Designing and Developing Lifelike, Engaging Lifestyle Coaching Agents and Scenarios for Multiparty Coaching Interaction

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ABSTRACT

The use of Embodied Conversational Agents (ECAs) in the domain of lifestyle coaching has been the subject of many studies in the last decades. With ageing populations in many countries, the pressure on healthcare systems is increasing. ECAs can be a potential tool to help combat this pressure through the promotion of a healthier lifestyle among older adults, as well as through coaching and counselling of older adults on how to manage their health. Designing more lifelike and engaging ECAs is of key importance to further this goal, as this could help encourage self-disclosure by the users towards the ECAs, could make the ECAs more persuasive, and could increase engagement and enjoyment of the interactions by the users, among other things. The Council of Coaches project aims to provide users with virtual coaching done by several lifestyle coaching agents with different domains of expertise as well as varying backstories, personalities, mannerisms, motivations and looks, among other things. To work towards this goal, work has been done on character and personality design for an initial set of lifestyle coaching agents and defined initial interaction scenarios. These were inspired by literature on coaching and ECAs, videos of interactions between healthcare professionals and patient actors, conversations with healthcare professionals, and brainstorming sessions. This paper presents the work done within the project thus far and closes out by presenting our plans to address the question: What are the possible advantages and disadvantages of a multiple agent approach as compared to a single agent approach to coaching interactions with older adults?

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; *User interface design*; • **Applied computing** → *Psychology*;

KEYWORDS

Characterisation, Lifestyle coaching agents, Multiparty interaction, Coaching, Embodied conversational agent and personality design, Scenario design

1 INTRODUCTION

This paper intends to showcase some of the work done on the characters and scenarios for multiparty coaching interaction in the Council of Coaches project, and elaborate on our plans to investigate questions regarding the multiparty interaction between lifestyle coaching agents and older adults. We will start by elaborating why ECAs are a useful tool to help tackle issues associated with the ageing population and their healthcare needs, specifically by having ECAs give lifestyle advice to older adults and coach them. We go on to explain why it could be interesting to look at the use of multiple agents instead of a single agent to perform lifestyle coaching. We follow this up by briefly discussing the Council of Coaches project and the work that was done on the design of the personalities and appearances of the characters, as well as the scenarios in this project. Finally, we focus our attention on some of the interesting questions to be asked about coaching dialogue and interaction with older adults using multiple agents and our initial plans to answer some of these questions in future work.

1.1 The ageing population and healthcare challenges: ECAs as a potential tool

The population of the world is ageing [27]. This ageing population is putting pressure on current healthcare systems, organisations, and professionals and is posing new challenges worldwide such as a required shift in focus to managing chronic illnesses among older adults and the increased need for long-term care [4, 22, 29, 36, 38]. Some of the ways to tackle the aforementioned challenges are to promote a healthier lifestyle among older adults to prevent and delay the onset of deterioration of health, and to improve self-care in patients suffering from chronic illnesses [12, 18, 36]. This can be done by increasing the health information available to older adults and persuading and motivating them to change their health behaviours in a tailored and realisable way through coaching, counselling and giving lifestyle advice [18].

ECAs make for an interesting tool to employ to persuade and motivate users to adopt a healthier lifestyle. Firstly, recent studies have shown evidence to suggest that ECAs are treated like social actors and can influence people [2, 3, 6–10, 13, 16, 17, 19–21, 23, 25, 28, 30–32, 34, 39], and more specifically have the ability to persuade people and impact their motivation [2, 3, 8, 11, 17, 32]. Lastly and most importantly, recent studies [10, 16] have already shown that ECAs can help to improve health behaviours of people.

1.2 Designing and developing effective ECAs

It is important to pay close attention to the design and development of effective ECAs when we want to employ them as lifestyle coaching agents. As we previously established, ECAs are treated like social actors. Just like how in human-human interactions many factors about the other can change the way we interact with them, this seems to be the case for ECAs as well. Previous studies have shown that appearance [2, 33], verbal and nonverbal behaviours [5, 6, 8, 13, 17, 19, 34, 35, 39], perceived personalities of the ECAs [30, 34], and the modalities of interactions [21, 24, 26] can have

an effect on the interaction with users, the perceived user experience, likeability and other aspects in many ways. In conclusion, as many factors about ECAs have an effect on the interaction with users, the users' perceptions and the users themselves, it is of importance to know what the goals of a system using ECAs are and what user group it is targeting. This should inform design decisions by developers of such systems.

