One for all or one for one? The influence of Cultural Dimensions in Virtual Agents' Behaviour

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Abstract. With the increase in the development of autonomous agents, there is a bigger demand on their capability of interacting with other agents and users in ways that are natural and inspired by how humans interact. However, cultural aspects have been largely neglected so far, even though they are a crucial aspect of human societies. Our goal is to create an architecture able to model cultural groups of agents with perceivable distinct behaviour. In particular, this paper focus on how to use two cultural dimensions proposed by Hofstede in order to influence the agent's goal selection and appraisal processes. Using our cultural architecture, we created two cultural groups of agents and asked users to visualise them performing a short emergent story. We then asked them to describe the two groups visualised. Results confirmed that users did perceived differences in the groups, and those differences were congruent with the cultural parametrisation used.

1 Introduction

Nowadays, we are witnessing an increasing research on creating richer Intelligent Virtual Environments (IVEs). In the current development of these applications, many research challenges arise from the desire of leading users to experience the same kinds of social dynamics they would experience in the real world.

Consequently, there has been a large increase on studies related to agent architectures that take into account human social interactions, such as human dialogue and emotional responses. In particular, current architectures have acquired the capacity to create characters with distinguishable "personalities". This is usually done by associating the characters with different emotional profiles and personal goals.

However, culture which is a fundamental aspect of human societies, has been largely neglected so far in current agent systems. Research in culture specific agents has mainly focused on communication aspects [17] [7]. As a consequence, the social richness of the IVEs is diminished, since the behaviour of the characters ends up being distinguishable by their individual differences. While not

having culture embedded in the minds of the characters can be sufficient for representing simple real-world situations, we believe it is important for dealing with more complex scenarios and essential if we wish to build IVEs to represent multicultural worlds.

With this problem in mind, the aim of this research is to create an agent architecture that recreates general cultural aspects of human behaviour, not only related to different gestures or communication styles, but also to other important elements such as: rituals, goals and emotions. This architecture can then facilitate the creation of different cultural groups of agents with perceivable differences in their patters of behaviour, similar to the patterns found in real human cultures.

As described in [12], some previous work was done towards this goal by defining and implementing the notion of cultural rituals into an emotional agent architecture. Differently, in this paper we explore the use of an explicit model of *Cultural Dimensions* to influence the agent's behaviour. These dimensions were proposed by Hofstede in [6] and according to him, they indicate certain behavioural tendencies that are present in every human culture. In order to assess the model's capability to express different cultural behaviour, we performed a small evaluation with two sets of agents representing cultures with opposing dimensions. The results show that user's correctly classify the agent's behaviour as collectivist or individualist.

The structure of this paper is described as follows. In the next section we present some background on culture and describe in detail Hofstede's dimensional model. In section 3 we discuss related work in the area of culture specific agents in order to situate our approach. In section 4 we present the conceptual approach we used to model Hofstede's dimensions. Its implementation into an agent architecture is described in section 5. We then present a case study used to perform an evaluation where users watched two cultural groups with a different dimensional parametrisation. Finally, after analysing and discussing the results obtained, we draw some conclusions and present some future work.

2   Background

Culture is a vast concept, not easy definable. In 1952, a list containing 164 possible definitions of culture was compiled by Alfred Kroeber and Clyde Kluckhonn [8]. Still, no consensus has yet been reached in the present day.

The notion of culture here adopted is the one proposed by Geert Hofstede. The foundation for his theory is a large empirical study conducted in more than 70 countries. According to him, culture is "the collective programming of the mind that distinguishes the members of one group or category of people from another" [6]. These "mental programs" refer to patterns of thinking, feeling, and potential acting that are shared and learnt by members of the same culture. The patterns can manifest themselves at an implicit level, under the form of values, or at a more clearly observable level, under the form of rituals, heroes and symbols. These four types of manifestations can be described as follows:

Values - represent cultural preconceptions about what is desirable/undesirable;

Rituals - are essential social activities that are carried out in a predetermined fashion;

Heroes - are persons, alive, dead or even imaginary, that serve as role models.

Symbols - words, gestures, pictures, or objects that members of a given culture have assigned a special particular meaning.

