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Culture-Specific First Meeting Encounters between Virtual Agents

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Abstract. We present our concept of integrating culture as a computational parameter for modeling multimodal interactions with virtual agents. As culture is a social rather than a psychological notion, its influence is evident in interactions, where cultural patterns of behavior and interpretations mismatch. Nevertheless, taking culture seriously its influence penetrates most layers of agent behavior planning and generation. In this article we concentrate on a first meeting scenario, present our model of an interactive agent system and identify, where cultural parameters play a role. To assess the viability of our approach, we outline an evaluation study that is set up at the moment.

1 Introduction

Imagine you are in Japan for the first time in your life. You looked at the first chapter of a Japanese language text book to learn some phrases beforehand and now you know how to greet someone you meet for the first time:

A: Kon'nichi wa.
B: Kon'nichi wa.
A: Watashi wa Yukiko Nakano desu. Hajimemashite.
B: Watashi wa Machiasu Remu desu. Hajimemashite. Doozo yoroshiku.

Although you know the phrases, you are still feeling a bit uncomfortable because it is not only the language that is different but also the nonverbal interaction habits. The language text book could not prepare you for the actual situational context. How do you behave in this situation? Do you shake hands? Where do you look? How close do you get to your conversational partner?

In this paper, we regard culture as being a social rather than a psychological notion (e.g. [35]), with cultural influences becoming evident in interactions, where cultural patterns of behavior and interpretation are contrasted or mismatch. As culture constitutes a fundamental influence on a variety of human

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behaviors, it was shown in a number of studies that culture is also a psychological process (e.g. [22]). Nevertheless, for the scope of this paper the focus lies on culture as a social group phenomenon. In a given culture, cultural patterns of behavior are not necessarily consciously relevant but they are the common heuristics for people from that culture on how to behave "properly" and on how to interpret behaviors of others. Of course, some heuristics might get institutionalized like for instance traffic rules. Culture is thus a group phenomenon, established by a group of people that adhere to some common patterns of behavior, thinking, and interpretation. These patterns have been called heuristics, norms and values, or mental programs in different theories (see e.g. [9],[13],[23],[33]). They become especially apparent when contrasted to behavior that deviates from these heuristics. Most of the above cited theories like [13] or [33] focus mainly on national cultures. But we have to keep in mind that nation is not a self evident level of cultural organization. Granularity is a very important factor of this notion, ranging from such abstract concepts like the European vs. the Asian culture down to such specific concepts like the Punk culture vs. the Speed Metal culture that have nothing do with a given national background. In this article, we concentrate on the fairly abstract level of national cultures, mainly for the fact that the theories we rely on deal with national cultures. Additionally, although there are some examples that concentrate on finer distinctions (e.g. [15]), most applications with enculturated agents aim at differences found on this level of granularity (see next section).

Although culture manifests itself as a social group phenomenon, the individuals in a culture adhere to the corresponding heuristics and must have internalized them during their socialization process. Thus, it seems to be legitimate to model culture as a computational parameter that influences individual agents and penetrates most processes of an agent system. According to Hall [10] for instance, people from so-called high- and low-contact cultures have different spatial behaviors in that high-contact individuals will stand closer in interpersonal encounters. Thus, an individual agent needs to individually react to the spatial distance between himself and his interlocutor, e.g. by moving closer if the other moves further away.

Consequently, tailoring information presentation to the cultural background of the user can be expected to serve as a criterium for sucess e.g. in e-commerce applications or other persuasive technologies. In the area of virtual agents, there are a number of different application domains like serious games for coaching cross-cultural communication skills, experience-based roleplays as an addition to the standard language textbook, or creating meeting spaces like SecondLife, where it might become easy to explore cultural identities from your armchair, interacting with a mix of real users and virtual agents. And of course endowing virtual agents in games with their own cultural background allows them reacting in a believable way to (for them) weird behavior of other agents and the user.

In the following, we survey approaches tackling this challenge (Section 2) and present the CUBE-G[1] procedure, which combines an empirical data-driven with

[1] CUlture-adaptive BEhavior Generation: http://mm-werkstatt.informatik.uni-augsburg.de/projects/cube-g/

a theoretical model-driven approach (Section 3). For the implementation we concentrated on a prototypical scenario found in every culture, a first meeting of two strangers (Section 4). To assess the viability of our concept we designed a large scale web-based evaluation study that is presented in Section 5 before the article closes with open research questions (Section 6).

