Spoken Conversational Agents for Older Adults: Who Are the Stakeholders and What Do They Expect?

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Abstract

In this paper we discuss our road map to design a Dutch spoken conversational agent that helps older adults with self-management of their well-being. We conducted three usability studies with our conversational agent, each time after discussing it with different stakeholders. We discuss the challenges incorporating each stakeholder's wishes and needs whilst iteratively designing our agent.

Keywords

conversational agents, dialogue design, stakeholders, health, self-management, older adults

1. Introduction

Self-management has become an important feature in (western) communities, where we strive to live independently for as long as we can. This is a challenge for older adults who might face physical limitations, such as reduced mobility, hearing problems and visual impairment, or limited support from a social network. A social robot might support them with self-management [1], e.g. with physical activities [2] or social skills [3].

In our own research we have been developing a conversational agent (CA) that should support older adults in self-management of their well-being [4]. Self-management is a collaborative effort between older adults and a CA, to promote activation and empowerment and adopt health-promoting behaviours [5, 6]. We have explicitly chosen for spoken interaction because this is a low-threshold form of communication for this target group. Digital literacy is generally low in older adults, so using a chatbot can be a hurdle, while a spoken interface would definitely be more accessible, except for people with speaking or hearing problems. Speaking to a device is certainly easier than typing, which can be problematic, e.g. due to arthritis or visual impairments [7].

A systematic literature review on conversational agents in the health domain showed that interaction with older adults is seen as one of the big challenges in agent development [8]. Different stakeholders are involved in designing such a CA: care professionals,

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end-users (older adults), CA developers, funding agencies and researchers. In this paper we discuss the challenges that we faced in our own research and the lessons we learned, in the hope that these might be useful to others conducting similar research.

2. Speech-based CAs for well-being

We are not the first to use a spoken CA for supporting self-management of older adults [9]. A CA can be deployed to reduce loneliness or provide assistance in daily life [10, 11, 12]. For example, [3] developed a virtual CA that engaged with older adults on a regular basis over a longer period of time to help them improve their social skills. A study by [13] looked at a virtual companion agent for older adults. The authors found that topics that are generally interesting include storytelling, the weather, the family, and future plans they have with a live-in companion. Many practical issues remain with speech-based systems, and specifically for older adults, speech recognition accuracy can be improved by pre-processing the audio [14]. Current voice interfaces are trained for younger audiences, and even with pre-processing, syllable segmentation for older adults remains an issue [15].

3. Dialogue Design

We conducted a field and an online usability study and co-designed a dialogue with healthcare professionals from the field.

3.1. Field data collection

Towards the end of 2019, we conducted field usability studies with the first version of our Dutch spoken dialogue system *BLISS* [4]. We as researchers are interested how conversations from a positive psychology point of view would benefit end-users [16]. We created a small scripted dialogue that would ask about activities and social relationships, two important factors in a persons well-being about their daily activities and quality of life [17]. The conversation took about 2 minutes in total per participant. There was some limited Natural Language Understanding (NLU) capability in the Behaviour-based Language-Interactive Speaking Systems (BLISS) prototype for interpreting user answers. For example, if the user answered a question with "I think that would be cycling.", the system would ask "What would you miss most if you wouldn't cycle?".

At the early stage of our research we explored how adults with limited experience with agents interact with our CA. We went to three public Dutch conferences related to language and health using a demo stand to evaluate the prototype and dialogue with 56 people. These conferences were in a noisy environment, in spaces with many people and provided an ecologically valid test to see if our system was robust enough in natural conditions.

3.2. Online data collection

Due to the COVID-19 crisis we had to switch focus from physical interactions to online interactions. Therefore we designed a dialogue oriented towards older adults about social relationships and activities and how the COVID-19 crisis impacted them. The dialogue design contained questions about social relationships and activities and how the COVID-19 crisis has impacted this. Then, we contacted 6 older adults (70+) through a telephone call and evaluated the questions in a human-human telephone conversation. After correcting the dialogues for unclear, unnecessary and inappropriate questions, we implemented these

Table 1
Part of an example COVID-19 dialogue (Translated from Dutch).

#	S	Turn
1	A	Who in your family is close to you?
2	U	My youngest son
3	A	How would you describe your connection?
4	U	Very good
5	A	What do you think he means to you?
6	U	Also a close connection, a good relationship.
7	A	What kind of activities do you like to do with this person?
8	U	Eating, watching thrilling TV shows, walking.
9	A	How do you keep in touch?
10	U	He is still living at home.
11	A	Would you like to see each other more?
12	U	That's not really possible, we see each other every day.

questions in the BLISS CA. We contacted 10 participants, of whom 7 are older adults, to talk to the CA. Unfortunately, we could not visit the participants and thus set up the CA remotely by running it locally on a computer and set up a video call via Zoom, MSTeams or Skype with the participants, who were using either a tablet or a laptop. Most participants were assisted by a younger family member or were already familiar with video calls. Each conversation took about 10 minutes, and an excerpt of asking about social relationships (family) from one conversation is shown in Table 1. Note that in this conversation the question of the agent on line 11 does not make much sense given the previous response of the user.