Asides from the cultural manifestations presented above, Hofstede proposes five dimensions on which cultures vary [6]. Different from the previous manifestations, which can be very specific to a certain culture or subculture (e.g. the Japanese tea ceremony), Hofstede argues that these dimensions are universal. They are directly based on the culture's values and indicate general behavioural tendencies shared by the members of the culture. These tendencies should be not considered deterministic, since other factors such as the individual's personality, also play an important role on human behaviour. Hofstede's five dimensions can be described as follows:

1. **Power Distance Index (PDI) -** the degree to which less powerful members of the group expect and accept that power is distributed unequally. In small PDI cultures (e.g. Austria), people tend to regard others as equals despite their formal status. In high PDI cultures (e.g. Malaysia) powerful people have more privileges and like to wear symbols that reflect their status.

2. **Individualism (IDV) -** versus its opposite, collectivism, indicates the extent to which individuals see themselves integrated into groups. In collectivistic cultures (e.g Guatemala), everyone looks out for one another in exchange for unquestioning loyalty. On the other hand, in individualistic cultures (e.g. USA) people stress the importance of personal achievements and individual rights. Everyone is expected to be only responsible for themselves and their immediate family.

3. **Masculinity (MAS) -** versus its opposite, femininity, refers to the distribution of roles between genders. In very feminine cultures (e.g. Sweden), relationships and quality of life are very important. Both sexes should have equal rights and responsibilities. Very masculine cultures (e.g. Japan), favours assertiveness, ambition, efficiency, competition and materialism. Also, differences between gender roles are accentuated.

4. **Uncertainty Avoidance Index (UAI) -** this dimension indicates to what extent people prefer structured over unstructured situations. In low UAI cultures (e.g. Singapore), people have as few rules as possible and unfamiliar risks and ambiguous situations cause no discomfort. In an opposite manner, in high UAI Cultures (e.g. Portugal), people tend to have strict laws and rules and also various safety measures to avoid situations that are novel, unknown, or different from usual.

5. **Long-Term Orientation (LTO) -** indicates to what extent the future has more importance than the past or present. Short-Term oriented cultures (e.g Nigeria), value the respect for tradition, quick results, fulfilling social obligations and reciprocation of gifts. On the other hand, in long-term oriented cultures (e.g. China), people give more importance to the future than the past and present.

The main advantage of this model is the fact that it gives a clear and detailed notion of universal differences between cultures. As such, we believe the model serves the purpose of our work by indicating how we should characterise general cultural aspects of behaviour.

3   Related Work

A substantial part of the research done on culture in virtual agents involves the adaptation of the agents to the user's culture. This research is strongly motivated by the study conducted by Lee and Nass in [9], which showed that users tend to prefer to interact with a virtual agent that has a similar cultural background. In this line of investigation, CUBE-G is an interesting project that uses Hofstede's dimensions. They are used for exclusively modelling nonverbal communication aspects of the different national cultures. During a conversation with virtual agents, the cultural background of a user is inferred by sensing his nonverbal behaviour using a Nintendo's Wii remote controller. Then the nonverbal behaviour of the virtual agents is dynamically adapted according to the culture inferred. In [10], the manual adaption of a virtual agent to achieve believability in several cultural audiences was also studied.

To a lesser degree, virtual agents have also been adapted to specific cultures that are intentionally different from the user's culture. For example, in the Tactical Language Training System [7], users interact with autonomous characters from a foreign culture in order to train the culture's spoken language and gestures. The goal is to teach communicative skills in languages that are less commonly taught in USA, such as Arabic, Chinese or Russian. Learning such languages with traditional courses can be very time-consuming, due to their unfamiliar writing systems and cultural norms. However this system only addresses communicative aspects of a culture, namely spoken language and gestures.

As for agent architectures that include social and cultural factors in virtual agents' internal knowledge and reasoning, research is quite new. In the Tactical Language Training System the architecture that drives the behaviour of the characters in called Thespian [19]. It embeds cultural norms in the character's conduct by using social relationships such as trust and by allowing the definition of cultural obligations between agents. Thespian was built on top of PsychSim [16], a architecture for social behaviour. PsychSim implements a social theory called Theory of Mind, which is defined in [14] as the human ability of attributing mental states such as intentions, beliefs, and values, not only to oneself but to others as well. A similar feature was required in our cultural agents in order to model collectivistic cultures where people care a lot about the consequences their actions have on others.

