Robotic e-Partner

that engages in music-related group activities
with people affected by dementia

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The Design and Evaluation of a Robotic e-Partner Engaging People with Dementia in Joint Activities with Music

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By

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Abstract

The number of people affected by dementia is expected to rise to 135.5 million people over the course of the next two decades. Awaiting the discovery of a treatment able to cure dementia, current treatments focus on improving the social, physical, and emotional well-being of people with dementia.

This thesis project aims to contribute to the availability of such treatments by presenting the design, development, and evaluation of a robotic ePartner that engages people with dementia in group activities with music. Following a user-centred design approach, a robot was developed to support three group activities: 1) physical exercises, 2) reminiscence, and 3) music bingo. The robot was tested in a 3-week observational study, in a meeting centre for people with dementia, where people with dementia meet for daytime activities under the guidance of professional caregivers and volunteers.

People with dementia - and the activity coordinators - interacted with the robot in 3 weekly 90-minute sessions at a meeting centre for people with dementia in the Netherlands. Based on this research, the outcomes of the study suggested that the robotic ePartner could provide useful and suitable support for group activities in the meeting centres, especially if it were able to take charge of the procedural part of initiating, explaining, and coordinating group activities.

Keywords: Robot; ePartner; People with dementia; Music; Group activities; User-centred design

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CHAPTER 1

Introduction

> "While no one can change the outcome of dementia, with the right support you can change the journey. "

As the worldwide population ages, the prevalence of dementia is increasing. The rising number of cases of dementia is closely related with the aging of the population. According to the World Health Organization, 2015 currently 47.5 million people, worldwide, have dementia and there are 7.7 million new cases every year.This number is expected to increase to an estimated 75.6 million in 2030 and to 135.5 million in 2050 (Alzheimer's Disease International, 2015). Dementia is a syndrome with a collection of symptoms and signs for which there are many causes. The syndrome can manifests itself in a variety of ways associated with an ongoing decline of the brain and its abilities. Alzheimer Disease (AD), vascular dementia, frontotemporal dementia and dementia with Lewy bodies all fall under dementia but the most common form of the condition is AD. The symptoms of dementia largely vary between types, and between people. However, in general, people with dementia (PwD) display a subset of the following symptoms: memory loss, impairment in cognitive function, speech impairments, declined control over focused movements, changes in personality, deterioration in emotional control, social behaviour, and motivation (National Institute on Aging, 2016).

In more detail the effects dementia has on a person's daily life fall into four main categories: Cognitive, Functional, Behavioral and Psychological. Examples of *cognitive* effects are difficulty in recognizing people and places, and remembering details. *Functional* effects include, for example, difficulty in completing everyday tasks and activities of independent living, problems following social cues and slower reactions. *Behavioral* effects include amongst others, loss of social skills, overly active response to changes or stimuli in the environment, repetitive behavior patterns and inappropriate responses or behaviors. And lastly *psychological* effects include irritability, mood swings, frustration and anger with self and others, changes in personality, anxiety, and depression (Alzheimer's Disease International, 2015; World Health Organization, 2015).

As a result of the symptoms described above, dementia has an overwhelming impact on the people suffering from the syndrome, as well as on their family and friends. One of the main challenges is assisting the person to sustain communication and connection to family, caregivers and the environment. Dementia can make it more difficult to communicate with others. As dementia progresses it becomes harder for a person to tell others about themselves and to understand what others are saying to them. This leads to people feeling cut off and isolated.

Because dementia is a progressive disease and its symptoms are irreversible, with no treatment able to cure it, most treatments aim to improve the quality of life for PwD and their kin. One of the needs most frequently reported by PwD and their caregivers is the need for engagement in meaningful daytime activities (Miranda-Castillo et al., 2013). In the Netherlands, this need is met by special-care meeting centres, where PwD meet in so-called living rooms for daytime activities under the

guidance of professional caregivers and volunteers. At these meeting centres, the potential of music-related activities has attracted a lot of attention. Research investigating the effects of music on the well-being of PwD shows that music stimulates physical activity, evokes positive moods and emotions, supports social interaction and stimulates self-disclosure, while reducing anxiety and negative behavioural and cognitive symptoms (Bosco & Lancioni, 2015; Lazar et al., 2014b; Li et al., 2015; Livingston et al., 2008; Raglio et al., 2015; Subramaniam & Woods, 2012; Testad et al., 2014; Vasionyte & Madison, 2013a). For these reasons, music-related activities are increasingly part of the activities offered at meeting centres in the Netherlands.

Another emerging tool, although not as thoroughly investigated, is the use of social robots in the care of people with dementia. Socially assistive robots are a form of assistive technology encompassing all robotic systems capable of providing assistance to the user by means of social interaction. They can provide help in a variety of ways like supporting a user's cognitive or functional abilities (e.g., task reminding and monitoring or offering the user opportunities to enhance social participation and psychological well-being (e.g., communication and social applications) and coaching the user to facilitate the promotion of healthy behavior and achievement of health-related goals (e.g., physical activity).

Research in this field investigates the therapeutic use of the robots to reach out to people affected by dementia and how robots could provide an alternative mode of engagement (Mordoch et al., 2013). In order to be accepted, social robots need to be perceived by users as useful and relevant to their current unmet needs. A mismatch between needs and the solutions offered by robots are a barrier to acceptance and robot adoption (Graaf et al., 2015; Pino et al., 2015). However, especially in collaboration with caregivers, social robots could enhance the dementia care practice. Therefore, this research aims to investigate the potential benefits of music-related activities with social robots in the dementia care practice as explained in the next subsection.

1.1 Research Objectives

This thesis explores the idea of using a social robot in combination with music activities to support and foster the social participation of PwD. It aims to research how dementia patients and their caregivers can be enabled to autonomously go through their musical activities/ therapy and foster interaction and social participation with the help of a computer-driven assistant(e-Partner) in the form of a robot. The purspose of the e-Partner is to assist as a partner during the music activities and as a social companion. The research conducted uses a situated and user-centred design approach, including interviews, focus groups, and a user-based evaluation study.

The research pursues two main research objectives: (1) the design of the e-Partner and its behaviour, and (2) the evaluation of the interaction between the e-Partner and its users (i.e. the PwD and their caregivers).

1.2 Thesis Outline

The next chapter describes the outcomes of a literature study investigating the state of the art of social robots for people with dementia and the use of music to activate people with dementia. The outcomes of the literature study provided the foundation for the initial design rationale, which is presented in Chapter 3. Chapter 4 describes the prototype and its behaviour, both of which were founded in the design rationale. Chapter 5 explains the experimental design and methods used to evaluate the prototype, while Chapter 6 describes the analysis and results of the evaluation study. Chapter 7 discusses the results obtained in the evaluation study, describes the refinement of the design based and the implications for future studies.

CHAPTER 2

Literature Review

This chapter describes the background research and literature review and is divided into two parts. The first part focuses on existing literature on the topics of music in dementia while the second part focuses on social robots in dementia.

2.1 Music in Dementia

Dementia affects not only those diagnosed with the disease but also informal caregivers and other people close to the patients. The effects of the disease can place a significant emotional burden on relationships. One way to alleviate some of the effects of dementia is through music. Music is an easily accessible medium, which can be enjoyed alone or with others even in the context of severe dementia. Music is part of most people's lives, so it is often associated with different situations, life events or familiar faces (Belfi et al., 2016). Music may help improve a person with dementia's cognitive abilities, such as their ability to communicate or remember. In research studies music has been shown to have a positive effect on PwD as well as their social environment. It also has the potential to stimulate positive emotions in people with dementia and to trigger their cognitive abilities and memory. Also, music has been found to decrease levels of agitation and anxiety, encourage social interaction, and brighten moods (Ridder et al., 2013).

Musical memory remains largely unaffected by the disease. The relationship between music and memory appears to be mutually supportive: not only does the memory of music endure, but it additionally appears that music is able to support memory function. There is a lot of literature which focuses on the effects that music-related activities or music therapy can have on people with dementia (Holmes et al., 2006; Ray & Mittelman, 2015; Svansdottir & Snaedal, 2006; Wall & Duffy, 2010). Explicit memory impairment is the primary deficit in the initial stages of dementia. However, memories that do not require conscious recollection, also called *implicit* memories, have been demonstrated to be more durable. Memory for music appears to be particularly enduring, continuing to outlast other cognitive capacities and memories, even in the final phases of the condition.

Listening to music can activate areas of the brain involved in short-term memory and processing. Verbal memory and focused attention have been shown to significantly improve in patients who listen to their favourite music on a daily basis compared to patients who listen to audiobooks or receive no listening material (Jäncke, 2008). Studies have been conducted to study the impact of music therapy for people whose memory has been affected. The underlying idea is that listening to music activates areas of the brain involved in short term memory and processing (Särkämö et al., 2014).

Reminiscing and reminiscence therapy aim to help the people with dementia reach their memories. Reminiscence therapy involves discussing and sharing memories, reviewing and evaluating those memories, and re-capturing the emotions and feelings that are an important part of those memories. This process is either done one-on-one or in groups. Music therapy is one of the most popular and effective ways

to stimulate reminiscing. A song might trigger memories of things a person was doing forty or fifty years ago. They might re-live personal moments such as weddings or birthdays, or remember high school days and school dances. Reminiscence not only exercises the brain's memory mechanism, it also provides positive emotional feedback, which can improve the quality of life (Cox et al., 2014; Dassa & Amir, 2014; Elliott & Gardner, 2016; Haslam et al., 2014; Lancioni et al., 2014; Vasionyte & Madison, 2013b).

The question of how assistive technology for music-based reminiscence can contribute to dementia care is a growing concern. Since it is difficult to find a sufficient number of caregivers for dementia patients in many countries it is important for technology to provide stimulating activities and social functions. Research on supportive technology for reminiscence and autobiographical memory for PwD shows promising results. The use of memory wallets, personalised reminiscence, smartphones that repeatedly collect daily activities data for later use in conversations, and computer-based multimedia systems are very encouraging for maintaining the personhood in PwD. At the same time, technology could make the burden of care more affordable for the professional caregivers who can spare time and resources for more effective relationships with persons with dementia (Giulio Lancioni, 2015; Huldtgren et al., 2015; Peeters et al., 2016).

Use of music therapy and technology by itself is however not enough to support PwD and their caregivers. In order to use music in a meaningful way to support social interaction, it is important to pay attention to the social, environmental, and subjective aspects of how PwD experience music; aspects often overlooked in research on the topic of music and dementia (Bruer et al., 2007; Chu et al., 2014; Lin et al., 2011; Raglio et al., 2008; Sung et al., 2006; Sung et al., 2010; Sung et al., 2012; Takahashi & Matsushita, 2006; Tanaka et al., 2012; Vink et al., 2014; Ziv et al., 2007). So the question remains; how can assistive technology for music-based reminiscence be integrated in the work environment and operations of the dementia care practice (Moyle et al., 2013a; Mutlu & Forlizzi, 2008; Sabanovic et al., 2014).

2.2 Social Robots in Dementia Care

As technology progresses, more and more robotic applications are developed that can provide assistance to people in general and to the older population in particular. Research in the area of social robots aims to determine if the use of social robotics can assist the elderly living with dementia to improve affect and decrease agitation, as well as provide companionship, enrich social interaction and quality of life (Broekens et al., 2009).

Social robots are a special class of robots which provide help through social interaction with users (Feil-Seifer & Mataric, 2005). Social robots typically come with a physical embodiment and multimodal communication channels, allowing it to communicate with users (verbally and non-verbally) in a social manner. As a result,

users benefit from communication or from interaction. Social support typically aims to reduce social isolation and enhance well-being. Zoomorpic appearances have thus far been most successful as social robots (Figure 2.1). For instance, PARO (Figure 2.1c), AIBO (Figure 2.1b) and Pleo (Figure 2.1a) have been successfully used to facilitate therapeutic work with people with dementia. Research shows that these robots can be used to enhance social interactions and reduce social isolation (Chang et al., 2013; Klein & Cook, 2012; Sung et al., 2015; Takayanagi et al., 2014; Wada & Shibata, 2007b). Socially-assistive robots have been shown to reduce feelings of social exclusion and decrease levels of stress (Bemelmans et al., 2012), indicating that they might be used as social companions for people with dementia. As such they can reduce the feeling of social exclusion and are helpful for decreasing the level of stress, both effects of dementia .

(a) Pleo

(b) AIBO

(c) Paro

Figure 2.1: Zoomorphic robots used in dementia care

A different type of appearance commonly found in robots is the humanoid form (see Figure 2.2). Research on humanoid robots for people with dementia has also shown promising results in terms of instigating positive interactions with their users. For example, Bandit (Figure 2.2d), is a humanoid robot providing a music based game has been used for cognitive therapy (Tapus et al., 2009; Tapus & Vieru, 2013). The robot provided PwD with verbal and non-verbal feedback to stimulate their ability to concentrate on a cognitive music game. Bandit was tested with older people with cognitive impairment residing in a senior living care facility. Their findings showed that all participants responded to the music provided by the robot. Another example

is Palro (Figure 2.2c), a humanoid robot that can walk, play music and games, dance, and remember users after communicating with them. Inoue et al. (2014) investigated the robot "Palro" (Figure 2.2c) and found that participants with mild dementia responded better in verbal and non-verbal interaction with others than those with more advanced disease. Palro effectively encouraged communication, activity and fun.

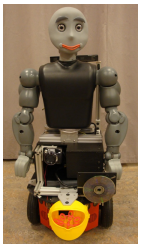
Literature studies on the effectiveness of exercise on cognitive impairment and Alzheimer's disease have identified that structured physical exercise appears to be a promising non-pharmacological strategy for preventing cognitive decline. Individuals with mild or moderate dementia that are more physically active could prevent major losses of physical fitness and function (Balsamo et al., 2013).

Palro is on of the robots that have been successfully deployed to engage PwD in physical exercises (Hamada et al., 2016; López Recio et al., 2013). The elderly people were not wary and had a sense of affinity with the small humanoid robot, enjoying the game and exercises together. Also the participants showed improved memory ability by participating in the games, and social communication by the players communicating with each other. In other studies, social robots served as companions while listening to music. The findings of the study showed that the robot's dance-like response to music caused participants to feel that the robot was co-listening with them, and increased their liking of songs (Hoffman et al., 2016).

