believability as a value *LV1: believability* (100% of the group) exhibiting one or more beliefs tied with it. 67% of the group stated that *LB1: the more human-like, the more believable* the robot. In addition, they explained their preference by saying that *LA1: otherwise it looks like a toy* (67% percent of the subset) suggesting that *LB2: human-like looks make the robot seem like a more serious concept* referring to value LV1 yet again. Last attitude shown was *LA2: if it's supposed to replace humans it should resemble one* (67%).

A bigger group of part takers (LC2- 70%) voted for machine-like looks. Since the whole group (100%) shared the opinion that *LA1: human-like looks make a robot creepy* without any further justification, it is unclear what values they adhered to. The closes to an explanation was a statement that *LB1: it should look like a robot cause it's a robot* (10%). In addition, two participants (20%) stated that *LA2: design of a robot should be pragmatic* while praising the design of Pepper (foot-note); a big, humanoid robot with a tablet.

Category *CC: control* was distinguished at the means of controlling a robot were a commonly mentioned aspect of HRI. Furthermore, it was seen as an obstacle for successful introduction of robots, as described in sub-category *NC2: adoption*. A predominant code was distinguished for the category *CC1: full speech control* found in answers of 70% of all participants. Key values users appeared to have held in mind were: *CV1: ease of use* (70%) and *CV2: naturalness of interaction* (40%). The ease of use was sometimes tied to the belief that *CB1: voice control is the easiest for elderly* (40%). Some participants (42%) followed that by stating *CA1: robots like Zora are currently too difficult to use for elderly*. As suggested by numbers not all participants reveled their reasoning, however, generally speaking, most participants thought full speech control would make the robot more accessible for elderly. Furthermore, some believed it would add to the naturalness of interaction (CV2- four participants). A belief that *CB2: a companion robot should not feel like a tool* (40%) fell right under that value. They shared views such as "a robot is something you can "totally interact with" and "you can just talk to it and it will work" which is summarized as an attitude *CA2: a robot companion should respond to all users voice commands*.

Category *IC: intelligence* describes participant opinions about intelligent robots and what level of intelligence they expect from a robot companion. Interestingly, participants had the tendency to comment on or ask about intelligence of robots even when not inquired about it. When the tendency was noticed, questions were added. Thanks to that two coherent sub-categories were distinguished *IC1: unintelligent robots* and *IC2: intelligent robots*.

IC1 reflects a motion that robots should not do anything beyond their pre-programmed functionality. That point of view was expressed by 40% of participants. The values adhered to are unknown, however the majority of the group (75%) held a belief that *IB1: a smart robot is "creepy"*. Some (50%) also thought that *IB2: if robots get too much freedom, things can go wrong*. The consensus within the group was that *IA1: intelligence of a companion robot should not go beyond memorizing information provided by the user and following user's instructions*.

IC2 as a whole suggests that more intelligent robot companions are needed. The remaining 60% of participants shared a view that *PB1: a smart robot is useful and/or realistic*. P8 explains "And with Alice I think it's more.. I think it could be better for the long haul because it also remembers things and makes decision. And here the interaction is up to you. You have to decide what you want to do. So it's more like a toy than like a companion." However, users opinion varied in regards to the extent of intelligence that they would expect from a robot. For example, some users (40%) led by *IV1: utility* believed that *IA1: robots need intelligence, also emotional one*. P3 justifies that view in her statement "Cause, for example, you'd give it [the robot] to elderly people and they'd show like a picture or something but it doesn't remember, they'd need to tell it all over again, like you know, every time. And.. for regulating emotions I think that's kind of important too.. Cause a human can also kind of regulate emotions, like sense them in a way.. So I think that's just important that.. I don't know, that it doesn't just like start dancing when someone doesn't feel like dancing [giggle]. That would be kind of weird. That's why I think it's important, the artificial intelligence. Cause otherwise there wouldn't really be a point in giving the robots to older people or children." Others thought that *IB1: robotics is not developed enough to create a believable social HRI* (20%). Furthermore, two out of six participants (33%) felt that *IA2: totally autonomous robots are an ideal-world solution*. The remaining four (67%) thought that *IA3: robots should be able to make their own decisions to some extent, but the user should stay in control*. One of them justified his decision with a following belief *IB2: if not supervised carefully, machines can lead to accidents*.

