Could a Virtual Agent Be Warm and Competent? Investigating User's Impressions of Agent's Non-verbal Behaviours

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ABSTRACT

In this abstract we introduce the design of an experiment aimed at investigating how users' impressions of an embodied conversational agent are influenced by agent's non-verbal behaviour. We focus on impressions of warmth and competence, the two fundamental dimensions of social perception. Agent's gestures, arms rest poses and smile frequency are manipulated, as well as users' expectations about agent's competence. We hypothesize that user's judgments will differ according to his expectations, by following the Expectancy Violation Theory proposed by Burgoon and colleagues. We also hypothesize to replicate the results found in our previous study concerning human-human interaction, for example high frequency of smiles will elicit higher warmth and lower competence impressions compared to low frequency of smiles, while arms crossed will elicit low competence and low warmth impressions.

CCS CONCEPTS

• **General and reference** → **Empirical studies**; • **Human-centered computing** → *Natural language interfaces*; • **Applied computing** → *Psychology*;

KEYWORDS

First impressions; Social cognition; Warmth and Competence; Non-verbal behaviour; ECAs.

ACM Reference Format:
Beatrice Biancardi, Angelo Cafaro, and Catherine Pelachaud. 2017. Could a Virtual Agent Be Warm and Competent? Investigating User's Impressions of Agent's Non-verbal Behaviours. In *Proceedings of 1st ACM SIGCHI International Workshop on Investigating Social Interactions with Artificial Agents (ISIAA'17).* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3139491.3139498

1 INTRODUCTION AND MOTIVATION

During the first moments of any new encounter we automatically form a first impression of others [2]. Guided by others' appearance and non-verbal behaviour, but also by stereotypes [10], people are able to form quite accurate impressions about other's personality, attitudes, sexual orientation and other dimensions [2, 15]. These impressions play an important role in the quality and duration of interactions with others and can affect the occurrence of future encounters [2].

Warmth and competence (W&C) are considered as the two basic dimensions processed when perceiving others (e.g., [9]). Warmth reflects others' intentions and has been defined with traits like friendliness, sociability, morality; competence reflects the ability to enact these intentions and has been defined with traits like intelligence, skillfulness, capability (for a review of different terminologies, see [1]). These two variables are not independent: some authors support a positive correlation between them, called *halo effect* [15], while others showed evidence for a negative correlation, called *compensation effect* [11].

We are interested in endowing an embodied conversational agent (ECA) with the capability of managing the first impressions elicited in the user during the interaction with him. First impressions are crucial also in this context, for example they affect user's willingness of further interactions with the agent [8].

W&C perception in virtual agents has been measured in several studies (e.g., [14], [3]). Nguyen et al. [13] also implemented a computational model for agent's W&C starting from videos of actors playing these dimensions. These studies encourage us to investigate first impressions generated by a virtual agent, by focusing on the role of non-verbal cues in W&C impressions.

When studying first impressions, expectations can have a relevant influence on them. Burgoon and al. [6] state that people have expectations about others' behaviors during interactions, primarily based upon social norms and specific characteristics of the communicators. These expectations can be confirmed or not during the interaction. According to the Expectancy Violation Theory (EVT) proposed by Burgoon et al. [6], four different outcomes could be produced: Positive Violations (PV), when the communication exceeds expectations favorably; Negative Violations (NV), when the communication is worse than expected; Positive Confirmations (PC), when the communication is expected and positively valenced; Negative Confirmations (NC), when the communication is expected but undesirable. PV are predicted to produce better outcomes than PC, as well as NV are predicted to generate unfavorable outcomes when compared to NC.

Burgoon et al. [7] showed that humans follow EVT also when interacting with virtual agents. It seems thus that people can have expectations about agent's behaviour and these expectations can be violated.

Their results encourage us to investigate how expectancies can influence user's perception of W&C of the virtual agent.

ISIAA'17, November 13, 2017, Glasgow, UK

ACM ISBN 978-1-4503-5558-2/17/11…$15.00
https://doi.org/10.1145/3139491.3139498

Our main motivation is to improve the quality of agent's impressions generated on the user and user's engagement in human-agent interaction, by investigating whether the same processes that characterize human social perception also apply in human-agent interaction.

