The effect of entertainment content in messages on the feeling of connectedness to a SAR

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This master thesis is part of 'Early Warning Accompanies Robotics Excellence' (eWare) project which is financed by the European Active and Assistive living program (AAL). The eWare system supports the daily life of people with dementia and their (in)formal caregivers, by monitoring the lifestyle of the client. The system integrates two technologies, lifestyle monitoring of Sensara and social robotics of Tinybots. Sensara lifestyle monitoring consists of motion sensors and open/close sensors and Tinybots is a socially assistive robot called Tessa. The research context of this thesis is in line with the eWare project goals.

Abstract

Due to the ageing of the population of Europe there will be a shortage of care workers and strong need for seniors to live longer at home. For these senior population, help in activities of daily living (ADLs) is needed. In the field of eHealth a promising technology that can support in such care setting is the eWare system. Previous research within eWare investigated the acceptance and showed that there is a lack of emotional bond between the user and the social assistive robot (SAR). The user's engagement with a technology is essential to fulfill the desired goals. To create this engagement with the eWare system, the users feeling of connectedness to the SAR is needed. In that way users are intrinsically motivated to perform the tasks that are suggested by the system. The feeling of connectedness can be enhanced by creating pleasant and useful human robot interactions. In other words, increasing the quality of the stimuli, i.e. the messages provided by the SAR. Important characteristics for engagement are active involvement, personalization, relevant feedback, challenge and enjoyment. This study explored these indicators within the situation of the eWare system, by interviewing experts. The outcomes of the user experience analysis were examined in a repeated measures lab experiment. Basic task messages were created and merged with assumed entertainment values; personalization and situation generated content. The study examined the differences in perceived feeling of connectedness to a SAR affected by entertainment value in the messages provided by a SAR. Adding an entertainment value to the messages was expected to positively influence the connectedness. A positive trend could indeed be found for inclusion when adding the 'fun' entertainment value to a message. The effect of personalization of the messages should be examined further as for only adding a name no effect was found. This research contributes to the evaluation of the eWare system and proposes developments to create an emotional bond between user and the SAR.

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1. Introduction

The population of Europe is ageing due to decreasing fertility rates and increasing life expectancy (European Commission, 2018). The prognosis is that the seniors population (65 years and over) will be 28.6% of the total population in in the year 2050. This forecasts a large growth, compared to 19.2% of 2016. This matter brings in worrying long-term projections in economic and financial fields, of which the increasing long-term care costs is one. The senior related expenditures are dependent on the working-age population. This yields also for the services, since an increasing number of citizens need long-term care as older people have higher prevalence of disabilities, ill-health and chronic diseases such as dementia (European Commission, 2018).

Dementia, a progressive neurological condition, is one of the most prevalent age-related health issues. The abnormal brain changes that occur in people with dementia (PwD) cause different symptoms, e.g. a decline in thinking skills and changes in behavior and feelings (Alzheimer's Association, 2019). The decline of cognitive skills for PwD obstructs the performance of so-called activities of daily living (ADLs). Self-care tasks that are part of a normal daily routine become a struggle. For PwD who still live at home, help with ADLs is needed. Long-term care for PwD is much dependent on the ratio status of the population and human resources become more scarce. As the workload of health care workers will be higher and the care that is needed cannot be given, more family and friends of PwD need to be involved in care. These informal caregivers, mostly a spouse, child or friend, assist PwD mostly in their home context with their day to day tasks (Liu et al., 2007). The provided informal care contains different types of tasks associated with household, personal care, nursing, emotional support and accompanying on visits. This informal care giving takes a lot of effort and is both physically and mentally demanding (Boogaard, van der Steen, de Boer, & van Groenou, 2019). Informal caregivers provide care with increasing intensity and – in case of a spouse – live longer together in the same apartment or house, which can lead to a high level of burden (Chiao, Wu, & Hsiao, 2015). The evolved stress leads to limitations in the care tasks. The duration of visits often decreases and the required care cannot be maintained (Gijzel et al., 2017). Another consequence of giving informal care is reducing informal carers employment working hours. This is often needed in order to facilitate the care that one's spouse, family or friend needs (Fast, Dosman, Lero, & Lucas, 2013).

When the implementation of care supporting technologies has the possibility to decrease the stress of the caregivers, it can help in sustaining the situation of seniors living in a home context. These supporting technologies in care are often called 'eHealth'. The term eHealth is

used when digital applications are implemented in health (van Lettow, Wouters, & Sinnige, 2019). The eHealth monitor of this year concluded that the burden for caregivers in elderly care can be alleviated by implementing Health technologies. Besides, caregivers that have experience with eHealth technologies are very enthusiastic about the possibilities they provide (Wouters et al., 2019). Dutch politicians recently discussed that it is 'time for action', they experienced that the implementation of eHealth technologies is urgent (Ministerie van Volksgezondheid Welzijn en Sport, 2019). Mobile applications, serious gaming and robotics are promising assistive technologies that can be implemented as eHealth in long-term care. But the implementation of these technologies often fails, for example due to complexity in use. There is a strong need for further developments of eHealth to increase the effectiveness, before implementing (Nap, 2019).

1.1 Assistive technologies

Assistive technologies could contribute to older people living longer, safely and pleasantly at home. These technologies assist in daily tasks, enhance safety of the performance of the tasks and are straightforward in use (McCreadie & Tinker, 2005). A social assistive robot (SAR) is an assistive technology that can improve the quality of life, by supporting better care and enlighten the care workers (Bemelmans, Gelderblom, Jonker, & De Witte, 2012). The added value of robots in elderly care is reviewed in different studies and positive results are found in enhancing the quality of life of users, especially for companion-type robots (Bemelmans et al., 2012). Robots like Paro and Zora are liked by seniors, as they support them in self-reliance. Besides, they have the potential to improve the seniors' mood and health by decreasing the feeling of loneliness and stress (Bemelmans et al., 2012; Broekens, Heerink, & Rosendal, 2009; Valentí Soler et al., 2015). SARs that are used in care centers nowadays are mostly implemented as part of pilots and can only support easy tasks. The positive effects of these kind of pilots are already noticeable, but more research and collaboration of knowledge fields are the key in the success of care robots (Nap & Cornelisse, 2019). To increase acceptance of a technology by its users, it is crucial that it is well embedded in practice.

To test and understand the acceptance and use of a technology by different stakeholders, technology acceptance models are used. The first acceptance model, TAM, was developed by Davis (1989) and over the years different variations and expands on the TAM are created; UTAUT, Almere Model, TAUM (de Jong, 2017). In these models the needs, intentions, and usefulness are analyzed to achieve the desired outcomes (Heerink, Kröse, Evers, & Wielinga,

2009). In general, the models are operationalized in a questionnaire that involve all the stakeholders and their potential use of the technology. By measuring the determinants, these models help to understand how to create a more positive experience towards the SAR (Broadbent, Stafford, & MacDonals, 2009). The eWare system supports the daily life of people with dementia and their caregivers by monitoring the lifestyle of the client (Casaccia et al., 2019). In previous research within eWare the acceptance and usability of the system was studied for different stakeholders and highlighted the importance of the interaction with the SAR (de Jong, 2017; Kroos, 2019). With this in mind solely testing the usability of a new technology by using the technology acceptance models is no guarantee for success. To create a pleasant experience, users need to somehow be emotionally connected to the technology (Flandorfer, 2012; Sponselee, 2013). In user experience research, this emotional connection is often referred to as engagement (O'Brien & Toms, 2008).

1.2 Engagement

Engagement is related to the enjoyment someone experiences when using a product (Quesenbery, 2003). In human computer interaction, engagement is defined conventionally as a mental state of attention and enjoyment, mostly accompanied by a subjective experience of long-term flow (Perski, Blandford, West, & Michie, 2017). Even so engagement was described in the concept of flow by psychologist Csikszentmihalyi (1990). Flow is a state of engagement, concentration and involvement, experienced when the user performs an action successful and enjoys it. Quesenbery (2003) describes engagement as one of the 5 dimension that identify the usability of a technology. This highlights the importance of studying users' engagement. Therefore, not only the task and function of a technology needs to be studied, but the enjoyment component is potentially of equal importance.

The user's engagement with a technology is essential for the success of it. So it is profitable to review which characteristics of a technology have the ability to create engagement. O'Brien & Toms (2008) tried to define user engagement based on likewise theories and used the attributes affective appeal, challenge, feedback, motivation and sensory appeal. In a later study the measurement of user engagement was investigated. Factors that were included in the self-report of engagement were perceived usability, focused attention, attractiveness, involvement, interest and success of interactivity (O'Brien, Hall, & Cairns, 2018). An active involvement with the stimulus is needed to create engagement as a whole such as found in game research (Gajadhar, 2012). O'Brien & Toms (2008) state that user engagement will be enhanced by feelings of connectedness to the technology. When the user

has this feeling of connectedness, they often have a feeling of closeness to the technology and experience a better interactivity. Such interactivity can be defined as the information exchange between a system and users indicated by attributes like responsiveness and synchronicity (Huang, 2003).

Some strategies to create connectedness to a system are related to feedback. Herewith it is important that the feedback is efficient and meaningful, so the user understands what the system is doing (O'Brien & Toms, 2008). To create such a meaningful feedback, the content of stimulus needs to be related to the current situation (Renaud & Cooper, 2000). As a result, the user interprets the system as socially intelligent and the stimulus as useful. Yaros (2013) found a similar effect of personalization and interactivity on engagement in his study about social media use for education purposes. When the content of the messages was adjusted to the user (personality) or to previous results or situations (context), the user sustained their interest in the media longer. Besides feedback, challenge is mentioned as an enhancer for connectedness. The stimulus of the technology needs to challenge the users but should not be impossible to perform. When that balance is found, the user stays motivated (Cziksentmihalyi, 1991; O'Brien & Toms, 2008). Sherry (2004) describes the importance of enjoyment and flow in media interactions. It was found that also positive affect and feelings of belonging arise when the user has a positive flow experience. As has been mentioned, it is important that the user feels engaged to a system, in order to fulfill the goals of it (O'Brien & Toms, 2008). To sum up, important characteristics for engagement are active involvement, social interactivity, feedback, challenge and enjoyment.

1.3 Engagement in Human Robot Interaction

To resume to the user experience analysis of robotics, it is useful to explore the engagement concept specifically for human robot interaction research. Some human robot interaction studies tested and discussed the engagement effect of different care robots for PwD (Perugia, Díaz Doladeras, Mallofré, Rauterberg, & Barakova, 2017; Perugia et al., 2018). Engagement is measured most often by using self-report assessments (O'Brien et al., 2018; Poels, de Kort, & IJsselsteijn, 2019). For PwD it is not possible to use this method of self-evaluation due to their cognitive decline. Instead of self-report, observational techniques are used as measurement in studies. In one of the studies the conventional observational rating was combined with analyzing electrodermal activity for measuring engagement of PwD. The participants were studied in pairs when doing a playful activity with a social robot (Perugia, Rodriguez-Martin, et al., 2017). Engagement with the care robots was concluded to be

correlated to resistance to distraction and an energetic and positive mood (Perugia et al., 2018). This is likewise discussed in a use study of a SAR for PwD by Tapus, Tapus, & Mataric (2009). They found that PwD show a better task performance when they feel engaged and have more interest in the interaction with the SAR (compared to lower levels of engagement). In healthcare robotics engagement can be indicated among others by the social abilities of a robot (Chu, Khosla, Mohammad, & Khaksar, 2017). Social abilities of a robot (or system) can contribute to the experience of the social intelligence and social awareness. When the user has the feeling that they are part of the interaction, it is more likely that the attention can be sustained (O'Brien & Toms, 2008).