2 Related Work

Whereas static presentations like e.g., websites can be easily tailored to culture-specific demands during the design process (given that the designer recognizes the challenge), interactive systems pose an additional challenge because they have to react dynamically to situational and contextual factors. An overview is presented by Payr and Trappl's [28] collection of different aspects of agent culture. Ruttkay [32] argues that it is indespensable to take care of cultural influences during the whole development process. Because every developer brings in his own culture and associated heuristics, it is necessary to make them explicit in order to keep the development process "clean". Most approaches in this area concentrate on learning environments or interactive role-plays with virtual characters. Khaled and colleagues ([20], [21]) focus on cultural differences in persuasion strategies and present an approach of incorporating these insights into a persuasive game for a collectivist society. Maniar and Bennett [25] propose a mobile learning game to overcome cultural shock by making cultural differences aware to the user. Johnson and colleagues [18] describe a language tutoring system that also takes cultural differences in gesture usage into account. The users are confronted with some prototypical settings and apart from speech input, have to select gestures for their avatars. Moreover they have to interpret the gestures by the tutor agents to solve their tasks. Core and colleagues [5] describe a training scenario for different negotiation styles which is set in a different culture than the trainees'. Unfortunately, they haven't realized culture-specific negotiation styles yet but acknowledge the importance of such a step. Warren and colleagues [36] as well as Rehm and colleagues [29] aim at cross-cultural training scenarios and describe ideas on how these can be realized with virtual characters. Jan and colleagues [16] describe an approach to modify the behavior of characters by cultural variables relying on Hofstede's dimensions. The variables are set manually in their system to simulate the behavior of a group of characters. Miller [26] provides an overview to work on politeness or "etiquette" in interactions between users and computers and presents a computational model to characterize, quantify and simulate such effects in human machine interactions. Although politeness strategies are generally described as universal [4], the realization and contextual parameters for their application can differ from culture to culture.

Even though there are a number of approaches to simulate culture-specific agents, a principled approach to the generation of cross-cultural behaviors is still missing. Furthermore, there is no empirical validated approach that maps cultural dimensions onto expressivity dimensions. In order to realize cross-cultural agents, we need to move away from generic behavior models and instead simulate individualized

agents that portray idiosyncratic behaviors, taking into account the agent's cultural background. To this end, we propose a combination of an empirical data-driven and a theoretical model-driven approach that is detailed in the next section.

3 Combining an Empirical and a Theoretical Approach

We tackled the challenge of assessing the impact of culture on multimodal behavior from two sides. Based on a well-established cultural theory by Hofstede [13], we developed a theoretical model of cultural influences. Hofstede is a recent representative of a theoretical school that defines culture as a set of norms and values that members of a given culture adhere to. He presents a dimensional approach to culture that defines culture as a point in a five-dimensional space. The difference between individualistic and collectivistic cultures is for instance covered by the identity dimension. Hofstede's approach is described in more depth in Section 3.2. To ground our theoretical model not only in the mostly anecdotal data found in the literature, we conducted a standardized comparative study of multimodal interactions in Germany and Japan focusing on three prototypical situations: first meeting, negotiation, and status difference.

3.1 Empirical Approach

A first meeting between strangers, a negotiation process, and an interaction of individuals with different social status have been chosen for the corpus study due to their prototypical nature, i.e. they can be found in every culture and they constitute situations a tourist or ex-patriate is likely to encounter. Analysis of the corpus started with the first meeting scenario. There are several specific reasons for including this scenario. According to Kendon [19], it is not only found in all cultures but it also plays an important role for managing personal relations by signaling for instance social status, degree of familiarity, or degree of liking. There is also a practical reason for this scenario because it is the standard first chapter of every language textbook and thus known to everybody who ever learned a foreign language revealing a potential application of the results in a roleplay for first meeting scenarios. For Argyle [1], a first meeting is a ritual that follows pre-defined scripts. Ting-Toomey [34] follows his analysis by denoting a first meeting as a ceremony with a specific chain of actions. Knapp and Vangelisti [24] emphasize a first meeting as a step into the life of someone else, which is critical for a number of reasons like face-keeping or developing a network of social relation. Thus, the ritualistic nature of a first meeting makes sense in order to "to be on the safe side" by establishing such a new relationship in a satisfactorily, i.e. facekeeping, manner for both sides.