5 DISCUSSION

Based on the findings, Dutch young adults see an assistive friend companion as a large, humanoid robot, for instance Pepper [11]. Pepper's humanoid appearance is seen as machine-like enough not to make a robot look creepy. Although Nao is also a humanoid robot produced by SoftBank robotics, Pepper is larger in size and has a built-in tablet. These two properties were seen as pragmatic and put Pepper as number one on the list 2. The vast majority of participants associated the word 'creepy' with the extremely human-like android robots, for instance Sophia [12]. Also a doll-like design of robots like Alice [13] appears to be unfortunate. The girl-like, baby doll face of Alice proved to evoke an association with Western horror movies, for instance Annabelle [14], for some users. Secondly, according to participants an assistive companion should be a semi-intelligent and semi-independent agent. Such an agent would be able to memorize and process information about the user and their surroundings and act accordingly. However, that information would not involve emotions or other human-like features. Moreover, thanks to voice control, the user would stay in control. According to the interviewees the user should always stay in control as the robots should not be given too much freedom. The previously described2.1.2, *'Robots will take over the world'* scenario, common in Western media, was referred to in that context. Furthermore, although a few interviewees thought that emotion regulation is essential for a companion as it would help it act natural, most participants either felt uneasy about human-like traits being exhibited by machines or thought the interaction would not be believable either way. In general participants believed that, granted the boundaries described above are preserved, partial intelligence and independence add to the utility of a robot companion. Interviewees believed a robot that can observe things and take initiative at times is more useful and realistic. Supposedly, a machine that does not always require an explicit user command feels less like a toy and more like a companion.

At this point of the discussion, it is important to note that the word 'toy' as used by participants, has negative connotations. In their eyes, a toy would not fulfill the requirements of their conceptualization of as a care-bot. A toy is funny, but it lacks utility. Taking into account that most of the participants' expectations were driven by pragmatism, an impractical solution could be rejected within the Dutch market. This theory is confirmed by the participants' perceptions of Zora and Alice. Participants perceived Zora as a cool and funny, but rejected her as a usable care-bot solution. On the other hand, Alice was commonly referred to as functional and therefore, she was perceived as a more serious concept than Zora. However, interviewees found her too human-like, in terms of both looks and behaviour, to be an acceptable solution. She was referred to as creepy, just as often as functional. These tendencies comply with findings of previous researchers [12**?**] who concluded users do not expect human-like behaviour and appearance from robots. While participants' expectations toward the appearance of the robot have already been described, the question that arises now is- what behaviour is expected from a care-bot? So far, this has been only partly specified.

Aside from the partial intelligence and independence that participants would require from the assistive friend companion, they also expressed strong preferences regarding how the robot should be controlled and what features it should have. The majority of participants voted for speech control, as shown in 3. In fact, they expect a full voice control meaning that, a user "could just talk to it and it would work" (P5). It was believed that voice control is the easiest means of control for elderly and that it would also make the interaction more natural. The naturalness of interaction was a recurring value in the context of behaviour as a whole. Participants believed that a robot that is supposed to be human's companion should not feel like a toy nor a tool. Instead, it should be something you can "totally interact with". Participants were strong in these beliefs; lack of voice control and problems with voice recognition were some of the reasons why Zora was rejected as a care-bot solution. However, it should also be mentioned that in the case of speech control, the voice recognition should work seamlessly. Similarly as in other studies [23], participants seemed to trust robots are faultless.