1.3 Multiparty coaching interaction

The previous examples looked at interactions between a single ECA and user. To the best of our knowledge, little work has been done to examine the effects of interaction with multiple agents or ECAs in a coaching setting. We are interested in investigating the possible advantages and disadvantages of a multiple agent approach to interaction with older adults in a lifestyle coaching setting, with a focus on dialogue including verbal and nonverbal behaviour. We postulate that there could be an added benefit to there being a group of ECAs interacting with each other as well as the user when they act as lifestyle coaching agents trying to persuade and motivate users. It allows for discussion between agents regardless of user input, which allows the system to inform and potentially engage the user even when they are not responding. When the interaction with the system involves different characters with different personalities, appearances, backstories, motivations, solutions to issues and such, it could make interactions with the system be more of an interactive experience and thus make the interactions more engaging and fun. Prior work [1] seems to give an indication that these benefits could exist. Splitting out roles and functionality of the coaches could also help improve motivation and retention of information [2]. Finally, the different perspectives of the lifestyle coaching agents can show users different approaches to tackle issues and could make them reflect on what they think the best way to handle them could be. This would be harder to do during a conversation with a single coaching agent. Group interaction does further complicate matters, as it could introduce new social phenomena to consider that have been observed in group dynamics in human-human interactions. Furthermore, for the coaches to effectively help the users, we might want to consider literature on effective teamwork such as [14, 37] to make sure the coaches work as one team to help the users. On top of the aforementioned, we are also interested in looking into the effects of the agents and the interaction being lifelike on the user. In short, there are many interesting questions to be addressed with regards to multiparty coaching interaction and dialogue with older adults and we hope to address these in our future work (Section 3).

1.4 Aim of this paper

The aim of this paper is to present part of the work done so far in the Council of Coaches project on lifestyle coaching agent design and scenario development for multiparty interaction between several lifestyle coaching agents and an older adult user, and discuss the impact this could have on the interaction and user. The paper also intends to give insight into our plans for future studies on the multiparty interaction the coaches will have with older adults with their goals of engaging them, and motivating and persuading them to improve their health behaviours and management of their chronic illnesses. When speaking of older adults in the context of this paper, we mean people of the age of fifty years old and above.

We will now outline the structure of the sections in this paper. In Section 2 we briefly summarize the goals of the Council of Coaches project and how the consortium set out to achieve them, the work on designing virtual characters and their personalities thus far (Section 2.1) and the work done on developing initial interaction scenarios (Section 2.2). In Section 3 we will present our plans for future research into multiparty coaching interaction.

2 ONGOING PROJECT WORK

The goal of the project is to develop a system employing a group of agents fulfilling the role of lifestyle coaches that persuade and motivate older adults to adopt a healthier lifestyle, improve their social, physical, mental and cognitive health, and improve their management of their chronic illnesses (diabetes type 2 and chronic pain). To do so, the agents will use differing coaching techniques and will all behave differently in the interactions due to having their own areas of expertise, personality, backstory, and mannerisms, among other things. We intend to investigate the differences between these interactions and interactions with a single lifestyle coaching agent, as well as investigate how to make the multiparty coaching interactions feel natural and be persuasive and motivating for older adults.

When the Council of Coaches consortium started working on the project, it was decided to first get inspiration for the design and development work. This came from looking into literature regarding coaching and ECAs, speaking to several healthcare professionals to get their input on the role the coaches could play for older adults, brainstorming sessions inspired by observations and discussion about the kind of scenarios in which the coaches would interact with older adults.

Furthermore, the work was motivated by a related set of patient interviews [15], conducted by partners in the Council of Coaches project[1]. This material gave the consortium the opportunity to see what interactions between multiple healthcare and coaching professionals and a patient with the goal of changing patient behaviour could look like (Figure 1).

2.1 Virtual character and personality design

Once the aforementioned steps were taken, the consortium set up a Character Design Task Force (CDTF)[2], which were tasked with deciding on several initial characters. Using previous reading, talks to professionals, observations and brainstorming sessions as inspiration, the CDTF discussed what to describe about the coaches and how to portray them. After some discussion, the members of the CDTF were tasked with each describing one coach in their own

[1]The patient interviews were led by Alison Pease, Mark Snaith and Dominic De Franco (arranging, co-ordinating and recording sessions) at the University of Dundee, in collaboration with Tessa Beinema and Harm op den Akker (development of personas and scenarios) from Roessingh Research and Development; Catherine Pelachaud, Reshmashree Bangalore Kantharaju from Paris-Sorbonne University and Gerwin Huizing (advice on recording equipment and setup) from the University of Twente, and Nicholas Conway (organising and hosting) from the University of Dundee.

