

Sarah: An ECA in the wild

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ABSTRACT

In this paper we report on a Wizard of Oz interaction study with an Embodied Conversational Agent. The agent was placed on a large display in the university crush area, an informal student meeting space over the course of a week. The main goal of the experiment was to gain information about interesting conversation topics for the students in order to inform the design of an autonomous version of the agent that can act as a long term companion in a natural social setting. We report the study results, discuss the possible reasons for the lack of meaningful conversation that the ECA could elicit from the students and report on lessons learned from this experiment.

Categories and Subject Descriptors

H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—*Artificial, augmented, and virtual realities*

General Terms

Experimentation, Human Factors

Keywords

Embodied Conversational Character, Wizard of Oz experiment

1. INTRODUCTION

Embodied conversational agents (ECAs) are becoming increasingly more prominent in today's world whether in the field of games, entertainment [28], sales [5], education [6], museums [40, 26] or therapy [39, 25] to list a few. These agents are usually designed to interact and converse with humans, hence, reside in social environments. The interaction setting calls for the establishment of a natural interaction interface if the agent wants to maintain a long-term relationship with its interaction partners. It has to fulfill its tasks in a manner that is acceptable and comfortable to humans [8].

In our work, we plan to develop an ECA that appears on a large screen in a common social area of the university where

students gather. The main objective is to allow students to interact with the agent that will act as an interactive source of information about local university- or course- related issues. The agent might also act as a match finder in the way that it can help students to connect to each other by identifying students with the same interests, cultural background, common course, etc. The students' interaction with the agent over an extended period of time will be observed, thus, may provide guidelines or hints to the design of agents that can maintain long-term relationship with users.

Much work on ECA interaction [24, 27, 33] has been in a functionally-oriented experimental one-to-one setting in which the motivation a user might have to interact with the ECA cannot really be explored. This can only be explored 'in the wild', that is in natural human social settings, which is one of our aims of the LIREC project¹ and which has only been attempted sparsely, e.g. [26], where an ECA has been employed as an interactive information system in a museum and [2], which evaluated an online health advisor. In contrast to those studies, however, our work is looking at a much less structured social setting. We are interested in finding out whether we can motivate users to interact by giving the ECA specific content.

This paper presents a preliminary study using the Wizard of Oz approach to identify students' interests that can ground the design of our application. The following sections detail our experiment setting, discuss the data collected and our observations during the experiment. This is followed by our proposal of potential refinement that may improve the interaction between the students and the ECA taking into consideration psychological, social influence, human-human social relationships, human-computer interaction and technical issues.

2. EXPERIMENT

2.1 Experimental setting

The experiment was carried out using the ECA Greta [34, 9], which is named Sarah in our scenario.

Sarah was setup for two hours during lunch time everyday for a week in the crush area of the Computer Science De-

¹www.lirec.eu

partment, Heriot-Watt University as depicted in Figure 2. There are two lecture rooms beside this area with lectures running at 11.15am, 12.15pm and 1.15pm everyday. Sarah was easily visible to any passerby in the crush area as it appeared on a 42 inch screen.

During this period the user could interact with Sarah by sending text messages. There were several reasons for choosing this interaction modality: mobile phones are widely available among the student population, everyone knows how to send text messages with their phone and we did not have to expose the keyboard of the machine, which could lead to students trying to shut down the system. Although using speech as an input modality may improve the users' experience, it is important for us to carry out the study in a setting that can be supported by a future autonomous version of Sarah so that the information we gather reflects the real situation. Current speech recognition technology is still not reliable enough for our purposes.

Sarah's reply was controlled by a human experimenter (the wizard) situated in another room of the building. Sarah can show different emotional facial expressions and perform gestures accompanying her speech. As no camera was installed, the wizard could not see the interactants, thus, relied only on the messages he received to generate responses.

Since the study was performed 'in the wild' with unsuspecting subjects we could not count on the student's suspension of disbelief. The wizard thus had to operate with the restriction of acting within the parameters of what computer science students would deem believable behaviour for an artificial agent. This means, for example, that the wizard had to pretend not to understand complex requests.

Another experimenter acted as a passive observer in the crush area to jot the users' behaviour and discussions during the interaction. The observer sat at a distance of about 2 meters from the screen and was unknown to the students as we intended to collect data in a natural setting.

Due to our aim of building an ECA that can establish a long-term relationship with users in a real world environment, we had to ensure the experiment was carried out in natural conditions. Thus, the behaviour and discussions of the users were collected only at a superficial level due to the unobtrusive observation method.

The following instruction was attached to the bottom of the screen as guidelines for interaction.