Feature-wise, the quantitative findings shown in 1 comply with the implications of the qualitative data (Please see Appendix A). According to table 1, interviewees saw communication and daily management as the most important features of a robot companion. Similarly, they saw social companionship and daily support as the most positive aspects of a companion robot (Appendix A. Although, as mentioned before, a human-like behaviour was not

[11] Pepper by SoftBank Robotics- https://www.softbankrobotics.com/us/pepper
[12] Sophia by Hanson Robotics- https://www.hansonrobotics.com/sophia/
[13] https://www.dazeddigital.com/artsandculture/article/23905/1/arti cal-intelligence-is-here-and-she-s-kinda-cute
[14] Annabelle (2014) Warner Bos https://www.warnerbros.com/movies/annabelle/

desired, robot's ability to have a conversation was seen as crucial. Participants considered a robot companion "someone to talk to" for elderly. Furthermore, they believed conversing with a robot would make people less lonely and, what follows, would make a valuable addition to the social life of elderly. These implications comply with findings of previous studies [12**?**] suggesting human-like communication is an important element of HRI. They also suggest fighting loneliness is an important value that could drive the use of care-robots for elderly. Together with pragmatism, they were the most prevalent values. The participants have shown that utility is most important to them and out-bids moral concerns. That conclusion argues with the results of other study in the Netherlands [31] where moral concerns were found to be more important than utility. In this study, participants have shown that although they might have ethical concerns regarding social HRI, they are prone to consider it as a solution as long as it is pragmatic for them and helpful for the elderly. Few of them held family as a significant value and their were not willing to adapt their daily life and schedules to take care of their elderly family members. What follows, they concluded care-bot could give the elderly the attention that they cannot and make a pragmatic solution.

In addition to social companionship, users collectively assumed a care-bot should support the user in their daily life. This was believed to be of help for the elderly user, but also for their human caretaker(s). Overall, participants assumed that elderly could use some assistance in their day-to-day life and that health-care is currently facing a work overload. They concluded that a robot companion that would be "an extra set of brains" for the elderly and, for instance, remind them of actions on their agenda would be of help for both the elderly and the health-care workers. Reminders were the most commonly mentioned example of a daily management task. That indicates that younger adults believe that memory-loss is one of the most prevalent problems among elderly.

Although entertainment is ranked as the third most important feature (1), negative opinions about a fun companion were predominant. Users admitted that a fun robot could entertain the elderly, however they saw it as short-lived. They believed the elderly would soon get bored of the entertainment and that, unlike communication, fun is not a priority. That explains why Dutch young adults do not see robots that focus primarily on entertainment like Zora as a solution for elderly, even though it evokes positive first reactions. In the long-term perspective, young adults appear to seek a solution that would be applicable to the bigger problems faced by the elderly and the health-care.

A worry concerning robot companions widely shared by participants was a potential adoption of such robots. Participants doubted whether robots could be a solution for the current generation of elderly. They were concerned with the interaction design of existing solutions such as Zora, arguing that tablet-based control is not suitable for their grandparents. However, they implied that introducing full voice control could easen the adoption. In addition, participants mentioned that the current generation is skeptical about technology. Nevertheless, they not only admitted that some elderly might be open to try out something new, but they also noticed that the technology barrier will have disappeared by the next generation of elderly. That suggests care-robots could be successfully adopted; if not at present, then within the next 20 years.

In summary, findings of the study imply that Dutch young adults are generally positive about robot companions. These results comply with the outcomes of a 2018 study involving Dutch health-care professionals [31] suggesting companion robots could pave the way for other care robots.

Delving into expectations toward a robot companion, on the dimension *helper/fun companion versus friend companion*, participants were actually most in favour of the daily management and the social companionship. This preference forms a new sub-category of robot companions and could be named, for instance a *helper friend companion* or a *assistive friend companion.* Although it can be argued how to name such an agency, the name will not affect the conceptualization of the agency as shared by participants. The young adults in the study have conceptualized an assistive friend companion as a large, humanoid-robot. The participant believed that the robot should be given enough intelligence and independence to support the user in their daily life and converse with them, however it should not be given too much freedom or act too human-like. Unfortunately, it is not entirely clear what is meant by too much freedom, however, there is a clear directive that a user should always stay in control. In terms of human-like behaviour, actions related to emotional intelligence, for instance, exhibiting emotions and asking personal questions is most likely seen as too human-like, however, that line also remains somewhat unclear. Furthermore, participants shared their expectation that it should be possible to fully operate a robot companion via speech. In their eyes, a user should be able to just speak to the robot and the robot would act accordingly. The preference for human-like communication, but not human-like looks nor behaviour complies with findings of previous studies [12**?**].

