Patterns of Use: How Older Adults with Progressed Dementia Interact with a Robot

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ABSTRACT
Older adults represent a new user group of robots that are deployed in their private homes or in care facilities. In the presented study tangible aspects of older adults' interaction with an autonomous robot were focused. The robot was deployed as a companion in physical therapy for older adults with progressed dementia. Interaction was possible via a mounted touch screen. The menu was structured in a single layer and icons were big and with strong contrast. Employing a detailed observation protocol, interaction frequencies and contexts were assessed. Thereby, it was found that most of the interaction was encouraged by the therapists and that two out of 12 older adults with progressed dementia showed self-inducted interactions.

Keywords
Human-Robot Interaction; older adults, robot use; real-world trial

INTRODUCTION
Due to recent developments evermore robots are introduced to older adults in their private homes (e.g. HOBBIT [1]), or elder care facilities (e.g. ROREAS [2]). Therefore, older adults represent a new group of potential robot users. Whilst studies focus on probable robot tasks [3, 4] or aspects of acceptance of older adults towards robotic devices [5, 6], rather few studies focus on tangible aspects of older adults' interactions with robots (for example [7]), especially when they suffer from dementia. Therefore, we raise the question how older adults with progressed stages of dementia interact with an autonomous robot, providing interaction possibilities on its screen.

1. ROBOT SYSTEM
The platform used is a SCITOS G5 non-holonomic mobile base, with an added HRI superstructure comprising a 15" touch screen on the robot's back including stereo speakers and a pair of actuated eyes in an acrylic bowl resembling a head (Fig. 1). The screen can be adjusted to lower or higher viewing angles, serving standing or sitting interaction partners. Apart from odometry sensors, a SICK S300 laser scanner for navigation, and a Primesense 3D camera for obstacle detection, the robot comprises an ASUS Xtion RGB-D camera on a pan-tilt unit mounted above the robot's head with a pan and tilt radius of 360 and 90 degrees, respectively, to complete the sensory equipment.

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2. MATERIALS AND METHODS
From April to June 2016 the described robot was deployed in a real-world long-term trial at a care facility for a third iteration (following deployments in 2014 and 2015). Among other tasks, it served as companion and source of entertainment and motivation in "Nordic Walking Groups" as part of physical therapy for older adults with progressed dementia. These groups were scheduled every Monday and Thursday afternoon and were led by two therapist teams, respectively, each team consisting of two therapists. In total, 12 older adults (9 women and 3 men) with progressed dementia participated, although some of them engaged only irregularly. The group gathered in front of the therapy room from where they started to walk a tour throughout the ground floor of the care facility. Between stretches of walking, the groups also rested on chairs which were aligned the sides of the corridors. Therapists supported participants when walking, talked to them or sang with them, to keep up their motivation.

During the robot trial, the robot accompanied the groups five times on Mondays and five times on Thursdays. Thereby, the robot met the group in front of the therapy room, where it positioned itself with its screen facing the chairs where people waited to start. Through the touchscreen interface, it offered to play music, view a picture gallery or a video (Fig. 2.b). The entertainment interface was carefully designed for the target group, e.g. using large high contrast icons enabling the patients to operate the robot's screen themselves (Fig. 2.a – 2.f). To decrease cognitive load, the number of buttons was kept at a minimum, e.g. the pictures would loop automatically and did not require to press a next button, and the interface had only two hierarchical levels.

When the whole group had gathered, therapist would send the robot ahead to follow a predefined route, leading the group. During walking bouts, it played hiking songs, which were chosen by therapists according to their usual therapy repertoire. On four predefined waypoints the robot stopped to wait for the group. Either participants or therapists then could press a button on the screen labeled "weiter" (continue) (Fig. 2.a) to send the robot off again. This presented an opportunity to facilitate the interaction of older adults with the robot and give them direct influence on the robot's behavior. When approaching the resting points, participants could klick on the screen if they would like to continue or to take a rest (Fig. 2.c). During rests participants set down on the chairs. Therapists could send the robot to single participants, with the robot stopping in front of a certain chair and turning around to present its screen. There participants could choose again from the entertainment options themselves (Fig. 2.b and 2.d – 2.f). This set up offered three different interaction-possibilities for older adults with progressed dementia on the robot during these Walking Group sessions.

