Poster: Eldertainment or Functional Necessity? How Virtual Agents Affect the Home Lives of People with Dementia Using the Quality of Life (QOL-AD) Scale

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ABSTRACT

A large literature evaluates how virtual agents impact the lives of people with dementia using perceptions of technology. We assess how a home virtual agent from "Living Well with Anne" impacts the *quality of life* of elderly with dementia rather than only their perceptions of the technology. Assessing impact on life alongside technology perception is pertinent given the importance of a person's perceived quality of daily home life and that positive technology perception does not always lead to actual use. We propose an approach to evaluate assistive technology for elderly people with dementia by assessing impact on life using semi-structured interviews and the QOL-AD scale. A preliminary proof-of-concept study tests whether perceptions of a virtual agent, actual use of the agent and participants' quality of life are related, and whether a virtual agent improves quality of life.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; *Empirical studies in interaction design*; • **Social and professional topics** → *People with disabilities*; *Seniors*;

KEYWORDS

Dementia, Virtual Agent, Quality of Life, Field Study

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1 VIRTUAL AGENTS FOR DEMENTIA CARE

Cognitive assistive technology is an emerging solution to help adults with dementia (46 million people worldwide [14]) remain independent at home [12]. Virtual agents have been proposed to have a powerful impact on people's lives, perhaps because they can be aware of people's needs through speech and monitoring, to help maintain a person's dignity. It is therefore unsurprising that virtual agents have been used to assist people with dementia in their homes ([12, 19, 23]).

A key question for cognitive assistive virtual agents is whether and how they influence people's lives. Since designing proof-of-concept prototypes is a major research focus, it is unsurprising that intervention assessments often draw from measures in human-technology interaction and user experience (e.g., [23]). Those works may therefore be well suited to deliver guidelines or requirements on trust in and expectations of virtual agents, but less suited to evaluating virtual agents' impact on people's lives. Literature from dementia research, conversely, uses measurement scales specific to the quality of life of dementia patients, and may be meaningful in assessing how technology impacts their lives.

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We therefore assess how a virtual agent influences people's lives using the novel measure of *quality of life* and explore how conventional measures focused on the perception and adoption of a virtual agent relates to use and quality of life.

2 VIRTUAL AGENTS' INFLUENCE ON HOME LIVES OF PEOPLE WITH DEMENTIA

Past work evaluating virtual agents' influence on the lives of people with dementia has primarily focused on technology perception or acceptance. For example, [23] interviewed people with cognitive impairment and found some participants, particularly younger ones, were reluctant to use a virtual agent but acknowledged it might be useful for others. [19] found that elderly with dementia who played a game with a virtual agent had similar learning as those who played with a therapist. [12] found adults with dementia washed their hands more when they received prompts from an autonomous system than without prompts. [13] found elderly persons both with and without cognitive impairment rated a virtual character pleasant to interact with more than text and speech or text only, and had inconclusive results about whether the media type influenced participants' recall of the conversation. Among studies with older adults, [2] found they rated a virtual agent exercise advisor as trustworthy and felt close to it as if it were a friend. [8] found that seniors and caregivers who interacted with a conversational agent assistant for daily activities rated its usability as 57 out of 100 and said that the virtual agent might increase the risk of social isolation. [20] found older adults' satisfaction and acceptance of a home virtual agent were above scale midpoints and measured usage time, topics of conversation with the agent and self-reported social ties, but did not assess the agent's impact on social ties or correlate perceived impact with usage. Among works that measure aspects of a person's life rather than technology perception, [11] found older adults report better mood with an iPad activity compared to without the iPad, but did not assess life measures apart from short-term mood and did not use a virtual agent. As a whole, these works do not explicitly assess a virtual agent's impact on quality of life; yet QOL could be a key benefit of virtual agents in dementia care as suggested by past works' claims that they can improve lives.

3 QUALITY OF LIFE AND VIRTUAL AGENTS

Quality of life (QOL) is defined by the World Health Organization as: "individuals' perceptions of their position in life in the context of the culture and value systems in which they live in relation to their goals, expectations and concerns" [7] (pp. 1403). Although quality of life and related phrases like "improving people's lives" are mentioned in literature advocating the use of virtual agents in dementia care (e.g., [10]), the measures researchers use to assess those virtual agents focus on technology perception rather than impact on a person's life. Moreover, research in virtual agents for the elderly that discusses quality of life may not look at quality of life as presented in dementia literature. Given the importance of quality of life in dementia literature and past work demonstrating that virtual agents can have benefits extending past the time people use the technology (cf. [3]), we assess whether a virtual agent in the homes of people with dementia affect their quality of life.

> Hypothesis 1: The Anne virtual agent will improve participants' overall quality of life.

Quality of life is a multidimensional concept that includes psychological, social, physical and other aspects. [16] related it to physical well-being/health, living situation, participation and mental well-being, and an inventory of models and measuring instruments explicated QoL into sub-concepts (cf. [16]). Because of the multi-dimensional nature of QOL, we ask which dimensions of QOL a virtual agent will improve.

> Research Question 1: Which dimensions will the Anne virtual agent influence?

Quality of life scales may ask caregivers to rate their patients' QOL to complement self-report scales. Prior studies showed that caregivers tend to rate patients' QOL as lower than patients' own self-ratings across five dimensions of quality of life, particularly for caregivers with high levels of burden [15]. We therefore hypothesize the same is true in the specific context of a study that involves a virtual agent.