However, unlike Dutch health-care professionals [31], Dutch young adults have shown to put utility above moral concerns. They have proven to be willing to accept care robots as a health-care solution granted they would be helpful the elderly or the health-care workers. They found social companionship and daily support the most helpful features. Unlike the Dutch general population [23], Dutch young adults were prepared to let the robots take care of their elderly family members. They saw robots as a pragmatic solution, especially as they did not see the possibility of caring for the elderly themselves. Last, but not least, participants rejected fun companions as a solution, prioritizing long-term utility.

5.1 Limitations

Although the research question has successfully been answered, the study has a number of limitations. Firstly, the number of participants was small and therefore it would difficult to generalize the findings to all Dutch young adults. Furthermore, the study involved one live HRI trial and one video-taped HRI trial. That might have affected the findings as a live trial provides a more accurate overview of the HRI. Lastly, due to time constraints, the interviews have been relatively shown. Longer interviews would gave provided more insights into participants' way of thinking.

6 CONCLUSION

Dutch Young adults appear to be willing to accept robot companions as a solution for elderly. Although they have some doubts

whether care-bots could be successfully adopted within the current generation of elderly, they are positive about their adoption in the future.

In their perceptions Dutch young adults have demonstrated a large dose of pragmatism. Even when facing moral concerns, they have shown to put convenience and helpfulness first. Led by these values they conceptualized a companion care robot as an assistive friend companion. They rejected a fun companion as an impractical and short-sighted solution. Their conceptualized solution is utile, but not human like. Dutch young adults would expect an assistive friend companion to provide their elderly user with daily support and social companionship. They have shown to believe that a robot companion can be an effective aid for elderly users and help them face their most prominent problems such as loneliness and memory loss.

Dutch young adults conceptualize a companion care robot as a large, humanoid robot such as an existing SoftBank Robotics' solution, Pepper [15]. They expected the robot to have full-speech control enabled and for the voice control to work unconditionally and seamlessly. In addition, they expect the robot to be smart and independent enough to provide a high quality of daily support and social companionship, using the information and observation gathered. However, they expect that the user always stays in control. Lastly, it is not entirely clear what extent of AI is expected from a robot companion, however, emotional intelligence is not desirable.

7 FUTURE WORK

For future studies, it would be interesting explore some of the expectations in more depth. For instance, a study where participants' view on AI of robot companions would be helpful. Ideally, a study like that should involve a use of a companion care robot that uses complex AI systems, i.e. Alice. Such study could help to elicit a more detailed list of requirements for the intelligence of a care companion.

Moreover, it would be interesting to develop a prototype of an assistive friend companion meeting the guidelines described above and test it with elderly users. While this project describes assumptions that young adults made about the elderly and their problems, attitudes and technical capabilities, it would be invaluable to check test assumptions with Dutch older adults.

Last, but not least, it could be interesting to repeat the study with young adult representatives of another Western culture. Comparing the findings could provide an indication whether the study could be generalized for Western cultures.

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[15] Pepper by SoftBank Robotics- https://www.softbankrobotics.com/us/pepper

