Measuring the Effect of Personality on Human-IVA Shared Understanding (Demonstration)

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ABSTRACT

Personality traits have been widely studied in the context of collaboration in human teams. Research has shown that the personality traits of team members affect the team's common understanding and hence the overall performance. Although there is much research on Human-Intelligent Virtual Agent (IVA), teamwork, designing IVAs with personality traits that support the development of a human-IVA shared cognitive state has not been studied. In this paper, we present a demonstration where both humans and IVAs have to collaborate to achieve a shared task in real-time. Team performance and the human's perception of the IVA's personality are measured to determine the impact/effect of different IVA personality traits on shared understanding.

Categories and Subject Descriptors

I.2.11 [**A**rtificial **Intelligence**]: Distributed Artificial Intelligence – *intelligent agents, multiagent systems.*

General Terms

Design and Human Factors.

Keywords

Human-Agent Collaboration; Multimodal Communication; Big Five personality traits; Extraversion; Agreeableness.

1. INTRODUCTION

It has been noticed that, building a believable Intelligent Virtual Agents (IVAs) requires convincing simulations of human behavior [7]. Human behaviour includes emotions, social interaction and personality. Personality and emotions can influence all capabilities featured by believable IVAs.

A number of psychological theories have sought to explain or understand human personality [2]. The Big Five model of personality is widely considered to be the most robust mean to describe personality differences [5]. The Big Five model consists of five traits, namely extraversion (level of sociability and enthusiasm), agreeableness (level of friendliness and kindness),

conscientiousness (level of organization and work ethic), neuroticism (level of calmness and tranquility), and openness (openness to experience). Over the last 50 years, Big Five has become a standard in the field of psychology.

Integrating personality into IVA design could be exhibited either via physiological manifestations and/or cognitive states. The majority of studies on designing believable agents with personality have focused on physiological manifestations, such as facial expressions, hand/body gesture, and vocabulary selection. Neto and Silva [7] stated that very few works have investigated how personality influences cognitive states such as perception. One cognitive state that has not been studied is the development of mutual cognitive beliefs between human and IVA teammates [8]. To address this gap, we have built a virtual environment that includes an IVA with personality traits according to the Big Five model. This paper describes our prototype and evaluation study.

2. SCENARIO AND TECHNOLOGY USED

To evaluate the impact of an IVA's personality on the development of a shared understanding between IVAs and humans, a collaborative virtual scenario was designed. A survey was used to measure the dependent variable *IVA's perceived personality* to see whether the human's perception of the IVA's personality matched the intended personality assigned by the researcher to the IVA (the independent variable). The second dependent variable *performance* sought to capture the overall human-IVA teamwork performance and was measured through combination of two factors: time to complete the task and acceptance/rejection ratios. As studies (e.g. [4]) have shown that shared understanding is essential for good team performance, performance was used as an indirect measure of shared understanding.

The collaborative scenario was implemented using the Unity3D game engine (www.unity3d.com). The scenario included a task where both a human user and an IVA, namely Charlie, have to collaborate to achieve a shared goal that is to pass a sequence of four obstacles to reach their target (scientific laboratory). The four obstacles were: brick wall, wooden gate, bush and hill (see Fig. 1). In order to get over each one of these obstacles both the human and IVA have to select a pair of tools from a toolbox that contains 12 tools (pruning shears, bush hook, hammer, chisel, ladder, rope, matchsticks, matchbox, screwdriver, nipper, shovel and mattock). These tools were picked so that each pair of tools would be complementary, i.e. a single tool cannot work without the function of the complementary tool. For example, the chisel needs the hammer and matchstick needs the matchbox. In addition, each obstacle could be passed using different tools. For example, the bush obstacle could be chopped, burnt or climbed. Hence, there

should be agreement between the human and the IVA concerning the best way to overcome the obstacle and to select which pair of tools is most suitable for the task.

To demonstrate the effect of the IVA's personality traits on human-IVA collaboration, we selected two of the Big Five factors, extraversion and agreeableness to be embedded in the IVA in the scenario. Extraversion and agreeableness were selected because they have been shown to be predominant traits in collaboration and teamwork [1]. In our implemented scenario, these two personality traits were encoded in the IVA's verbal and non-verbal communication. Based on the features that characterize personality traits listed in [6], several parameters used for each trait to encode the verbal and non-verbal communication. For the IVA's verbal communication the following parameters were used to represent extraversion/introversion trait: verbosity, restatements, content polarity, verb strength, and exclamation. The IVA's nonverbal communication was encoded using the following parameters: head tilt, hand gesture and position to interlocutor.

3. EVALUATION

To verify the impact of different IVA personalities on human-IVA shared understanding in the context of a collaborative task, an experiment was carried out with 55 undergraduate participants. The participants were divided into 5 groups, one control group and four groups with the possible permutation of the 2 traits (i.e. Extraversion and Agreeableness).

Data was collected by two means; the first means was automatic data logging to track both the human's and the IVA's behaviours, messages and selections. The second means was a survey that contained 25 Likert scale questions (strongly agree, agree, neutral, disagree and strongly disagree) to acquire the user's impression about the IVA's verbal and non-verbal behaviour. In addition, a

Figure 1. A snapshot from the virtual system (in this treatment IVA was high extrovert and low agreeableness)
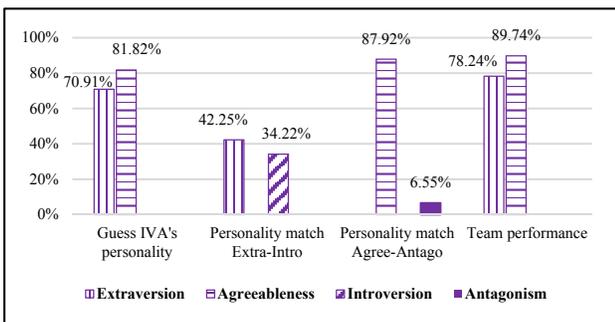

Figure 2. Ratios of guessing IVA's personality, human personality match and overall task achievement

personality test according to the Big Five model was applied to evaluate both the human's personality and human's perception of the IVA's personality. The collaborative activity can be found at:

http://comp.mq.edu.au/~richards/AAMAS2014-demo/Personality_Video.html

The results, see Fig. 2, showed that 70.91% and 81.82% of the participants correctly guessed the extraversion/introversion and agreeableness/antagonism personality traits of their IVA teammate. In addition, the results showed that there were more matching traits between humans and IVAs for agreeableness (47.24% the average of 87.92% and 6.55%). Moreover, the teammates that matched in agreeableness traits tended to achieve more towards the shared goal (89.74%).

An initial descriptive analysis of the results showed that the IVA's personality traits (extraversion and agreeableness) were easily interpreted by humans. This easy interpretation showed how well the personality traits were represented in the IVA's verbal and non-verbal communication and how easily humans can detect these traits. Our finding of a relationship between agreeableness and performance is consistent with other studies which indicated that agreeable persons tends to feel strong rapport with IVAs with agreeable personality traits [3].

To conclude, this demonstration aimed to study the relationship between the match in personality between human and IVA teammate and the development of a shared cognitive state represented by the overall performance in a collaborative task.

4. REFERENCES

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