Please help us with our research by interacting with Sarah here, a prototype virtual character for acting as an interactive information system in public places. She cannot see or hear (yet) but you can chat to her by sending text messages to:

xxxxxxxxxx (standard UK mobile rate)

You will see Sarah's reply on the screen. You can ask her about university information or just try small talk. Naturally she will not understand or know everything so please be patient. Sarah will be here every day this week for a few hours around lunch time so you can always come back to continue your chat because she will remember you. We would also be grateful if you could fill out one of the feedback forms to help us improve Sarah and leave it in the box.



Figure 1: Sarah



Figure 2: Crush area where Sarah was setup

Additionally, we provided the interactants with optional feedback forms (placed on a chair beside the screen) which attempt to gather their interaction experience with Sarah. We also asked them about desired functionalities and improvements that they would like Sarah to have in future. The list below shows some questions from the feedback form (all ratings were performed using a 5-point Likert Scale).

- How comfortable would you feel with Sarah storing a profile of you and your interests?
- How useful would you find the following functions of Sarah?

Help to get to know other students with similar interests
 Advertise student projects or societies
 Link to your VISION account and remind you of lectures and exams
 Link to your Social Networks like Facebook to learn more about you

- Which other functions would you find useful?
- Please rank the following interaction features for Sarah by importance : Recognise your face, speech recognition, subtitles, recognising your body language, only you can hear Sarah (through directed speakers)
- Which other interaction features would you like Sarah to have?
- If the above suggestions were all taken into account and Sarah would be here constantly, how likely would it be for you to interact with her regularly?

2.2 Interaction log

Based on the interaction log, the amount of messages sent by each interactant to Sarah is shown in Table 1. It can be observed that 68 percent of the interactants sent only one text message to SARAH, 13 percent sent two messages while only 5 percent send more than 5 messages.

Table 1: Amount of text messages

Number of text messages	Number of interactant(s)
1	26
2	5
3	3
4	2
more than 5	2
Total	38

Table 2 in Section A shows a summary of the type of messages Sarah received. In total, 106 messages were received over the 5-day period and these messages fall under different communication categories such as greetings (14.2%), answers (6.6%), questions (50.9%), information giving (6.6%), requests (11.3%) and other remarks (10.4%).

2.3 Feedback forms

Overall, we received only 3 feedback forms. The main comments were that Sarah was taking too long to respond and it was unclear to whom she is responding. The responses to Sarah storing a profile of the user and his/her interests and the usefulness of Sarah’s different functions were divided. Overall, all the 3 interactants find the link to Social Networks like Facebook not useful. They suggested other functions such as announcements of daily events and weather information. As for the interaction features, again no conclusion can be drawn. However, the likelihood of them interacting with Sarah regularly given that their comments and suggestions are addressed was rated 4 out of 5.

2.4 Observations

The main observation of the interaction was that the interactants sent messages to Sarah in groups, that is, they gather around the screen, having a small talk about Sarah, discussing about what to send and waiting for her reply together. Each group interaction may involve more than one person sending message(s) to Sarah. Almost all of the interactants were male with only 4 groups involving some female users, although it was unclear if the female users sent any messages to Sarah or they were just giving advice on what to

send and making comments. There was only one individual female interactant and 4 individual male interactants.

At the first sight of Sarah, three of the students started talking to her while two were trying to move from left to right to see if Sarah’s gaze follows their movement. Most of the interactants were students who came for their lectures and stayed in the area for not more than 15 minutes. Those who stayed longer in the crush area were mostly involved in some discussions, reading books, working on their laptops, etc. and were not interacting with Sarah although from time to time, they may observe others interacting with her.

The proximity of the interactants to Sarah (the screen) ranges from 0.50 meter to an area beyond the crush area with most interactants standing within 1 meter from Sarah. Some of the students seemed to have signal reception problems and had to move to the window to send text message(s). There were also students that sent messages to Sarah even when they were not around the crush area.

2.5 Discussion

Based on the interaction log and observations, we may deduce that there was a lack of motivation for the students to interact with Sarah. The basic assumption for communication is triggered by the desire to get into contact with others and to establish lasting social relations and attachment for the fulfillment of our need for affiliation [11, 10]. Since most of the students came in groups, they might not have any desire to establish additional contact since their need for affiliation is satisfied.