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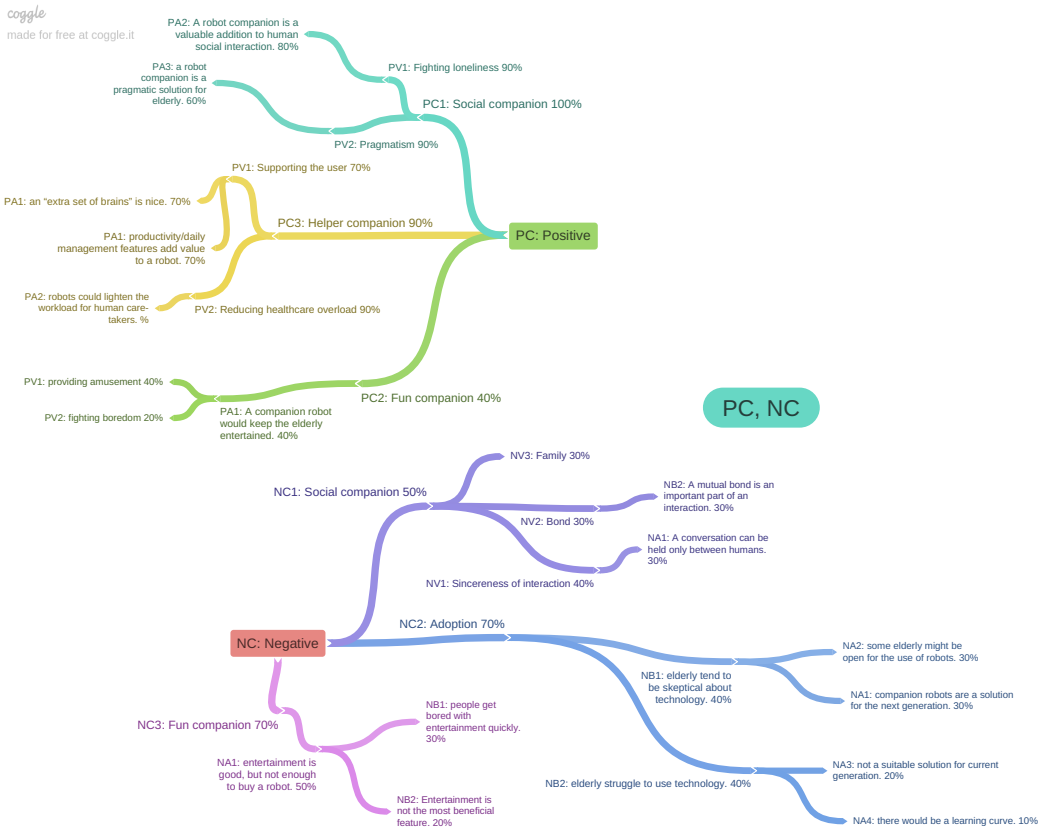
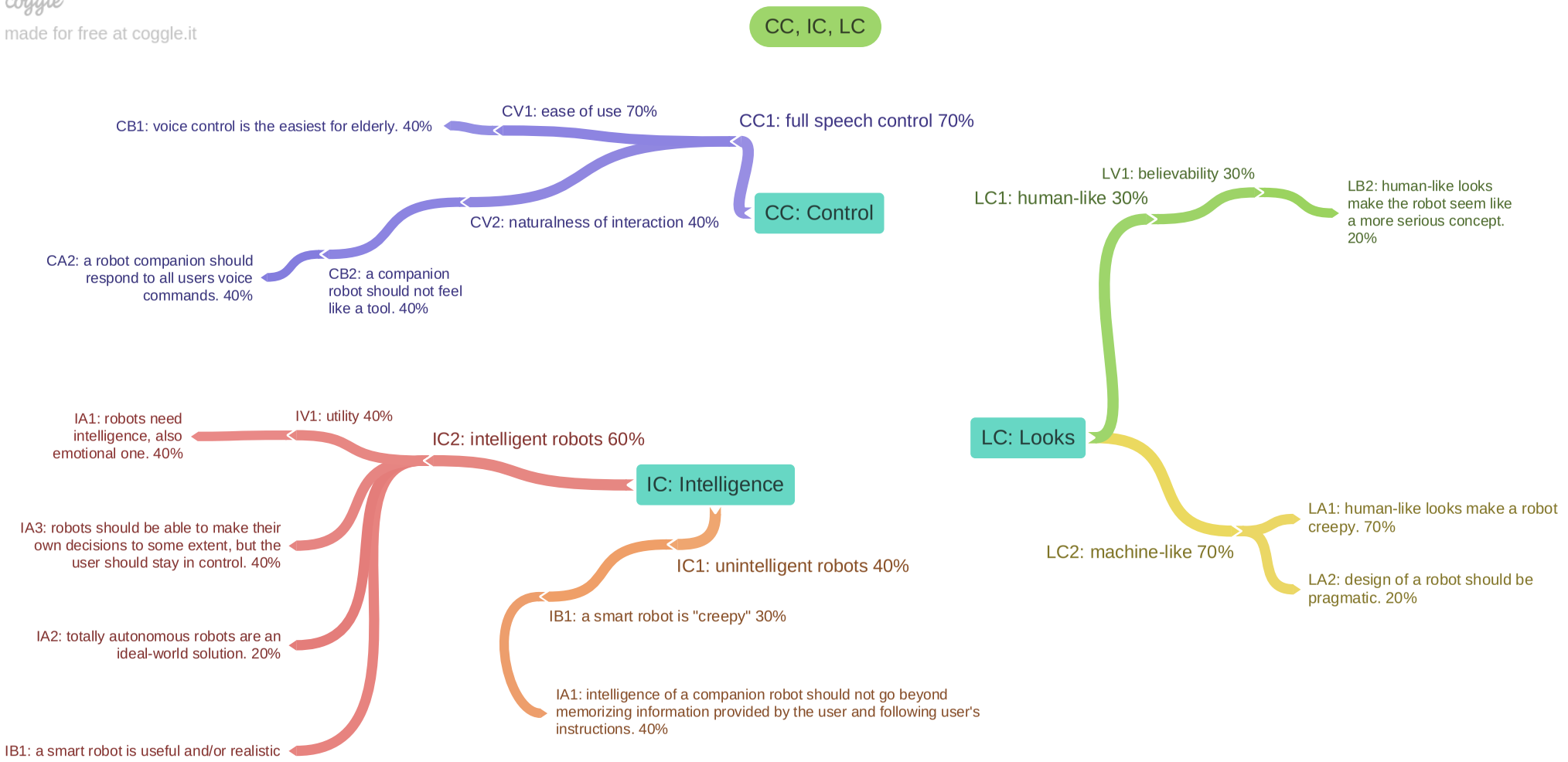
A TOP CODES