All these human robot interaction studies found remarkable outcomes in positive mood and task performance as a results of engagement. However, this review of engagement research also shows the importance of the context and tasks. Therefore, it is important to consider the situation to understand the possibilities to optimize the interactivity.

1.4 Engagement in eWare context

The primary function of eWare is goal attainment of ADLs, in which the SAR provides reminders for tasks related to a goal. The SAR is then used as a motivator to attain the desired behavior. In previous research within eWare the importance of direct interaction between PwD and the SAR was marked (de Jong, 2017; Kroos, 2019). Pre-alpha eWare studies likewise found that a lack of enjoyable social interaction between users and eWare seemed to result in a lack of interest and motivation to attain the preset goals (H. H. Nap, personal communication, December 9, 2019).

As the engagement literature shows, we can attain these goals by engaging people with the technology (O'Brien & Toms, 2008). To create engagement with the eWare system or its functionalities, the users feeling of connectedness to the SAR is needed. Engagement is a long-term experience of attention and involvement in which enjoyment of interactions over time play an important role. To enhance this overall emotional feeling towards the SAR, the different stages of single interactions and stimuli need to create a pleasant feeling for the user. The quality of interactions is important for engagement (Quesenbery, 2003) and thus we need to create proper human robot interactions by analyzing the different stimuli during an interaction. By improving the quality of the stimuli in the eWare system, i.e. the messages said by the SAR, the feeling of connectedness can be enhanced. In that way users are expected to feel intrinsically motivated to perform the tasks that are suggested by the system (Gajadhar, 2012).

In order to gain knowledge about the quality of interactions within the situation of the eWare system, experts were asked about their experiences. By using semi-structured interviews, a small user experience study was performed (see Appendix A). The eWare system has a main focus on goal attainment; the extent of improvements in ADL performance. For each client, targets associated with ADLs are set, e.g. having regular breakfast. The SAR will help the client in achieving this goal, by sending task-oriented messages. The experts marked the importance of the engagement and connectedness and gave some recommendations. They described that solely focusing on these task-oriented messages work contrary and the goals will not be achieved. Users who feel more connected to the SAR, have experienced a more effective communication in which feedback and interactivity both play an important role. These interviews revealed the importance of not only focusing on the tasks (functional support) but also provide social support (as companion or entertainment).

When we explore the possible improvements of the interaction of the SAR we are limited to the software intelligence. For that reason, this study will focus on the content of the messages said by the SAR.

1.5 Research aims

When considering the favorable and beneficial factors in the interaction with the SAR, the experiences of the system can be optimized. As literature review above showed, this is related to quality of the interaction and its stimuli. In both the engagement literature and the interviews, personalization and situation generated messages were assumed to influence the users feeling of connectedness to the system. The aim of the current study is to further investigate these assumption in an experimental setting. To simplify the reporting of the variables, labels were made. 'Personal' indicates personalization of messages, 'fun' will be used for situation generated content and 'Entertainment values of messages' is the umbrella term. This leads to the main research question:

RQ. 'What is the effect of adding entertainment value to the messages provided by a SAR on the feeling of connectedness with this SAR?[1] *'.*

The addition of an entertainment value is expected to result in a higher feeling of connectedness as proposed in the interviews, see Appendix A. When adding an entertainment

[1] The research domain of this thesis is the complete eWare system, but for the experiment we will disregard the Sensara lifestyle monitoring and only focus on the SAR 'Tessa'.

value to the messages, we assume to have a higher quality interactivity which is an indicator of engagement and thus increase the feeling of closeness to the system (Quesenbery, 2003). This leads to the hypotheses:

H1a. Adding an entertainment value to the messages provided by a SAR will induce a higher connectedness compared to not adding this entertainment value.

Two kinds of entertainment value, personalization and situation generated message, will be examined. When adding more entertainment value, in this case combined both, we expect that it induces more connectedness then only adding one entertainment value.

H1b. Adding a combined entertainment value to a message provided by a SAR leads to a higher connectedness compared to adding only personal or situation generated content.

Based on the experts experiences the assumption was made that the entertainment values used, personality and situation generated message, were related to enjoyment.

H2. Adding an entertainment value to the messages will lead to higher level of enjoyment of the messages compared to not adding this entertainment value.

2. Method

2.1 Participants and design

For this study I aimed to collect data of 40 participants, but due to the COVID-19 pandemic, entrance to the laboratories was forbidden from March up to July in 2020 (Eindhoven University of Technology, 2020). The experiments of this study were interrupted and no more data could be collected. Nonetheless 12 males and 2 females (M_{age} = 23.1, SD_{age} = 1.2, Range: 22-27), participated in a lab study in Dutch with a 1x4 (messages; control vs. personal vs. fun vs. combined personal & fun) within subjects design. The value of entertainment of the message is the independent variable, i.e. the condition. In the control condition the SAR only spoke task-oriented messages, e.g. *"Do you want a glass of water?"*. In the other three condition there was an entertainment value added to the messages. For the personalized condition this was purely adding the name of the participant to the message, e.g. *"Sarah. Do you want a glass of water?"*. In the fun condition the added entertainment value was a situation generated fun fact related to the task, e.g. *"Do you want a glass of water? I would recommend it, because drinking water can increase your concentration"*. For the combined condition, both the name and a fun fact were added to the task message, e.g. *"Sarah. Do you*

want a glass of water? I would recommend it, because drinking water can increase your concentration". The participants experienced all conditions in a counterbalanced order.

2.2 Materials

SAR Tessa

In this study the SAR that is part of eWare was used, named Tessa. Tinybot Tessa is a small stationary SAR displayed in Fig. 1a (Tinybots, n.d.). The eyes are visualized with LED lights and show basic eye movements like blinking. It uses a microphone to speak preprogrammed messages with the Dutch voice 'Jasmijn' created by the open source Acapela Group (2020).

Fig. 1a. *Tinybot Tessa*

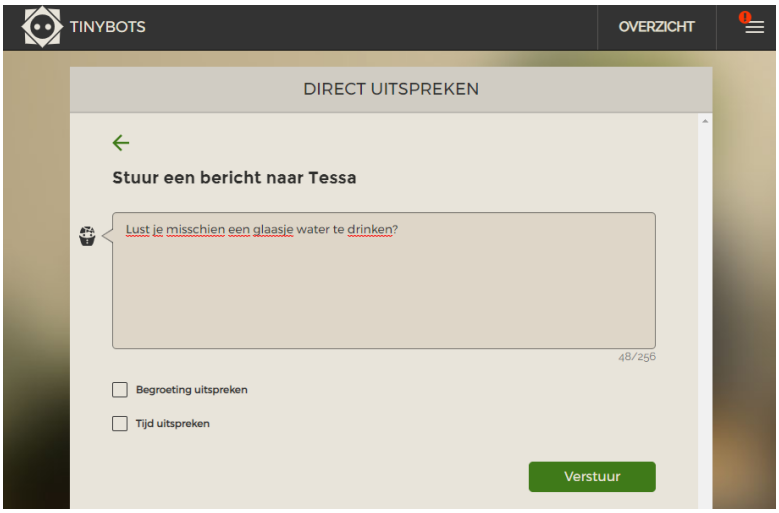

Fig. 1b. *Tinybots web application: Direct Messages tab*

It makes use of a loudspeaker to provide sound and messages and is located in the front and hidden under the clothes. Before a message was provided by Tessa, a particular tune is played as a prompt to gain attention. The Tessa robot that was used in this study was property of the expertise centre Vilans. The SAR operated via a Linux system and was connected via an ethernet cable to the computer and network. Besides, a power supply and volume knob are also situated at the back of the SAR. For this experiment the volume was set at a medium level in which Tessa was easily heard by the participants, but did not bother other lab experiment. A special Tinybots account was created for this experiment and coupled to the serial number of the Tessa. The experimenter used a web application of Tinybots to send the messages directly to Tessa (see Fig. 1b). The messages were predefined (see Table 1 for an overview) and - during the experiment - copied in the web application and send to Tessa by the experimenter. When sending the message, the Tinybots system transforms the written messages to a spoken message that was played by the speaker that is build-in in the SAR.

Messages

In each condition 3 messages were presented (1. Take a drink or snack, 2. Motivating messages, 3. Time indication). To prevent repetition of messages, four different versions were made of each subject. In table 1b the original used Dutch messages are presented per version. Both the condition and the version were counter balanced for the aimed amount of 40 participants and then randomized in order. The used distribution for the 14 participants is presented in appendix B. In between these messages at least 1 minute of silence was needed to concentrate and prevent Tessa from giving to much distraction. Based on the experiences that were collected during trial runs of the experiment, the decision was made to take 7 minutes per task. Dependent on the version of the messages, the messages were played on specific times during 7 minutes (see appendix B).

Table 1a. *Composition of messages*

Condition	**Message**
Control	Basic
Personal	'Name participant' + Basic
Fun	Basic + Fun
Combined	'Name participant' + Basic + Fun

Table 1b. *Content of messages*

	Basis	**Fun**
1	*Lust je misschien een glaasje water te drinken? *Je bent goed bezig! *Je hebt nog twee minuten de tijd, om deze puzzel zo ver mogelijk af te maken.	*Ik denk dat het je goed zou doen, want water drinken verhoogt je concentratie. *Wist je trouwens dat deze soort puzzels, Zweedse puzzels heten. *Gemiddeld hebben mensen vijftien minuten nodig voor het maken van de puzzel.
2	*Als je wil? Mag je een snoepje pakken op de tafel. *Ga zo door. *De laatste minuut van je tijd is ingegaan	*Die snoepjes bevatten flink wat suiker, maar zijn wel erg lekker. *Wist je dat het goed is voor je hersenen om vaak te puzzelen? *Je loopt voor op de gemiddelde tijd.
3	*Je mag best een slokje water pakken. *Ik ben trots op jou. *Je hebt nog twee minuten voor de puzzel.	*Wist je dat je op 1 dag in totaal twee liter water moet drinken. *Uit onderzoek blijk dat de cijfercode in deze puzzel zorgt voor extra motivatie. *Dat is genoeg tijd voor nog drie woorden
4	*Als je wil, mag je een koekje pakken uit de trommel op de kleine tafel. *Je doet het goed. *Over 1 minuut is het tijd voor de vragenlijst.	*Wist je dat de kruiden die ze gebruiken in deze koekjes heel anders zijn dan die in speculaas koekjes. Toch noemen we ze vaak hetzelfde. *Het is trouwens bewezen dat puzzelen een ontspannende functie kan hebben. *Je doet het beter dan de gemiddelde speler.