(a) Alice

(b) NAO

(c) Palro



(d) Bandit

Figure 2.2: Humanoid social robots

Lazar et al. (2014a) did a systematic review of the use of technology for reminiscence therapy. Their review found that there are a few challenges, one of those is that many of the systems described in the studies require technical expertise for setup or operation and may not be ready for independent use by family caregivers.

Benefits include the enjoyment derived by people with dementia from viewing reminiscing materials through various forms of multimedia, and that individuals can benefit from technology supported therapy by having increased opportunities for interactions and greater ability to take ownership of the conversation. Additionally, technology can aid reminiscence and professional caregivers by reducing session preparation time and making available materials possible to find on their own.

Despite the majority of research in this area showing positive results, there are also some negative effects. Moyle et al. (2013b) described in their research that the staff members of the nursing homes had a negative attitude towards robots. They could not be convinced that it would be beneficial to the resident and family and could potentially have a positive impact on their provision of care. There are also objections that have been raised about social robots use, especially about PARO; that it could lead to reduced social contact, and that its use involves the deception, and infantilisation of vulnerable older people, and that it negatively affects their dignity (Sharkey & Wood, 2015).

The use of social and therapeutic robots described in this section has demonstrated positive effects on people with dementia, examples of which include the areas of affect, social interactions, and decreases in stress and loneliness (Inoue et al., 2011; Wada & Shibata, 2007a; Wada et al., 2005). Also, staff experienced less burnout when therapeutic robots were used (Wada et al., 2004). Nevertheless, the effects of interaction between a human user and a robot do not always have positive implications. It may happen that the initial effect of novelty and curiosity toward a robotic aid and its use fades resulting in a decline of personal interest and changes in the user attitude.

The literature study described in this section revealed that activities in the form of exercises, games, and reminiscence have been shown to have great potential for integrating social robots in the dementia care practice. It also provided a clear and thorough foundation for the design rationale of the robotic e-Partner. This design rationale is presented in the next Chapter.

CHAPTER 3

Design Rationale

3.1 Design Approach

For the design of support systems, well-thought requirements that specify what the technology should be able to do and claims that specify why these functions are needed (concrete and testable positive/negative trade-offs) are essential. In doing so, it can be helpful to decompose the design of the robot's interaction into smaller use cases (Westera et al., 2010). The development process of this project is structured using the sCE (situated Cognitive Engineering) method (Neerincx & Lindenberg, 2008). The sCE method provides guidance for the design process. It is an iterative, incremental development process using three components: a foundation of operational, human factors, and technological analyses, a specification of requirements, and the evaluation by simulation or prototype which validates and refines the requirements baseline (see Figure 3.1). The system specification consists of use cases, requirements, and claims (Figure 3.2). These elements will become more clear in the following sections by the provided examples.

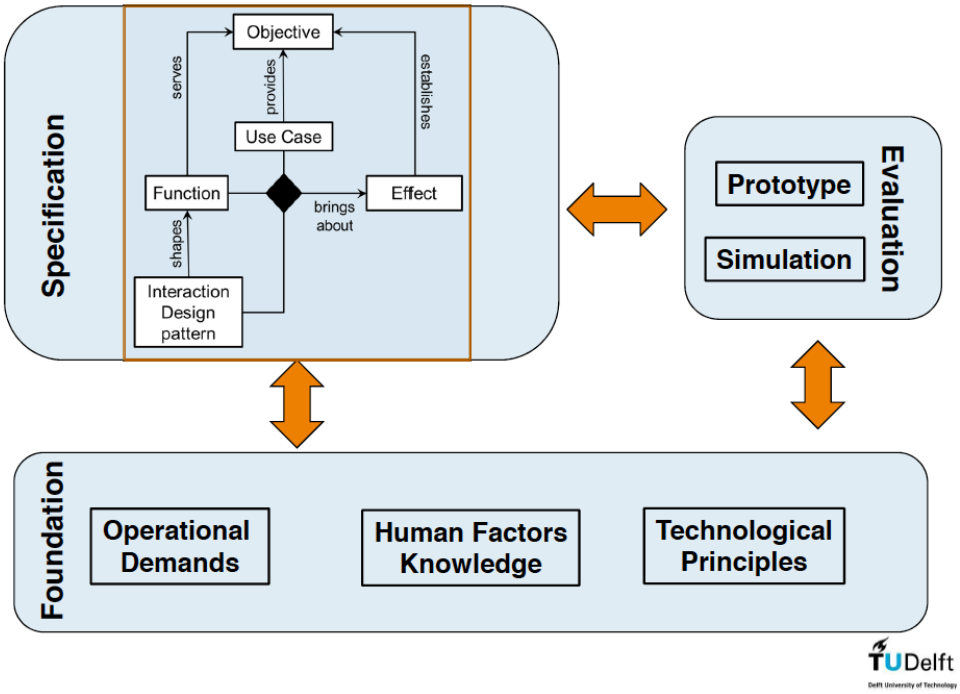


Figure 3.1: The sCE Method illustrated

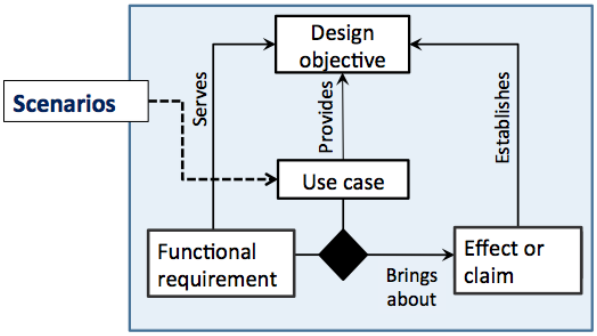


Figure 3.2: Relations in the sCE Method

3.2 Design Rationale

The design rationale of the e-Partner is grounded in two major observations found in the literature. The first one is that music can stimulate the emotional cognitive physical and social activities of elderly people with dementia and the second that social robots show great potential in supportive roles in health care.
Social assistive robots could provide important and feasible alternatives to some of the dementia care needs. However, it is also important to provide quality human contact in the dementia care environment and incorporate the assistive robots in a way that does not disturb human interaction but enhances it. The role of the robot in this research is not to replace the caregiver. Its main purpose is to collaborate with them and assist them by undertaking the repetitive or procedural part of the activities. While the caregiver's role is to allow the robot to organize the activities and focus on the interaction and social communication part.

The problem addressed in this thesis is how to support group activities at meeting centers for people with dementia, where professional activity coordinators guide people through daytime activities. To conceptualize the main users of the e-Partner, two personas were created as described in Table 3.1. Personas provide a way to model, summarize and communicate research about people who have been observed or researched in some way. A persona is depicted as a specific person but is not a real individual, it usually is synthesized from observations of many people.

Table 3.1: Two personas for the design of the e-Partner

name(age)	**Description**
Mary (70)	Mary is a member of many associations and clubs. She loved to organise and host events, and when she attended other people's events she often engaged in heated debates about books or current affairs. Yet ever since she was diagnosed with Alzheimer's disease, she is no longer able to organise social events, nor can she engage in coherent discussions at social events. She feels as though people are avoiding her, and she gets frustrated with her new role as a passive participant.
Anna (54)	Anna is an activity coordinator (AC) at a meeting centre, where PwD meet and engage in daytime activities together. Anna enjoys her job and tries to provide the best possible care for the elderly, however sometimes her performance is impeded by the amount of tasks she has to do.

3.3 Scenarios

Based on the theoretical foundation and field research (see Appendix F) scenarios were created to provide insights in the design objectives and describe the envisioned solution, i.e. how the e-Partner aims to solve the problem. The scenarios help to contextualize the design of the Robotic e-Partner.

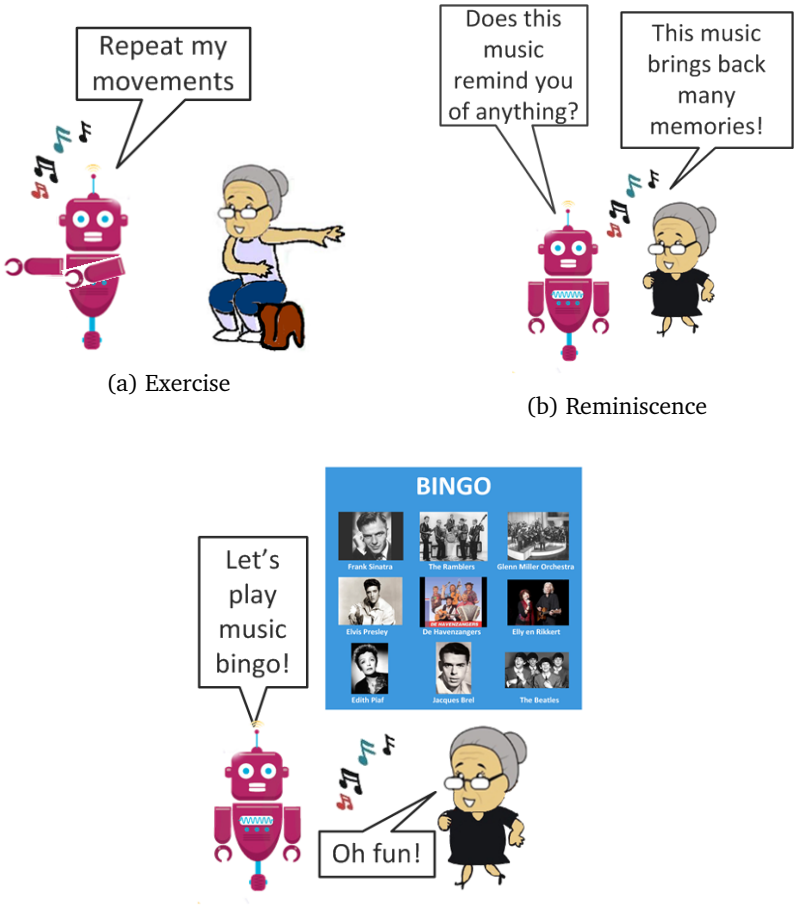
The problem scenario describes the problem the design aims to solve, providing insights in the system's objectives, while the design scenario aims to show how to system can be used to solve the problems in the problem scenario, and the objectives it reaches (see Table 3.2).

Table 3.2: Two scenarios for the design of the e-Partner

Problem Scenario	Part of Anna's responsibilities is to organize recreational group activities for the PwD. During those activities she has to introduce each activity and take care of the process. During the activities she has to pay close attention to the group dynamics and the emotional well-being of the individual group members. At times, she finds it difficult to coordinate the recreational activities, while also paying attention to all the people and their emotional responses. Mary joins the meeting centre every day to take part in the activities and enjoy her time with other people. However, because of her condition she has difficulty initiating conversations. At times she becomes frustrated and her anger can flare up, thereby negatively influencing the atmosphere in the group.
Design Scenario	Anna employs a robotic e-Partner to coordinate the recreational activities. She turns on the robot and introduces it to the group members. Then she describes the activities the robot will do today and lets the robot coordinate the activities. Now Anna has time to participate and pay attention to the group dynamics, and the emotional well-being of the people in the group. For Mary the robot becomes a point of discussion with the other people in the group. The questions and activities proposed by the robot provide a common ground for conversation and entertainment. She is happy that Anna notices when Mary wants to say something and redirects the attention of the group towards her, so she can tell the group about that one time she sneaked out of her window to dance with her late husband.

3.4 Use cases

The e-Partner should be able to support a set of music-based group activities that were altogether physically, emotionally, socially, and cognitively stimulating. The literature review described in the previous Chapter showed that some of the most beneficial and enjoyable activities for people with dementia include exercises, reminiscence and games. Exercises can help PwD maintain physical fitness and prevent cognitive decline. Reminiscence provides enjoyment and individuals can benefit by discussing and sharing memories. And cognitive games can stimulate their memory and ability to concentrate, while providing entertainment. Therefore based on activities described in the literature and the type of activities provided at the meeting centres, a decision was made to include physical exercises, a game, and a reminiscence activity. The activities are described in three use cases (see Figure 3.3).



(a) Exercise

(b) Reminiscence

(c) Bingo

Figure 3.3: The three music-based group activities

3.4.1 Use case “Music & Exercises"

The first use case describes the physical exercise activity. During this activity, the e-Partner invites the PwD to participate in a series of physical exercises. It instructs the PwD to mimic the behaviours the e-Partner displays (Table 3.3).

Table 3.3: Use case “Music and Exercises"

Description	The use case describes the steps associated with the Music and Exercises activity. The e-Partner suggests a set of exercises the PwD can mimick and plays appropriate music.
Actors	Activity coordinator (AC), Robot e-Partner, PwD
Pre codnitions:	The Robot e-Partner has access to music, has generic knowledge of appropriate music for exercises and is capable of engaging the users.
Post conditions:	The users are in improved/worse/no-effect situation after the activity.
Action sequence:	1. The activity starts when the activity coordinator initiates the e-Partner. 2. The e-Partner introduces the activity and plays suitable music. 3. The robot performs exercises and encourages the users. 4. The users mimic the movements of the robot.
Alternative sequence:	1. The users are not able to perform the movements of the robot 2. The activity stops
Requirements:	RQ01, RQ02, RQ03

3.4.2 Use case “Music & Reminiscence"

The second use case describes the reminiscence activity. During the reminiscence activity the e-Partner proposes to listen to music and talk about the music together. After each song, the e-Partner poses questions, such as “Does this music remind you of anything?” and “ Would you like to talk about it?” (Table 3.4).

Table 3.4: Use case “Music and Reminiscence"

Description	The use case describes the steps associated with the Music and Reminiscence activity. The e-Partner suggests plays music based on users preferences to improve mood or to evoke memories.
Actors	Activity coordinator, Robot e-Partner, PwD
Pre codnitions:	The Robot e-Partner has access to music, has generic knowledge of the music preferences* of the users
Post conditions:	The users are discussing and reminiscing.
Action sequence:	1. The activity starts when the activity coordinator initiates the e-Partner. 2. The e-Partner introduces the activity 3. The e-Partner starts playing appropriate music 4. The robot engages the users in discussion after each song.
Alternative sequence:	1. The users don’t like/enjoy the music. 2. The e-Partner asks the users what they would like to listen to. 3. The e-Partner plays the requested music.
Requirements:	RQ04, RQ05, RQ06

3.4.3 Use case “Music Bingo"

The third use case describes the music bingo activity. During the music bingo activity, the e-Partner starts by explaining how the game is played. The AC is asked to hand out the bingo cards and pencils. The bingo cards for this activity are custom made based on the feedback received from the focus groups. They contain 9 (3x3) pictures of artists and their names (Figure 4.6). The e-Partner plays 30-second clips of songs corresponding to the bingo cards, and asks the PwD if they recognise the artist. The e-Partner then encourages the PwD to discuss among themselves whether they know the name or image of the artist, and to mark the right artist on their cards if they do. The first person to have marked three artists in a row, wins the game (Table 3.5).