For the two cultures examined in our corpus, some specific differences are described in the literature for such a first meeting scenario. Greeting are expected to be longer in Japan because according to Ting-Toomey [34], greetings in individualistic cultures (like Germany) are shorter than in collectivisitic cultures (like Japan). Ting-Toomey also claims that Germans use more gestures than Japanese,

and that the organisation of the dialogue will differ due to different time conceptions. Germany is stated to be a m-time culture (monochronic) whereas Japan is a p-time culture (polychronic), which means that Germans follow a line (e.g. first questions about university, then about private life) and Japanese discuss more things concurrently ([10], [34]). Moreover, Japanese have a smaller public self than Germans, thus they do not reveal too much information during a first meeting. According to Hall and Hall [11], this is due to the high-context nature of this culture. Consequently, we can expect our Japanese subjects to talk mainly about their occupations, whereas for the German subjects we additionally expect conversations about hobbies and personal life. In both cultures we expect information exchanges about the university and the experiment itself following Knapp and Vangelisti [24], who showed that questions concerning the setting or the enviroment of the first meeting always occur. We also expect more body contact in the form of a handshake in Germany for the actual greeting whereas in Japan non-contact bowing is expected. Greenbaum and Rosenfeld [8] have shown this difference in a comparison of US and Japanese culture.

Other information especially about multimodal behaviors is often of an anecdotal character like for instance, Southern Europeans tend to use more gestures in interactions than Northern Europeans. The corpus study allows us a more principled investigation of such differences.

Results. The analysis of the CUBE-G corpus is concentrating on nonverbal behavior at the moment. The behavior under investigation is comprised of postures, gestures, gestural expressivity, gaze, volume, and proxemics. Here we shortly report on our first results on differences in posture and gesture use. But beforehand let us have a quick look on Greenbaum and Rosenfeld's claim that there will be more body contact for the German sample when greeting each other. The data for the Japanese sample is unambigous. Apart from two participants all bowed to each other without any attempt for body contact. For the German sample the result is not so clear. One third of the participants (7 out of 21) initiated a hand shake. Thus, there is definitely more body contact during the actual greeting in the German sample but it is not the predominant behavior. Moreover, there is a gender effect because six of the seven participants that initiated the hand shake were male. For postures we found some consistent differences mainly for hand and arm postures. The predominant hand and arm postures for Germans are crossing the arms in front of the trunk or putting the hands in the pockets of the trousers. For the Japanese, the typical posture is joining hands in front of the body. Figure 3 exemplifies the postures. Frequency of gesture use is consistent with the above mentioned results from the literature. We found a significant difference in the number of gestures that were used in the German and the Japanese samples. German participants used more than three times more gestures than Japanese participants (22.1 (German) vs. 6.6 (Japanese) on average for a single encounter, t-test, $p < 0.01$). We also found significant differences for the two expressive parameters spatial extent (ANOVA, $p < 0.01$) and speed of a gesture (ANOVA, $p < 0.1$). Additionally, we looked into speech pauses in and between turns assuming after Hecht and colleagues [12] that in European conversations