Puzzle task

Tessa is used as a motivator and its speaker mainly plays task-oriented messages. To create a context related to the situation in which Tessa is normally used, we needed to simulate a task that was reasonable to perform by the participants in which Tessa could guide them. This situation was created by giving the participant several puzzle tasks. As performance task we took Swedish crossword puzzles, by keeping in mind that people needed to focus for a total of 4x7 minutes. Four Dutch puzzles were selected from a booklet 'Swedish puzzles: level medium' of Denksport, a Dutch brand specialized in producing memory puzzles (Denksport, n.d.). In appendix C the selected puzzles are presented. They were renamed to 'Yellow', 'Brown', 'Orange' and 'Black' to have natural names (instead of numbers or alphabetic letters) to refer to during the experiment. The participant performed four puzzle tasks in which the SAR motivated them. The same four puzzles were presented to all the participants, but in a randomized order. The performance of the puzzles was measured to check whether they were similar in difficulty. The number of correct completed puzzle words were counted and labeled as performance score. The puzzles consisted out of 50 puzzle words in total and thus the maximum score was 50.

2.3 Measures

To measures people's general feeling and experience of the conditions a self-report questionnaire was used that was completed by the participant after each condition. The Dutch questionnaire is represented in Appendix D and is a selection of questions from below presented scale items, translated by the researcher.

The measurement of connectedness was done by transforming the 7 image items of the Inclusion of Other in the Self (IOS) Scale to 'I' ('Ik' in Dutch) and 'Robot' (Aron, Aron, & Smollan, 1992). Participants indicated which picture (out of 7) best described their relation to the SAR. To measure the social perception of the SAR itself we measured the Warmth (6 items, Cronbach's $\alpha = 0.86$) sub-scale of the Robotic Social Attributes Scale (RoSAS) by using a 7 point scale (1= Definitely not associated; 7= Definitely associated) (Carpinella, Wyman, Perez, & Stroessner, 2017). Several scales from the Almere model (Heerink, Kröse, Evers, & Wielinga, 2010) and the Game Experience Questionnaire (Poels et al., 2019) were analyzed and translated. Specifically, Perceived Enjoyment and Sociability (PES; 4 items, $\alpha = 0.81$), Positive Affect (PA; 4 items, $\alpha = 0.78$), Negative Affect (NA; 4 items, $\alpha = 0.64$) were measured on a 7-point agreeable scale (from 1= 'Completely not agree' to 7= 'Completely agree'). The Cronbach's alpha found for NA was questionable and hence the scale was

analyzed with specific caution. As negative affect is phrased in negative direction, the scores are reversed for further analysis (indicated with Negative Affect (R)). Some additional items were added with the joint theme ‘Competence and Challenge’ (5 unconfined items). These were measured in the same sub question with PES, PA and NA in which the items were presented in randomized order. The perceived enjoyment of the messages was measured to control if the entertainment messages were experienced as more enjoyable then the basic message (control). For testing H2 the first item of the PES scale is used: ‘I liked the messages said by the SAR’.

Next to the self-report scale items, open questions about participants’ experiences were included (see Appendix D). The participants were asked which of the experienced messages they preferred, if they experienced a difference between the four situations and what features of Tessa they liked.

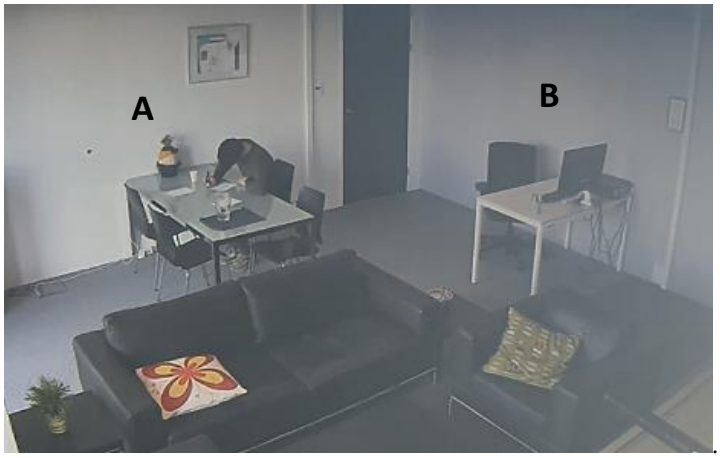

Fig. 2. *Experimnetal set-up in Usabilty Lab*
Situation A: Performing puzzle task close to Tessa
Situation B: Computer for questionaires (Demo, 4x Self-Report and Open)

2.4 Procedure

The experiment took place at Eindhoven University of Technology in the Usability lab that is part of the Human Technology laboratories situated in the Atlas building. One person at a time could participate. When the participants entered, initially the information form was read and by approval they signed the informed consent from (Appendix F). Next, they were welcomed in the ‘living room’ as presented in Fig. 2. They were instructed about the materials and introduced to Tessa. The experimenter guided them to sit on a chair close to Tessa, who was placed on a table. The distance between the participant and Tessa was about 70 cm in which they could see and hear Tessa adequately (situation A in Fig. 2). The

procedure was shortly explained by the experimenter in which she remarked the importance of the independent rating of the four situations, after which she left the room. The experimenter then typed the first message in the application and by sending the message, Tessa's speaker played the prompt tune (as always) and the introduction message, in which she introduced herself and gave a summary about the procedure of the experiment. This introduction was followed by the instruction to fill in the demographics part of the questionnaire. The questionnaire was filled in on a computer which was placed on another table in the room (situation B in Fig. 2). When participants finished this first part of the questionnaire (indicated with 'Demo' in Fig. 3) they went back to the seat and Tessa told them to start with a specific puzzle (situation A in Fig. 2). They had seven minutes to complete each puzzle task. During each puzzle task Tessa played three prepared messages. After each puzzle task Tessa friendly instructed the participant to fill in the experience questionnaire (indicated with 'Q' in Fig. 3) on the computer (situation B in Fig. 2). Subsequently the seat close to Tessa was taken again and the participant was asked to start with the second puzzle task. This order was followed for all four puzzle tasks. Eventually after the fourth experience questionnaire the open questions were asked in the online survey. At the end of the experiment, the participant was thanked via Tinybot Tessa for participation. After that, the experimenter entered the experimental room to give a debriefing and answered potential questions. The study took 45 minutes in total to complete and all participants received a compensation of € 7,50.

Fig. 3. *Graphic of experiment procedure*
Demographics questions - 4 puzzle tasks followed by the self report questionairre (Q) - Open questions

2.5 Data analysis

Two participants reported that they did not experience any difference between the four conditions. Browsing through their data, no specific outliers were found compared to other participants. For this reason and the fact that the sample is small, we kept their data for the analysis.

3. Results

In this section the scores on the self-report measures of the 14 participants, who indicated that they had never seen Tessa before, are presented and analyzed. The mean and standard deviation for all scales are presented in Table 2. These average scores visualized in Fig. 4 show that the scores of 'Inclusion' and 'Perceived Enjoyment and Sociability' score in general lower than the other 3 scales. For almost all factors the lowest score can be detected for the control condition and thus the entertainment messages score higher. In contrast, the Negative Affect (R) graph shows a different trend than expected. When combining the negative affect scores with the positive affect scores, it shows that the emotional state of the participants does not change much over the different conditions.

Table 2. *Mean values and standard deviation of the scales per condition*

Scales	Control *M (SD)*	Personalized *M (SD)*	Fun *M (SD)*	Combined *M (SD)*
Inclusion	1.92 (0.92)	2.00 (1.03)	2.79 (1.37)	2.57 (1.28)
Warmth	3.24 (0.72)	3.50 (1.01)	4.07 (0.98)	4.11 (0.88)
Perceived Sociability and Enjoyment	1.80 (0.65)	1.91 (1.05)	2.30 (1.08)	2.25 (1.13)
Positive Affect	4.88 (0.91)	4.91 (0.67)	5.04 (1.00)	5.23 (0.85)
Negative Affect (R)	5.50 (0.90)	5.36 (0.85)	5.36 (1.03)	5.29 (0.93)

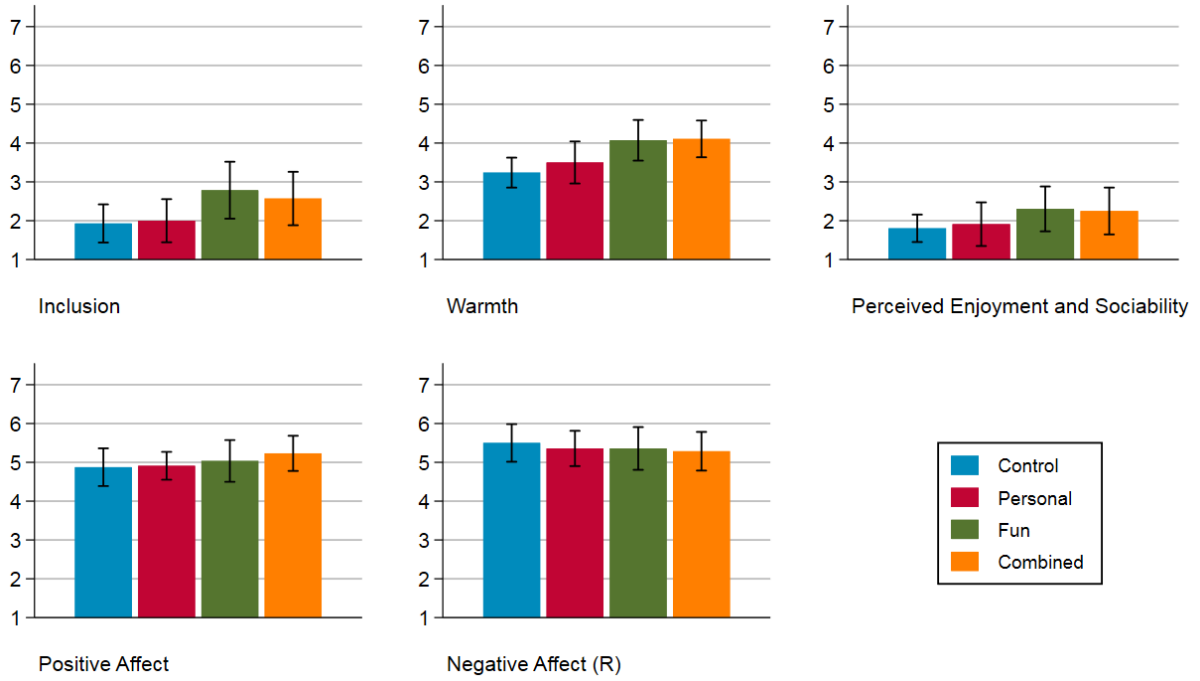

Fig. 4. *Mean score of scales and 95% confidence interval error bars for the different conditions*

3.1 Effect of entertainment messages on connectedness

Inclusion

Shapiro-Wilk tests for inclusion were performed and showed that the dependent variable was normally distributed in all conditions. Mauchly's Test[2] of Sphericity indicated that the assumption of sphericity had not been violated $\chi 2(5) = 8.611, p = 0.127$. To test the hypothesized effect of connectedness (H1a), a one-way analysis of variance (ANOVA) was performed, by indicating the condition groups as repeated measures. A statistical difference was found between the condition means; F (3, 39) = 3.0 with $p = 0.04$ and an effect size of $\eta^2_p = 0.188$. Pairwise comparison were performed to investigate the means in more detail. Because there are 6 post-hoc tests, a Bonferroni correction was applied and the α-level was set from 0.05 to 0.0083. The mean comparisons with Bonferroni did not yield a significant difference between condition means. The smallest p value was found for the difference between fun and control ($p = 0.012$).