coggle
made for free at coggle.it
PA2: A robot companion is a valuable addition to human social interaction. 80%
PV1: Fighting loneliness 90%
PA3: a robot companion is a pragmatic solution for elderly. 60%
PC1: Social companion 100%
PV2: Pragmatism 90%
PV1: Supporting the user 70%
PA1: an "extra set of brains" is nice. 70%
PC3: Helper companion 90%
PA1: productivity/daily management features add value to a robot. 70%
PC: Positive
PA2: robots could lighten the workload for human care-takers. %
PV2: Reducing healthcare overload 90%
PV1: providing amusement 40%
PC2: Fun companion 40%
PV2: fighting boredom 20%
PA1: A companion robot would keep the elderly entertained. 40%
PC, NC
NV3: Family 30%
NC1: Social companion 50%
NB2: A mutual bond is an important part of an interaction. 30%
NV2: Bond 30%
NA1: A conversation can be held only between humans. 30%
NV1: Sincereness of interaction 40%
NC2: Adoption 70%
NC: Negative
NA2: some elderly might be open for the use of robots. 30%
NB1: elderly tend to be skeptical about technology. 40%
NA1: companion robots are a solution for the next generation. 30%
NB1: people get bored with entertainment quickly. 30%
NC3: Fun companion 70%
NA3: not a suitable solution for current generation. 20%
NA1: entertainment is good, but not enough to buy a robot. 50%
NB2: elderly struggle to use technology. 40%
NA4: there would be a learning curve. 10%
NB2: Entertainment is not the most beneficial feature. 20%



Interview with Dutch students

The semi-structured interview involves an in-person HRI experience with a care robot Zora and other supporting tools in the form of pictures and video clip(s)