[2]The CDTF consisted of Harm op den Akker, Tessa Beinema, Marijke Broekhuis and Silke ter Stal from Roessingh Research and Development, Catherine Pelachaud and Reshmashree Bangalore Kantharaju from the Paris-Sorbonne University, Alison Pease and Mark Snaith from the University of Dundee, and Jorien van Loon and Gerwin Huizing from the University of Twente.

Figure 1: An example of one of the interactions between an actor (left) and healthcare and coaching professionals (right).

way. Some of the recurring information given about the coaches were their names, coaching roles, genders, ages, mottos, general background information, physical characteristics, backstory, main strength and main weakness, mannerisms and personality. Furthermore, the members all added some visuals of existing characters and people to showcase what they imagined their coach would look like. This was done to give a clear idea to the rest of the consortium about the possibilities there were for the coaches to be diverse and lifelike characters with different ways of interacting with the users and different coaching approaches.

In this first step of the process we worked on Helen, the cognitive coach. We envisioned and described her as a recently retired psychologist that used to have her own practice. We imagined her to be living in a smaller town close to nature in England, as she loves nature. Nature would be a topic she would enjoy to discuss, and she could also involve solutions to issues involving nature. Her motivation would be to want to understand what drives people to do what they do. She would be a good listener and would not spend much time on chitchat, but instead dive in deep with a lot of questions. She would have an easy time talking about personal things, and would open up easily. We envisioned her poking and prodding at the ideas people have to help them change their minds and consequently their lives, while having a healthy amount of respect for what someone feels and thinks due to her background. We imagined she would feel quite wise due to her life experience and would not have much experience with teamwork. This could lead to her needing quite some explaining and convincing to consider the viewpoints of fellow coaches. Furthermore, we gave her some tendencies befitting of a retired psychologist, such as summarizing what someone else said to show understanding. This information was intended to give a clear idea of what kind of coach Helen would be and how she would act.

Once the initial coaches were defined, the CDTF set out to showcase what interactions with them could look like. To do so they developed dialogue trees for introductory dialogue including some gesturing and facial expressions. These scripted interactions included content such as the coach introducing themselves, giving the user a brief backstory about themselves, telling the user a bit about their hobbies, trying to coach the user on a health-related topic and responding to perceived silence by the user. In all branches of the tree the dialogue was inspired by the original description of the coaches while attempting to make them feel as lifelike as possible. These scripted interactions had the function of showing off the characters in interaction as more than just flat descriptions, and to show the effects of some of the different aspects that were defined about them on their interaction with the users. We worked on these dialogues for Helen, as well as Hank.

Besides fleshing out the coaches by means of showcasing an interaction with them, the CDTF also worked on initial visual representations of the coaches using 3D character models (Figure 2)[3].

Figure 2: Initial character designs, from left to right Helen, Hank, Owen, Alexa, Francois and Melissa.

These were inspired by the visuals and description of physical characteristics included in the initially defined characters. The coaches were physically diverse with the purpose of having a diverse and interesting cast of coaches for the user to interact with, as well as have their appearance align with their differing backgrounds. Furthermore, it could be of interest to see the effects of these different appearances on the user during the multiparty interaction.

2.2 Scenario Development

Meanwhile, the consortium partners of the Council of Coaches project worked on specifying several initial scenarios for the coaches to interact with the user in. A total of seven scenarios were discussed during a meeting and each highlighted different aspects to focus on, such as use of humour, showcasing differences in perspective between the coaches, differences in their personalities and coaching styles, language use, using storytelling to get a point across, using motivational interviewing techniques, and using behaviour change strategies. The CDTF decided on starting with an introductory scenario with three of the developed coaches leading into the coaches using the behaviour change strategy goal setting. The goal was to showcase the varying coaches with different backstories, hobbies and ways of interacting as well as show goal setting as a behaviour change strategy and to show how negotiation about goals could be done by the user as well as by other coaches.

3 OUR PLANS

Now that an initial set of lifestyle coaching agents to coach older adults and initial scenarios for them to interact in with the users

[3]These 3D models were made by Reshmashree Bangalore Kantharaju from the Paris-Sorbonne University and validated with the members of the CDTF that designed each of these coaches.

have been defined, we will be able to study what the effects of the many aspects of the characters and scenarios could be on the user as well as the interaction itself in multiparty interaction.