The condition means and hypothesized effect directions were also examined by doing contrast analysis (control weights: -1, 1/3, 1/3, 1/3). As the contrast analysis test performs a focused test, no correction was required (α-level: 0.05). The theoretical prediction of a higher inclusion score when adding an entertainment value compared to not adding an entertainment value was supported F (1, 13) = 4.81, with $p = 0.047$ and $\eta^2_p = 0.270$. Hypothesis 1a was supported based on the ANOVA and the contrast analysis tests, but in the pairwise comparisons with correction no significant difference in means was found. These results bring forth that adding an entertainment value to the messages provided by a SAR has the possibility to induce a higher feeling of connectedness to the robot (H1a), but our data does not support it.

This study hypothesized (H1b) that adding two entertainment values to a message (combined) leads to a higher connectedness compared to adding one (personal or fun). Inspection of the inclusion graph in Fig. 4 suggests that adding both entertainment values to a message does not have a higher effect on connectedness than only adding one of them. In contrast it shows that the highest effect is found in the fun condition and not in the combined one. A contrast analysis was performed to test the prediction made in hypothesis 1b. The theory (contrast weights: 0, -1/2, -1/2, 1) was not supported F (1, 13) with $p = 0.5$ and $\eta^2_p = 0.034$. Moreover, the test results of H1a showed that adding a personal entertainment content

[2] Mauchly's test sometimes fails to detect departures of sphericity in small samples. Performing a Greenhouse-Geisser corrected test for inclusion yielded $p = 0.064$.

to a message provided by a SAR has no effect, but adding a fun fact do has influence on the score of inclusion. There is no larger effect of adding the combined entertainment value on inclusion compared to adding only personal or fun.

3.2 Perceived enjoyment of the entertainment messages

Secondly, this study hypothesized that the entertainment conditions will lead to a higher level of enjoyment than the control condition (H2). To test this, the scores of the first item of the PES scale ('I liked the messages said by the robot') was analyzed. In table 3 the mean and standard deviations are presented over the conditions. Shapiro-Wilk test as well as Mauchly's test[3] cannot be rejected and thus assumptions of normality and sphericity were met for this specific item. The effect of entertainment value on 'liking' the messages was tested with an repeated ANOVA; F (3, 39) = 0.4 with p = 0.7 and η^2_p = 0.04.

Next the differences in the conditions were examined with a contrast analysis. The main hypothesis predicted that the entertainment conditions score higher compared to the control condition on the inclusion scale (contrast weight; -1 1/3 1/3 1/3). No support was found in the contrast test; F (1, 13) = 0.95 with p = 0.3 and η^2_p = 0.07. These results show that messages with entertainment value are not liked more than the basic message.

Table 3. *Mean values and standard deviation of the scales per condition*

	Control *M (SD)*	Personal *M (SD)*	Fun *M (SD)*	Combined *M (SD)*
AM1	3.93 (0.92)	4.21 (1.25)	4.29 (1.20)	4.50 (1.16)

3.3 Explorative analysis

Warmth

This study focused on increasing the feeling of connectedness of the user during the interaction with the SAR. As indicator for connectedness, and tested with hypothesis 1, the inclusion scale is an adequate measurement. Based on the literature, also other factors can have an impact on the feeling of connectedness. The warmth scale was measured to gain information about the participant's perception of the social attributes of the SAR. For testing hypothesis 1, the warmth scale is less sensitive than inclusion, but reasonable to predict the feeling of connectedness. When exploring the wamth graph in Fig. 4, it suggests a positive effect of entertainment messages on warmth score.

[3] Mauchly's test sometimes fails to detect departures of sphericity in small samples. Performing a Greenhouse-Geisser corrected test for AM1 yielded p = 0.65.

Normality was tested for warmth in all condition and the assumption was met. The Mauchly test for Sphericity was violated $\chi 2(5) = 13.046, p = 0.023$. Therefore, a repeated measures ANOVA was performed with a Greenhouse-Geisser correction and determined that mean warmth differed statistically significant between the conditions; F (1.815, 23.591) = 5.11 with $p = 0.016$ and $\eta^2_p = 0.282$. Pairwise comparisons were performed with a Bonferroni correction (α-level: 0.083) to investigate the mean differences in more detail. An effect was found between the mean warmth score of control and fun ($p = 0.006$) and between control and combined ($p = 0.008$). These results show that adding a fun entertainment value and a combined entertainment value have an effect on the warmth perception of the SAR.

Table 4. *Average scores of the scales over time and output results of contrast analysis tests*

Scales	Situation 1 *M (SD)*	Situation 2 *M (SD)*	Situation 3 *M (SD)*	Situation 4 *M (SD)*	Contrast analysis *F(1,13)*	*p* value
Inclusion	1.93 (0.83)	1.93 (1.03)	2.57 (1.22)	2.86 (1.41)	8.3	0.01
Warmth	3.54 (0.92)	3.49 (0.96)	3.90 (0.92)	3.99 (1.03)	3.8	0.07
Enjoyment and Sociability	1.96 (0.96)	1.80 (0.90)	2.09 (1.00)	2.41 (1.11)	1.8	0.20
Positive Affect	5.00 (0.67)	4.93 (0.76)	4.98 (0.90)	5.14 (1.09)	0.3	0.62
Negative Affect (R)	4.64 (0.83)	4.25 (0.95)	4.29 (0.99)	4.32 (0.90)	0.6	0.45

Learning effect

When becoming more familiar with a technology, the perception and preferences of the characteristics change (Koay, Syrdal, Walters, & Dautenhahn, 2007). The experience of a SAR can differ over time due to the habituation of the robot and its interaction with the user. To examine this habituation effect in our study, we compared the scores over time. The participants were presented with 4 different situations over time. In table 4 it becomes clear that in the most cases the scores increased over time, which is also visualized in Fig. E1 in appendix E. A comparison between the means of all scores was performed and yielded no significant difference between condition means. As the learning effect suggests a positive effect over time, the effect direction was tested using a focused contrast analysis. The tests were performed separately for each scale, but with the same contrast weights (-3, -1, 1, 3). The learning effect theory, i.e. the increase in scores over time, did only yield for the Inclusion score ($\eta^2_p = 0.39$). The F scores and p values for the test are presented in table 4.

Moreover, the means scores of the scales in table 4 suggests a difference in the first half (situation 1 and 2) versus the second half of the experiment (situation 3 and 4). This assumption was tested for all scales with contrast analysis (contrast weights -1, -1, 1, 1). The

tests did only yield support for the prediction in the effect of inclusion (F (1, 13) = 6.5 with p = 0.02 and η^2_p = 0.33)

Performance

The measurement of the puzzle performance shows large individual differences, which probably is due to experience of making puzzles and IQ which are both not measured in the study. Table 2 shows the performance of the puzzles over condition and over type of puzzles. There is almost no effect of condition, but we see a difference in performance for the kind of puzzle (indicated by a color). Although the puzzles were chosen on their corresponding level, the scores in the table suggests that the yellow puzzle is the easiest one. When exploring the data of the questionnaire scales, no effects of type of puzzle were found. In Fig. E2 in appendix E visualized the average scores of the scales for the different types of puzzles. In the competence and challenge part of the questionnaire, the separate item 'I experienced the puzzle as difficult' was measured. This revealed that indeed the yellow puzzle was experienced as easiest and black as the most difficult (see Table 6). The puzzle task were used to challenge the participants, as challenge is a factor that can enhance the feeling of connectedness (O'Brien & Toms, 2008). In table 6 the scores of the item 'I felt challenged' are presented. Unless the fact that for some participants the task was almost impossible to perform as for others it was 'quite' easy, people in general felt challenged. The individual differences in performance, probably due to experiences in making puzzles, vanished the possibility to investigate the influence of the challenge factor compared over the type puzzles.

Table 5a. *Average performance score per condition*

Condition	Performance *M(SD)*
Control	17.07 (11.58)
Personal	16.07 (11.11)
Fun	17.29 (10.03)
Combined	15.36 (9.27)

Table 5b*. Average performance score per type of puzzle*

Puzzle	Performance *M(SD)*
Yellow	20.93 (11.60)
Orange	17.29 (9.04)
Brown	16.07 (8.92)
Black	15.36 (10.94)

Table 6. *Average evaluation score of experienced difficulty and experienced challenge per type of puzzle*

Condition	Difficulty *M(SD)*	Challenge *M(SD)*
Yellow	4.29 (1.44)	5.43 (0.76)
Orange	4.64 (1.65)	5.50 (0.76)
Brown	5.36 (1.34)	5.21 (1.25)
Black	5.50 (1.34)	5.86 (0.53)

4. Discussion

The ageing of the population of Europe yields long-term projections; expected shortage of care workers and need for seniors to live at home longer. Especially for people with chronic diseases such as dementia, extra help in ADLs is needed. This is often done by informal caregivers and based on the projections their workload will increase. Assistive technologies and eHealth are promising technologies that can support in care settings, but there is a strong need for further developments before implementing these. Previous studies within eWare showed that the users experience a lack of interactivity and had almost no emotional relation with SAR.

In the current thesis I examined the possibilities to increase the users feeling of connectedness with a SAR. Based on explorative interviews with users and experts, the scope was narrowed to the effect of adding entertainment value content to the messages provided by the SAR on the feeling of connectedness. To research this question, a repeated measurement study was performed by inviting participants to a lab representing a home environment.

4.1 Connectedness

Adding an entertainment value to the messages provided by the SAR was expected to positively influence the connectedness. A positive trend could indeed be found for inclusion when adding the ‘fun’ entertainment value to a message. The effect was supported by the main tests (ANOVA and contrast), but corrected post hoc analysis revealed no significant differences in means. Therewith the effect found was put into question and withhold the conclusion that the main hypothesis was supported by the data. The results of the inclusion scale did not support the sub hypothesis (H1b). The effect of adding entertainment value was not cumulative, as inclusion did not score higher in combined condition compared to the personal and fun condition.

Furthermore, the connectedness with the SAR was in general rated quite low. This indicates that the participants almost felt no emotional relationship with the SAR. I argue that one of the reasons for this was the relative short interaction time. But as the current study was interested in the influence of single interactions and stimuli, the used scenario was more suited. Moreover, the inclusion measurement was done based on only one question per condition and thus determinative and restricted. To create a better interpretation of the participants feeling of connectedness, more items could have been assessed. Besides, the low score can possibly be explained by the appearance of the SAR as Tessa is especially designed for seniors (with dementia).

4.2 Enjoyment

Interestingly the added entertainment values did not have an influence on liking the messages and thus also no support was found for H2. In general, the perceived enjoyment and sociability scores are quite low and thus suggest that the interaction was not experienced as enjoyable. Contrary results are found when analyzing the answers on the open questions (see Appendix E). The participants described the SAR and the interaction with it as pleasant. The same yielded for the messages and the situations in general. As the literature showed (Cziksentmihalyi, 1991; Perski et al., 2017), enjoyment is crucial for creating engagement and connectedness. The current study indeed showed that the entertainment message, which were assumed to be more enjoyable, influenced the perception of the SAR and the emotional relation to it. The results revealed that the entertainment messages itself are not liked more, but that they do contribute to the enjoyable experience of and with the SAR.