Interview structure

1. Intro- introduce yourself, explain the goals of the interview, reassure about the ethical issues, ask to record, present an informed consent form.
2. Warm-up- Questionnaire- ask the participant to fill out the Negative Attitude Towards Robots (NARS) questionnaire.
3. Demo- 10-15 mins of interaction
4. Questions section Aa
5. Play a video clip(s) of a more autonomous, emotionally aware robot that can engage in a conversation with a user.
6. Questions section Aa repeated
7. Questions section Ab
8. Questions section B
9. Questions section C
10. A cool-off period - include a few easy questions to defuse tension at the end
11. Closure - thank interviewee, signal the end, e.g, switch recorder off.

Interview questions

A. How do people perceive companion care robots?

a. What does Zora/Alice evoke in human minds?

i. What are your general thoughts about Zora/Alice after the demonstration?

ii. What words would you associate with Zora/Alice?

iii. What activity performed by Zora did you like the most?

~~iv. Did any of the actions performed by Alice or aspects of the Alice-elderly woman interaction bother you?~~

b. Are people positive or negative towards companion care robots?

i. Looking at your elderly family members and their living/carer situation do you think they (and possibly their caregivers whether family or professional) could use the assistance of a human-operated robot like Zora?

1. What functionality do you think they would find most useful?

ii. Would you consider putting an autonomous robot with more AI like the Alice prototype in their house?

1. Do you see it more as an addition to social interaction or as a replacement?

iii. As explained at the beginning of the experiment, autonomous robots are one of the suggested solutions for increasing the psychological well-being of older adults. Another tested solution tested in Dutch care homes was to ask family members of participants spend at least 4 hrs a month each at the care home.

1. Imagine being in that situation, would you commit to that?

a. So you would you be willing to commute to all your elderly family members?

~~2. Looking at your parents/adult family member, how much time do you think an adult with a family is able to commit to their elderly family members?~~

B. What companion care robots should do?

a. Imagine your family robot had a companion robot, please express how you feel about a robot performing each one of these tasks and arrange the cards from the most to the least important:

i. Leading rehabilitation/movement exercises

ii. Productivity activities i.e. Reading the news, PowerPoint

iii. Daily management i.e. Weather Forecast, Reading agenda

iv. Entertainment i.e. Stories, Dancing, Singing

v. Entertainment requiring user involvement i.e. Quiz

vi. Communication- a user having a dialogue with a robot

vii. Cuddling

C. How companion care robots should look like and interact?

a. In your mind, what does a robot look like?

b. Which design would you choose for a companion robot for your elderly family member?

i. An android robot i.e. Sophia

ii. A big humanoid robot i.e. Pepper

iii. A small humanoid robot i.e. Nao

iv. A doll i.e. Alice the 60cm tall ‘sociobot’

c. Through what means would you prefer to interact with your care robot? Please arrange the cards from the most to the least acceptable options?

B INTERVIEW QUESTIONS AND HELPS

i. speech

ii. touch screen

iii. “totally autonomous”

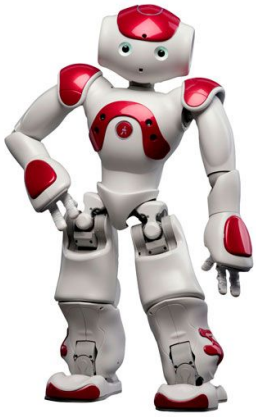
d. Artificial Intelligence of the robot

i. To what extent would you feel comfortable with the robot being autonomous?

A doll i.e. Alice the 60cm tall ‘sociobot’

A big humanoid robot i.e. Pepper

An android robot i.e. Sophia



A small humanoid robot like Nao

C INFORMATION SHEET AND CONSENT FORM

Participant Number

☐ ☐

UNIVERSITEIT VAN AMSTERDAM

Title: What are Dutch citizens' expectations and attitudes towards companion care robots?