More recently, the Culturally Affected Behaviour (CAB) model [20] allows the encoding of specific ethnographic data on cultural norms, biases and stereotypes, which is used to influence the behaviour of virtual agents. In addition to the Theory of Mind, the model is also inspired by the Schema Theory proposed by D'Andrade [2]. This theory postulates that a culture can be represented as a shared organisation of schemas. The main difference with our work is that CAB's cultural norms are tied to very particular tasks or actions such as giving alcohol or showing pictures of one's wife to a stranger. Our dimensional model addresses more general predispositions and behavioural tendencies.

4   Cultural Dimensions in Agents

Hofstede's model has five different cultural dimensions which normally range from 0 to 100. Our intention was to use similar values to change the agent's behaviour in a way that is congruent with Hofstede's findings. As described in section 3, the work done in CUBE-G already maps these dimensions to expressive nonverbal behaviour. We wish to pursue a different approach. As such, we decided to use similar dimensions to influence two other important aspects that are strongly influenced by culture in humans [2, 13]: (1) goal utility and (2) emotional appraisal. The first one is used for the agent to make more rational decisions about what he should do at any given moment. The latter serves to simulate human emotional responses to events.

For simplification purposes, we decided to encompass only two of the five dimensions (the ones that seemed to be more easily recognisable in a short-term interaction and easier to start from): (1) Individualism vs Collectivism and (2) Power Distance. As such, the other dimensions are left as future work.

4.1   Goal Utility - Individualism Dimension

So, how can culture affect goal utility? Hofstede states that, in an individualistic culture, "people are expected to be only responsible for themselves and their immediate family." [6] Also, close friendships are very important. On the other hand, in a collectivistic culture "everyone looks out for one another in exchange for unquestioning loyalty". As such, it seems clear that our cultural characters should evaluate a goal's utility under two different perspectives: (1) the impact the goal has to themselves and (2) the impact the goal has to others (which requires the ability to form mental models of others, like the agents from PsychSim). Individualistic characters are much more concerned with the first perspective as the second one is only important if the character has a strong interpersonal attraction (symbolising a close bond) with any of the other characters. Oppositely, collectivistic characters are equally concerned with both perspectives and treat everyone alike (regardless of social bonds). Based on these facts the following equation (1) was proposed for calculating a goal's utility based on the individualism score (IDV), the impact the goal has on the character's self (SI), the impact the goal has on others (OI), and a positive relationship factor (PREL), which considers interpersonal attractions between the targets of the goal and the character:

$$Utility(g) = SI(g) + OI(g)(\frac{100 - IDV}{100} + \frac{IDV}{100} \times PREL(g)) \qquad (1)$$

Note that $PREL(g)$ is normalised to a scale of 0 (no positive relationships) to 1 (maximum positive relationships) and the exact equations for $SI(g)$ and $OI(g)$ are domain-dependent. To explain the rationale behind this particular equation, we will use the following situation: character A is considering the goal of giving an apple to character B versus the goal of giving the apple to character C. A has plenty of apples so loosing just one has a small negative

impact, such as *SI(g) = -1*. However, B is hungry and poor, so receiving an apple would have a considerable positive impact like *OI(g) = 5*. On the other hand, C is also hungry but wealthy, so the impact for him of receiving the apple is a little lower, for example *OI(g) = 4*. Moreover, A has a negative interpersonal attraction towards B, thus *PREL(g) = 0*. On the other hand, A has a positive interpersonal attraction towards C, which makes *PREL(g)* return a positive multiplier depending on the intensity of the relation (in this particular scenario, we'll assume that it returns 0.5).

Using the previous situation, let's examine three different cultural scenarios: (1) an extreme collectivistic culture; (2) an extreme individualistic culture and (3) a neutral culture. In the first scenario IDV is equal to zero, so both goal impact functions are weighted equally which means that a character considers his own well-being to have the same importance as the well-being of others, regardless of the existent relationships. As such, regarding the example depicted, the utility of giving B the apple is higher (*Utility(g) = 4*) than giving it to C (*Utility(g) = 3*).

In the second scenario IDV is equal to 100, so the others well-being depends only on the existence of a positive relationship. Since in the previous situation A disliked B, then PREL(g) = 0. Thus, A now will never create an intention to give B the apple, since the goal has a utility of -1. But for C, since A has a positive relation with him it makes PREL(g) return a positive multiplier (e.g. 0.5). Thus, the utility of giving C the apple will now be equal to 2.