4.3 Entertainment values

The label entertainment value was used to scope both personalization and situation generated content messages. Experts who had experiences with the SAR Tessa remarked the importance of adjusting the messages to personal preferences and address the users in a personal way (appendix A; Yaros, 2013). As the messages were made prior to the experiment and then only data about the name of the participants was known, the personalization of the messages was restricted to adding the name in the message. For adding the personal entertainment value, only small differences were detected. And thus it seems that adding only a name to the basic message does not affect the evaluations of the SAR. The other entertainment value tested was adding situation generated content. In the experiment a fun element about the situation was used as recommended by previous eWare studies (Kroos, 2019). When feedback is related to the current situation, the user experience an interactivity as more pleasant and understand the system more (Renaud & Cooper, 2000). In this line it was found that wrong feedback can bring about irritation and unpleasant experience; the experts explained that the messages sometimes were provided when the user was not in the room or already performing the task (see appendix A). Encouraging and positive feedback was given in each third added fun message. In game research it was found that such positive related feedback increased the enjoyment and performance (Nap, 2008), which is in line with our findings. The results indeed show that adding this situation generated content with a fun element to a basic message leads to higher evaluations scores on the inclusion, warmth and perceived enjoyability and sociability score.

4.4 General

Expert Interviews

This study performed a small qualitative study to gain knowledge about the context of eWare (eWare, n.d.) and the experiences of the SAR users. Although it was not the main research of this study, it did yield some proper recommendations. The results contribute to creating the right method for the lab experiment and revealed other possible improvement for eWare in general. The suggestions of the user experience analysis are shown to influence the feeling of connectedness. In more detail the aspect of adding personal and enjoyable content to the messages provided by the SAR are shown to affect the measured scores.

Explorative analysis

The empirical results show some interesting trends and effects for non-hypothesized effects of adding entertainment. For the perceived warmth of the SAR a positive trend is seen in the mean scores. When adding the fun or the combined entertainment value an effect was found on warmth. Even though the measurement of warmth was not hypothesized as the direct measurement for connectedness, the experience of social attributes contribute to a positive human robot interaction and the attention for the technology is more likely sustained (Gajadhar, 2012; O'Brien & Toms, 2008).

Another remarkable finding is the difference in mean scores over time, which suggests a small positive trend. A possible explanation is that when the user gets more familiar with the situation or the SAR in specific, it evaluates the situation and the SAR as more positive and pleasant. Such an effect was similarly found in acceptance research. After a longer period of use of a technology, the acceptance was in several cases increased (Venkatesh & Davis, 2000). This positive direction effect was found for the inclusion scale. If this learning effect was indeed present, it had no impact on the scores over the condition as we controlled for this by counter balancing[4] them over the participants.

The inclusion data showed that adding the fun entertainment value leads to the highest feeling of connectedness. When users feel connected to and have interest in the interaction with the SAR, they show a better task performance (Tapus et al., 2009). Besides motivational feedback, which was used in some of the fun elements was expected to increase the performance. This was congruently found in our data, as the fun condition yielded the highest task performance. Unless the difference in score, the effect was not significant.

[4] The conditions were counter balanced over the total of 40 participants and then randomized.

4.5 Limitations

General

First of all the small sample size was one of the limitations for this research. In figure 4 the average scores were visualized and showed quite small error bars. As we increase the sample size, the errors will probably become even smaller. As clear trends were found in the inclusion and warmth scale, I assume that this effect is present, yet our data could not support it due to the few participants.

The questionnaire used in the research was conducted specifically for this research. Different existing scales were transformed and added together in which a correct measurement was made for this research. Even though the scales formed correlated factors with a decent alpha level, the results could not be easily compared with other studies.

In this research a lab study was performed in which it is easier to control for environmental factors and focus on the question of interest. Moreover, by performing the lab experiment the proposed improvement could be easily tested and assumed to yield a large collected data set. Contrary participants did not experience the real context as no daily life was simulated with caring tasks, but just a short period out of a day. In more detail, the goal attainment in eWare is usually focused on tasks like eating breakfast regularly or go outside. Which is a major difference with the used goals and task in our experiment. Another cost of the lab experiment is that a different user group is analyzed. The stakeholder that are involved in the eWare system are the care givers and the PwD. To test the results found in this research, a follow up study should be performed with more focus on the end-users. When doing such research, it should be kept in mind that for PwD and seniors there are more in group differences than for students. This indicates that there is more potential to find larger error bars when performing such follow up research. For future research it is important to considerate combining knowledge of different research and validate findings by retesting.

Puzzle task

To simulate the eWare situation, the messages should had a contributing value and motivate the participants to perform a task. Besides, the added personal and situation generated content needed to be similar for the participants and should be made prior to the experiment. Based on these restrictions, a Swedish crossword puzzle was chosen as task to perform. I argue that it was likely a correct task for the research conducted, nevertheless it had some pitfalls. First of all I aimed to present four puzzles with the same level (the puzzles had equal score of difficulty, equal amount of puzzles words and a similar score during the pilot studies). Unless,

the ‘yellow’ puzzle was experienced as easier compared to the other puzzles. Secondly the puzzles task showed extreme individual differences in performance, probably due to experiences in making puzzles.

4.6 Future work

General

A proposal for future studies is to perform a long-term study to measure the effects and trends found in a more realistic context. By doing an in-situational research with PwD, the end-user group of eWare, based on observation and qualitative data valuable insights can be gained. Situation generated content does have an influence on the connectedness to the SAR based on inclusion and warmth and this effect can be explored in different settings. For the effect of personalization of messages provided by a SAR future research should not only focus on adding the name, but taking more preferences into account.

eWare

The current research was performed in the scope of the eWare project (eWare, n.d.). The possible improvements that this study investigated were based on previous findings within the project experiences of users of the pilot version. A quantitative analysis was performed and some of the recommendations could be validated. For increasing the feeling of connectedness to Tessa it is crucial to make messages related to the situations. Anticipate on the actions of the users which can be done by for example analyzing the sensor data. Another important factor is that the focus should not only be on the task oriented messages (the basic messages is this research). To enhance the relationship to the SAR it is important that it also provides entertainment messages. These entertainment message in general are the situation generated messages about specific actions, something in the room, the clothes the user is wearing or the weather outside. As Tessa cannot perceive images, has no video recording system or other sensors, the messages should be created by the caregiver on the basis of knowledge. Yet there are possibilities as Tessa has a microphone which can perceive sounds and can be used in a creative way to understand the situation.

Even more important is the preference of the user itself. What someone experiences as entertainment or enjoyable is different for each user. Adjust the messages to the activities that the user performs (like watching a TV show or reading the newspaper). Alternate these entertainment messages with the relevant task messages or combine them as presented in this research. Moreover, the results found in this research can be discussed with different experts,

to get even more insight in the user experience and to validate the results for a larger user group consisting first of students, but also with PwD. Next, pilot test in the eWare project can be used to test the trends that are found in this research.

4.7 Conclusion

In the current thesis I investigated the differences in perceived feeling of connectedness to a SAR affected by the entertainment value in messages provided by a SAR. A positive trend was found on the feeling of connectedness when adding a fun entertainment value. Besides, an effect was found for adding situation generated content on the perceived social warmth of the SAR. Which yield the main results of this thesis: adding situation generated content, with a fun element and positive feedback, to a basic message, leads to higher evaluations scores on inclusion, warmth and perceived enjoyability and sociability. The effect of personalization of the messages should be examined further as for only adding a name no effect was found. Moreover, the results of this study show that entertainment value of a message does not influence the affect (positive and negative).

This research brings forward new insights about the influence of the messages provided by a SAR. Above all, the results of the experiment validate the recommendation given by the user analysis. This research contributes to the evaluation of the eWare system and proposes developments to create an emotional bond between user and the SAR. The advice is to not only focus on task oriented messages. The addition of fun entertainment value to the messages provided by the SAR within the system will potentially increase the goal attainment in the use of eWare.

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Appendices

Appendix A - Interviews

Method:
For this explorative part of the research a two folded qualitative user experience analysis was performed. The aim was to gain insight in the use of eWare and especially the SAR, both as stand-alone as part of the project together with sensors (in eWare). The focus of this analysis was on the interaction experiences, especially correlated to connectedness feeling of the PwD with the system.

First informal semi structured interviews were done via telephone with four experts (3 care professionals and 1 informal care giver). Subsequently the results of the interviews were shared with innovation policy staff members of different care organizations via email. They were asked for feedback and additional recommendations. The participants were recruited via Vilans.

Examples of questions that were asked:

- Can you explain the situation of the client and what role Tessa plays.
- What are important indicators in human-human interaction, accordingly to engagement?
- What are features of the system or Tessa that the client like.
- What goes often wrong? And how can it be improved?
- What kind of interactions are important?
- What kind of interaction are experienced as pleasant?
- What kind of interactions can be added to the system?
- What is important (in interaction) to give the client the feeling of closeness to the robot?
- What factors can improve the engagement?
- What are your experiences with the acceptance of Tessa and what factors can increase this?
- What is missing in the current system?

Results Summary

Experiences

Tessa is experienced as a buddy and is cozy. Less scary and easier to accept compared to other home systems. Positive experiences: when system fits the users activities. Negative experiences: when messages are said wrongly or not react on the situation accordingly. What goes wrong: message play when people are in different room or when task is already performed, which leads to frustration.

Improvements

Possibility to adjust the tempo of messages. It is useful when the care giver experience feedback about the messages said by Tessa, now it is not controllable if messages are plaid and what client did.
Still need for more interaction, for example more response from Tessa.

Recommendations in use

Frequency of the messages: ideally 5 to 10 messages a day
Content of the messages: 1. Adjust messages according to preferences of the client (content, formulation, addressing). 2. Alternate task messages with fun messages about environment (newspaper, tvshow, weather, hobby) 3. Longer messages give client the time to understand and be aware of message. 4. Make the messages easy to understand.

User Analysis keywords during interviews

Dutch keywords classified in themes

Thema: Acceptatie
Gezellig en prettig, leuk contact, maatje
Frustratie wanneer niet verstaanbaar
Frustratie wanneer een melding komt, als niet in de ruimte / wanneer melding gemist
Vooral laten zien wat de client wel nog kan
Hoofdoel: ondersteunen bij herinneringen – Subdoel: leuke meldingen
Maar bied omgekeerd aan, laat eerst zien welke leuke dingen ze kan en daarna dat ze ook kan helpen herinneren aan eten/medicijnen.
Neem schaamte weg, niet creëren
Maak verschil per client, voor verschillende instellingen en opties

Thema: Meldingen
Inhoud
Niet alleen zorgmeldingen instellen, van groot belang om ook vrijetijd zaken erin te zetten (voorbeelden, 8u nieuws – ajax wedstrijd – tv show – krant pakken)
Langere zinnen toevoegen, hierdoor overbrug je de fase van onoplettendheid
Veranderen/ toevoegen aan de hand van ‘seizoen’ (winter/zomer)
Dag en tijdstip aangeven bij eerste beweging in huis - (ruimte waarin de Tessa zich bevindt)
Inhoud boodschap instellen naar behoefte client (vb: aanspreken met voornaam of achternaam)
Inspiratiekaartjes van Tinybots
Algemeen
Stem is fijn
Juiste melding op juist tijdstip: reageren op waar de persoon zich bevind.
Meer dan alleen ‘taken’
Regelmaat in meldingen
Meerdere meldingen op een dag (5-10)
Test uit, hoe de melding wordt uitgesproken door Tessa
Waarschuwing dat er iets aankomt (nu alleen geluidje, misschien moet dit duidelijker.. meer tijd)
Optie: herhalen van het bericht wanneer niet goed verstaan.
Extra melding, na boodschap: is het gelukt?