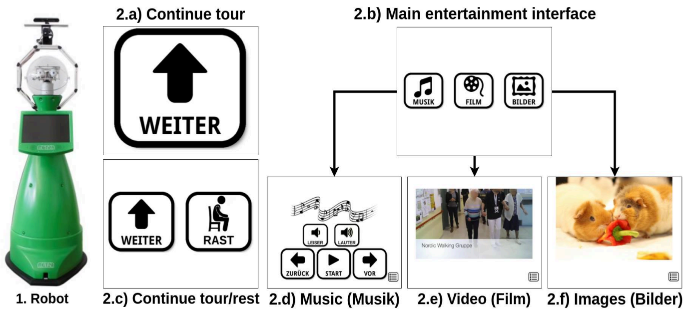

Figure 1. SCITOS Robot; Figure 2. Overview of the Robots Touch Screen Elements

In order to assess the patterns of the participants' interaction with the robot, observations were conducted with one observer being present during each Walking Group session. Sessions were divided into different phases: waiting in front of the therapy room, walking, and resting. For each participant, frequencies of clicks on the screen were noted in an observational protocol according to the phase of the session. It was annotated whether therapists encouraged an interaction or if participants themselves initiated it. Furthermore, the frequency of participants touching the robot other than clicking the screen, and speaking about it, was recorded. To allow comparison of interaction patterns between all participants, interactions of single participants were normalized based on their total number of participations in sessions.

3. RESULTS

Taking all sessions and phases together, therapists encouraged participants 130 times to click on the robot's screen. Across all sessions, 95 clicks of participants on the touch screen occurred. Of these, 11 (12%) were self-facilitated and 84 clicks (88%) followed the therapists' encouragement. This shows that 65% of the encouragements were "successful". Participants touched the robot's hull 10 times e.g. to push it forward when it was stopping with the "continue" icon on its screen or to stroke the robot. 46 times participants spoke about the robot. Most prominently, two participants, Mrs. B. and C. contributed 28 talking bouts. Two participants showed self-facilitated clicks: Mrs. B. performed most self-facilitated clicks (8) and also most clicks motivated by the therapist (23), totaling in 31 clicks. Mrs. G. had 3 self-facilitated and 13 clicks where she was encouraged by the therapists, hence, with a total of 16 clicks she had the third most clicking activity. Mrs. C., overall, had the second most clicking activity. She performed a total of 19 clicks, all encouraged by the therapists. Two male participants showed the lowest engagement level: Mr. J. did neither click on nor touch the robot, nor did he talk about it. Mr. H talked once about it in 4 attendances. In total music and the picture gallery were the most accessed features.

4. DISCUSSION

In this report we present preliminary results about how older adults with progressed stages of dementia made use of a robot companion in their physical therapy sessions via a touch screen. We found that in the majority of cases the therapists had to encourage participants to interact with the robot. Just two out of 12 participants showed self-facilitated clicks on the screen. One participant did not interact at all. In [7] it was shown that older adults with mild cognitive deficiencies encountered problems when interacting with a robot. Our study points towards a similar direction, indicating that, despite designing a simple interface structure older adults with progressed dementia mostly require guidance by a therapist. In the presented setting, help or encouragement could easily be provided by the therapists. But when designing robots that should increase the users' independence and, therefore, be used without the help of a therapist, more research is needed on specific user patterns and on what difficulties this user group faces when interacting with a robot. All in all, these results suggest, that human-robot interaction still faces limitations when it comes to user groups with progressed cognitive decline which has to be addressed in future research.

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