Table 3.5: Use case “Music Bingo"

Description	The use case describes the steps associated with the Music and Bingo activity. The e-Partner engages in a game of Music Bingo with the participants and organizes the activity for them.
Actors	Activity coordinator, Robot e-Partner, PwD
Pre codnitions:	The Robot e-Partner has access to music, has generic knowledge of the music preferences* of the users
Post conditions:	The users are involved in social interaction and exercise their memory.
Action sequence:	1. The activity coordinator hands out bingo cards and markers. 2. The activity starts when the activity coordinator initiates the e-Partner. 3. The e-Partner plays 30second clips of songs corresponding to the Bingo cards. 4. The users mark off the images or names of the artists on their bingo cards. 5. When someone gets 3 in a row, they yell "BINGO" 6. The robot congratulates them and gives them a present.
Alternative sequence:	1. The user does not recognize any of the songs. 2. The user feels bad about failure to recognize songs.
Requirements:	RQ07, RQ08, RQ09

3.5 Requirements

The baseline requirements for this project have been defined by an iterative process that included an interview with a patient and their informal caregiver (see Appendix F). To come to the requirements in this section the interview was analyzed for additional requirements. Requirements specify what the technology should be able to do (functions) and claims that specify why these functions are needed (concrete and testable positive/negative trade-offs). Both are essential in order to design the behaviors of the e-Partner.
Requirements following from the ‘Music & Exercises’ use case:

- **RQ01:** The e-Partner shall offer physical exercises as a group activity
- **RQ02:** The e-Partner shall play music from the 50s-80s
- **RQ03:** The e-Partner shall play up tempo music (approximately 128 bmp) during the exercises activity

Requirements following from the 'Music & Reminiscence' use case:

- **RQ04:**The e-Partner shall offer music-based reminiscence as a group activity
- **RQ05:**The e-Partner shall ask the PwD to talk about the music and the memories it triggers
- **RQ06:** The e-Partner shall play personalised music tailored to the individual people in the group during the reminiscence activity

Requirements following from the 'Music Bingo' use case:

- **RQ07:** The e-Partner shall offer music bingo as a group activity
- **RQ08:** The e-Partner shall ask the PwD to mark on their cards the artists of the songs played
- **RQ09:** The e-Partner shall play music that is familiar to all the people in the group during the bingo activity

3.6 Claims

The set of requirements described in the previous section is supported by an argument explaining why that requirement should be part of the design rationale. The argument for each requirement consists of a set of positive and negative claims, derived from e.g. prior human factors research and theories, domain knowledge, or expert knowledge. The claims in this section are described as testable hypotheses, thereby offering a systematic approach to evaluations of the design in user studies. Table 3.6 shows the claims drawn from the requirements of the e-Partner.

Table 3.6: Requirements and claims of the e-Partner design

Requirement	**Argumentation (consisting of claims)**
The e-Partner shall offer physical exercises as a group activity by asking PwD to mimic its movements	+ Physical exercises activate PwD physically + Physical exercises stimulate PwD cognitively – Physical exercises may be tiring for the PwD – PwD may have difficulty mimicking the movements of the robot – PwD might find it silly to repeat after the robot – PwD might become frustrated with the e-Partner if it does not adapt to their performance
The e-Partner shall play up-tempo music from the 50s-80s during physical exercises	+ Up-tempo music will encourage people to start moving + Music from the 50s-80s will be familiar to PwD – The music may make it more difficult to hear what the robot says – The music may be distracting
The e-Partner shall offer music-based reminiscence as a group activity by asking PwD to talk about the music and the memories it triggers	+ Talking about the past will evoke positive emotions in PwD + Talking about the past will stimulate cognitive activity + Talking about the past will stimulate social interaction – The music may also trigger negative emotions
During reminiscence, the e-Partner shall play personalised music tailored to the individual people in the group	+ Personalised music will encourage people to talk about their past – Personalisation within a group means sometimes just a few like and/or know the song
The e-Partner shall offer music bingo as a group activity by asking PwD to mark on their cards the artists of the songs played	+ Playing music bingo will stimulate memory recall + Playing music bingo will evoke social interaction + Playing music bingo will elicit positive emotions – The music may also trigger negative emotions – This activity may be frustrating when someone has trouble remembering the names of the artists
During music bingo, the e-Partner shall play music that is familiar to all the people in the group	+ Familiar music will stimulate social connectedness + Familiar music will evoke singing + Familiar music will evoke a sense of recognition – Even when music is familiar, it may not be someone's taste in music

3.7 Conceptual Design

This conceptual design proposes the development of a prototype that will be able to interact with dementia patients and suggest appropriate music activities such as “Music and Exercises", “Music and Reminiscence" or “Music Bingo". The suggestions will be generated based on the activity, appropriate music, and the user preferences. The robot agent will act as the interaction point with the patient. But it can also be used by formal caregivers and the relatives to monitor the user’s recent activities or to modify the music and activities. The basic idea is shown in the conceptual diagram (Figure 3.4).

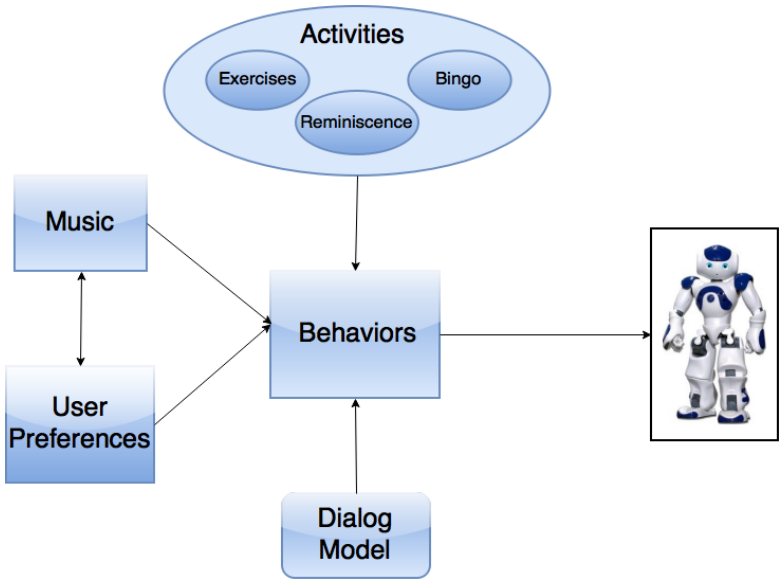


Figure 3.4: Conceptual Design of the e-Partner

Figure 3.6 illustrates the knowledge reasoning required for the e-Partner, based on the requirements and claims. The different ‘activities’ require ‘suitable music options’ which are partially based on ‘user preferences’ and the nature of the activity. For example, suitable music options for the exercises activity are those with tempo (tempo is the “speed” of a piece of music as measured in beats per minute (bpm)) of approximately 128 bpm because it is high enough to motivate and encourage positive thoughts and at the same time safe for seniors (Karageorghis et al., 2010). ‘Settings’ such as speed of speech/movement, should also be taken into account and be adjustable depending on the audience in each session. Finally the system should incorporate user feedback (e.g. positive feelings on a song) and include it in the user preferences.

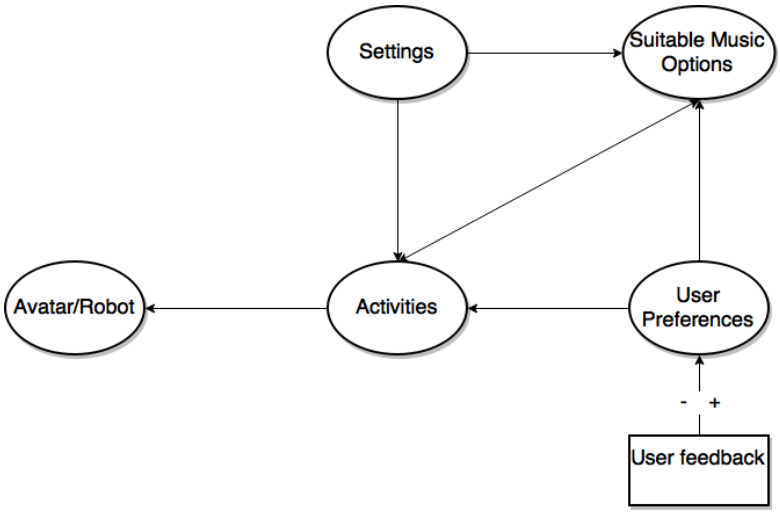


Figure 3.5: Knowledge Reasoning

Figure 3.6 depicts the overall behavior flow of the e-Partner. It also describes the relationship between features, and how they interconnect with one another.

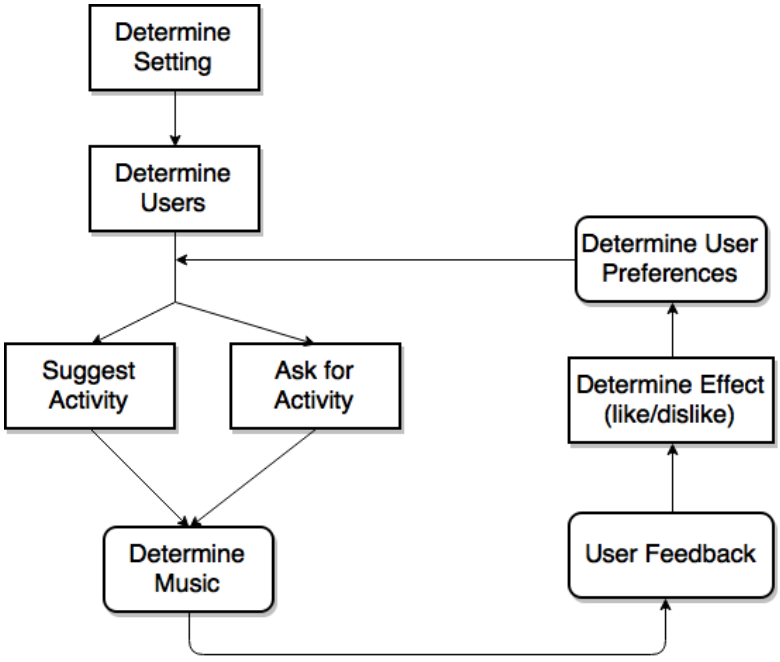


Figure 3.6: Task Flow

CHAPTER 4

Prototype

Based on the design rationale and envisioned interaction design, a prototype was developed. The robot NAO (see Figure 4.2) was selected to act as the interface and interaction point of the e-Partner. For the design and implementation of the activities the PAL/RoboTutor environment was used.

4.1 PAL Environment

The PAL environment is composed of a social robot (NAO), its (mobile) avatar, and an extendable set of applications, which all connect to a common knowledge-base and reasoning mechanism. Figure 4.1 depicts the general architecture of the PAL environment.

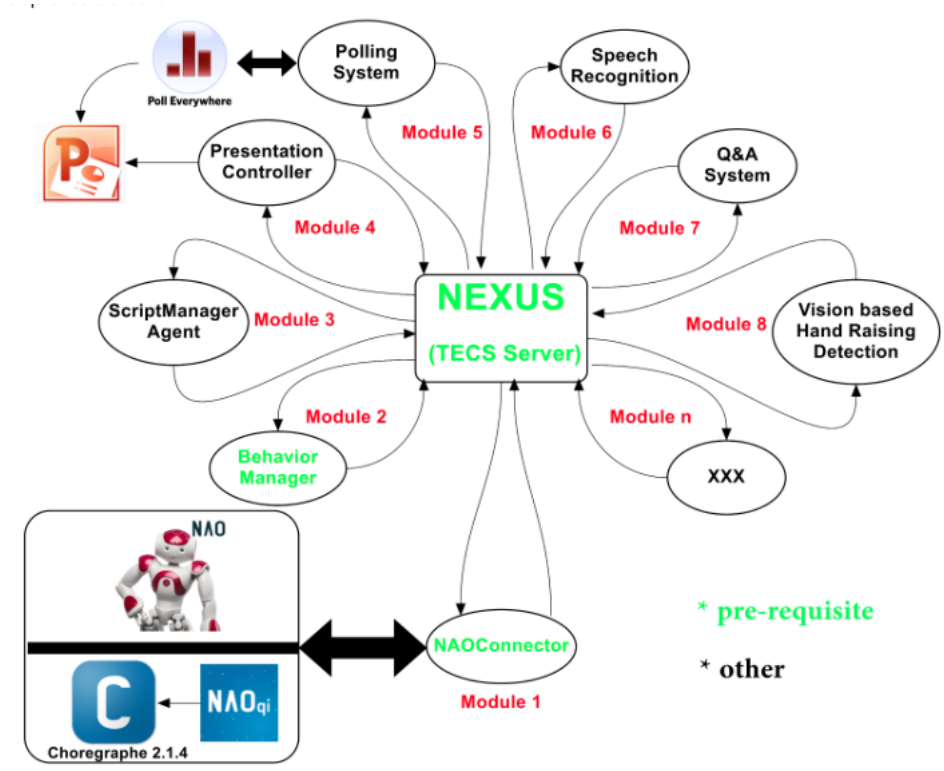


Figure 4.1: PAL Environment

4.2 Nao Robot Functionalities

The humanoid NAO robot (Figure 4.2) is developed by Softbank Robotics (Softbank Robotics, 2016). NAO is a 25 degrees of freedom robot equipped with eight full-color RGB eye leds, two cameras, an inertial sensor, a sonar sensor, and many other sensors that allow it to perceive its surrounding environment with high precision and stability. It is measuring 58cm tall and weighing 4.3 kg. This robot was employed in the evaluation studies.