In a previous study, we analyzed a corpus of natural human-human interactions between an expert and a novice. We annotated gestures, arms rest poses, head movements and smiling of the expert, as well as his warmth and competence perceived by annotators. We then analyzed the association of the non-verbal cues with expert's W&C variations (increase and decrease). Among the results, we found smiling to be positively associated with warmth and negatively with competence, while arms rest poses such as arms crossed were negatively associated with both W&C [4].

At the actual stage of our investigations, our main purpose is to investigate whether it is possible for a virtual agent to express different levels of W&C by manipulating its non-verbal behaviour. At the same time, we are interested in collecting user's reactions linked to their impressions of W&C. These data could be exploited by the agent in a further step to predict user's impressions and detect them in real time.

To address these issues, we are planning a series of experiments with two main purposes:

- On one hand, to investigate user's impressions of the virtual agent when manipulating agent's non-verbal behaviour;
- On the other hand, to measure user's reactions, by collecting physiological data, in particular facial Action Units, heart rate and skin conductance, as well as user's non-verbal behaviours towards the agent. This part will be accomplished in collaboration with the Multimedia Interaction group of the University of Geneva, thus it is not further described in this abstract.

2 METHODOLOGY

In our experiment, the task of the participant will be to watch to 16 videos of a virtual character saying a brief sentence, and to fill in some questionnaires after each video. Each video lasts around 15 seconds, and the total duration of the experiment does not exceed 30 minutes.

The agent will utter the same sentence with the same verbal behaviour during each trial, while its non-verbal behaviour will be manipulated. The sentence contains 3 emplacements where the agent can display a gesture, and 3 emplacements when the agent can smile. The choice of the non-verbal cues to manipulate is based on our previous work described above [4].

We describe the factorial design of the study in the next paragraph.

2.1 Independent Variables

We are planning a 2x2x2x2x2 design, with one between-subjects factor and 4 within-subjects factors.

The between-subjects variable concerns the description of the virtual agent and has 2 levels: **agent** vs **avatar**. The scenario provided to the participant will introduce the agent either as an autonomous synthetic character endowed with artificial intelligence (agent condition) or as an avatar controlled by a real human (avatar condition). These different descriptions are supposed to elicit different expectations about agent's competence; we are going to evaluate our scenarios in order to validate in which of the 2 conditions the agent is considered as more competent. According to literature (see Section 1), also expectation about agent's warmth should be influenced by this manipulation, either in the same direction (*halo effect*) or in the opposite one (*compensation effect*).

The within-subjects variables we are interested to manipulate are:

- Type of gesture: the agent could perform **beat** (rhythmic gestures not related to the semantic content of the speech) or **ideational** gestures (more complex gestures related to the semantic content of the speech) [5, 12];
- Frequency of gestures: **low** (the gesture occurs in 1 of the 3 emplacements) vs **high** (the gesture occurs in all the 3 emplacements);
- Frequency of smiling: **low** (the agent smiles in 1 of the 3 emplacements) vs **high** (the agent smiles in all the 3 emplacements);
- Type of arms rest poses: **arms crossed** vs **akimbo** (i.e., hands on hips).

2.2 Dependent Variables

After each video, the user will be asked to:

- Write down, optionally, 1 to 3 adjectives describing the agent. This will contribute to fix his impressions, and will be used for a qualitative analysis;
- Judge agent's warmth, by rating on a 5-points Likert scale how he perceived the agent as *kind, pleasant, friendly, warm*;
- Judge agent's competence, by rating on a 5-points Likert scale how he perceived the agent as *competent, effective, skilled, intelligent*;

3 CONCLUSION AND EXPECTED RESULTS

In this abstract we introduced the design of a study with which we aim at demonstrating that a virtual agent can be perceived as expressing different degrees of warmth and competence, by modifying its non-verbal behaviour. We are interested in whether the frequency of gestures and smiling plays a role in impressions formation. Concerning type of gestures and rest poses, we are interested in whether the same results found in our previous study, where humans were judged, replicate for a virtual agent. Therefore, we hypothesize that user's impressions about warmth and competence of the virtual agent can be influenced by the expectancies we elicited through the different scenarios used to present the virtual character (avatar controlled by a real human vs autonomous agent).

4 ACKNOWLEDGMENTS

This work is being supported by ANR IMPRESSSIONS project number ANR-15-CE23-0023.

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