Consent Form for Interviews: a Qualitative Study

Thank you for reading the information sheet about the interview study. If you are happy to participate then please complete and sign the form below. Please tick the boxes below to confirm that you agree with each statement:

	Please tick box:
I confirm that I have read and understood the information sheet and have had the opportunity to ask questions.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	☐
I understand that my responses will be kept strictly confidential. I understand that my name will not be linked with the research materials, and will not be identified or identifiable in the report or reports that result from the research.	☐
I agree for this interview to be tape-recorded. I understand that the audio recording made of this interview will be used only for analysis and that extracts from the interview, from which I would not be personally identified, may be used in the report developed as a result of the research. I understand that no other use will be made of the recording without my written permission, and that no one outside the research team will be allowed access to the original recording.	☐
I agree that my anonymized data will be kept for future research purposes such as publications related to this study after the completion of the study.	☐
I agree to take part in this interview.	☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	
Principal Investigator	Date	Signature

To be counter-signed and dated in the presence of the participant for face to face interviews

UNIVERSITEIT VAN AMSTERDAM

Information Sheet

Research project title: *What are Dutch citizens' expectations and attitudes towards companion care robots?* MSc Thesis Qualitative Research
Research investigator: Dagmara Kukawka
Address & contact details of the research investigator: 189 Prins Henrikkade A-37, 1011TD Amsterdam, dagmara.kukawka@student.uva.nl

Other Researchers may be involved in this project: Dhr. dr. Frank Nack- Research Supervisor

About the Project

The Project aims to investigate what are the expectations towards companion care robots for the elderly held by Dutch citizens. Companion care robots solutions that are currently available on the Dutch market are non-autonomous; they provide an addition to human caretakers and focus on providing their elderly users with entertainment and daily management. However, other types of companion care robots are currently under development. The aim of these developments is to create more autonomous care robots that provide humans with social and psychological care as well. As the number of elderly people in the Netherlands is expected to increase by 60% in the next few years, some suggest that companion care robots might provide a viable solution to the shortage of human caregivers, especially if the robots are given more autonomy and reasoning/emotion regulation power.

The Project aims to investigate whether companion care robots can indeed provide a valid solution to the rapidly increasing elderly to adults ratio within the Netherland, and what design of such robots, in terms of both looks and functionality, would increase their chances of being accepted by Dutch users and other stakeholders.

Who is responsible for the data collected in this study?

The interview will be audio-recorded and transcribed by the interviewer. Only the interviewer will have access to the audiotape. All information will be coded and anonymized. Once the transcript has been completed, the audiotape will be erased.

The electronic data collected can only be accessed with a secure password. Only the researcher and their supervisor will have access to the data.

The data we collect will be used only for the purpose of this research; if data were to be used for future studies, further approval will be sought. The transcripts will be kept for two years.

All information which is collected about you during the course of the research will be kept strictly confidential.

What is involved in the study?

At a scheduled day and time in May 2019, you will participate in an interview involving a Human-Robot Interaction and a video trial with a care robot. The interview will be audio-recorded and stored in the cloud. Prior to the interview, you will the asked to fill in an online demographics questionnaire. You can opt out of the study at any point of the interview.

What are the benefits for taking part in this study?

You will have contributed to the development of guidelines for companion care robots within the Netherlands and, through that, potentially take an active part in helping to accomodate care for the increasing amount of elderly citizens. You can find out about the final results of the study by reading the MSc Thesis that will be made available in mid-July 2019.

What are your rights as a participant?

Taking part in the study is voluntary. You may choose not to take part or subsequently cease participation at any time.

Will I receive any payment or monetary benefits?
You will receive no payment for your participation. The data will not be used by any member of the project team for commercial purposes. Therefore you should not expect any royalties or payments from the research project in the future.

For more information
If you have any further questions or concerns about this study, please contact:

Name of researcher: Dagmara Kukawka
Full address: 189 Prins Henrikkade A-37, 1011TD Amsterdam
Tel: 0683512068
E-mail: dagmara.kukawka@student.uva.nl

You can also contact Dagmara Kukawka's supervisor:

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Full address: Science Park 904, Kamernummer: C3.140
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