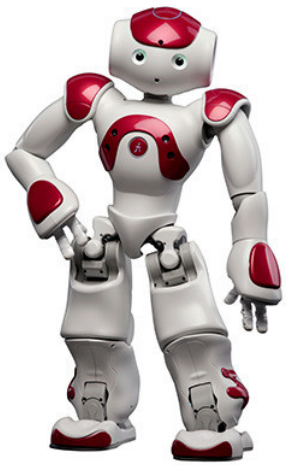


Figure 4.2: NAO robot

The NAO robot can also talk and sing with a robotic voice. Its movements include moving its neck and arms, walking and dancing. Software was developed to allow the robot to act out a script for therapy sessions. These scripts included effects like speech, music and movements. During the session, the experimenters could control the activation of and progression through the script using remote control software installed in a laptop. The experimenters were able to pause the script, repeat sections of it, or jump to another section. It was also possible to use the software to remotely operate the robot in order to make it talk or move.

4.3 Focus Groups

To gather knowledge about the target user groups, their needs and limitations, and the dementia care practice in which the robotic e-Partner was used, two focus groups were conducted. The focus groups took place with caregivers (including a physical therapist, a psychologist, a general practitioner, geriatrician, and a nurse) from the Pieter van Foreest facilities. During the focus group sessions the prototype was presented and its capabilities were demonstrated. After the demonstration a constructive discussion took place where the caregivers could voice their opinions on the design, functionalities and what could be improved. During the focus group ses-

sions, notes were kept about all the comments and observations of the caregivers. Some of the issues raised by the professional caregivers regarded the speed of speech, the speed of movement, the appropriateness of the exercises, the length of each activity, and the design of the bingo cards. Based on the feedback from the focus groups the design of the robot was refined to address the needs of the target group.

4.4 Technical Design

The prototype has been created by writing program code in Java for the interface, the retrieval of Muziekweb's songs and the connection to the NAO robot. In addition GOAL was used to define a few of the robot's dialogues and movements.

GOAL is an agent programming language for programming rational agents. GOAL agents derive their choice of action from their beliefs and goals. The language provides the basic building blocks to design and implement rational agents. The language elements and features of GOAL allow and facilitate the manipulation of an agent's beliefs and goals and to structure its decision-making. The language provides an intuitive programming framework based on common sense notions and basic practical reasoning. Agents receive information about their environment through percepts and can request the environment to perform actions. Agents are part of a multi-agent system and can exchange information between themselves through messages. Cognitive agents maintain a cognitive state that consists of the knowledge, beliefs, and goals of the agent which are represented in some knowledge representation language (Interactive Intelligence TU Delft, 2016). For this project the GOAL plug-in for the Eclipse IDE was used to allow the connection with the PAL environment. The reason for selecting the GOAL language is that it provides programmable agents and that is an effective way to ensure that the robot responds appropriately, and is prepared for each interaction.
In order to make the system behave more intelligently, a speech recognition module was implemented using Google's SR API and a microphone as a sound input. The Google Speech API converts audio to text by applying neural network models. One of the reasons for selecting this API is that is recognizes the Dutch language and returns recognition results while the user is still speaking. Unfortunately because the speech recognition did not perform well when multiple people talked at the same time, it was not used in the final prototype.

During the development of the prototype a few technical challenges arose. As described above, the focus groups with professional caregivers indicated that the speed of speech and movement should be slower for the PwD to be able to follow the robot. In order to incorporate their feedback into the robot, the settings and configuration files of the PAL environment had to be altered by modifying the parameters and values, and testing them on the NAO Robot until an acceptable speed was found.

4.5 Music e-Partner Module and Behaviours

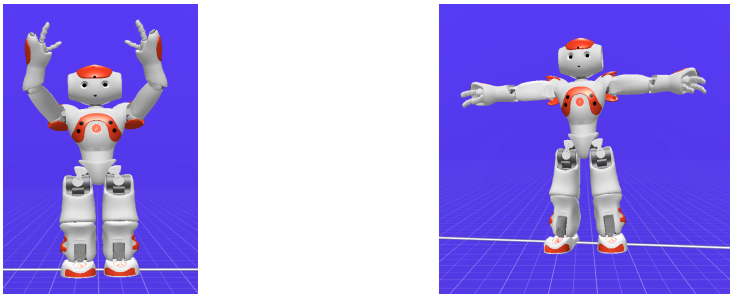
For the project, three behavioral programs for the NAO robot were developed and added to the PAL Environment: (A) Music & Exercises, (B) Music & Reminiscence, and (C) Music Bingo.
The music e-Partner module is responsible for playing songs through the speakers, generating dance moves based on the song's beat, responding to voice commands, triggering nonverbal behaviors, and responding through Wizard of Oz to events received on the robot's wireless network. In addition, the robot can maintain eye contact by using it's default autonomous behavior, which is a feature that allows the robot to recognize people and sounds around it and orient itself towards them.

4.5.1 Activity 1: Music & Exercises

One of the needs of older people in general is to exercise regularly, because it is known that keeping the body in good shape prevents the development of age-related conditions.
The NAO robot was programmed so that it could perform exercises that were previously specified by Alzheimer's Society, 2016 and the activity coordinators of the VierstroomZorg meeting center in Zoetermeer and Pieter van Foreest dementia care facility in Delft. Exercises like that are performed on a regular basis in the VierstroomZorg's sport sessions.
The robot demonstrates physical upper-body exercises accompanied by music. The group of people with dementia is encouraged by the robot to move along with the robot and to try and replicate its movements. For this activity, the robot uses uptempo (128bpm) music from the 60s, 70s, and 80s. Example songs are:

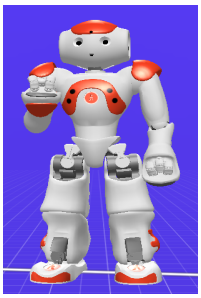
- Wake up little Suzzie by the Everly Brothers
- The loco-motion by Little Eva
- We are family by the Sister Sledge

Some of the exercises the robot performed can be seen below in Figures 4.3, 4.4, 4.5.

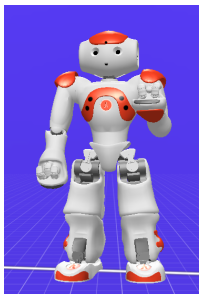


(a) Arms up (b) Open Arms

Figure 4.3: Example Exercise 1

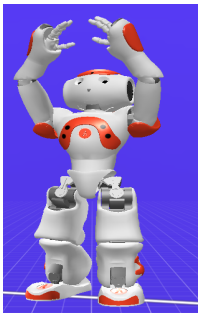


(a) Bending right arm

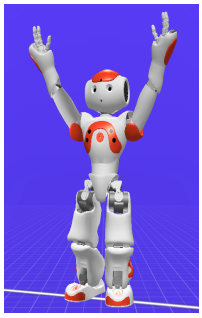


(b) Bending left arm

Figure 4.4: Example Exercise 2



(a) Clap



(b) Extend arms

Figure 4.5: Example Exercise 3

4.5.2 Activity 2: Music & Reminiscence

The robot plays personalised music (i.e. music that has been shown/known to elicit memories in the people in the group) and engages in conversation about the songs with the people with dementia. The robot, caregivers, and researchers encourage the people in the group to interact and talk with the robot and with each other about their memories of the songs played. Example songs used during this activity are:

- Shophietje by Johnny Lion
- Rock around the clock by Bill Halley; His Comets
- Ach Vanderlief toe drink niet meer by Zangeres zonder Naam

4.5.3 Activity 3: Music Bingo

The robot proposes to play a game of music bingo as a group activity. People receive bingo cards (either 3x3 or 2x2, depending on the group's stage of dementia, see figure 4.6). The cards correspond with the music the robot plays. The robot encourages the people in the group to mark their cards after each song has been played for 30 seconds. As the NAO robot is not particularly good at moving around and handing out sheets of paper, the robot will request for help in distributing the bingo cards and pencils. Here the robot will most probably have to rely on human caregivers or volunteers working in the meeting centers. The first person with Bingo receives a small prize. The type of music used for this activity is sing-along songs that everyone in the group knows and can sing along with. The personalised music playlist is created in advance in consultation with professional and informal caregivers. Example songs for this activity are:

- Branded zand by Anneke Gronloh
- Kom van dat dak af by Peter Koelewijn
- When the saints go marching in by Dutch College Swing Band

Figure 4.6: Example Bingo Card

CHAPTER 5

Evaluation

5.1 Methods

While executing the experiments, in some cases there were some technical issues with the PAL environment and the NAO robot. In the beginning of the experiments, the PAL environment tended to react extremely slow and could not establish a connection with the NAO robot. Thus the requirements for the project could not be met with the use of the PAL Environment. For this reason it was decided to reprogram the same behaviors in Choregraphe 2.1.4 (which is the native software package of the NAO robot). For the users there was no difference between the two different setups the prototype behaved in exactly the same way.
The rest of this chapter describes how the robot's behaviours are to be evaluated with the target group to assess the contribution to the second research objective: evaluating the interaction between the robot and its users. More specifically, we wanted to evaluate to what extent the interactions with the robot improve the social, affective, cognitive, and physical well being of people with dementia.
To accomplish this objective, the following research questions were evaluated in a user study:

(a) Does the robot have a positive effect on people's affective state?
(b) Does the robot have a positive effect on people's physical activity?
(c) Does the robot have a positive effect on people's cognitive activity?
(d) Does the robot have a positive effect on people's social interaction?
(e) How do the effects/interactions change over the course of three sessions?

The introduction of the e-Partner to PwD's life could have an effect to their social, affective, cognitive and physical well-being. So the physical, emotional, social and cognitive activity are the dependent variables.

Independent variable:

- The use of the e-Partner

Dependent variables:

- Physical activity: Involvement in the activities with body movements (e.g. clapping, dancing, exercising)
- Emotional activity: Mood and affective state (e.g. cheerful, smiling)
- Social activity: Communication and social interaction (e.g. starting conversations, requesting songs, sharing memories)
- Cognitive activity: Engagement and mental stimulation (e.g. remembering memories, lyrics, song titles, artists)

Hypothesis: "The use of a musical e-Partner in the form of a robot improves the social, affective, cognitive, and physical wellbeing of people with dementia."
All of the variables were measured in two ways; through the MiDAS form and video observations.

5.2 Participants

The participants included people at the Vierstroomzorg meeting centre in Zoetermeer. In total there were 3 groups who participated, each consisting of 8-15 people, and attended by 1 group activity coordinator. The participants' ages ranged between 50 and 80. The female to male ratio was approximately 2:1. A total of 30 PwD, 4 professional caregivers, and 4 volunteers participated in the studies. The conditions of the participants varied: all participants (except for the program coordinators) had some form of dementia, being caused by either:

- Alzheimer's disease
- Parkinson's disease
- Frontotemporal dementia
- Vascular dementia
- Mixed dementia
- Dementia with Lewy bodies

The stages of dementia also varied.

5.3 Materials and facilities

The experiment was conducted in the respective living rooms of each of the three groups. In other words, the participants could stay in their regular environment during the evaluations room. The living room contained a table to place the robot on and chairs for the participants to sit around so that all of them could see the robot. All sessions were recorded on videotape and searched for actions based on observation forms (see Appendix C). During the sessions one of the experimenters was asking questions throughout the session to catch the responses from the participants and to investigate their attitudes towards the robot and the activities. Furthermore, before and after each session, caregivers filled out the MiDAS scale (see Appendix B). After the end of the evaluation study the researcher posed interview questions (see Appendix E) to the caregivers.

5.3.1 Instructions to the activity coordinators

To ensure comparable situations across the groups, sessions, and activity coordinators, all activity coordinators were instructed to behave in line with the following guidelines:

–Introduce the robot and the activity before each activity.
–During the activities, try to calm people down and make them feel at ease.
–Emphasize that the goal of the research is not to test people, but to test the robot
–Act along with the activities as you normally would.
–Show enthusiasm, interest, and compassion for the people and the activities in which they are engaged.
–Moderate the group behaviour and encourage people to talk, move, be active and

social
–Motivate people to respond to the robot
–Keep in mind that the emphasis of all activities is to have a good time together, and to remain active in all possible ways
–To get a clear view of the effects on particular individuals in the group, we would like to ask you to fill out a short questionnaire (7 items) for two people in the group, once before the session, and once right after the session.

For the Dutch version of these instructions, please see (Appendix F).

5.3.2 Technology

For the setup of the experiment the following equipment was needed:
–Video cameras (2x)
–Tripod (2x)
–NAO Robot
–Wifi router
–Speakers

5.3.3 Questionnaire for the formal caregiver

Before and after each session, the formal caregiver was asked to fill out the Music in Dementia Assessment Scales (MiDAS) (McDermott et al., 2015) for two people in the group. MiDAS has been shown to have acceptable face and content validity through consensus methods, expert and peer consultations, and by collating feedback from therapists and care home staff during the refinement stage of the pilot MiDAS. MiDAS can be completed by different observers and at different times, e.g. 'before' and 'after' music therapy by care home staff, and 'beginning' and 'during' music therapy by music therapists. The form consists of five Visual Analogue Scale (VAS) items: Interest, response, initiation, involvement, and enjoyment. Interest is the main indicator that PwD find the music meaningful and the activity mentally stimulating. Response shows how PwD responded to the activity, did they join the conversation, or make eye contact and body movements. The initiation variable allows us to notice the levels of communication and activity for example did people start conversations, did they request songs or triggered memories that people where willing to share. Because music activities allow different levels of participation, the involvement variable shows peoples' engagement during the activities. Finally the enjoyment variable indicates the effects of the music activities on the mood of PwD.

Furthermore, it includes a supplementary checklist of six notable reactions (agitation/ aggression, withdrawn/low in mood, restless/anxious, relaxed mood, attentive/interested, and cheerful/smiling), as well as space for observers' comments (McDermott et al., 2014). The Dutch version of MiDAS as used in this study can be found in Appendix B.

5.4 Procedure

The process started by applying for ethical approval for the studies from the Human Research Ethics Committee of Delft University of Technology. After the approval was granted the meeting center recruited participants for the study. The meeting centre asked all the visitors of the meeting centre whether they would like to participate in the study, whether they would be interested in interacting with the robot and whether they agree to being filmed. They also asked people to sign the informed consent forms (see Appendix D).