In the third scenario with a neutral culture (IDV = 50), i.e. a culture that is neither inclined to individualism or collectivism, the utility for giving B the apple is equal to 1.5. It is not negative but is lesser than the utility of giving it to C, which is equal to 2. This means that generally characters of a neutral culture care for all other agents but will give preference to their friends.

4.2   Goal Utility - Power Distance Dimension

According to Hofstede [6], in low-power distance cultures people tend to regard others as equals despite their formal status. Oppositely, in high power distance cultures powerful people are expected to be privileged. As such, we want characters that belong to a high power culture to favour goals that positively affect others who have a higher status. To achieve this result, we propose to augment equation 1 with a component related to the power distance score (PDI), and a power distance factor (DIST) that considers the differences of power between the targets of the goal and the character:

$$Utility(g) = SI(g) + OI(g)(\frac{100 - IDV}{100} + \frac{IDV}{100} \times PREL(g) + \frac{PDI}{100} \times DIST(g))$$
(2)

Similar to the positive relationship factor (PREL), DIST is also normalised to a scale of 0 (power equal or lower than self) to 1 (power is higher than self). Consider that in the previous "giving apple" situation, character A has a power

of 5, character B a power of 3, and C a power of 10. Since B has lower power than A, DIST(g) is equal to zero towards him. However, C has a power that is two times higher than the power of A, thus DIST(g) will return a value greater than zero (e.g. DIST(g) = 0.5). In the extreme collectivistic scenario (IDV = 0), we previously concluded that A would prefer to give the apple to B (Utility(g) = 4) than to give it to C (Utility(g) = 3). Now, considering also the power distance dimension, the situation can change when PDI becomes greater than zero. If we consider the extreme case (PDI = 100). The goal of giving the apple to C has now an utility of 5 and so A prefers to give him the apple instead of giving it to B (which remains with an utility of 4).

4.3   Emotional Appraisal

The idea that emotions are elicited by subjective evaluations (appraisals) of events or situations is the basis of several appraisal theories [18]. But how does culture affects emotions? According to Mesquita and Frijda [13], "cross-cultural differences as well as similarities have been identified in each phase of the emotional process." Regarding cultural differences that we can relate to the appraisal process and to Hofstede's dimensions, there are distinctions related to the Individualism dimension, proposed by Markus and Kitayama in [11]. They argue that in individualistic cultures the individual "appears as focused on his or her independence and self-actualization", while in a collectivistic culture the individual is "focused predominantly on his or her relationship with in-group members or with the in-group as a whole." Consequently, individualists appraise events in "terms of their individual achievements and properties" while collectivists appraise events in "terms of group the person belongs to or as affecting the interpersonal relationships." Concerning the Power Distance, so far we could not find any distinctions that we could correlate directly to Power Distance. However, based on the notions previously presented, we propose equation (3) for calculating one of OCC's [15] appraisal variables - the praiseworthiness of an event. As stated in the OCC theory of emotions [15], events with a positive praiseworthiness will potentially cause the character to feel pride or admiration, and a negative praiseworthiness result will potentially cause the character to feel shame or reproach.

$$Praiseworthiness(e) = \begin{cases} 0, & \text{if } AI(e) > OI(e) \geq 0 \\ (OI(e) - AI(e)) \times \frac{100-IDV}{100}, & \text{if otherwise} \end{cases}$$

(3)

The equation proposes is based on the impact the event has on the character who caused it (AI), the sum of impacts the event has on the other characters (OI), and the individualism score (IDV). In general terms, the first branch of the equation refers to events that did not harm others ($OI(e) \geq 0$) but had a more beneficial effect for the character who caused them (AI(e) >OI(e)). As such, no matter how collectivistic a culture is, a character will not be ashamed if, for example, he has just eaten an apple (an event that had a positive effect

on himself but a neutral effect on others). As for the second branch, it provides the following results: (1) the more collectivistic a culture is (i.e. the lower the IDV), the more an event that is undesirable for others (OI(e) <0) but is beneficial for the responsible character (AI(e) >0) will be blameworthy (e.g. stealing something); and also (2) the more collectivistic a culture is, the more an event that is good for others (OI(e) >0) but is bad for the responsible character (AI(e) <0) will be highly praiseworthy (e.g. giving food). In other words, collectivistic characters will find highly admirable a spirit of self-sacrifice for the well-being of the group and will find highly reproachable selfish acts.