On the other hand, the social perception [20] of Sarah, that is, the attention the students gave and the way they perceived Sarah might have been influenced by their overall first impression and expectations on its capabilities. Since artificial agents are not usually a part of our daily lives yet and they can show a great variety of appearances and abilities, the students expectations about Sarah may not be very accurate and may be greatly influenced by sci-fi contents given that they are computer science students. Many of the students expected Sarah to see, listen and talk as observed from their attempt to talk directly to Sarah and their movement to gain Sarah’s attention prior to reading the instruction. The realisation that Sarah can neither see nor hear might have led to an expectation failure and disappointment.

Additionally, first impression might also have been formed based on how Sarah was described in the instruction. There was a lack of background information about Sarah in terms of age, ability, interests, role and so on. Nass and Moon [31] found that humans tend to fill the ambiguity of interaction norms with social agents by applying human social norms if the companion appearance is human-like as in the case of Sarah. This might have led to the “uncanny valley” experience since Sarah does not live up to these expectations [29]. According to [12], the expectations we develop after an inaccurate first impression is usually rather persistent and influences our further perceptions and impressions. Thus, due to the initial disappointment, the students might find Sarah not worth interacting with. Moreover, the effort and time spent interacting with Sarah was too short to create a valid impression of her.

There are also studies that show that personal expectations of artificial social agents are very likely influenced by the general attitude of society towards technology, religious issues and the media, especially the so called “early adopters”

[35, 16]. In general, people are skeptic about the future role of social robots in society [16]. This trend is especially strong among women who also think that more time is required for the notion to become a reality as compared to men. This might explain why there were not many female interactants in addition to the fact that the population of female students is low in the Computer Science Department.

The distances between the interactants and Sarah fall under ‘intimate’ zone (an area up to 0.50m), ‘personal’ zone (an area up to 1m), ‘social’ zone (an area up to 3-4m) as well as ‘public’ zone (beyond 4m) [22, 21]. Most interactions occurred within ‘intimate’ and ‘personal’ zones. However, there was one interactant who sent messages to Sarah continuously even when he was not around the crush area. This caused confusion and annoyance to the people in the crush area because it led to an impression that Sarah was talking randomly. An extract of the interaction is shown below:

Student	My name is Damien	11:51:22
Sarah	Hello Damien, nice to meet you	11:51:39
Sarah	How can I help you?	11:51:55
Student	Hi boys	11:52:20
Sarah	Hello	11:51:44
Student	How are you?	11:52:54
Sarah	My name is Sarah	11:52:58
Sarah	I feel great (<i>joy</i>)	11:53:20
Student	Do you like Craig?	11:54:13
Sarah	Who is Craig? (<i>surprise</i>)	11:54:34
Student	Craig is smelly	11:55:16
Student	How do you feel?	11:55:51
Sarah	I feel confused, I don’t know Craig	11:56:18
Student	Pseudo exit	11:56:37
Student	Craig is a bad bad man	11:56:53
Sarah	(<i>uncertain gesture</i>)	11:57:40
Student	How do you feel?	11:58:34
Sarah	Would you like to talk about music?	11:58:41
Student	Yes	11:58:59
Sarah	What music do you like?	11:59:22
Student	Rapid	11:59:50
Sarah	What music do you like?	12:00:17
Student	Wolf wolf	12:00:49
Student	Bite me	12:01:13
Sarah	(<i>head shake gesture, sad</i>)	12:01:44
Student	My name is yan	12:02:41

From this extract, it can be observed that the interactant was trying to confuse Sarah and was not serious in the conversation. At least 30 percent of the total texts falls into similar categories where the interactants texted random greetings, questions, information, requests or remarks to Sarah (please refer to Table 2 in Section A). Besides trying to test or confuse the system, many interactants applied social communication strategies in the text such as greetings and personal address although some of these addresses were rude (5.6%). Some of the questions and requests made by the interactants were also considered rude, for example “say my name”. Since most of the text were questions (50.9%) rather than answers despite Sarah’s attempt to give information and make small talk about music, university events, etc., our attempt to gather information about the topics students would like to talk about was not fruitful.

3. AN EXPLANATION USING FISKE’S SOCIAL CORE MOTIVES

According to Fiske [19] there are five unifying motives for the establishment and maintenance of successful long-term relationships: **Belonging** (need for strong, stable relationships), **Understanding** (need for shared meaning and prediction), **Trusting** (need for viewing others as basically benign), **Controlling** (need for perceived contingency between behaviour and outcomes) and **Self-Enhancing** (need for viewing self as basically worthy or improvable). Applied to our scenario, this means that in order to establish a successful relationship with a student, Sarah needs to be able to cater for all these motives. A social motive centric analysis of the experiment can therefore provide insights into possible reasons for the missing engagement.