The question we intend to address is: What are the possible advantages and disadvantages of a multiple agent approach as compared to a single agent approach to coaching interactions with older adults? As previously mentioned, we are not aware of previous studies into this topic and we postulate that it is interesting to investigate the impact interaction with multiple coaching agents could have. Thus, our goals by doing studies into the effects of the defined coaches and scenarios in multiparty interaction is to find out in what ways a multiparty interaction differs from a one on one interaction with a lifestyle coaching agent, which variables could have an effect on how older adults experience multiparty interaction as feeling more or less natural and engaging, could have an effect on how lifelike each of the individual coaches feel to the older adults, could have an effect on how persuasive and motivating the coaches are to older adults, could an effect on the trust of users in individual coaches as well as the coaching team as a whole, and could have an effect on how interesting and engaging the coaches are, among other things. Some of the variables we are considering to study are the amount of coaches participating in the interaction, backstory, perceived personality, body language, appearance, use of interpersonal social behaviour, presentation of different perspectives, the form disagreement between coaches as well as between coaches and the user takes in their interactions (e.g. having a fierce discussion as compared to trying to come to a solution both parties can agree to), and coaching strategies employed, among others. Studying these effects could lead to new insights to be used in the development of coaching applications for older adults as well as other user groups in future work. To achieve our goals, we plan to do a literature study, study recorded interactions, as well as do stakeholder studies and user studies. We will shortly elaborate on the use of each of these kinds of studies to further our goals and present the ideas for future studies that we currently have.

Firstly, we intend for our literature study to give us a better understanding of the state of the art in the field of coaching applications and ECAs, and specifically the use of ECAs as lifestyle coaches. This will give us a solid foundation of knowledge to work from when we further develop the coaches and scenarios, as well as give us something to base our decisions on regarding what could be of interest for our stakeholder studies and user studies.

Secondly, we plan to further study recorded interactions such as the aforementioned one made by our colleagues to find out what kinds of aspects about the interaction could be relevant in a multiparty coaching interaction for the coaches to not only be lifelike and engaging, but also effective at persuading and motivating users to change their health behaviours. We plan to look at verbal and nonverbal behaviour in these recordings. We expect that this will give us insight into the kind of behaviours agents might need to be able to display in their interactions with older adult users.

Thirdly, we will conduct stakeholder studies to give us insight into best practice currently followed by healthcare and coaching professionals when working with older adults and the strategies and techniques they use when interacting with them. Furthermore, they could give us further insight into our target group of older adults and how the coaches should interact with them, specifically the ones suffering from the chronic illnesses type 2 diabetes and chronic pain. Finally, they could also help us evaluate the coaches by interacting with them, or observing interactions with users and giving us feedback on what could be done differently to make the interaction more engaging and make the coaches feel more lifelike as well as be more persuasive, motivating and effective at changing health behaviours of older adults.

Fourthly and finally, we intend to conduct user studies to study the effects the coaches, scenarios and interactions have on the users and compare multiparty coaching interactions to interactions with a single coaching agent. This will be done to try and discover what aspects of them have an effect on the perceptions and behaviour of the users. Our goals are to try to find the differences in effect between multiparty coaching interaction and interaction with a single coaching agents, as well as what aspects could have an effect on how engaging and natural feeling the multiparty interaction is, and what variables could have an effect on the persuasiveness and ability to motivate older adult users of the agents.

The next step we plan to take is to investigate the effects of some of the previously mentioned variables on the multiparty coaching interaction through the use of several studies inspired by the work done on the developed characters and some of the developed interaction scenarios. One of the first studies we plan to do is a wizard-of-Oz user study comparing having the same message being delivered by one lifestyle coaching agent and by multiple agents (2 agents, 3 agents, et cetera) to investigate whether this has an effect on older adult users. We expect this to give us insight into advantages and disadvantages of using multiple agents. If any notable effects are found, we could investigate these further through evaluation methods such as questionnaires and interviews in a follow-up study to further expand upon the causes of these effects. Another study we plan to do is a study of recorded interactions to investigate the verbal and nonverbal behaviour and group dynamics displayed by healthcare and coaching professionals when performing the role of coaches in a group coaching session with someone playing the role of a patient. This study could help improve understanding of key verbal and nonverbal behaviours and group dynamics for lifestyle coaching agents to display in a multiparty interaction with a user. We could then evaluate the effects of the behaviours and group dynamics we observe in this study when they are displayed by the agents in follow-up user studies. By doing so we intend to investigate which of them are of interest when developing a coaching system employing multiple agents.

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