Table 2
Part of a dialogue after redesign with healthcare experts (Translated from Dutch).

#	S	Turn
1	A	Could you tell me something about your childhood?
2	U	Uhm, that's been a while
3	A	Which city were you born?
4	U	I was born in [CITY]
5	A	I know that place! Did you grow up there or somewhere else?
6	U	No, I did grow up in [CITY]
7	A	How was it like growing up there as a kid?
8	U	It was really fun.
9	A	That's interesting. Do you still know people from your childhood?
10	U	Yes.
11	A	Did you often play outside as a kid?
12	U	I still do, but yes a lot.

3.3. Co-design of dialogues

After these two data collections, we invited two domain experts, healthcare workers, to evaluate and improve our dialogue designs and co-design a better dialogue that is more suited for older adults in a healthcare facility. Based on the feedback, we improved the dialogues to include more self-disclosure and backchanneling by the system. An example of this is shown in Table 2. We tested these dialogues with 7 healthy adults, of whom 4 were over the age of 70, and the others between 50 and 70 years old.

4. Stakeholders

Designing and testing a spoken CA requires the help by and collaboration with many different stakeholders. Each stakeholder has different wishes and needs they bring to the table. The first and foremost stakeholders are the older adults, the end-users of our CA.

They need to be comfortable with the technology and this needs to be accessible to them. It can take up to two months before people accept social robots, and even take half a year before a CA will be integrated in its environment [18]. [12] mention the following things that are important to the older adults: retaining control, being encouraged for tasks or activities, safeguard their privacy and usefulness and quality of social skills of an agent. In our online study, older adults also commented on the voice lacking clarity and empathy, which is also found in earlier research [19, 20].

The second type of stakeholders are the healthcare professionals. Their main interest is providing the best care they can in which the CA must be a support tool and not a hassle. In the co-design session, the healthcare workers who were in direct contact with clients expressed the need for a CA that would (just) engage, entertain and distract clients; they preferred an intervention that can help with boredom and loneliness. They did not yet see the usefulness or applicability of a personal user profile that could be collected through such an engaging CA, in contrast to what some of healthcare management would like to see.

Thirdly, there are CA developers who implement state-of-the-art technologies in the CA. Their interest is in seeing how their technology is accepted by the end-users and iteratively improve the technology. However, much (research) software becomes outdated due to shifts in maintenance and time and/or funding is too limited for achieving the research goals.

Fourthly, funding agencies often require a clear valorisation and societal and scientific impact of the research, focusing on novel research. They often only see the global part of a project and have to deal with many projects at the same time. They are usually only involved during writing of proposals and reviewing of the project mid-way and at the end. Adding more possibilities for other stakeholders to ask for support because of new discoveries in research could benefit all stakeholders.

Finally, we as researchers want to evaluate the use of the CA, the user experience, the conversation flow, long-term usage and test novel ideas to publish and develop knowledge. We design prototypes based on theories and/or datasets and evaluate them with end-users. Only recently more focus has shifted to co-designing with end-users, actively involving them in the whole design process of CAs. Researchers might still have problems explaining to other stakeholders what is possible and what is not, and to fully accommodate other stakeholders' needs, especially the end-users.

All these stakeholders' expectations impact the design of the CA and we have to combine the wishes and needs of all parties. In fact, we experienced that this can be very challenging during our data collections.

5. Conclusion

The application of interactive and intelligent CAs offers many possibilities to the healthcare field. We believe that a personalised CA can help both clients and professionals: improved self-management for clients, and a better insight into clients' needs and wishes for professionals. Discussions with healthcare management have confirmed this.

The healthcare workers, the professionals who are in contact with the clients on a daily base, are the gatekeepers of these interventions. Their main focus is on providing good care for the client, and especially during the COVID-19 pandemic their time is pressed. As such, they are naturally looking for solutions that provide an immediate improvement.

There is an inverted mismatch between the current needs and wishes of healthcare professionals and end-users, and the design and technological possibilities of our CA for re-

searchers and CA developers. Professionals in direct contact with older adults are satisfied with a system that (just) engages and gives attention, while healthcare management is also interested in the longer-term benefits of collecting valuable data about clients, in order to provide even better personal care. Additionally, CA developers are the most knowledgeable about the CA's capabilities and are interested in usability of their latest technology. Mindset broadening seems to be required.

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