Some aspects that may provide a sense of **belonging** are the ability to recognise the users and to provide a personalised interactions experience. Sarah can recognise users through identification of their mobile phone numbers but was not able to share its experiences and personalise its interactions with users due to the short interaction period. To create a sense of **understanding** between Sarah and users, display of emotions and gestures is useful. Although Sarah can express her own emotional state, she was not able to recognise and understand the user’s emotions. She also did not provide enough background information about herself, her role and her functionalities that may help the users to understand her better.

In order for users to **trust** Sarah, she will need to act consistently, appropriately and reliably so that the users are comfortable with the interaction. Due to the randomness of speech as responses to ‘invisible’ users, other users might have formed an impression of weirdness and unreliability about Sarah’s behaviour. Additionally, there was doubt about Sarah’s trustworthiness, which is reflected in the responses on the feedback forms where all the 3 users were not in favour of Sarah linking up to their social networks and extracting information about themselves. Through the observations, there was also chat/worries about sending texts to the unknown phone number.

The **control** motives can be viewed from the perspective of both the users and Sarah. Users have control over the interaction by being able to decide when to interact with Sarah. This sense may be enhanced if they are given the ability to teach Sarah / tell Sarah about their preferences, interest, etc. and get the assurance from Sarah that their information will be kept confidential. By being able to communicate with Sarah more privately might also be beneficial.

From Sarah’s perspective, control would mean the ability to maintain its competence through carrying out its tasks successfully. In the experiment, Sarah was able to answer some of the users’ questions but failed to live up to its role of match finder by connecting students through common interests, courses, etc. due to the lack of information and interaction from the students. This lack of interaction may have also led to the indifference in the sense of **self-enhancement** (increased self-esteem or possibility of self-improvement) in the users. Sarah did not get the opportunity to provide enough information that may increase their knowledge or make them feel better.

4. POTENTIAL FACTORS THAT MAY INCREASE MOTIVATION

Social and demographic factors, proximity and physical attraction have been found to be important factors to the beginning of a relationship. People tend to be attracted by someone who is similar to themselves in terms of attitudes and beliefs particularly for those attitudes and beliefs that they deem important [4]. According to Byrne's attraction paradigm [3], positive affect is evoked when hearing someone expressing similar attitudes while negative affect is evoked when hearing someone express dissimilar attitudes to oneself. Thus, people who are similar to oneself are judged as more likeable than less similar people.

This finding is true not only for humans but artificial agents as well. Nass and colleagues [32] found that people tend to be attracted by a computer with a similar personality to their own than a computer with dissimilar personality. Therefore, the matching of Sarah's personality to the users' could facilitate its acceptance. However, this is not feasible because the personalities of students can vary widely and we want Sarah to be liked by most students. Ideally, Sarah could have the ability to adapt to users' interests and style of communication, thus giving the users a personalised interaction experience. Sarah could start with a neutral attitude towards a subject and adapt the conversation as she gets to know the user better.

Physical proximity is important to a relationship because physical closeness increases the likelihood of contact [36] and the more often individuals meet each other, the more likely they discover mutual interests and attitudes, and thus, get to know the other person better. Festinger, Schachter and Back [18] in their study showed that more friendships were developed among students that lived on the same floor as compared to with other students within the same building. Supporting this view, a recent article in *New Scientist* [1] revealed that people are more attached to things they see regularly. This is because frequency of contact and degree of familiarity lead to enhancement of likeability of a person [41]. Thus, by locating Sarah in the crush area for a longer period we may increase communication between her and the students. The accessibility of Sarah may enhance the interest of building a relationship with her and according to Walther and colleagues [38], under a natural setting, adaptation will take place and communication with a companion will slowly grow more fluent and efficient as time passes. Additionally, placing Sarah in the crush area during out of lecture and lunch hours might produce different results because then students will not be in a hurry to attend lectures or go for lunch.

Physical attraction plays a vital role to a good first impression. Aesthetic appeal has been used as a powerful marketing tool since the emergence of industrial design in the early 1900s [13]. Physical attractiveness can lead to a person being perceived as more socially skilled, sympathetic, favourable and has a better mental health than unattractive people - "what is beautiful is good" stereotype [17]. Being attractive can result in the "halo effect" and lead to an overall positive impression of that person [30]. Thus, a companion that has an attractive outer appearance can make a pleasant first impression that may facilitate a good relationship more effectively than a companion that the owner has to get used to. Therefore, improving Sarah's appear-

ance might help her to establish a relationship with users more effectively. Additionally, physical appearance can also be interpreted as signs of competence or authority. Sarah might want to show disapproval to users' behaviour that is socially impolite or unacceptable through facial expressions. Moreover, Sarah's appearance should provide hints of her role so that the users have an idea of what Sarah is capable of doing. However, care should be taken to ensure that an impression that suggests "false" affordances to users are avoided.