To give an example, consider the following situation: agent B has asked directly agent A for an apple and A denies it. This has a positive impact on A considering he keeps the food for future use (e.g. AI(e) = 1). However, it has a negative impact on B who is very hungry (e.g. OI(e) = -3). Let's consider that agent A and agent B are from a culture that has an IDV of 27 (a value representing a collectivist culture). Applying the equation, agent's A decision will have a praiseworthiness value of -3 approximately. This means that A will potential feel ashamed, while B would feel reproach for A. Instead, if A decides to give B the apple, it will have a negative impact on A (e.g. AI(e) = -2) but a positive effect on B (e.g. OI(e) = 3). The praiseworthiness value of this decision will be 3.6. As such, A will likely feel pride, while B will feel admiration for A. Finally, if we re-examine both decisions, now considering the characters belong to a culture with an IDV of 91 (the value of the USA culture), we'll confirm that both decisions have a very low praiseworthiness. Namely, the decision of giving B the apple will be equal to 0.4, while keeping it -0.3.

5   Integration into an Agent Architecture

For the implementation of our cultural model, we have extended an emotional agent architecture [4]. Asides from the added cultural elements, agents have also individual behaviour, determined by their emotions, needs, quick reactions to events, and goals. The concept of emotions is based on the OCC cognitive theory of emotions [15], which defines emotions as valenced (good or bad) reactions to events. The subjective evaluation of events that causes such reactions is called the appraisal process. Motivational needs (grounded on a psychological model of human action regulation called PSI [5]) are used to select between alternative goals. The extended architecture is shown in Figure 1.

In this paper we will provide a brief description of the overall behaviour, without detailing previous existing components. For more information about them please see [3]. When an event is perceived it passes through a Symbol translator that translates the meaning of the event according to a culture's symbols (for instance a waving hand may considered greeting in one culture and insulting in another one). The event is then used to update the agent's Knowledge Base (KB) and Autobiographic Memory. At the same time is used to update the agent's motivational state. For instance, if the agent finished an eating action, its need for energy will go down. The agent needs to model the same process
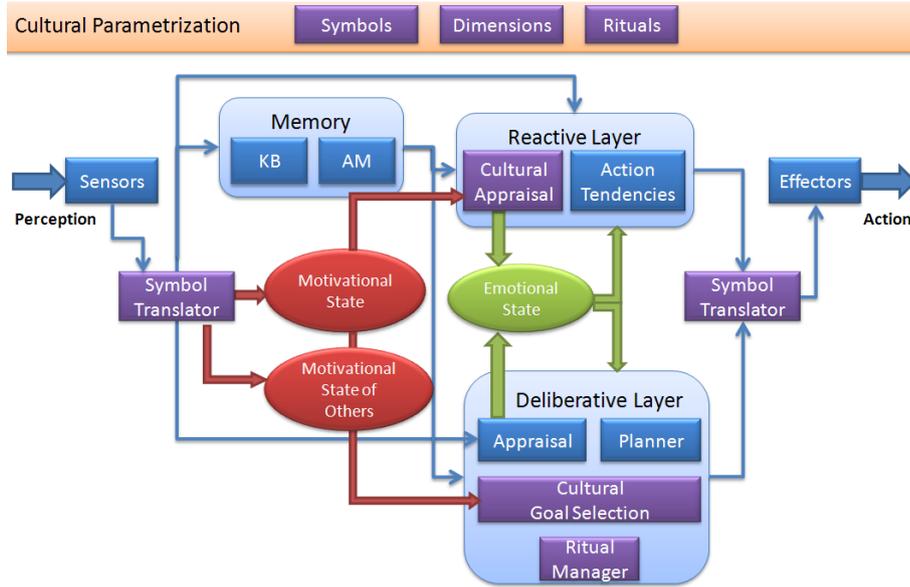
Fig. 1. Cultural Agent Architecture

for others, and so it builds and updates a motivational state of others according to events perceived. This information is used later in the cultural goal selection and cultural appraisal processes.