> Hypothesis 2: Caregivers will rate elderly's quality of life as lower than elderly's own ratings.

4 ROLES OF TECHNOLOGY

Past work in virtual agents for dementia care often mentions the agent's role (e.g., [5]) without exploring what the (perhaps unintended) effects the agent has say about its role. We therefore explore how sub-scales of the QOL-AD implicitly assess what role a virtual agent has. We collect a list of roles from literature and run a design workshop to identify what roles can be measured by the QOL-AD items and which items correspond to each role.

> Research Question 2: (a) Which QOL-AD items match which roles a virtual agent has? (b) What agent roles influence quality of life?

5 PERCEPTION OF TECHNOLOGY

Past work on virtual agents for dementia has measured success using perceptions of usefulness, usability and intent to use. Common self-report scales are the Technology Acceptance Model (TAM3) [21], the Unified Theory of Acceptance and Use of Technology (UTAUT2) [22] and the Almere Model [9]. The 51-item TAM3 measures how much participants

Figure 1: Virtual agent Anne (one of the possible avatars)

accept new technology. The 29-item UTAUT2 measures consumer acceptance and use. The 41-item Almere Model measures acceptance of assistive social agents by elderly users.

Studies of virtual agents in dementia care often measure perception of technology but not actual use (e.g., [23]). A field study [1] measured both actual use and technology perception but did not compare the two measures. As an exception, [17] found that intention to use but not perceived usefulness correlated with actual use. However, few past works measure broader potential effects of using virtual agents in dementia care, such as quality of life, which could indicate important effects of virtual agents. Therefore, we assess whether QOL correlates with technology perception.

> Research Question 3: Do quality of life ratings correlate with perception of the technology?

6 CURRENT STUDY

We run an in-home field study to assess if a virtual agent affects the QOL of people with dementia and their carers.

7 METHOD

The Living Well with Anne Project

Anne (Figure 1) is a virtual agent designed to support elderly with cognitive impairments that allows the user to access agenda (personal & medication), news and video calling by speech or touchscreen. Anne's features aim to aid with memory loss and cognitive impairment. Anne expresses emotions and uses natural language to give information and emotional feedback. The system design is the result of the project researchers' past work in assisted living as well as comprehensive participatory design following ISO 9241-210, which involved potential users in all stages of development. The first design iteration [5] gathered requirements from professional and informal caregiver focus groups. Elderly with dementia did small tasks with a prototype of Anne in the second iteration. In the third, we will conduct exploratory field-research with 20 people with cognitive impairment or dementia in the Netherlands, Italy and Luxembourg for 5 weeks.

Measures and Analysis

We use the QOL-AD [18] (both self-report and caregiver versions) to measure quality of life of the participant. Over 1000 known scales of quality of life exist (cf. [18]). The QOL-AD is a brief, dementia-specific scale that can be used as a self-report scale by people with dementia or as a caregiver-report scale of the caregiver's or the patient's quality of life. It contains 29 questions in 13 dimensions: physical health, energy, mood, living situation, memory, family, marriage, friends, self as a whole, ability to do chores around the house, ability to do things for fun, money, life as a whole. It was developed by a literature review on dementia, has been validated in the UK, US, Korea and Brazil and is widely used [4].

We deliver a QOL-AD pre-test prior to the introduction of the system and a post-test at the study conclusion. Participants' last session includes the Almere model to measure technology perception and a semi-structured interview about how the virtual agent's presence or features may have influenced quality of life self-reports. Data tracking of system functions will measure actual system use.

We analyze QOL using paired t-tests of the pre- and post-intervention QOL-AD, correcting for multiple comparisons. We analyze relationships among technology perception, actual use and overall QOL using Pearson's correlation. Interview results are qualitatively analyzed using grounded theory to identify reasons for any observed changes in QOL.

8 DISCUSSION AND LIMITATIONS

People tend to judge agents that show one positive quality as having other positives despite those qualities not being demonstrated. This "halo effect" applies to judgments of an agent, but could also mean a positive view of Anne leads to positive QOL (e.g., if elderly believe the QOL questions are about how Anne influences their life). We try to mitigate this by using QOL questions not directed at technology itself, interview questions to probe if changes in QOL are due to factors other than Anne and by measuring system use.

We do not explore behavioral measures of QOL (e.g., how often a person goes on walks, physical exam reports). Although it is possible that such measures are influenced by a virtual agent, we initially use self- and caregiver-reported measures to assess whether a virtual agent can improve people's lives. Although the QOL-AD has been validated, it may be subject to biases in self-reporting that could be avoided using more objective measures in future work.

We use QOL-AD subscales as types of QOL. Future work can better categorize quality of life in the context of work such as [6], which uses affect, self-esteem/-image, attachment, social contact, enjoyment of activities, sense of aesthetics in living environment, physical & mental health, financial situation, security & privacy, self-determination &

freedom, being useful or giving meaning to life and spirituality. Moreover, we do not generate specific hypotheses about subscales, instead correcting for multiple comparisons. Since this runs the risk of failing to detect meaningful effects and doesn't assess how the functions of a particular virtual agent may influence specific categories of quality of life it targets, we consider the current work as exploratory and further hypothesis development as future work.

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