Table 5.1: Schedule of the 9 sessions with the three groups distributed over a 3-week time span

Week 1 (Session 1)			**Week 2 (Session 2)**			**Week 3 (Session 3)**		
Tuesday	Wednesday	Thursday	Tuesday	Wednesday	Thursday	Tuesday	Wednesday	Thursday
Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3

Upon agreement, the meeting centre proposed nine occasions distributed across a time period of 3 weeks (see table 5.1). At these occasions the researchers could come by the meeting centre to engage with the robot in the groups. Each session took approximately 1 hour of interacting with the robot, going through all three activities (i.e. physical exercises, reminiscence, and music bingo). Activity coordinators (ACs) all behaved in line with the instructions they received (see Materials section). The procedure they followed was as follows:

–The AC introduces the robot and the activity.
–The AC starts the physical exercise activity by nodding to the researchers that itâĂŹs ok to start the first activity.
–The researchers launch the activity for the robot.
–The robot performs 8 minutes of exercises.
–The AC motivates people to act along with the robot, and performs the exercises herself as well.
–Once the exercises are finished, the researchers wait for the AC to signal for the next exercise.
–The AC nods to the researchers to start the next activity.
–The researchers start the next activity, which is the reminiscence.
–The robot plays a song.
–After the song has finished, the researcher instructs the robot to ask a question about the song.
–The AC stimulates the people to answer the question.
–The robot performs 10 minutes of songs and questions.
–Once the people have reminisced enough, the AC nods to the experimenters
–While the robot introduces the activity, the AC hands out premade bingo cards and stamps/markers.
–The AC nods to the researchers to start the next activity.

–The researchers start the next activity, which is music bingo.
–The robot plays 30 seconds of a song.
–The robot asks the people to mark their cards if they recognize the artist and title of the song.
–The robot reminds people to shout bingo if they have found 2 in a row (or 3).
–The AC checks people's cards to see if they have indeed bingo.
–The robot announces that the next song will start.
–This is repeated until all 4 (or 9) songs have been played.

During all sessions, two researchers were present: MP and IP. Each session started with researcher MP placing the cameras and tripod at the designated spots (the cameras were turned on and faced the participants). Researcher IP would set up the robot and the rest of the equipment. During the session, researcher MP acted as a participant observer and was participating along with the group she was observing. She was paying close attention to the participants and interacted/discussed with them at regular intervals, posing the interview questions throughout the session to catch the responses from the participants. Researcher IP acted as a non-participant observer and controlled the robot, software and camera while paying close attention to the participants and their reactions. All sessions were recorded on video to be replayed afterwards, using the camera recordings to append and double-check the annotations made throughout the sessions. After 1 week, ACs were asked for feedback in additional interviews.

5.5 Failsafe protocol

In order to deal with unforeseen problems of people becoming agitated, scared, or upset, a failsafe protocol was developed. If the researchers felt that the atmosphere in the group was becoming grim or uncontrollable, the researchers would ask the activity coordinator whether he/she thought it best to stop the session. If the activity coordinator agreed, the session was stopped immediately (with an explanation to the group). Vice versa, the activity coordinator can at all times propose to stop the session, and the researchers will adhere to this request at all times. The failsafe protocol was never used throughout the evaluation studies, but one was prepared just in case.

5.6 Data Analysis

The researchers analysed the data collected from the interviews with the caregivers after the end of each session by searching their answers for patterns, themes and trends and clustering the similar ones together.

5.6.1 Video Observations

Initially, the researchers watched all of the video-recorded sessions to get a comprehensive overview. Afterwards all video-recorded sessions were analysed by systematic observations using the observational scoring form (see Appendix C). Each

segment was documented in detail and everything that happens minute-by-minute that is relevant to the study was noted.
The following behaviour categories were recorded in the observation forms:

1. Lively/active/happy
2. Agitated/nervous/unhappy
3. Calm/relaxed/enjoyment
4. Distracted/frustrated/annoyed
5. Socially active/talking/eye contact
6. Sleeping/introvert/dozing/closed off

5.6.2 MiDAS

Furthermore, the outcomes of the MiDAS were analysed with repeated measures analysis for each group, and across time (session 1-3). For statistical analysis, the software package SPSS was used. All experiment results and all measurements are independent of each other. For each variable, the mean, minimum, median and maximum values are calculated.

5.6.3 Interviews

One week after the end of the evaluation studies the activity coordinators were asked for feedback in additional interviews. The purpose of the interviews was to gather feedback from the activity coordinators. Particularly what they thought went well, what could be better, further functionalities that would be useful in the robot, and their opinions on how they thought the PwD perceived the robot.

CHAPTER 6

Results

After the experiments had been executed, all the data was collected and the required variables were extracted from the video observations and from the questionnaires.

6.1 Video Observations

The total number of observed behavioural responses varied across groups and sessions. This variation was partly due to variations in the length of the reminiscence and bingo activity. At times the participants requested more songs from the robot so the reminiscence activity was extended. The length of the bingo activity depended on the number of songs required before the first bingo was called, and in some occasions everyone was having such a good time, that the activity would continue until everyone had bingo. To allow for interpretation of the data, Table 6.1 shows the occurrence of each of the behaviours as a percentage of the total number of observed behaviours for each of the activities and for each of the sessions.

In some cases people moved their chairs during the session, causing them to no longer be visible from the camera's point of view. In such cases, their reactions were not recorded, resulting in some missing observations. Observations of people in the "distracted" category can be attributed to people not paying attention at that specific point in time (e.g. when people would receive a cup of tea or coffee from one of the ACs). Participants took the bingo sessions very seriously, causing them to keep silent during the songs and during the robot's instructions. The observational scoring form contained no category for attentive listening so their reaction was listed as silent enjoyment.

The findings presented in Table 6.1 reveal that people were most actively participating (moving to the music) during the exercise session. During the reminiscence activities people were more talkative and engaged with one another, while also singing and sometimes clapping/dancing to the music. During the bingo activity, people were more focused, meaning they'd be less physically active, yet active on a cognitive level, busy processing the activity, the music, and the questions.

Regarding the changes in interaction across the sessions, the results indicate that during the first two sessions people were less active compared to the final session. In the first session people were more socially active (talking to the robot, for instance), while in the last two sessions people were also silently enjoying the music. An interesting point to mention here is that in session 2, people were more distracted. Upon reviewing the videos, this can be explained by the fact that during the second session, one of the participants in group 2 refused to engage with the robot ("I think it's a stupid thing"). Her behaviour influenced the other participants in the group, causing the other people to be more reluctant towards the robot, especially during the exercise activity. During the reminiscence activity the atmosphere improved and people even started to dance. Furthermore, in group 3 during session 2, one of the participants was knitting during most of the activities, although she did sit at the table and interacted with the robot on occasion, and sang to some of the songs. During the reminiscence activity, she decided to put away her knitting and join the activities.

Table 6.1: Percentages of observed behaviours for each of the activities, aggregated over the three groups.

Activity	Session	Active participation	Social participation	Passive enjoyment	Distracted	Agitated	Sleeping
Exercises	1	82.2	9.3	6.2	1.6	0	0.8
	2	84.8	0	2.5	12.7	0	0
	3	87.4	0	9.2	3.5	0	0
Total Exercises		84.4	4.1	6.1	5.1	0	0.3
Reminiscence	1	20.4	43.1	28.7	7.4	0	0.5
	2	25.7	27.4	37.1	9.4	0	0.4
	3	37.9	25.8	30.6	5.3	0	0.3
Total Reminiscence		29.6	30.8	32.1	7.1	0	0.4
Bingo	1	3.2	41.1	49.5	4.2	0	2.1
	2	14.7	32.4	45.6	7.4	0	0
	3	21.4	19.4	52.0	6.1	0	1
Total Bingo		13.0	30.7	49.4	5.8	0	1.2
Total session 1		34.8	32.7	26.6	5.0	0	0.9
Total session 2		35.7	22.7	31.6	9.7	0	0.3
Total session 3		42.9	20.5	31.1	5.2	0	0.4

In addition to the mentioned observations, the following noteworthy moments occurred throughout the sessions:

- During session 1 in group 1, one participant (female, in her 70s), participant A, could not take her eyes off of the robot. She would continuously address the robot by repeating its name (Charlie), telling it that it was cute, and saying that it was a little man from the moon. During session 2 in the same group one of the other participants (female, in her 70s), participant B, refused to interact with the robot, causing the participant A to withhold her attention for the robot. However, in the final session, when the participant B no longer refused to interact with the robot, participant A went back to interacting with the robot without reservations.

- During session 2 in group 1, one of the participants (male, in his 60s, severely impaired vision, usually shy and quiet) started talking about his youth upon hearing a rock 'n roll song. While talking about memories popping up, he started

to roll up his trousers, because that was fashionable back then. Another participant (female, in her 70s) got up from her chair and started to twist to the music, while everyone else was clapping. The male participant was visibly moved by it all, while saying "Who would've thought we could still have an experience like this together?"

- During session 2 in group 2, one of the participants (female, in her 70s, severely impaired vision) started to cry upon hearing a rock 'n roll song. She explained that she used to dance to this song together with her husband, who recently passed away. People in the group comforted her and talked with her about her husband, how they used to dance, and how they met.

- During session 2 in group 2, one of the participants (female, in her 80s) was triggered by a song from right after the Second World War. Everyone else was happy to hear the song, as it reminded them of a liberated nation, but this lady was sad to hear it, because it reminded her of her Jewish father who was killed right before the liberation, and of the years thereafter when her family was struggling to make ends meet.

- During session 2 in group 2, one of the participants (male, in his 80s) was triggered by a song from Indonesia, where he had been stationed right after the war. It reminded him of his time there; he talked about the islands.

- During session 2 in group 3, one of the participants (female, in her 60s) got emotional upon hearing a country song. She explained that she used to dance to this song together with her husband, who passed away a few years ago. She explained that she was happy to hear the song again, and that it made her think of her late husband.

6.2 MiDAS Scores

A repeated measures analysis was conducted to analyse the outcomes of the MiDAS questionnaires, consisting of five Visual Analogue Scale (VAS) items: Interest, Response, Initiation, Involvement, and Enjoyment. All experiment results and all measurements are independent of each other. For each variable, the mean, minimum, median and maximum values were also calculated.

Table 6.2: Results of the repeated measures analysis

Test	F	p	effect	power
Multivariate	1.527	.248	.370	.375
Univariate Interest	6.480	.021	.276	.670
Univariate Response	1.942	.181	.103	.260
Univariate Initiation	.967	.339	.054	.153
Univariate Involvement	1.050	.320	.058	.162
Univariate Enjoyment	3.038	.099	.152	.376

The results of the multivariate analysis (see Table 6.2) show no significant differences before and during the sessions for the MiDAS scores ($F(1,17)=1.527$; $p>.05$). Even though the overall MiDAS scores were higher during the sessions ($M=7.72$; $SE=.52$) than before the sessions ($M=6.62$; $SE=.42$) (also see Table 6.3), this effect is not statistically significant. Examination of the failed identification of any effects showed that the power of the test was low ($\beta=.375$). Looking at the univariate tests, we see that there seems to be an effect on interest and possibly enjoyment, but this is merely a trend that deserves additional investigation in future studies with more power.

Table 6.3: Means (SEs) of the MiDAS forms

Dependent variable	before session	during session
Interest	6.36 (.45)	7.91 (.45)
Response	6.87 (.43)	7.85 (.48)
Initiation	6.48 (.48)	7.27 (.64)
Involvement	6.82 (.49)	7.69 (.57)
Enjoyment	6.58 (.53)	7.89 (.61)
Overall	6.62 (.42)	7.72 (.52)

In all cases, the "during" session was higher on average than "before" session (see Table 6.3) so findings are in line with the original hypotheses.

6.3 Interviews

After the third week, the ACs were approached for an additional interview. Two of the four ACs were interviewed, the first through email and the other over the phone.

The first AC to respond to the interview request was one of the ACs in group 3. She had been present during sessions 2 and 3. She mentioned that the two sessions were very different, and that the atmosphere in the group was very important for the success of the activities. She said that, with the exception of one person, everyone in group 3 liked the sessions with the robot. She pointed out that peo-

ple mostly paid attention to the robot at the start of the sessions, but after a while people started to interact with one another more than with the robot. She also mentioned the need for the ACs to keep motivating and stimulating the people in the group, and stressed that such interaction with the ACs is really needed to keep the activities going. The AC mentioned that people paid attention to the exercises, but that at times people had trouble following the movements. She also noticed that during reminiscence people initially addressed their song requests to the robot, but once they noticed that the robot does not understand them, they addressed their questions to the researchers and ACs. She also pointed out that the reminiscence activity really triggered the PwD; people started to clap, sing, and dance. One of the ladies moved her fingers across the table as if it were a piano, and other people were clapping to the rhythm of the music. The AC also mentioned that most people really appreciated the final activity, bingo, although most of them needed help from the ACs because many of them did not recognise the artists on the pictures (this might also be due to impaired vision). She also noticed that, during the bingo session, people paid less attention to the robot (were less mesmerized by the robot), as they were more involved with the activity itself. Furthermore, she mentioned that one of the participants got scared by the robot when it suddenly started to talk after having been quiet for a while.

The second AC (group 1, present throughout all sessions) reflected on the sessions as follows. She looks back at both the first and third session as having been a great success, yet the second session not so much (as previously described in the observations, one of the participants refused to interact with the robot, thereby influencing the group as a whole). The AC mentioned that in her view, the exercise activity had no added value to the interactions with the robot, stressing that the robot should mainly serve the purpose of conversational interaction. In her opinion, the music has the most added value - music triggers people to talk about themselves and to remember their youth. She stressed the importance of having the ACs present during the activities to guide the activities and stimulate the people. However, she did think that the robot could be of added value, especially if it could be programmed by the AC in advance. The robot could take charge of the activities, so the ACs could pay closer attention to the people in the group and guide the group dynamics. She mentioned that the robot should have a less monotonic voice and that it was sometimes difficult for people to process what the robot said. However, she reported that after two weeks people were still able to recall the robot visiting the group, but they did not remember listening to music together, nor the singing and dancing. Lastly, she pointed out that people's responses to the robot varied and changed over time along with people's moods and the atmosphere in the group.

CHAPTER 7

Discussion and Conclusion

In this chapter, we summarize, discuss and interpret the results of the study, in light of each other and of the relevant scientific literature, producing answers to the research questions. As discussed in the theoretical background, music plays an important role in the lives of elderly people with dementia. It can stimulate the emotional, cognitive, physical and social activities. On the other hand social robots have also started to show great potential in supportive roles in health care. In combination with music social robots could address some of the social and recreational needs of PwD. That is why the study in this thesis aimed to investigate how to improve the social, affective, cognitive, and physical well-being of people with dementia with the use of a musical e-Partner in the form of a robot.