After updating the motivational states, the event is finally appraised. There are two main appraisal processes, the deliberative one that handles emotions related to the achievement of goals (e.g. satisfaction, disappointment), and the reactive one that consists in associating predefined appraisal values to the event (and then generating the corresponding emotions). The Cultural Appraisal was integrated in the reactive appraisal component. The Praiseworthiness appraisal variable is now automatically determined using equation (3) where AI(e) is equal to the effect the event had on the motivational state of the agent responsible for causing the event while OI(e) is equal to the effect the event had on the motivational state of the other agents affected by the event. This effects are manually defined for each possible action. The resulting emotional state is then used to trigger Action Tendencies (reactive actions).

In the deliberative layer, the event perceived will also activate predefined goals, and the agent will have to select between competing alternative goals. Here we introduced the Cultural Goal Selection process that calculates the expected cultural utility for each active goal using equation 2, where SI(g) was associated to the expected impact the goal will have on the agent's motivational state and OI(g) to the expected impact the goal will have on the goal's target (determined using the representation of that agent's motivational state). The goal with highest expected cultural utility will be selected as the agent's cur-

rent intention, and the planning component will develop and execute a plan to achieve the goal.

6   Case Study

The implemented cultural architecture was used for the development of ORIENT [1], an agent-based educational role-playing game that aims to promote intercultural empathy for young teenagers. Even tough it is a promising project, the game currently has only a single culture. Hence, we could not use it to measure the power of our architecture in creating various distinct cultures. Instead, for evaluating the architecture we created two different cultural groups of five autonomous characters to enact a common real-life situation in a 3D virtual world, namely, a dinner party (see Figure 2). The only difference between the two groups is that one of them was defined as extremely individualistic (IDV = 100) and the other extremely collectivistic (IDV = 0).

Fig. 2. Characters at the dinner table

For simplicity reasons, the overall plot is very short: the characters arrive at the party location; greet each other; socialise for a while; and then sit together at a dinner table and start to eat. Despite the fact that the characters all look alike, they have some individual differences. For example, one character feels sick and another has some medicine with him. Also, the character that has the medicine has just built a new house and needs someone to help him paint it. These individual differences were made for originating situations to explore the parametrisation of the culture's dimensional scores. For instance, in the collectivistic culture the agent will give the medicine to the sick character.

7   Evaluation

Using the case study presented, we performed an evaluation to determine the differences the users could recognise in the behaviours of the two groups of char-

acters created. Again, the groups are only different in their associated value for the Individualism dimension. Thus, we wanted to check if users did in fact could recognise one group as more individualistic and the other as more collectivistic.

7.1   Methodology

Two videos were created with the system working and generating the situations. The actions of the characters allowed for the emergence of the stories enacting a dinner party situation. Both videos were then used in an online questionnaire which starts by asking participants to watch one video and then answer two groups of questions about the characters depicted in it. Afterwards, the participants were asked to watch the other video and again answer the same groups of questions. Since repeated measures were used, participants were randomly assigned to a visualization order.

In the first question group participants had to decide if a given statement was appropriate to the conduct of the characters or not (in a scale from -3 to 3). These statements (see Table 1) were based on the questions used by Hofstede in his cultural questionnaire and represent cultural values associated either to Individualism/Collectivism. The idea was to see if users would associate the Individualistic/Collectivistic agents to the corresponding statements.

In the second question group, participants had to choose a number between two opposite adjectives in a scale from -3 to 3, according to what they thought to fit best with the characters. The adjectives chosen were: Individualist / Collectivist; Approachable / Distant; Equal / Biased; Independent / Sharing; Polite / Impolite; Pleasant / Unpleasant; Unfriendly / Friendly; Relaxed / Tense; Compassionate / Indifferent; Serious / Cheerful; and Warm / Cold.

Finally, the questionnaire consists in two additional questions that tries to access if any differences between the videos presented were perceived, and if so, if participants understood those differences as being caused by the culture of the characters, or by their personalities, or by neither one of these factors.