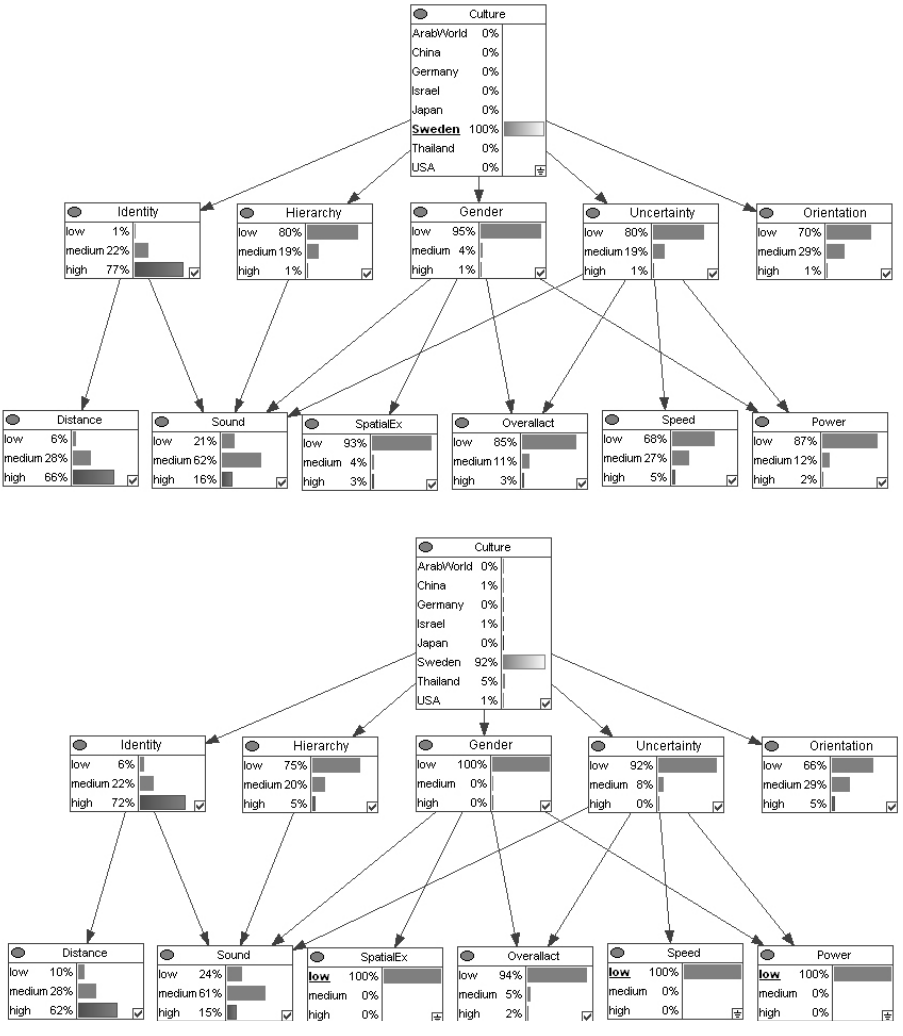

Fig. 1. Bayesian Network modeling the interrelation between cultural dimensions and nonverbal behavior: inferring nonverbal behavior given a specific culture (causal inference, above) vs. inferring the cultural background given a pattern of gestural expressivity (diagnostic inference, below)

pauses are often sensed as unpleasant and thus we expect Japanese to use pauses more frequently than Germans. For the analysis we distinguish between long (>2 seconds) and short pauses (1-2 seconds). In the five minute long first meeting encounters, we found 7.1 short and 1.3 long pauses on average for the German sample vs. 31 short and 8.4 long pauses on average for the Japanese sample. The differences were highly significant for both types of pauses (t-test, $p < 0.01$). More information on the design of the corpus study, the applied annotation schemes as well as the results can be found in [7] and [31].

3.2 Theoretical Approach

As described above, the influence of culture penetrates most of the processes in an interactive agent system, be it the interpretation of user input, be it behavior planning or generation, be it rendering of animations. Here we concentrate on the low level influence of cultural patterns of behavior. Our first model is a Bayesian network based on Hofstede's [13] five-dimensional model of culture and his ideas of synthetic cultures [14], which define stereotypes for the five dimensions. In the long run, these stereotypical values will have to be replaced by specific empirical data like the data we derive from our corpus study. The five dimensions are hierarchy, identity, gender, uncertainty, and orientation. Hierarchy denotes if a culture accepts unequal power distance between members of the culture or not. Identity defines to what degree individuals are integrated into a group. Cultures can either be more collectivistic or more individualistic. Gender describes the distribution of roles between the genders. In feminine cultures for instance roles differ less than in more masculine cultures. Uncertainty assesses the tolerance for uncertainty and ambiguity in a culture. Those with a low uncertainty tolerance are likely to have fixed rules to deal with unstructured situations. Orientation distinguishes long and short term orientation, where values associated with short term orientation are for instance respect for tradition, fulfilling social obligations, and saving one's face. It has to be noted that Hofstede's theory is not without controversy. His theory is based on a large-scale questionnaire study with IBM employees, which constitutes a strong selection bias on the results. Nevertheless, Hofstede's theory has a great appeal for computer science because of its quantitative nature (see Section 2).

According to Hofstede, nonverbal behavior is strongly affected by cultural affordances. The identity dimension e.g. is tightly related to the expression of emotions and the acceptable emotional displays in a culture. Thus, it is more acceptable in individualistic cultures like the US to publicly display strong emotions than it is in collectivistic cultures like Japan [6]. Uncertainty avoidance like identity is directly related to the expression of emotions. In uncertainty accepting societies, the facial expressions of sadness and fear are easily readable by others whereas in uncertainty avoiding societies the nature of emotions is less accurately readable by others, which was shown by Argyle [1]. For the above mentioned synthetic cultures, Hofstede, Pedersen, and Hofstede [14] show how specific behavior patterns differ in a principled way depending on where a culture is located on the five dimensions. For instance, in a culture with a low power distance (hierarchy dimension) people tend to stand closer in interpersonal encounters. The same holds true for collectivistic cultures in contrast to individualistic cultures (identity dimension). A similar effect was shown by Hall [10], who analyzed spatial behavior in interpersonal encouters and distinguishes between high- and low-contact cultures.