Eagly [15] showed that physical attractiveness has less effect when individual information such as personality and background is presented. Storytelling is an important aspect in human-human communication and has been used throughout history to organise information in ways that are comprehensible, engaging and enjoyable. We create and recite stories as we present our life experiences and since stories are presented in context, they enable others to remember the information more easily.

Thus, a way to make Sarah's conversation with users more interesting is by presenting funny or interesting personal experiences and background stories. This will not only help them to know Sarah better, but also reduce the ambiguity of Sarah's knowledge and capabilities. The appropriate amount of information that Sarah would disclose about herself will depend on subtle cultural rules [14]. Topics that are usually regarded as sensitive include money, the own body, personality and sexuality. Additionally, including fun factor into the interaction may also help. On top of being a source of information, Sarah can play simple riddles or games with the users. She can also tell jokes and make humorous comments when necessary.

Besides social and demographic factors, proximity and physical attraction, Curtis and Miller [7] stated that people tend to like others who like them, thus, Sarah may employ means such as positive facial expressions and gestures that make her appear to like the users to increase their liking of her. Direct verbalisation in this case might not be appropriate and may sound creepy given that Sarah is a virtual agent with a synthetic voice. To make Sarah understand speech and gestures implies a lot of hardware and software challenges. On the other hand, Walther [37] found that people adapt their communicative behaviour to their interaction partner as far as social signs, the content of the communication, and its coding are concerned. They are usually willing to accept shortcomings of technical devices in order to establish social contact with artificial agents [31] since friendship has an emotional component and demands mutual respect of the friends [23].

Besides social factors, there are technical problems that may enhance the interaction. In order to address the 'invisible' interactants problem, a camera or computer vision system can be employed so that Sarah talks only if she sees someone within the proximity. Additionally, feedback should be given to users to ensure them that their messages have been received by displaying the recently received text on screen. This may also avoid confusion because users will have an idea of which text Sarah is currently responding to.

To address privacy issue which might have led to users' reluctance in interacting, a directed speaker can be installed so that only the user standing within zone can hear Sarah, hence preventing the conversation from being overheard by someone else. Moreover, this may allow a deeper bond to

develop between Sarah and the user. In terms of users' feedback, providing some kind of reward might motivate them to fill the feedback forms.

5. CONCLUSION

Our approach of collecting specific conversational content for an ECA through a Wizard of Oz trial 'in the wild' was not as successful as we would have hoped. The ECA itself could not elicit enough interest from the students to engage them in longer conversations. In this paper we have reviewed several social and psychological theories that may explain the reason for this failure. Our conclusion is that it takes more than specific content to integrate an ECA into such open social settings. Thus, our next step is to take the different factors into consideration to address the shortcomings discussed above. A good start would be to make Sarah more interesting and fun to interact with. While overcoming the technical problems, we are thinking of testing this idea using a real human role play as this approach may be carried out faster, hence, allowing us to get a quick feedback on the feasibility of this move.

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APPENDIX

A. SUMMARY OF TEXT MESSAGES BASED ON COMMUNICATION CATEGORIES

Table 2: Summary of text messages

Category	Examples	Frequency, N = 106
Greeting		Total: 15 (14.2%)
Name greeting	My name is damien	9
Informal greeting	Yo wat apening	3
Formal greeting	Hello	3
Questions		Total: 54 (50.9%)
hline Commonplace phrases	How are you today?	14
Incomprehensible	What does the fab buffer represent?	5
Questions about University/courses	Where is the best place for lunch on campus?	9
Questions/Opinion about someone/something	Do you think paddy is ugly?	4
Personal	Do you want to take a coffee with me?	7
Pornographic/Sexual	Where can I get free condoms?	5
Verify	Can you repeat the answer?	2
Ask for name	What is your name?	4
Other questions	How many times have you been asked questions today?	4
Answers		Total: 7 (6.6%)
Relevant Answer	I Like Rapid Music	7
Information giving		Total: 7 (6.6%)
Irrelevant	Choi and the dirt is gone	4
About someone	Elise Is Awesome	3
Request		Total: 12 (11.3%)
Random action	Bite me, Sudo make me a sandwich	7
Say Name	Say my name	5
Remarks		Total: 11 (10.4%)
Personal	Hey sarah i love your purple dress, You are fat	5
Others/Flaming	Get out of here	6