7.1 Interpretation of the Results

7.1.1 Experiment design

The experimental setup is an important factor determining how the results of the experiment turn out. So we will now look at the experimental setup of this research and see if there are elements of this setup that might have a negative or positive effect on the results. Some of these factors have to do with the design of the experiment, other factors are unforeseen issues with the robot or the experimental setup.

To investigate how a robot can contribute to the social, affective, cognitive and physical well-being of people with dementia in a real world setting, we performed a 3 weeks experiment in a meeting center for PwD. The influence of using a robot to support PwD in joint music activities was tested using observation forms and the MiDAS scales that contain five variables: interest, response, initiation, involvement and entertainment.The observational scoring forms were created to structure the observations of interaction between the robot and the participants. The MiDAS questionnaire was selected because the five variables measure key areas that joint music activities might impact.

While the results from the MiDAS forms don't give definitive evidence for the effects (Table 6.2), a positive trend is visible in the data (Table 6.3). One of the possible reasons why the effects were not significant is that when designing the experiment we opted to have the MiDAS forms filled in for only two participants in each session, in order to keep the workload of the activity coordinators to a minimum. It was left to the discretion of the activity coordinators to select for which participants to complete the MiDAS form. After gathering the data from the forms an unexpected pattern became apparent; almost all of the activity coordinators selected to report the results of a participant that had a positive experience and one that had not. However, we cannot be sure if any of the two reported scores is representative of the whole group.

7.1.2 Running the experiment

While the experiment was run, some unexpected things happened which could have had an effect on the results of the experiment. The Exercise and Bingo activities were fully automated but the Reminiscence activity was partially scripted and the dialogue was controlled by a Wizard of Oz (WoZ). If the dialogue controlling wizard of Oz could respond quickly to the responses of the participants the interaction would feel natural and without interruptions. But sometimes the participants asked things of the robot that were not included in the script, sometimes they asked things the WoZ could not understand (due to limited knowledge of the Dutch language) or they asked the robot to play a different song. To respond to these requests the wizard of Oz had to manually change the songs and select the text the robot had to say. As a result of this, the robot was quiet while the wizard was performing the changes. This could break the illusion of the experiment because the robot did not seem to respond very well to the participants.

Another factor that could have disturbed the interaction with the participants were some technical issues with the robot. Especially during Session 1 with Group 2, the robot did not function properly and fell twice during the Music & Exercises activity. To resolve this problem, one of the researchers had to step in, pickup the robot and set it upright again. This action required the researcher to restart the robot. When the robot restarted, it moved to its initial position so the researcher had to adjust it to continue were it left off. This procedure took some minutes and during that time the robot was silent and not responding. This interruption caused a lot of concern to the participants about the welfare of the robot, they seemed to treat it like a real person that could hurt itself, but it also broke the illusion about its intelligence and reliability.

An additional unforeseen issue was that while specific instructions were given to the activity coordinators with regards to the introduction of the robot, the activities, and the overall interaction, not all of them followed them at the same level or in some cases some might have been overenthusiastic. So this is also something that could have affected the overall results. During the experiments the researchers also noticed that the mood and overall atmosphere of the group was of importance since it affected not only the interaction with the robot, but the overall willingness to participate in the activities.

7.1.3 Limitations of the experiment

The experiment was done with 30 participants, 4 professional caregivers, and 4 volunteers. This is not a very large sample size to measure such subtle effects. The experiment was also done for a short period of time, only 9 occasions in 3 weeks and only two MiDAS forms were collected in each of these occasions.

In addition, during the study no direct feedback was asked from the people with dementia (e.g. in the form of a final interview or questionnaire). Prior investigations with professional caregivers indicated that open questions as well as written ques-

tionnaires are difficult to answer for people with dementia. And so as we were unsure whether people would be able to answer questions about their experiences with the robot, the decision was made to use observations and caregivers' perceptions instead. Throughout the sessions, the robot did ask on various occasions whether people were having a good time and if people wanted to hear another song. Most people responded affirmative and happy to such questions: (loudly) saying: "Yes!" to the robot. However, there are not sufficient data to prove the hypothesis.

After the end of the experiment, interviews were planned with the activity coordinators to discuss their feedback. Unfortunately, there was limited response and only two out of the four activity coordinators replied to the request for an interview. This limits significantly the different perspectives and feedback we received.

7.2 Revisiting the research questions

The goal of the observational study was to find answers to five research questions, as introduced at the beginning of Chapter 5. These will now be discussed one by one.

(a) Does the robot have a positive effect on people's affective state?

The observations show that interacting with the robot - and particularly the music during reminiscence - evoked both positive and negative emotions in PwD. The outcomes of the MiDAS scale suggest there might be a positive effect on people's interest and enjoyment, but this cannot be concluded from this study because of the low power. Additional studies are needed to get a clear answer to this question.

(b) Does the robot have a positive effect on people's physical activity?

The observations indicated that people became physically active when stimulated by the robot and the music. However, the physical exercises as they are now were not equally well appreciated by all participants. Even though most people engaged in the exercises, responses from the ACs lead us to question the enjoyment of the exercise activity by the PwD. Possibly, the robot could stimulate people to move by inviting them to dance instead of engaging in structured exercise classes. Another option is to review the exercises and slow them down, and to improve the robot's voice so it speaks more clearly and less monotonously.

(c) Does the robot have a positive effect on people's cognitive activity?

The observations showed that the reminiscence and bingo activities stimulated people to be cognitively active: people were triggered to recall facts from their past and to remember lyrics to the songs, artists names and faces. Also people appeared to experience this as motivating and fun.

(d) Does the robot have a positive effect on people's social interaction?

The observations indicated that when interacting with the robot - especially during the reminiscence activity - people also interacted with one another and told each other stories about the past. However, these interactions were mainly stimulated by the music and by the questions posed by the ACs. The robot is currently not able to keep up with the dynamics of the conversation, causing it to reply to people's utterances only after the conversation has moved on to a new topic, thereby interrupting the flow of the conversation.

(e) Do the effects/interactions change over the course of three sessions, and if so, in what way?

Over the course of the three sessions, people talked less to the robot, and engaged more with each other. Furthermore, people paid less attention to the robot, and became more interested in the music, singing, clapping, and dancing, and talking about the music with each other and the ACs. Interesting to note is that people who did not like the robot and the activities displayed declining interest levels after the first session; some of them decided to no longer participate in the study. The people that liked the robot, however, displayed continuously high interest levels for the duration of the evaluations.

7.3 Future Work

Our findings indicate that robots can support and enhance the activities of healthcare professionals in practice. These results provide no proof of the effects though. So to be sure that there are positive effects in the social, affective, cognitive, and physical well-being of the PwD, more experiments have to be conducted to confirm them. These can be experiments that replicate the experiment done in this study, or completely new experiments that try to investigate similar effects. To begin with, improvements for similar experiments will be discussed. After this, possible future research in related topics that can use the results of this research as a basis will be mentioned.

7.3.1 Improvements for future experiments

The evaluation studies were prepared with great with great care to make sure that everything would work as planned to get the best results possible. However there were still some unforeseen elements causing the experiment to divert from the planned procedure. We will discuss these elements here so other research on the topic of robotic e-Partners for people with dementia can benefit in the future.

Instructions

The instructions for activity coordinators used in the experiment also have a small

impact on the way the ACs interpret and respond to the activities proposed by the robot. The experiment done in this research tried to instruct activity coordinators to encourage participants to interact with the robot in a subtle way, by interacting with the robot themselves. In some cases the instructions were misinterpreted by the activity coordinators resulting in them being either too “insisting" that people participate or not encouraging them at all. Only a couple of them were able to lead by example and perform the subtle encouragement that was asked of them. It would be a good idea to test the interpretation of the instructions by the activity coordinators and give feedback to them before running the experiment.

Activities

The activities of the experiment were designed with the idea of adapting existing activities to create appropriate and fun joint music activities for people affected by dementia. In the exercises activity the ACs reported that people had sometimes trouble following the movements and speech of the robot, so an idea for future experiments would be to include more dance movements instead of structured exercises and modify the voice of the robot so it is less monotonic and more clear. Furthermore the Reminiscence activity relied on a Wizard of Oz which cause the robot to be slow in its responses. It would be beneficial to have a conversational module that would allow the robot to ask questions and reply to them on its own.

Measures & Sample Size

The evaluations studies performed in this research showed no significant effect on most variables, and only an indication of an effect on Interest and Enjoyment. Some factors that could explain our results were discussed previously. This experiment was done with 30 participants, this is not a very large sample size to measure an effect. So it might be that the effect on social, affective, cognitive, and physical well-being is present, but it is not shown as significant in this experiment because of the small sample size. Another thing that could greatly improve the results is strengthening the measures. By completing MiDAS forms for all the participants there will be more objective effects for the whole session. Also, adding a second rater for the video coding sessions will remove any bias and improve the reliability of the results.

7.3.2 Related Future Research

In order to develop social robots that support and enhance the activities of healthcare professionals in practice, situated co-design studies need to be conducted investigating how people in practice interact with social robots, and what they expect of them. This study investigated the use of a social robot in the dementia care practice and revealed useful insights in the requirements of a social robot engaging in group activities with patients. The outcomes suggest that especially the reminiscence activity was much appreciated. However, people expected the robot to be capable of natural language interaction, and were disappointed when this was not the case. Future research therefore should entail extraction of topics and generic conversational

structures to be used by the e-Partner to engage more accurately in conversations during reminiscence. In addition, the e-Partner could be extended with a module supporting speech-based music retrieval.

7.4 Conclusion

In this thesis the design, implementation and evaluation of a robotic e-Partner that engages people with dementia (PwD) in joint activities with music were described. The outcomes of the study suggested that the robotic e-Partner could provide useful and suitable support for group activities in the meeting centres, especially if it were able to take charge of the procedural part of initiating, explaining, and coordinating group activities. Observations showed that the robotic e-Partner and its music-related group activities stimulated the PwD physically, cognitively, emotionally, and socially. However, in order to better suit the dementia care practice at the meeting centres, the e-Partner should be able to play songs upon request, and respond to simple questions. Other requirements elicited through this study are that the robot should have a less monotonous voice, speak more slowly, and perform its movements - especially during the exercises - more clearly.

This project has contributed to the research into human-robot interaction for people affected by dementia. It has shown promising indications that musical robot e-Partners can lead to an improvement in the social, affective, cognitive, and physical well-being of people with dementia. There aren't any conclusive proofs for those effects though, but indications of the existence of the effects are there. Future research has to improve the technical aspects of the e-Partner and prove whether the positive effects are indeed present. The results of this research can be an interesting starting point for more extensive research in assistive music e-Partners for elderly people with dementia.

Appendices

APPENDIX A

Interview Questions for Patients

A.1 Introduction

I want to thank you for taking the time to meet with me today.
My name is Ismini Psychoula. I am a Master's student at TU Delft and I am currently working on my thesis investigating music for elderly people. My supervisors are Prof. Neerincx and Dr. Peeters. Specifically I will be studying how technology in combination with music can improve the wellbeing of elderly people and I would like to discuss your experiences with music.
The interview should take about 30 minutes. If it is ok with you, I will be taping the session because I don't want to miss any of your comments. Once the interview is finished I will transcribe your answers and delete the original audio recording. All responses will be kept confidential and anonymous. This means that your interview responses will only be shared with my supervisors and we will ensure that any information we include in our report does not identify you as the respondent. You don't have to talk about anything if you don't want to and you may end the interview at any time. Also you may request your data be deleted at any time.
Are there any questions about what I have just explained? Are you willing to participate in this interview?

A.2 Questions for Patient

Part I: "Settling in" questions
- What is your name?
- Nice/awful weather today - chat about travel to the interview location
- What are your hobbies?

Part II: Music Meaning
- Do you enjoy listening to music?
- What is your favorite
  - Kind of music?
  - Song?
  - Artist?
- Did you play and instruments at any point in your life?
  - If yes, what instrument?
  - If no, would you be interested in playing an instrument?
  - And how about singing?
- What does music mean to you?
- Are there any songs that have a special meaning to you?
  - What is this meaning?
  - Are there other people who share this memory/special meaning to the song?
- Are there any songs that strongly remind you of your loved ones?
- Are there songs that remind you of specific times in your life?

Part III: Music Use
- Has your condition influenced the way you listen to music?
  - When did you listen to music before?

    - When do you listen to music now?
- Do you engage in musical activities? For instance moving to music, or singing, clapping, dancing?
    - If Yes,
        - What do you think of it?
        - How do you feel after the music activity? (e.g singing)
        - Has being involved in this music activity made any changes in your life?
    - If No, would you be interested in music activities
        - Which ones would you like to have (singing, dancing, exercise)
        - How do you listen to music now?

Part IV: Technology

- When listening to music do you use any sort of technology aids such as mp3 or cd players?
    - If yes,
        - Do you find them easy to use?
        - Are there any problems?
    - If no,
        - Would you like to use them?
        - In what setting?
- Do you use mp3 or cd players during any activities?
    - If yes,
        - What activities?
        - Do you use them alone or with assistance?
    - If no,
        - Why not?
        - If an easy solution was available would you like to use it?
        - During what activities?
- How do you choose the songs?
    - Alone or with assistance?
    - What are the factors for the selection (mood, favorite artist, etc)?
- Do you have any further comments or questions for me?
- Do you want to be updated about the study, and if so how can I reach you?

A.3 Questions for family member

- Did your relative have any musical therapy or activities?
- Do you observe any changes during music activities in your family member?
- How do you know when music is meaningful to the person?
- Are there any activities that are preferred more than others?
- Do you have any additional comments to share?

APPENDIX B

MiDAS Questionnaire

B.1 English Version

MiDAS

Music in Dementia Assessment Scales

Version 6

Name:	**Time:**
Completed by:	**Date:**

MiDAS (Music in Dementia Assessment Scales) aims to assess if there have been changes in the wellbeing of a person with dementia participating in Music Therapy. Both staff and therapist complete **two forms each per session** to evaluate the potential changes. MiDAS uses Visual Analogue Scales; the 'Highest' score on the scale should be set as **the optimum level the individual can achieve**. This means that each individual will have a unique set of 'Highest' levels for each category.

Instruction for Staff

It is important **the same staff member completes both forms on the same day.**

1. Before form should be completed **before** the person's music therapy session. Please take a moment, reflect on the person's **wellbeing today** and decide the **average rating** for each item below and mark clearly with a vertical line on the scale.