Figure 1 gives an overview of the Bayesian network. Bayesian networks as described in [17] are a formalism to represent probabilistic causal interactions and have already been successfully applied to model emotional interactions for virtual agents ([2],[3]). In the domain of culture they are suitable for the

following reasons. Because there is a many to many mapping between culture and nonverbal behavior, it is not likely that individuals behave exactly like it is described for a given culture in every aspect of their behavior. Bayesian networks handle such uncertainties very well. Additionally, a Bayesian network explicitely models the relations between causes and effects. Thus, links in the network are intuitively meaningful. The theoretical effect that the more masculine a culture becomes the louder people in this culture will speak [14], is represented by a link between the cultural dimension of gender and the nonverbal behavior "volume". Moreover, Bayesian networks allow for causal as well as diagnostic inferences depending on where evidence is introduced into the network. Thus, such a model can be used to set or modify the nonverbal behavior of an agent by setting the evidence for a given culture (causal inference) as well as to infer the culture from given nonverbal behavior (diagnostic inference).

The middle layer defines Hofstede's dimensions. We already integrated all five dimensions but the dimension orientation has so far no influence on the outcome. This is due to the fact that the literature on this specific dimension is sparse and didn't allow defining a reliable influence on nonverbal behavior. The bottom layer consists of nodes for nonverbal behavior that can either be registered from the user or another agent or that can be set for a given agent. The top node which is labeled "Culture" is just for demonstration and interpretative purposes. It mainly translates the results from the dimensional representation of cultures into a probability distribution for some example cultures.

The Bayesian network only presents one building block for integrating culture as a computational parameter in an agent system. Cultural influences manifest themselves on different levels of behavior generation and interpretation and thus penetrate many processing modules in a system that takes these influences into account. Our first prototype concentrated on inferring the user's cultural background [30] and employing this information to adjust the nonverbal expressive behavior of a group of agents. The next section describes our concept of a more complex system and a prototype that incorporates the Bayesian network and further results from the corpus study.

4 Implementing Culture-Specific First Meeting Encounters

Figure 2 presents an overview about the current state of the agent system. The generated culture-specific behavior is exemplified by Figure 3 that depicts a sample from the corpus study along with an snapshot from the generated behavior for the German (above) and the Japanese culture (below). Cultural influences manifest themselves at all of the depicted processing steps.

4.1 Behavior Planning

Above it was shown that first meetings encounters have a ritualistic form defining specific phrases used for greeting, "proper" topics and sometimes the order, in

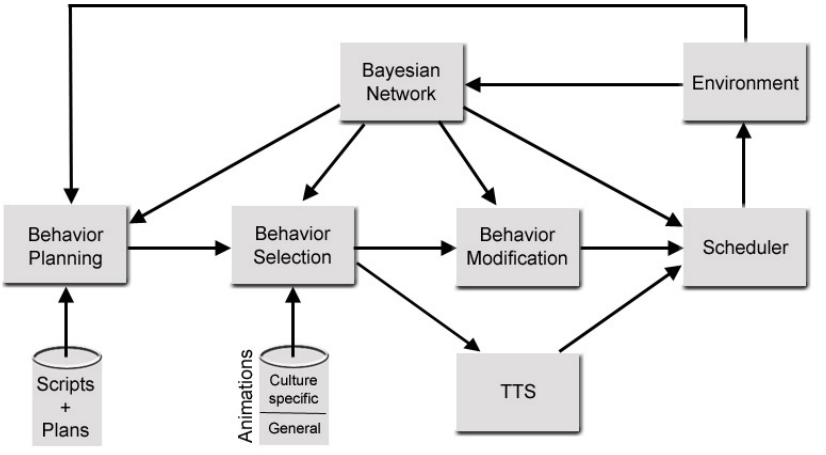

Fig. 2. General system architecture

which topics are discussed. Thus, the behavior planning module relies on the information about the agent's cultural background to either select a culture-specific plan or script or to modify a general plan if this is possible. The current state of the system relies on predefined scripts for first meeting encounters which have been developed following examples from language textbooks, information from the literature about first meetings (see Section 3.1), and observations from the corpus study. The Bayesian network provides the information about the cultural background of the agent. In this version of the system, the evidence for the agent's cultural background can be set freely for each run of the system. The arch from environment to Bayesian network symbolizes the possibility of infering the cultural background of an interlocutor, which is described in detail in [30].