Thema: Verzorgers
Gebruiksvriendelijkheid van het systeem is oké
Ontvangen niet genoeg feedback over functioneren (muziek afgespeeld of niet). Moeten aanwezig zijn tijdens de uitvoering van de ingestelde melding om ervaring te checken (zelf te observeren)
Besturing via Chromebook werkt niet in alle gevallen
Benut de kennis van zowel de mantelzorger als zorg-professional samen

Thema: Verstaanbaarheid
Volume is goed (makkelijk aan te passen met instelling volume)
Duidelijke stem
Soms te snel (nu alleen aan te passen met extra enters en spaties, niet met instelling)
Waarschuwingstoon vooraf

Appendix B - Messages

Table B1. *Messages send after x minutes – indicated per versions*

Bericht / Versie	1	2	3
1 & 3	1 min	3 min	5 min
2 & 4	1 min en 20 sec	3 min en 40 sec	6 min

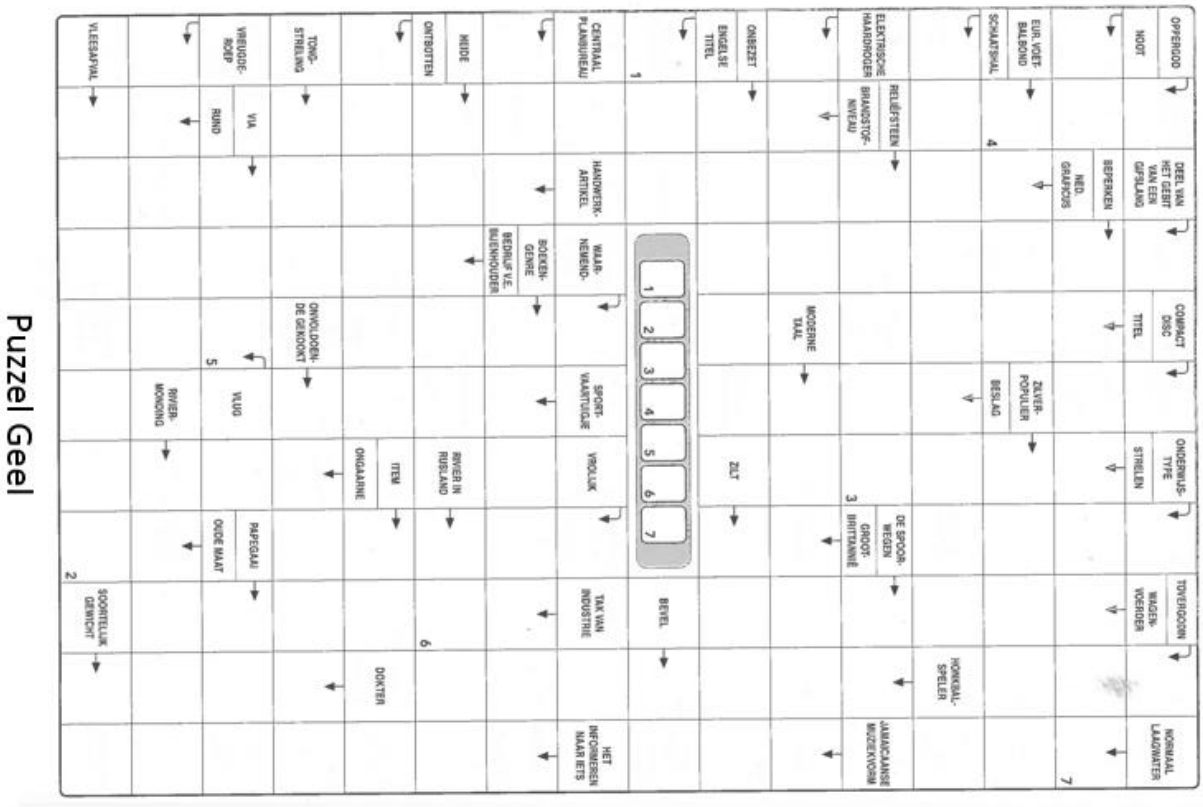
Table B2. *Distribution of Messages: Condition + Version per ID*

PP-ID	TASK1	TASK2	TASK3	TASK4
1	A 1	B 3	D 2	C 4
2	B 3	D 4	C 2	A 1
3	B 4	A 1	C 2	D 3
4	C 4	A 1	D 3	B 2
5	B 1	C 3	D 4	A 2
6	B 2	D 4	A 1	C 3
7	C 3	A 4	B 2	D 1
8	A 3	B 1	C 2	D 4
9	D 4	B 2	A 1	C 3
10	B 3	A 1	D 4	C 3
11	B 1	C 3	A 4	D 2
12	A 3	D 4	C 1	B 2
13	D 1	C 4	A 3	B 2
14	A 3	C 2	B 1	D 4

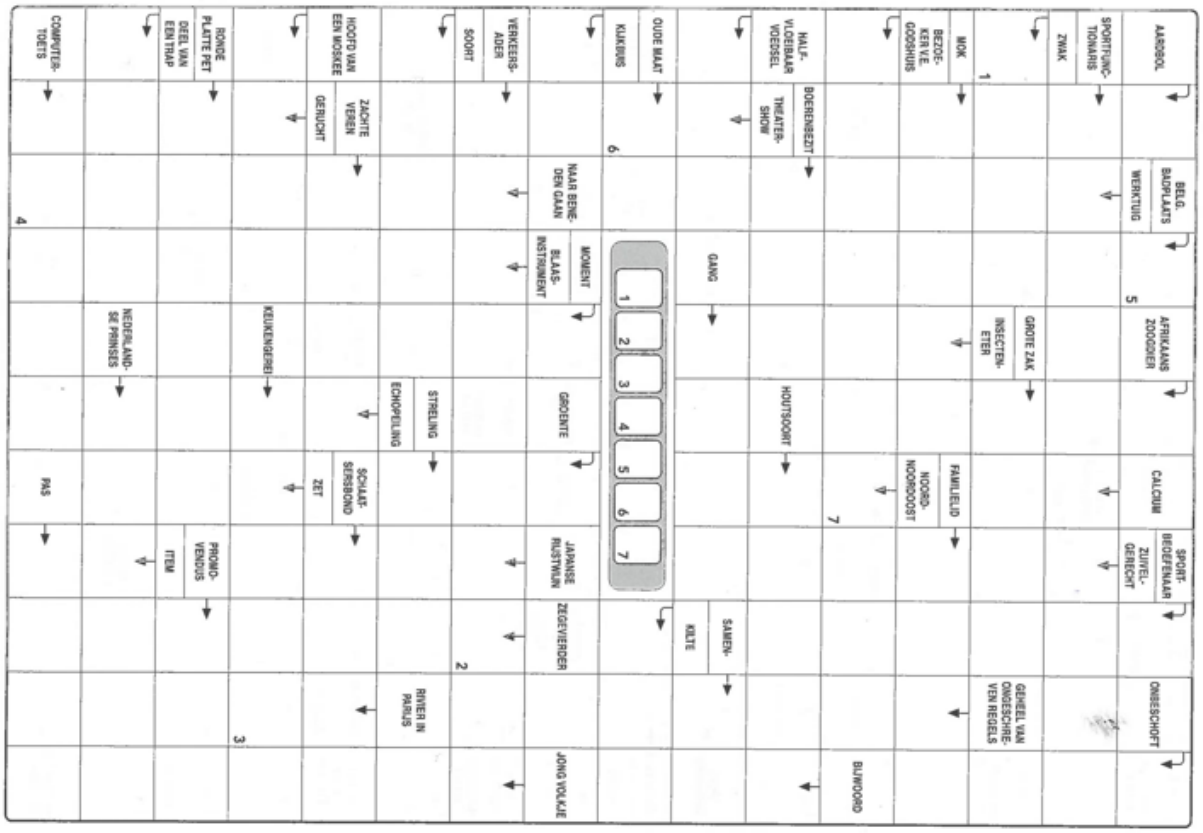
Table B3. *Distribution of Puzzles per ID*

PP-ID	PUZZLE1	PUZZLE2	PUZZLE3	PUZZLE4
1	Geel	Oranje	Zwart	Bruin
2	Zwart	Geel	Oranje	Bruin
3	Bruin	Oranje	Zwart	Geel
4	Geel	Oranje	Bruin	Zwart
5	Zwart	Oranje	Geel	Bruin
6	Oranje	Bruin	Geel	Zwart
7	Oranje	Zwart	Geel	Bruin
8	Bruin	Zwart	Oranje	Geel
9	Bruin	Oranje	Geel	Zwart
10	Oranje	Geel	Zwart	Bruin
11	Oranje	Geel	Bruin	Zwart
12	Geel	Bruin	Oranje	Zwart
13	Bruin	Geel	Zwart	Oranje
14	Geel	Oranje	Zwart	Bruin