2. After form should be completed **several hours after** the person's music therapy session **on the same day.** Rate the person's **average wellbeing after today's session.**

If you are a staff rater, indicate which rating this is:

1. Before ☐ **2. After** ☐

Instruction for Music Therapist (MT)

Both forms should be completed immediately after the session.

1. Beginning form should be completed based on the observation of the person during **the first 5 minutes** of the music therapy session. Decide the **average rating** for each item below and mark clearly with a vertical line on the scale.

2. During form should be completed based on the observation of the person during **the clinically most significant 5 minutes** of that session.

If you are a music therapist, indicate which rating this is:

1. Beginning ☐ **2. During** ☐

Order of rating:

Staff rating 1 (Before) > MT rating 1 (Beginning) > MT rating 2 (During) > Staff rating 2 (After)

If the person appeared asleep for most of the time, do not score question 1-6, but continue to question 7.

1. Levels of Interest in objects/activities/people around him/her **(attention)**. For example:

- Did he/she show his/her **interest in an activity** or **other people** around him/her?
- Did his/her **posture** or **facial expression** change if activities or music catch his/her attention?
- Did he/she become **animated** if activities or music catch his/her attention?

SCORE

None at all 0 —— Highest 100 ☐

2. Levels of Response in communication/activity **(awareness, interaction)**. For example:

- Did his/her **facial expression** or **body-movements** indicate his/her awareness of staff or therapist?
- Did he/she make **eye-contact** with staff, therapist or other group members?
- Did he/she join in **conversation**, **music making** or make **vocal sound**?

None at all 0 _____ Highest 100 ☐

3. Levels of Initiation in communication/activity **(intention)**. For example:

- Did he/she **try to communicate** with staff, therapist or other group members?
- Did he/she **start conversation, start music making,** or **initiate vocalisation**?
- Did he/she talk about his/her life experiences (**reminiscence**) or **mention music** meaningful to them?

None at all 0 _____ Highest 100 ☐

4. Levels of Involvement in communication/activity **(participation)**. For example:

- Did he/she become **engaged** in conversation, music making, or any forms of communication?
- Did he/she show his/her **enthusiasm** in activities that interest him/her?

None at all 0 _____ Highest 100 ☐

5. Levels of Enjoyment during communication/activity. For example:

- Smiling, laughing, **brighter mood**
- **Playfulness**, sense of humour
- **Relaxed** mood

None at all 0 _____ Highest 100 ☐

*SCORE: A numerical score can be added by measuring the distance from **'None at all' to your mark** with a ruler. Record the score in the box for each VAS (e.g. 60mm as '60'). **Each line needs to be exactly 100mm** for evaluation purposes.*

6. During this period of time did you notice any ***major reactions*** *from the person?*
Indicate if only major reactions are observed. Use this list as supplementary information to the five VAS.

Agitation/aggression	☐	**Relaxed mood**	☐
Withdrawn/low in mood	☐	**Attentive/interested**	☐
Restless/anxious	☐	**Cheerful/smiling**	☐

7. Any comments?

B.2 Dutch Version

MiDAS

Music in Dementia Assessment Scales

Version 1

Groep:	Tijd:
Naam observeerder:	Datum:

MiDAS tracht vast te stellen of er veranderingen in het welzijn van personen met dementie optreden als gevolg van deelname in muziektherapie. Stafleden vullen per sessie twee formulieren in om de mogelijke veranderingen te evalueren. MiDAS gebruikt hiervoor zogeheten Visuele Analoge schalen: de ` hoogste' score op de schaal kan worden gezien als de het optimale niveau dat een individu kan bereiken. Dat betekent dat elk individu een unieke set van ` hoogste' niveaus heeft voor elke categorie (niet alle mensen zijn hetzelfde).

Instructie voor de staf

Het is belangrijk dat hetzelfde staflid de formulieren invult voor en na de muzieksessie. Neem een moment om te reflecteren op het welzijn van de individu voorafgaand aan de sessie, en geef een gemiddelde rating voor elk item door een verticale lijn op de schaal te plaatsen. Na afloop van de sessie vult u het formulier opnieuw in met in uw achterhoofd de meest relevante 5 minuten tijdens de sessie.

Geef hier aan om welke warneming het hier gaat:	☐ Voorafgaand aan sessie	☐ Tijdens sessie

1. **Mate van interesse** in objecten/activiteiten/mensen. Bijvoorbeeld:
   Interesse in activiteiten en/of andere mensen
   Houding en gezichtsuitdrukking wanneer activiteiten of muziek de aandacht trekken
   Opgewektheid wanneer activiteiten of muziek de aandacht trekken

   Score

   Geenszins ——————————— Hoogste ☐

2. **Mate van responsiviteit** in communicatie/activiteit (oplettendheid, interactie). Bijvoorbeeld:
   Gezichtsuitdrukking of bewegingen die aangeven dat iemand zich bewust is van andere mensen
   Oogcontact met andere mensen
   Meedoen in gesprekken, het maken van muziek, of stemgeluid

   Score

   Geenszins ——————————— Hoogste ☐

3. **Mate van initiatief** tijdens communicatie/activiteit (intentie). Bijvoorbeeld:
   Pogingen te communiceren met anderen
   Starten van een gesprek, het maken van muziek, of het aangaan van stemgeluid
   Praten over levenservaringen (reminiscentie), of het noemen van de betekenis van muziek

   Score

   Geenszins ——————————— Hoogste ☐

4. **Mate van betrokkenheid** bij communicatie/activiteit (deelname). Bijvoorbeeld:
   Betrokken bij gesprekken, muziek maken, of andere vormen van communicatie
   Tonen van enthousiasme bij activiteiten die hem/haar interesseren

   Score

   Geenszins ——————————— Hoogste ☐

5. **Mate van plezier/genieten** tijdens de communicatie/activiteit. Bijvoorbeeld:
   Glimlachen, lachen, verbeterd humeur

Speelsheid, gevoel voor humor
Ontspannen stemming

Score

Geenszins ——————————————— Hoogste ☐

6. Heeft u tijdens deze periode nog enkele belangrijke reacties waargenomen?
Geef enkel aan of u grote reacties hebt geobserveerd. Gebruikt u deze lijst ter aanvulling op de vijf visuele analoge schalen.

- ☐ Agitatie/agressie
- ☐ Teruggetrokken/lage energie
- ☐ Rusteloos/angstig
- ☐ Ontspannen stemming
- ☐ Aandachtig/geïnteresseerd
- ☐ Vrolijk/lachend

7. Heeft u verder nog opmerkingen?

APPENDIX C

Observation Scoring Form

	Observation							Notes
One min Observation Segment		Activities						
	Participant	Moving along with the music, singing, clapping, laughing	Talking to robot, talking to other people, touching other people. Making eye contact	Smiling, silently enjoying music, introvert enjoyment, crying	Being restless, disturbed by the environment, not paying attention	Agitated, crying, fearful, shouting, angry	Closed eyes, dozing	
Robot does…								
Time 0	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
Time 1								
Time 2								
Time 3								
Time 4								
Time 5								
Time 6								
…								

APPENDIX D

Consent Form

Geïnformeerde toestemming betreffende het onderzoek "De muzikale ePartner". Dit onderzoek wordt uitgevoerd door Ismini Psychoula onder toezicht van dr. M.M.M. Peeters en prof. M.A. Neerincx van de Technische Universiteit Delft.

Ondergetekende,

Naam: .....

Geb. Datum: .....-.....-.....

verklaart hierbij vrijwillig deel te nemen aan het huidige onderzoek, geleid door mevr. I. Psychoula, dr. M. Peeters, en Prof. dr. M. Neerincx.

- Ik begrijp de bedoelingen van het onderzoek en de daarbij gevolgde aanpak. Eventuele vragen van mijn kant zijn door de onderzoeker beantwoord. Ik ben tevreden met de gekregen uitleg.

- Ik weet dat het onderzoek in totaal 4-5 weken zal duren en dat ik tijdens het onderzoek meerdere keren zal deelnemen aan een sessie van ongeveer 45-60 minuten.

- Ik weet dat de onderzoeker de sessies zal bijwonen om de interactie met de robot te observeren, aantekeningen te maken, en mij te interviewen over mijn ervaringen tijdens de sessie.

- Ik weet dat de sessies zullen worden opgenomen met een video camera.

- Ik weet dat er te allen tijden een professionele zorgverlener aanwezig zal zijn ter ondersteuning van de onderzoekers.

- Ik weet dat ik tijdens het onderzoek op elk moment kan aangeven dat ik wens te stoppen met het onderzoek, zonder opgaaf van reden.

- Ik weet dat de proefleider mijn deelname aan het onderzoek op elk gewenst moment kan beëindigen als hij/zij dat nodig vindt, zonder opgaaf van reden.

- Ik verklaar dat er - voor zover ik weet - geen belemmeringen voor mij zijn om aan het onderzoek deel te nemen.

Tevens verklaar ik dat ik toestemming geef voor de volgende zaken:

- De video-opnames van de sessies zullen gebruikt worden om naderhand de geschreven notities aan te vullen. De opnames zullen niet voor andere doeleinden gebruikt worden. Zonder mijn toestemming voor verder gebruik, zullen de opnames gewist

worden zodra de aantekeningen zijn aangevuld.

- Na afloop van het onderzoek mogen de onderzoekers mij benaderen met de vraag of korte delen van de video opnames bewaard mogen worden voor gebruik tijdens presentaties over het onderzoek, om andere onderzoekers te laten zien hoe de sessies verliepen. Ik weet dat ik in zulke gevallen toestemming kan weigeren zonder opgaaf van reden, en dat de opnames dan verwijderd zullen worden.

- Er zal anoniem verwezen worden naar resultaten uit de studie, bijvoorbeeld in de wetenschappelijke rapportage over het onderzoek. Op geen enkele wijze zullen derden de gerapporteerde resultaten naar mij kunnen herleiden.

- De anonieme gegevens van dit onderzoek zullen voor onbepaalde tijd op veilige en versleutelde wijze bewaard zullen worden.

- De onderzoekers zullen mijn contactgegevens op beveiligde wijze bewaren, zodat zij mij, indien nodig, in de toekomst nogmaals kunnen contacteren.

- Ik weet dat de proefleider mijn deelname aan het onderzoek op elk gewenst moment kan beÃńindigen als hij/zij dat nodig vindt, zonder opgaaf van reden.

Zoetermeer, ...-.....-2016

Handtekening deelnemer: .....
In te vullen door Proefleider

Ik heb mij ervan overtuigd dat deze deelnemer voldoet aan de selectiecriteria om aan bovengenoemd experiment deel te mogen nemen.

Zoetermeer, ...-.....-2016

Handtekening proefleider: .....

APPENDIX E

Questions for Formal Caregivers

E.1 Questions - English Version

The interview questions were posed throughout and at the end of the activities, in an open setting, and in the group, to be answered by the activity coordinator and/or the visitors. The interview questions were based on the Almere model, and were posed either in a “natural" way to keep the flow of the activity sessions going or after the end of the experiment to the formal caregivers.
Example questions were:

1. Anxiety
   Would you be afraid to use the robot on your own?(break it/make mistakes)
2. Attitude towards technology
   Do you think the robot makes activities more interesting? Do you think it’s a good idea to use the robot?
3. Facilitating Conditions
   Do you feel you know enough to use the robot?
4. Intention to use
   Would you like to keep using the robot?
5. Perceived adaptiveness
   Do you think the robot will be able to adapt to your needs?
6. Perceived Enjoyment
   Do you enjoy doing activities with the robot?/ Do you find the robot enjoyable?
7. Perceived ease of use
   Do you think you could easily use the robot?
8. Perceived Sociability
   Do you think it is pleasant to interact with the robot?
9. Perceived Usefulness
   Do you think it is convenient to have the robot for the activities?
10. Social Influence
    Do you think other people would be pleased if you use the robot?
11. Social Presence
    Do you feel like sometimes the robot is a real person, e.g. has real feelings, or is really looking at you?
12. Trust
    Would you follow the advice the robot gives you?

E.2 Questions - Dutch Version

- Zou je het spannend vinden om de robot alleen te gebruiken? (kapot maken, of fouten maken)
- Vind je de robot eng?
- Maakt de robot activiteiten interessanter?
- Denk je dat het een goed idee is om de robot te gebruiken?
- Heb je het idee dat je genoeg weet om de robot te kunnen gebruiken?
- Zou je de robot willen blijven gebruiken?

- Denk je dat de robot in staat is zich aan te passen aan je wensen?
- Vind je de activiteiten met de robot leuk?
- Vind je de robot leuk?
- Vind je het plezierig om dingen te doen samen met de robot?
- Vind je het handig om een robot te hebben voor deze activiteiten?
- Denk je dat andere mensen er blij mee zijn als je deze robot gebruikt?
- Krijg je het gevoel dat de robot een echt persoon is? Dat hij gevoelens heeft, of dat hij je aankijkt?
- Zou je de robot vertrouwen als hij je advies geeft?
- Zou je zijn advies opvolgen?

APPENDIX F

Instructions to Formal Caregivers

F.1 Dutch Version

Algemene instructies voor tijdens het onderzoek:

- Introduceer de robot en de activiteit voorafgaand aan elke activiteit.
- Tijdens de activiteiten is het de bedoeling dat de deelnemers gekalmeerd worden, en dat zij zich zo veel mogelijk op hun gemak voelen.
- Benadruk dat het doel van het onderzoek is om de robot te beoordelen, niet de mensen zelf.
- Doe mee met de activiteiten zoals je dat normaal ook zou doen.
- Toon enthousiasme (indien van toepassing), interesse, en compassie voor de mensen en de activiteiten waarin zij verwikkeld zijn.
- Grijp in wanneer de groep zich niet lekker dreigt te voelen, en moedig mensen aan om te praten, te bewegen, actief te zijn, en sociaal met elkaar om te gaan.
- Motiveer mensen om met de robot te interacteren.
- Hou in gedachten dat de nadruk van alle activiteiten is om een leuke tijd met elkaar te hebben en om actief te blijven op allerlei manieren.
- Om ook een beeld te krijgen van het effect op bepaalde individuen, zouden we u willen vragen om voorafgaand en na afloop van de sessie voor twee personen in de groep een vragenlijst in te vullen. De vragenlijst bestaat uit 7 items.