4.2 Behavior Selection and Modification

The behavior selection and modification modules enrich the utterances processed from the scripts by appropriate nonverbal behaviors. Because there are some typical behaviors in each culture (see Figure 3 for typical postures in Germany and Japan) it does not suffice to just modify the available animations by the results for the expressive parameters supplied by the Bayesion network. It is also necessary to have culture-specific animations for conversationally relevant gestures like bowing in Japan. Thus, our database of animations is partitioned into a general part with gestures that can be applied regardless of the agent's culture (but modified with the information from our Bayesian network) and a specific part with gestures relevant for a given culture.

4.3 TTS

The agent system makes use of the Horde3D graphics engine, which allows for interfacing with any TTS system that is compliant with the Microsoft Speech

Fig. 3. First meeting examples. German sample from corpus study and generated interaction (above) vs. Japanese sample from corpus study and generated interaction (below).

API and provides lip-synching functionality on this basis. The German utterances are generated by the Loquendo TTS system. Unfortunately, the Japanese TTS does not implement the Speech API, thus we had to create our own Speech API compliant layer to interface the system to Horde3D. The choice of the TTS would in principle depend on the cultural background set by the Bayesian network. For the evaluation study this feature is disabled because the language would be a much too strong hint on the culture of the agents. Thus, the utterances are mapped to gibberish to prevent participants in the evaluation study to concentrate to much on what has been said.

4.4 Scheduler

The scheduler keeps track of the dialogue and decides on the right timing for the agent's behaviors. The corpus study revealed that Japanese tend to make more and longer pauses which can be related to more collectivistic cultures. The information from this dimension is exploited by the scheduler for deciding on the right time to trigger the agent's next visible (and audible) action.

5 Evaluation

The experimental design of the evaluation study is based on the fact that culture is a social phenomenon. The system generates a first meeting encounter between

Fig. 4. Webinterface for the evaluation study

two agents that is tailored to the cultural background set for each agent. Thus, if the agents' behavior deviates from the user's expectations there should be an effect in the appraisal of this interaction compared to those that fit the user's expectations.

Of course it would be very obvious to see the difference between two agents that bow to each other and agents that shake hands instead. Thus, the evaluation focuses on more subtle clues of cultural influences like postures and gestural expressivity that were described above (Section 3.1). The hypothesis generated from this set up is: Users will rate agent interactions that show behavior not similar to their own cultural patterns as deviating on the examined parameters. The types of behavior that are tested are postures, gestural expressivity, and pauses in speech.

Participants are confronted with short videos of first meeting encounters generated by the system and have to rate how adequate certain aspects of the interaction are on a standard seven point Likert scale (see Figure 4 for an impression). These aspects are displayed postures, speed of gestures, spatial extent of gestures, and utterance flow. Four videos were created for the German, for the Japanese, and for a random culture respectively. Each participant is confronted with all videos in random order.

The agents' behavior is completely generated by the system based on evidence set for the cultural dimensions in the Bayesian network. Thus, we expect to find differences in the user's rating based on how the evidence was set in the network and on how the corresponding generated behavior deviates from the user's expectations about his own culture. The ratings of the random cultures will also allow us to gain insights into which of the behavioral features under investigation really contribute to the user's perception of the interaction.

6 Conclusion

In this paper we presented an approach of integrating culture as a computational term in an agent system relying on a combined data-driven and model-driven

approach to gain the necessary empirical data on the one hand and on the other hand to exploit the theoretical concepts from the literature. The resulting system concentrates on a prototypical scenario that is found in every culture, a first meeting between strangers. With the information about the agents' culture the system produces interactions tailored to these cultural backgrounds taking aspects of posture, gesture, and timing into account.

Although this is a comprehensive approach of integrating culture as a computational parameter, a number of open challenges remain. Most fundamental in our view is the question which aspects of behavior are attributable to a cultural influence and which are attributable to other factors. Because culture is not an isolated concept but intertwined with other concepts like personality (see e.g. [27]). If someone prefers to stand far from his interlocutor in an interpersonal encounter this might be due to the high power distance in his culture but it might also be an effect of his introvert personality. To capture such effects in our data, every participant of the corpus study did a NEO-FFI personality test. The results from the personality test have not yet been linked to the above described analysis but will hopefully reveal a more fine-grained picture for modeling the interrelation between social (culture) and psychological (personality) influences on agent behavior.

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