7.2   Results

We had a total of 42 participants (36 Portuguese, 5 German, and 1 British), aged between 18 and 34 years old of which 76% were male. Concerning the group of questions about the value statements we applied the Wilcoxon test to see if there was significant differences in the user's classification. For every statement related to Individualism or Collectivism (see Table 1) the results were statistically significant ($p < 0,05$). Users found the individualistic/collectivistic values to be more appropriate for the individualistic/collectivistic culture respectively. The highest effect ($r=0,38$) was for "They like to trust and cooperate with other people" statement. This suggests that users can recognise appropriate differences related to cultural values in groups of characters, by simply changing their parametrisation of our dimensions component accordingly.

For the adjective's classification we used the Wilcoxon test once more. Except for the *Equal/Biased* and *Warm/Cool* every other pair of adjectives yielded

Value Statement *(Culture Associated)*	Culture	Avg.	StD.	Differences between cultures
They are concerned with everyone's well-being *(Collectivism)*	Col.	1,62	1,56	|ΔAvg|= 1 p = 0,003 r = 0,33
	Ind.	0,62	2,16	
Personal achievements are very important *(Individualism)*	Col.	0,74	1,43	|ΔAvg|= 0,43 p = 0,006 r = 0,30
	Ind.	1,17	1,15	
Direct confrontations should be avoided *(Collectivism)*	Col.	0,50	1,64	|ΔAvg| = 0,5 p = 0,033 r = 0,23
	Ind.	0,00	1,81	
They like to trust and cooperate with other people *(Collectivism)*	Col.	2,05	1,08	|ΔAvg| = 1,43 p = 0,00 r = 0,38
	Ind.	0,62	2,22	
It is important for them to be independent *(Individualism)*	Col.	0,07	1,31	|ΔAvg| = 0,48 p = 0,015 r = 0,27
	Ind.	0,55	1,42	

Table 1. Results for the statements related to individualism/collectivism

significant results. As such, we can affirm that there was a significant effect of the Individualism dimension score in the user's classification of most adjectives. Amongst them are the adjectives *Individualistic/Collectivistic* (which had the largest difference in averages) and *Independent/Sharing*. Therefore, user's interpretation of the characters' behaviour matched the parametrisation used for the dimensions component. Interestingly, the majority of users formed a more positive opinion of the characters in the collectivistic video by rating them more Friendly, Polite, and Pleasant. We believe the fact most users are from Portugal (a strongly collectivistic culture) might have caused this effect. In the last two questions to assess directly if users perceived the videos as being different, only 1 did not found any differences. This corresponds to only 3% of the participants. From the resulting 41 participants (which answered they had perceived differences), 63% associated the differences to personality, 30% to culture and only 7% answered neither. We performed a a Chi-square test to determine if the result was not obtained by chance. The Chi-square value obtained was 5,158 and was significant (p=0,023).

The results indicate that the different parametrisation, used for the Individualism dimension, was strong enough to cause users to perceive significant differences in the cultural groups. Yet, most of the users did not attributed those differences to culture. This is congruent with Hofstede's argument that the behavioural tendencies associated to his dimensions are harder to interpret as cultural by the average person.

8   Concluding Remarks

In this paper we have argued the importance of considering culture in order to enhance the social dynamics of virtual agents. The research in culture-specific

agents is quite novel and the work existent has mainly focused on communication aspects. Differently, we have proposed a model that tries to recreate more general cultural behavioural aspects, inspired by an well-established anthropological theory on human cultural variation. This theory, proposed by Hofstede in [6], encompasses five different dimensions that exist in every human culture.

Two of these dimensions (Individualism vs Collectivism and Power Distance) were integrated into an agent architecture for autonomous synthetic characters. They are used to influence the emotions of the characters and the utility of their goals. The main idea for achieving this was to make characters more or less concerned with the needs and social statuses of others, according to the dimensional parametrisation established.

The cultural architecture was then used to create two different cultures, one extremely individualistic and the other extremely collectivistic. An evaluation was performed to determine the effect the dimensions implemented had on the user's characterisation of the created cultures. The results show that the different dimensional parametrisation used was strong enough to cause users to perceive significant differences in the two cultures. Users classified the cultures as individualistic or collectivistic in congruence with the parametrisation used. This is a very encouraging result as it shows that our model is able to create cultures with perceivable differences, just by changing a simple dimensional parameter. As future work, we would like to perform additional evaluations of the model. For instance, to perform the same experiment but with users from an highly individualistic culture. Also, we want to explore additional ways to use the dimensions implemented and consider the inclusion of the other dimensions as well.

9   Acknowledgements

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