De te volgen procedure is als volgt:

- De activiteitenbegeleider introduceert de robot en de activiteit.
- De activiteitenbegeleider begint met de fysieke oefening door een seintje te geven aan de onderzoekers dat het ok is om te starten met de activiteit.
- De onderzoekers starten de robot.
- De robot doorloopt 8 minuten aan lichamelijke oefeningen.
- De activiteitenbegeleider motiveert en enthousiasmeert mensen om mee te doen met de robot en doet zelf ook mee met de oefeningen.
- Als de oefeningen klaar zijn, wachten de onderzoekers voor het signaal van de activiteitenbegeleider om door te gaan met de volgende activiteit.
- De activiteitenbegeleider introduceert de volgende activiteit.
- De activiteitenbegeleider geeft een seintje om de volgende activiteit te starten.
- De onderzoekers starten de volgende activiteit: de reminiscentie activiteit.
- De robot speelt een muzieknummer af.
- Nadat het nummer is afgelopen, instrueert de onderzoeker de robot om een vraag te stellen over het nummer.
- De activiteitenbegeleider stimuleert mensen om de vraag te beantwoorden.
- De robot herhaalt deze activiteit voor 10 minuten.
- Nadat de activiteit is afgelopen, wachten de onderzoekers voor het signaal van de activiteitenbegeleider om door te gaan met de volgende activiteit.
- De activiteitenbegeleider introduceert de volgende activiteit.
- De activiteitenbegeleider deelt de vooraf gemaakt bingo kaarten uit en de stampers/markers.
- De activiteitenbegeleider geeft een seintje aan de onderzoekers om de

volgende activiteit te starten.
- De onderzoekers starten de volgende activiteit: muziekbingo.
- De robot speelt 30 seconden van een liedje af.
- De robot vraagt de mensen om hun kaarten te markeren als zij de artiest en de titel van het nummer herkennen.
- De robot herinnert mensen eraan om bingo te roepen als zij 2 (of 3) in een rij hebben.
- De activiteitenbegeleider controleert de kaarten om te zien of iemand bingo heeft.
- De robot kondigt het volgende nummer aan.
- Dit wordt herhaald tot er 4 of 9 nummers gespeeld zijn.

Voor de zekerheid is er ook een veiligheidsprotocol voorbereid. Het veiligheidsprotocol is als volgt: Wanneer er onvoorziene problemen zijn (bijvoorbeeld de groep raakt overstuur, of mensen raken geagiteerd) dan zullen de onderzoekers de activiteitenbegeleider vragen of het nodig is om de sessie stil te leggen. Als de activiteitenbegeleider instemt, zal de sessie direct gestopt worden, met een bijbehorende uitleg waarom we stoppen met de sessie. Andersom kan de activiteitenbegeleider ook op elk moment aangeven dat het beter is om met de sessie te stoppen.

APPENDIX F

Interview Transcript

F.1 Field Research

The purpose of the field research was to gain a 'deeper' understanding of the situation and elicit the requirements of the system in a real-world environment with patients and their (in)formal caregivers. The field study consisted of an interview with a PwD and his informal caregiver. We intended to interview more people but because the inclusion criteria was for the person to speak English it was difficult to find more participants. It should also be mentioned that prior to interview TU Delft's Human Research Ethics Committee had granted approval for the interviews. For the interview participants were instructed to bring their legal guardian to accompany them during the interview and to provide informed consent. They were interviewed about the role of music in their lives, their daily routines, the problems they face, and how music might give them some relief, and what are the biggest obstacles for them to listen to music as much as they'd like and in the way they'd prefer. Through the interview took place in the home of the interviewees and it was taped and transcribed. This arrangement did not occur as a result of any specifications from either party, but was agreed unanimously assuming that it would be preferable for all concerned.
The field research started with an interview with the dementia patient and their family member to discuss their relationship with music and their needs but also try and figure out additional requirements that should be taken into account in the design of the e-Partner. The interview was a semi-structured one and the questionnaire involved questions about the role of music in the participant's life, their use of and familiarity with technology, and how their illness has affected (and still affects) their music activities, daily lives, and routines. A set of questions was devised which was divided into categories (See Appendix A). Closed questions were avoided wherever possible.

F.2 Summary of the Interview

The interview began with the researchers introducing themselves and explaining the purpose of the visit. They requested permission to record the interview and emphasised that the interviewees, were at liberty to terminate the interview at any time, or to decline to be recorded, without the need for justification. An indication was also given of how long the interview could be generally expected to last and the interviewees where asked to sign consent forms.
Nick (not his real name) is 75 years old, speaks English and suffers from Alzheimer's disease. During our interview he mentioned he enjoys playing table tennis, while his narrative focused to his favorite type of music which is Calypso songs. Also during the interview he reminisced about how popular Calypso music was in the West Indies and that it had very nice dancing songs. He also mentioned that he used to listen music much more in the earlier days. He mentioned that now he listens to music on the iPad that his wife sets for him but if he had the opportunity he would like to participate in musical activities such as singing and dancing. When asked about a system that would help with their musical recreation

activities the patient's wife said that:
"I think that is great you need to ask him what to listen to, because with his condition he wouldn't be able to go through a lot to select or where is this where is that, that is out. But what you are talking about is the perfect fit for him it would make my job much easier (laughs). It would reduce my stress because sometimes I do forget when I am a bit busy I fail to give the attention of getting things ready for him "

F.3 Full transcript of the Interview

I don't speak Dutch
"How old are you?"
"I'm 75 or 76"
Do you have any hobbies?
"Table tennis is my favorite My eyes are a little bad but I still play I used to be a champion tennis player but I don't go often and I don't know a lot of people that play My wife and I go sometimes but there are not many of them that play at a high standard so it is not very entertaining."
What about music do you enjoy listening to it?
"I listen all the time to music. I listen a lot of pop music in West Indies you know Calypso is the thing Calypso type of songs. Do you know Calypso?"
Interviewer: "No I don't, what is it?"
"Calypso is a beach type song Like Reggae, do you know reggae?"
Interviewer: "Yes"
"Calypso is all the people listen, in the TV it has a beat to it."
Interviewer: "Do people also dance to the music?"
"Yes Calypso is a big dance music, but they do have jazz and balls and quickstep in the West Indies as well.
Guiana people there danced to all types of music, India is very musical in that way so I'm happy that I grew up in a country that has music all the time"
"Do you have a favorite artist?"
"Favorite artist hmm... In the old days there used to be the Calypsonians like Sparrow. You know there used to be this artist called Sparrow and he has known in all the West Indies. (starts singing) "Sparrow said tororo.. tororototo" We used to have everybody in the West Indies listening to Sparrow. There was a melody and another one he was a champion singer." Everywhere he is everyone listened, if he was there live you wouldn't be able to pay for him, he is very good"
"What about any music instruments, do you play the guitar or piano?"
"I plucked the guitar a little bit, not too much, I don't play the piano, I used to play a mouth organ? harmonica? (Researcher not sure about the instrument) and I don't play anything now. My brother has a guitar so he plays the guitar now. But I used to play the guitar regularly at one time but not now. Now I listen to music and so on. But I listen to all types of music and so on and enjoy every type of music.
"What about singing, do you like singing along with songs?"
I don't sing a lot but I sing along with the songs. Especially with the Calypso songs you tend to listen to the words they are difficult to remember you have to hear

them and figure out what the words are. But which words you can remember or work out you sing that. It is very difficult when you are singing the songs with the West Indian language, it is very difficult to work out exactly what words they are saying, but you can get near enough to the words (laughs softly)"

"What does music mean to you?"

Well I've always had music. You know when I was at school every morning the headmaster would come there and play music, mostly classical music, so we had to listen to music every single day at school, so when we were there for about half an hour listening to all types of music the headmaster used to bring out with all the teachers there contributing, and a whole lot of classical music but also Calypsos and other types of music. In our school we are lucky we used to have famous singers, famous musicians and so on they used to come to our school because we had a big hall and beautiful stage and so on so they all used to come to play at our school. Because we were at a school we were all allowed in for free, we didn't have to pay so we were always there and we had all those top musicians from all over the world coming, so we were really brought up with music.

"Are there any songs that you have strong memories of or strongly remind you of your loved ones?"

Not particularly reminding me of people and so on, I just loved the songs and the music all of it, not because it reminds me of anybody else. I don't thing there is any sort of memories and so on.

"What about music that reminds you of specific times in your life?"

Yes I still have Calypso music recording, my wife also is from Suriname they are Dutch they used to have Calypso as well which is more West Indian, but funny enough the Dutch people in Suriname they were like the Guiana people next door. I was British Guiana she was Dutch Guiana so they used to listen a lot and I have a lot of family in Holland and Suriname they play all this West Indian music and Guianese music and so on and it is really a very popular type of music people played in those parts of the world. And as I said with me, I also had classical upbringing with school everyday and music I got to know some classical music Beethoven and Bach and so on you know. So we have a lot of music background.

"What do you think of the classical music do you still like it or do you prefer the Calypso?"

I like all music, I listen to classical music all the time you know, I like to sit down quietly and listen to classical music all the time. But at the same time if there is any Calypso music going I'm there as well and it is good dancing and so on when you go to parties and Calypso's and beach like that. It is really enjoyable everybody dancing Calypso.

"Has the way you used to listen to music changed in comparison to how you listen to music now?"

I used to listen to music a lot more in those days yes, I listened to all types of music in the early days now I depend more on the tapes and records and so on. It is not a lot I don't go out to parties like I used to in the old days, there was a good party every other day, here now I don't think I've been to a party there is nobody inviting me (softly laughs). (Talks to caregiver) "Annika how are you doing, I am boring you aren't I?"

“When do you listen to music now?"
“When is it I listen what?"
(Interviewer clarifies the question: When do prefer to listen to music in the days, evening, weekends)
I listen mostly in the days. My wife mostly plays music as well, she is the one to do it because my eyes are not to good she is the one that takes over playing music. She likes the same type of music that I like. I don’t think she.. She likes the same music I like by large, so whatever she puts on.
“Do you have any other musical activities such as dancing?"
(The wife of the participant returns home and joins the interview)
(Participant talks to his wife) “We were just discussing what type of music you like"
(Wife talks) “He loves music sometimes I put the iPad on, he loves a wide range of music he is really in the 60’s the time when he was young and dancing and having fun that’s music he listens and he becomes sort of lively"
“Would you be interested in having any musical activities such as singing and dancing?"
I would if there were opportunities, if people were having parties with music, dancing and so on yeah I would be very glad to participate. In the West Indies there were parties when I went there and I enjoyed it, since then and for a long time we haven’t been anywhere, have we?
(Wife) No we haven’t been, do you mean to the West Indies?
No, not to any parties
(Wife) No we haven’t been, the last one was about two years ago at my sister’s eightieth birthday.
(Interviewer) That must have been some party!
Yeah her sister was 80, imagine dancing at 80.
“I would also like to ask you if you use any technology aids when you listen to music, your wife mentioned an ipad"
We have CD players but we listen anywhere there is music
(Wife) We listen mostly online
I used to have at earlier stages an audiogram and it had all sort of facilities, it would play records easily but I am so used to playing tapes, so I would play music of all types. But I am getting older so I am getting more lazy.
“Do you find the ipad and the other devices difficult to use?âĂİ
No no once I know, at early stages I had more opportunities these days my wife is the one that needs to turn on everything.
“In what setting do you listen to music with your wife?"
These days it is mostly at home, as I said we don’t go to parties and so on much, we used to in the old days but as we got older we become less active. So music is still there we play a lot of music but we don’t go out dancing or whatever these days.
“If there was an available solution that would allow you to play music on your own would you be interested in using it?"
Umm
(Wife) I think he would you know why I have this player, this cd player and I get all your stories(audiobooks) from England. So I leave it for him I put it on and I showed him how to turn it on and off I think if I put the music cd.

I don't see well, my left eye is completely blind I don't see anything and the right eye is not very good so it created difficulties for me. It is easy to say you could put the cd in, but it is not so easy you could scratch it and so on so you have to be careful you know.
(Wife) You know the white one I give you, he knows to pause it to go to the toilet, so he can do that, so what I need to do instead of sometimes doing a story is perhaps leave a selection of cd for him that he can choose and then play on his own but I think with his condition and so I tend to do things " would you like to do this today or would you like to do that today" "Shall I put the story on" then he says yes or no so I leave the story for him it plays and when I am gone he can stop it and play it again so he will say what he wants.
Tapes I use tapes
(Wife) And I love music in the car, so when I pick my granddaughter up I have a cd in the car and he goes with the cd I have chose.
Yeah my granddaughter loves music
(Wife) I bought a CD with all the songs they sing in England schools and I've got this in the car so he knows them as well it is so funny to hear all this old hits again.
"What are the factors when selecting music (mood, artist, type)?"
(Wife) I think it is because of how I feel, but I would still ask him 'Would you like to listen to this music today, I think it is his mood and the time of day in the night he might want to listen to something else, in the daytime something different, it depends on the day, time.
But I like all types of music
(Wife) And he was a good dancer, he loves dancing
I am quite happy whatever type of music
(Wife) Is this giving you the answers you are looking for
(Interviewer explains research project and possible prototype with voice commands)
(Wife) I think that is great you need to ask him what to listen to, because with his condition he wouldn't be able to go through a lot to select or where is this where is that, that is out. But what you are talking about is the perfect fit for him it would make my job much easier (laughs). It would reduce my stress because sometimes I do forget when I am a bit busy I fail to give the attention of getting things ready for him because when he listens to a story there are so many chapters and he listen to them all and doesn't want to go to bed then.
I like all the adventure stories
(Wife) Law was his area so I tend to ask England to send all this crime stories and detective stories like all the Grisham stories and then he gets interested but sometimes but sometimes I get busy and he isn't going to ask for something I have to say for example "Do you want a story now" and then he is well away but if I don't do it he does to sleep. It is like that, then I feel guilty if I haven't put anything ready. So I think your think if somebody talks to him and asks him "would you like to do this would you like to do that" it would be perfect. It would take the problem away.
"Do you have any questions for us?"
(Wife) What is the purpose of all this, you mentioned something on the phone but I was probably in a rush. Is it that you are doing a study?

(Interviewer explains purpose of study and prototype)
(Wife) It would help a lot because then you don't have to rely that much on other people that have jobs, like me I have to drive my granddaughter around a lot.

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