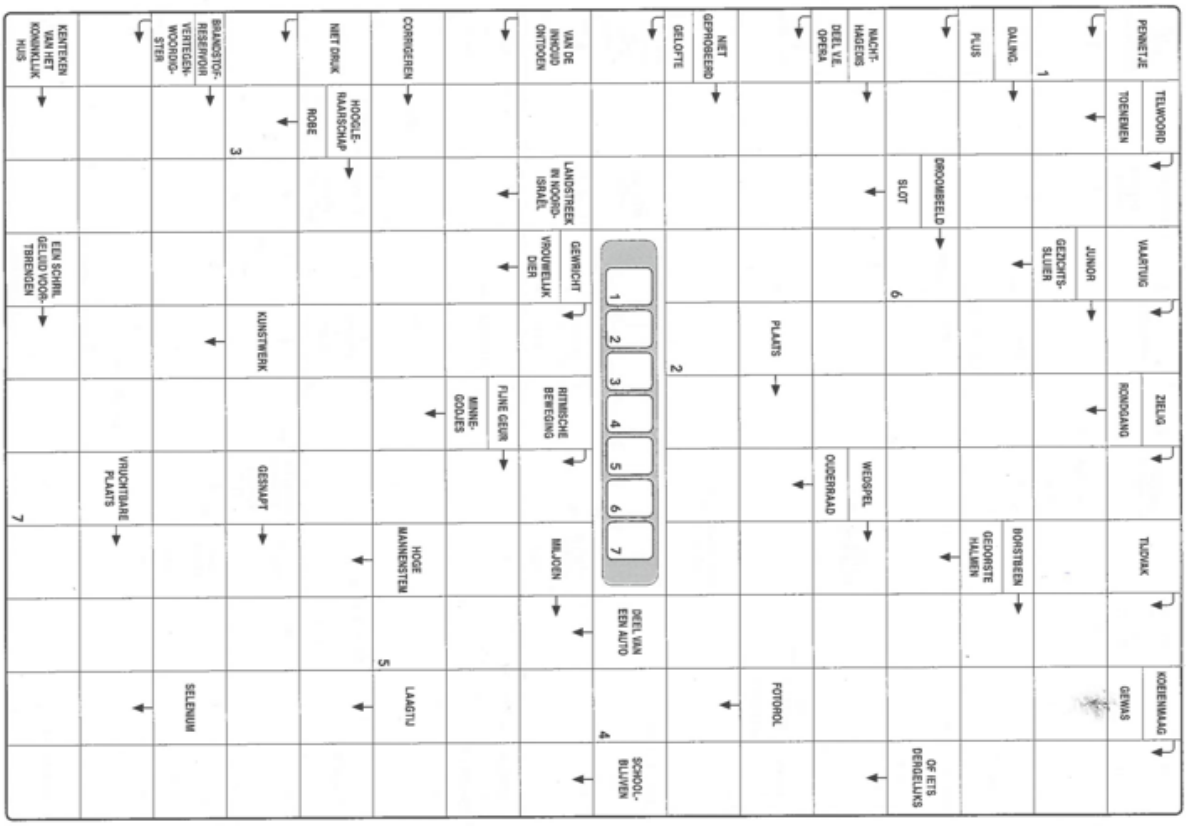
Appendix C - Puzzles



Puzzel Oranje



Puzzel Zwart



Appendix D - Questionnaire

Items: experience questionnaire

Warmth: Robot Social Attribute

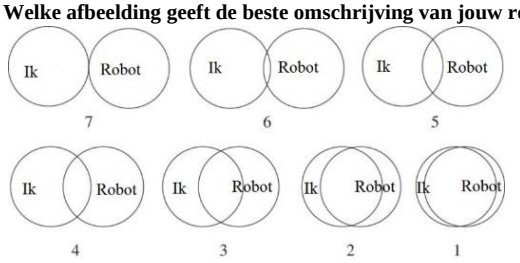
'In hoeverre associeer jij onderstaande woorden met de robot?'

1 = totaal geen associatie, 4 = neutraal, 7 = totale/ complete associatie

- Gevoelig
- Vrolijk
- Organisch
- Medelevend
- Sociaal
- Emotioneel

Inclusion: Closeness of the self to the other

Welke afbeelding geeft de beste omschrijving van jouw relatie tot de robot



Interactivity experience:

De volgende vragen gaan over de afgelopen 8 minuten, dus alleen de laatste puzzel taak.

Geef aan in hoeverre je het eens bent met onderstaande zinnen.

1 (Helemaal mee oneens), 4(Niet mee oneens en niet mee eens), 7(Helemaal mee eens)

Perceived Enjoyment and Perceived Sociability: Almere Model

- Ik vind de berichten van de robot leuk
- Ik vind de berichten van de robot saai
- Ik zie de robot als een plezierige gesprekspartner
- Ik vond de interactie met de robot fijn

Positive Affect: Game Experience Questionnaire

- Ik voelde me tevreden
- Ik voelde me lekker
- Ik vond de situatie plezierig
- Ik vond het leuk om te doen

Negative Affect: Game Experience Questionnaire

- Ik was met andere zaken bezig
- Ik voelde me verveeld
- Ik was afgeleid
- Ik vond het saai

Competence and Challenge: no reference

- Ik voelde me uitgedaagd
- Ik voelde tijdsdruk
- Ik voelde me vaardig
- Ik vond de puzzel moeilijk
- De robot maakte de situatie dragelijker

Open questions:

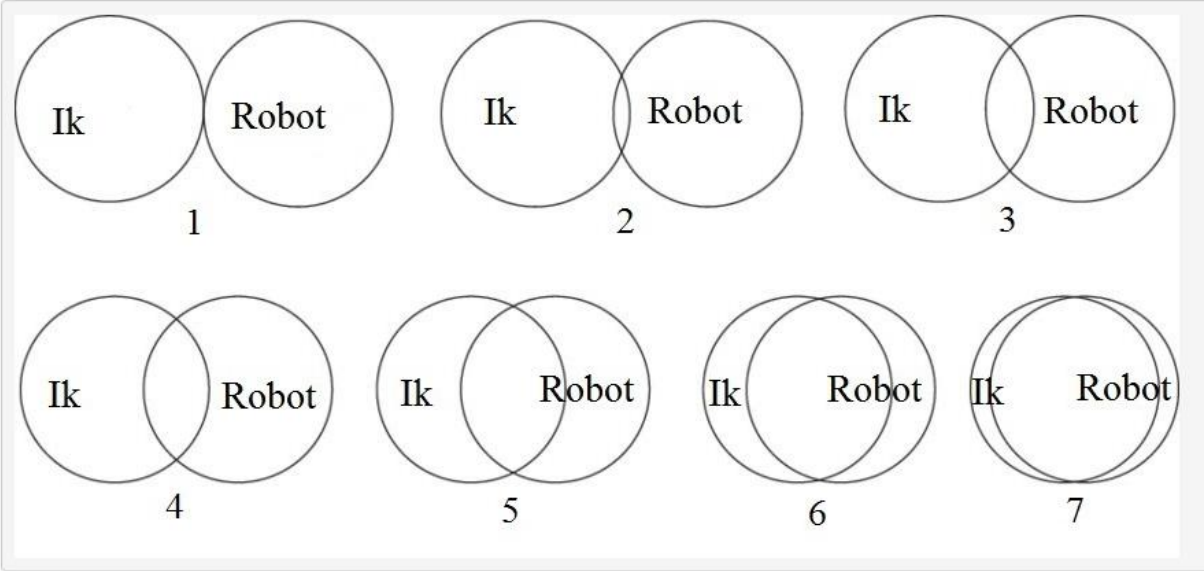
- Wat vond je leuk aan de sociale robot Tessa?
- Welke soort berichten spraken je aan? Of wat viel je op?
- Heb je verschil ervaren tussen de 4 situaties? Zo ja, vul in 'opmerkingen' in wat je opviel.

Presentation: experience questionnaire

*In hoeverre associeer je onderstaande begrippen met de Tessa robot?

	Totaal geen associatie	Geen associatie	Bijna geen associatie	Neutraal	Beetje associatie	Associatie	Totale associatie
Organisch	○	○	○	○	○	○	○
Medelevend	○	○	○	○	○	○	○
Emotioneel	○	○	○	○	○	○	○
Gevoelig	○	○	○	○	○	○	○
Sociaal	○	○	○	○	○	○	○
Vrolijk	○	○	○	○	○	○	○

*Welke afbeelding geeft de beste omschrijving van jouw relatie tot de robot?



*Geef aan in hoeverre je het eens bent met onderstaande zinnen op basis van je ervaringen tijdens de laatste taak.

	Helemaal mee oneens	Mee oneens	Beetje mee oneens	Niet mee oneens en niet mee eens	Beetje mee eens	Mee eens	Helemaal mee eens
Ik vind de berichten van de robot leuk	○	○	○	○	○	○	○
Ik vind de berichten van de robot saai	○	○	○	○	○	○	○
Ik vind de berichten van de robot hinderlijk	○	○	○	○	○	○	○
Ik zie de robot als een plezierige gesprekspartner	○	○	○	○	○	○	○
Ik vond de interactie met de robot fijn	○	○	○	○	○	○	○
Ik voelde me tevreden	○	○	○	○	○	○	○
Ik voelde me lekker	○	○	○	○	○	○	○
Ik vond de situatie plezierig	○	○	○	○	○	○	○
Ik vond het leuk om te doen	○	○	○	○	○	○	○
Ik was met andere zaken bezig	○	○	○	○	○	○	○
Ik voelde me verveeld	○	○	○	○	○	○	○
Ik was afgeleid	○	○	○	○	○	○	○
Ik vond het saai	○	○	○	○	○	○	○
Ik voelde me uitgedaagd	○	○	○	○	○	○	○
Ik voelde tijdsdruk	○	○	○	○	○	○	○
Ik voelde me vaardig	○	○	○	○	○	○	○
Ik vond de puzzel moeilijk	○	○	○	○	○	○	○
De robot maakte de situatie draagelijker	○	○	○	○	○	○	○

Appendix E - Extra results

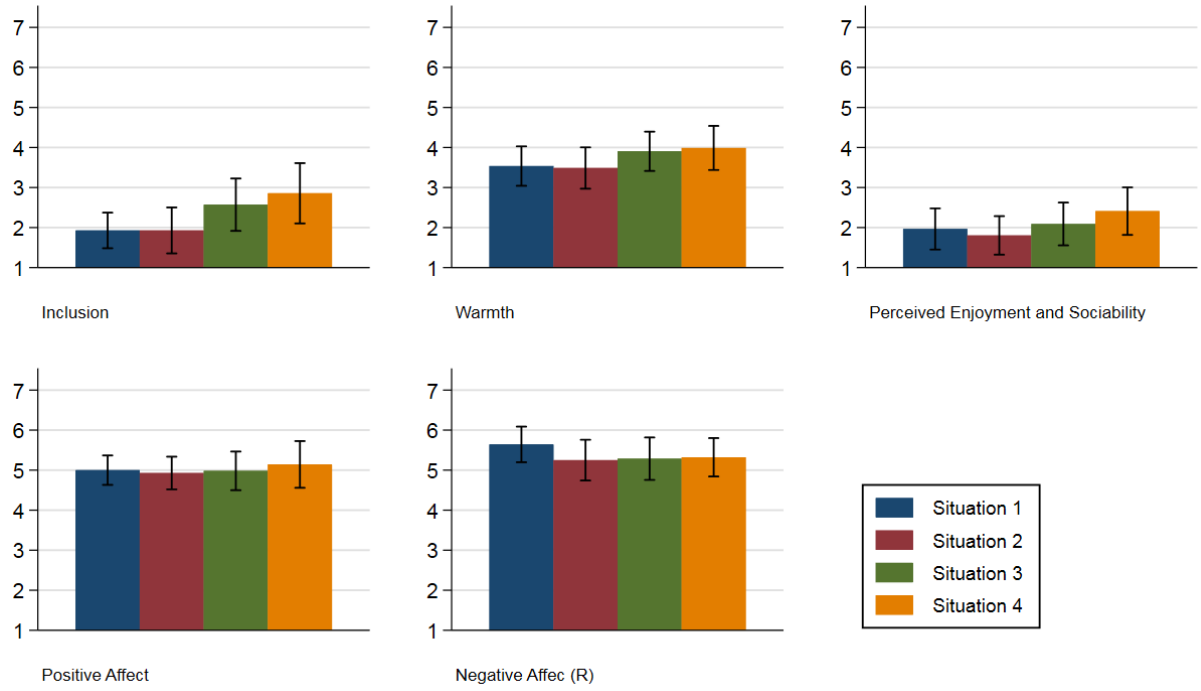


Fig E1. *Mean score of scales and 95% confidence interval error bars over the different situations in order of presentation*

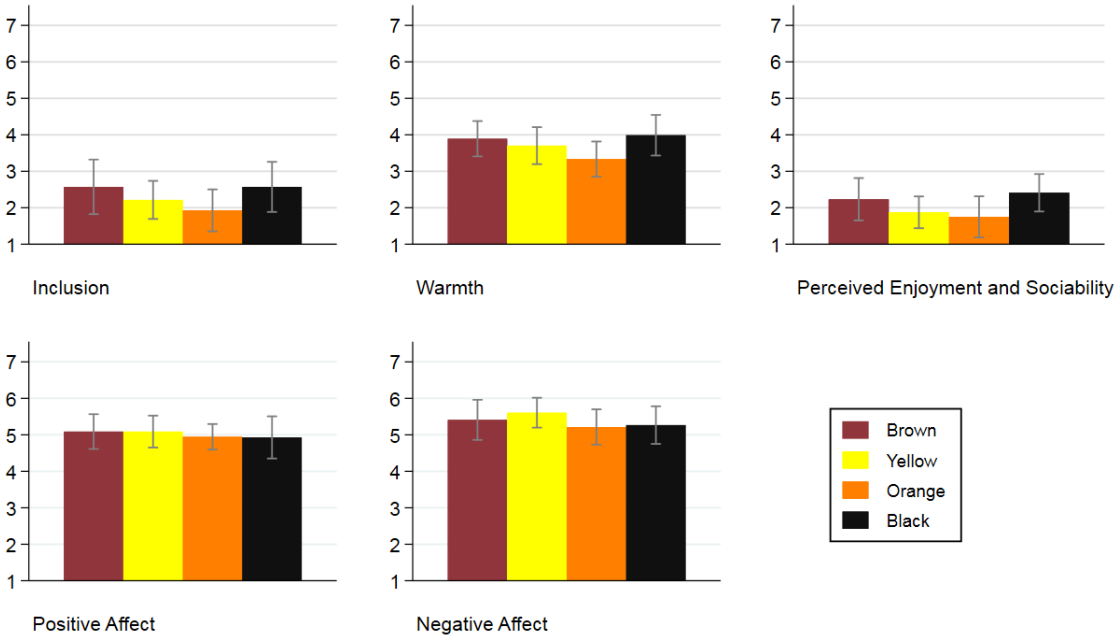


Fig E2.. *Mean score of scales and 95% confidence interval error bars for the different puzzles*

Table E1. *Answers on open question 1*

O1	**Wat vond je leuk aan de sociale robot Tessa?**
>	Gezellig als ze leuke feitjes gaf, vond het ook een fijne manier dat ze alles zo nu en dan onderbrak. Dit maakte het een best fijne flow
>	De instructies wat ik moet doen. Dat werkt wel
>	Dat Tessa je bij je naam noemt. Op het einde langere zinnen begon te vertellen (en soms ook weetjes)
>	Rustige stem, duidelijk verstaanbaar
>	Random feitjes, bijvoorbeeld over de kruiden van de koek. Ook de aanwijzingen dat je iets te eten/drinken kan/mag pakken laten je niet bezwaard voelen om iets te pakken.
>	De persoonlijke interactie
>	Het was leuk dat ze je naam kende, en je af en toe zei dat je het goed deed
>	Tessa wist van de situatie af en hield daar rekening mee.
>	Uiterlijk
>	Af te toe contact, niet constant praten maar ook geen hele lange tussenposes
>	Dat de robot me aansprak met mijn naam. Dat de robot af en toe wat 'weetjes' vertelde en dat de robot mij op mijn gemak probeerde te stellen en thuis wilde laten voelen.
>	De informatie was af en toe best interessant, maar de berichten over de tijdsduur waren wel handig.
>	Leuk om een beetje interactie te hebben. Ik was heel geconcentreerd aan de puzzel bezig en Tessa haalt je toch een beetje uit je concentratie, op een leuke manier wel.
>	Hoe ze er uit ziet

Table E2. *Answers on open question 2*

O2	**Welke soort berichten spraken je aan? Of wat viel je op?**
>	Het feitje over de koekjes was leuk, de feitjes over puzzelen waren niet heel bijzonder maar fijne afwisseling
>	De instructies waren goede berichten, dat spreekt me wel aan. Voor een gesprek zou ik niet met een robot gaan praten. Het viel me op dat de robot soms op compleet het verkeerde moment iets zegt. Bijvoorbeeld als ik vast zit met de puzzel "Je bent goed bezig".
>	In het begin waren het korte woorden/zinnen. Maar aan het einde werd Tessa's verhaal langer waardoor je er meer connectie mee voelde. Motiverende berichten vielen vooral op en wanneer je iets te eten/drinken mocht pakken
>	Sommige berichten waren persoonlijker dan andere (door het gebruik van mijn naam)
>	Het aanbieden van eten/drinken sprak me aan
>	Mijn naam werd genoemd
>	Je ben goed bezig! Pak nog wat te drinken of een snoepje of een koekje
>	Tessa vertelde vaak motiverende dingen. Bovendien vertelde ze dat je boven gemiddeld bezig was terwijl ik betwijfel of dat ook echt waar is, en dat is altijd motiverend of het nou klopt of niet. Ook vertelde Tessa wat je kon doen zonder dat ze het opdroeg. Bijvoorbeeld je 'mag' ipv 'doe' dit of dat.

>	Wat mij op viel was dat Tessa zij, je doet het beter dan andere (of zoiets) tijdens de eerste puzzel. Waarvan ik dacht, hoe kan je dat nu weten.
>	bij de laatste twee rondes was het natuurlijker
>	De berichten met weetjes spraken me aan.
>	Het aangeven hoeveel tijd er nog was, vond ik wel handig, de rest vond ik wat afleidend. Het viel me op dat de robot een vrij 'eentonige' stem had.
>	Het viel me op dat Tessa elke ronde soortgelijke dingen zei. Iets aanbieden, een complimentje en als laatste een tijdsindicatie geven.
>	De aanmoedigende berichten spraken me aan. Ik had het idee dat als ze zoiets zei ik kort daarna weer een woord erbij vond

Table E3. *Answer on open question 3*

O1	Heb je verschil ervaren tussen de 4 situaties? Zo ja, wat viel je op.
>	In de tweede was ze heel erg controlerend/dwingend en het voelde heel artificieel hoe ze mijn naam gebruikte
>	Soms feitjes tussendoor. Soms eten of drinken aangeboden. De instructies waren niet altijd hetzelfde.
>	- De frequentie van Tessa's inbreng - De hoeveelheid mbt inbreng - Toenemende motiverende berichten van Tessa
>	Gebruik van mijn naam vs. niet Meer 'onderbrekingen' bij sommige situaties Andere tijdsindicaties
>	Verschillende 'tussentijden' werden genoemd ('nog 1 minuut' terwijl een andere situatie 'nog 2 minuten') En natuurlijk eerste en tweede situatie 1x water pakken, terwijl derde situatie 1x koekje pakken en vierder situatie 1x snoepje pakken was.
>	De directheid van Tessa. Soms aanmoedigend, soms met wat meer pit
>	Nee
>	soms gebruikte ze wel mijn naam en andere keren niet.
>	Eerste twee keer werd gezegd nog 1 minuut en daarna nog 2 minuten.
>	laatste twee rondes kwamen wat natuurlijker over
>	De derde situatie was de robot minder lief. De eerste situatie was de robot wat killer, de laatste situatie had de robot meer medeleven
>	Het ene moment probeerde de robot meer aan te spreken dan het andere, en dat vond ik af en toe storend.
>	Nee
>	Ik vond het raar dat de robot me bij mijn naam noemde en het viel me op dat ze feitjes ging vertellen. Zo iets vind ik wel leuk normaal, maar niet als ik ergens mee bezig ben.

Appendix F - Copy of Information form and Informed consent

Information form for participants

This document gives you information about the study “Puzzle task with Tessa”. Before the study begins, it is important that you learn about the procedure followed in this study and that you give your informed consent for voluntary participation. Please read this document carefully.

Aim and benefit of the study

The aim of this study is to measure your experience of making a puzzle task with guidance of a Socially Assistive Robot (Tessa). This information is used to improve the human-robot interaction especially in care settings.

This study is performed by Bo Drummen, a student under supervision of P.A.M. Ruijten – Dodoiu and R.H. Cuijpers of the Human-Technology Interaction group.

Procedure

In this study you will perform 4 puzzle tasks in which the robot will guide and help you. For each puzzle task you get 7 minutes time in which also the robot will communicate with you.

After each puzzle task, you will fill in a self-report questionnaire on the computer. The experimenter and the robot will guide you in the steps.

Risks

The study does not involve any risks, detrimental side effects, or cause discomfort.

Duration

The instructions, measurements and debriefing will take approximately 45 minutes.

Participants

You were selected because you were registered as participant in the participant database of the Human Technology Interaction group of the Eindhoven University of Technology.

Voluntary

Your participation is completely voluntary. You can refuse to participate without giving any reasons and you can stop your participation at any time during the study. You can also withdraw your permission to use your data up to 24 hours after they were recorded. None of this will have any negative consequences for you whatsoever.

Compensation

You will be paid 7.50 euros (plus an additional €2.00 if you do not study or work at the TU/e or Fontys Eindhoven).

Confidentiality and use, storage, and sharing of data.

All research conducted at the Human-Technology Interaction Group adheres to the Code of Ethics of the NIP (Nederlands Instituut voor Psychologen – Dutch Institute for Psychologists), and this study has been approved by the Ethical Review Board of the department.

In this study personal data (your age and gender) and experimental data (performance of the puzzle task and answers to the questionnaires) will be recorded, analyzed, and stored. The goal of collecting, analyzing, and storing this data is to answer the research question and publish the results in the scientific literature. To protect your privacy, all data that can be used to personally identify you will be stored on an encrypted server of the Human Technology Interaction group for at least 10 years that is only accessible by selected HTI staff members. No information that can be used to personally identify you will be shared with others.

The data collected in this study might also be of relevance for future research projects within the Human Technology Interaction group

The coded data collected in this study and that may be released to the public will (to the best of our knowledge and ability) not contain information that can identify you. It may include all answers you provide during the study, including demographic variables (e.g., age and gender) if you choose to provide these during the study.

At the bottom of this consent form, you can indicate whether or not you agree with the use of your data for future research within the Human Technology Interaction group and the distribution of your data by means of a secured online data repository with open access for the general public. You are not obliged to letting us use and share your data. However, you must give your consent to share your data in this way in order to participate in this study.

No video or audio recordings are made that could identify you.

Further information

If you want more information about this study, the study design, or the results, you can contact Bo Drummen.

If you have any complaints about this study, please contact the supervisor, Peter Ruijten – Dodoiu, You can report irregularities related to scientific integrity to confidential advisors of the TU/e.

Informed consent form

Puzzle task with Tessa

- I have read and understood the information of the corresponding information form for participants.

- I have been given the opportunity to ask questions. My questions are sufficiently answered, and I had sufficient time to decide whether I participate.

- I know that my participation is completely voluntary. I know that I can refuse to participate and that I can stop my participation at any time during the study, without giving any reasons. I know that I can withdraw permission to use my data up to 24 hours after the data have been recorded.

- I agree to voluntarily participate in this study carried out by the research group Human Technology Interaction of the Eindhoven University of Technology.

- I know that no information that can be used to personally identify me or my responses in this study will be shared with anyone outside of the research team.

- I □ **do**
  □ **do not**
  give permission to make my anonymized recorded data available to others in a public online data repository, and allow others to use this data for future research projects unrelated to this study.

Certificate of consent

I, (NAME) ……
want and provide consent to participate in this study.

_____ _____

Participant's Signature Date