Culturally Appropriate Behavior in Virtual Agents: A Review

Mashael Al-Saleh and Daniela M. Romano

Department of Computer Science, University of Sheffield, UK

{mmalsaleh1, D.Romano}@sheffield.ac.uk

Abstract

Social behavior cannot be considered without the culture in which it is expressed. The following is a concise state of the art review of intelligent virtual agents displaying culturally appropriate behavior in games and serious games. In particular, it focuses on agents displaying personality and emotion, and their ability to engage in social interactions with others. The relationship between the characters' external representation and the cultural believability is highlighted; and the internal and visual aspects of the current state of the art agents are discussed. A schematic view of the literature and the elements required for embodied culturally appropriate agents is presented, offering opportunities for future research.

Introduction

Culturally appropriate behavior is not genetically programmed, but is instead learned from direct teaching, or by observing and interacting with others. For example, language is one of the primary abstract artifacts transmitted extra genetically. This paper provides a review of how culturally appropriate behavior can be achieved in synthetic agents and offers a concise overview of the relevant literature.

Bates (1994) describes believable characters as those delivering the "illusion of life". In order to achieve this illusion for culturally appropriate agents, many elements must be considered, including the characters' ability of perceiving synthetic characters and non-characters in the environment, also defined as social intelligence, and the ability to generate a response congruent with its behavioral, visual, and cultural aspects. In particular, the level of details of the visual representation must match the perceived social intel-

ligence for the character to be believable and for its abilities to meet the visual aspect requirements (Romano 2005; Romano and Wong 2004; Romano et al. 2005; Shaarani and Romano, 2006; 2007; 2008; Burkitt and Romano 2008; Gupta, Walker, and Romano 2008; 2010). For example, cartoons are an attractive solution for some applications in which the main goal is to portray stereotyped behavior. In contrast, other applications (e.g., tutoring and coaching agents) necessitate more human-like agents, where the characters' appearance and behavior might require a more accurate expression of emotions, a personality, and other aspects enabling social interaction (Gupta, Romano, and Walker 2005; Louchart et al. 2004; Romano 2005; Rosis, Pelachaud, and Poggi 2004). This paper assumes that exhibiting a culturally appropriate behavior increases the character's believability, and discusses how this has been achieved to date in literature from the perspectives of both computer science and cross cultural psychology.

Background on Culture and Synthetic Cultures

The relevant literature maintains many different definitions of culture, which vary according to the field of study. Hofstede has studied the features that allow us to discern different cultures (Hofstede 2001), defining culture as:

> "The collective programming of the mind that distinguishes the members of one group or category of people from an- other" (Hofstede 2001, page 9).

How people think, feel, and act is based on what they have learned from others in the society, and learnt patterns of behavior can appear in the form of values or can be observed in the form of rituals, heroes, and symbols (Mascrenhas, Enz, and Paiva 2009).

Most of the research in culturally appropriate agents to date has been built around Hofstede's five dimensions model (Hofstede 2001). These dimensions have been used differently in each architecture that implements agent models. For example, as reported in Table 1, Mascrenhas, Enz, and Paiva (2009) used these dimensions in two parts of their model: measuring goal utility and emotional apprais-

al; involving only the two dimensions of individualism and power distance. On the other hand, Rehm et al. (2007) found a correlation between all five dimensions and their effect on four agents' characteristics: overall activation, spatial extent, speed, and power.

Hofstede' five dimensions of any culture are as follows:

Power distance: concerns the acceptance of an unequal distribution of power in a given society. Democratic societies are considered low power societies because power is distributed equally. Conversely, in high power societies, people accept and respect the concentrated power of a few.

Individualism and collectivism: refers to whether priority interest is given to each individual or to the group. Societies with a higher priority to the individual require that people are responsible for their individual selves and the people close to them.

Masculinity versus Femininity: examines the strength of masculine values compared to feminine values in society.

Uncertainty avoidance: the level of tolerance to uncertainty in the society, in other words, the feeling of being threatened by unpredictable situations.

Short-Term versus Long-Term Orientation: the importance of future versus past and present.

Another approach used in the literature describes culturally appropriate behavior by directly mapping out how the social relationships typically take place within the group. This paper identifies the direct mapping of culturally appropriate behavior as social interaction rules (SIR). For example, when an agent is instructed on how to greet someone, their action culturally specific; if following the Japanese culture, their action would entail a bow, while if based on a western culture, a handshake would be required.

Culture-Adaptive Agents in Virtual Environments

Virtual environments and serious games provide opportunities for people to learn social and behavioral aspects (Bainbridge 2007). Some well-known environments used for research include Second Life and World of Warcraft. These allow for the creation of controlled environments in which the users are capable of experiencing different situations and cultures (Mascarenhas, Silva, et al. 2013).

The embedding of cultural concepts in the design of synthetic characters is very important in order to get users to believe these characters are alive, to stimulate interactions, and to provide an experience similar to that of the real world (Jan et al. 2007). Believable virtual characters help achieve one of the main objectives of human-computer interaction, which is to make the users feel that they are interacting with a human, rather than a synthetically generated being (Loyall and Bates 1997).

Hofstede's (2005) significant study in this domain consists of ten years of research with over 1400 participants who played simulation games using synthetic cultures. Each synthetic culture is used as a script for the role player, and was derived from the five dimensions of culture from Hofstede's model. He found that participants reported the game-play experience as an eye-opener that increased their understanding of cross-cultural conflicts. He also observed that the participants' intrinsic qualities such as personality, human nature (i.e., the basic social impulses that drive human behavior such as sex, affiliation, and dominance), and the participants' own cultures influenced the manner in which they played the game.

Architectures for Culturally Appropriate Agents

The literature reveals a strong interest in developing culturally adaptive agents in order to improve system performance and user satisfaction (O'Neill-Brown 2007; Wagner et al. 2006). Importantly, these systems differ based on whether the cultural aspects are relevant for verbal behavior (e.g., Kim et al. 2009) or non-verbal behavior (e.g., Blanchard et al. 2015) or both (e.g., Deaton et al. 2005).

The design of agents in virtual worlds typically targets a specific culture, regardless of whether this intention is explicit or not. If the design is later determined to be used within another culture, significant effort is required to adapt the agent to the new target culture (Jan et al. 2007). Alternatively, it is possible in the early stages of the design to conceive of an agent with a modular architecture in which culture is an element that can be replaced or extended to accommodate another culture. Table 1 below lists some examples of agent architectures and applications that include cultural aspects as part of the agents' non-verbal behavior design. Figure 1 below displays a schema highlighting how culture can be considered an independent module from the rest of the agent's architecture. Some of the architectures have been created as an extension of an existing emotion and/or personality model, as a way to increase the character's believability and its reaction congruence within the virtual environment.

Author/s - Year	Theories & Models	Synthetic Culture	Scenario / Aim	Evaluation Technique	Cultural aspects evaluated	AI technique used
(Hofstede 2005)	Hofstede's model	Hofstede's dimensions	Users create culture	Multi-player environment	How cultures are created	Not reported
(Mascrenhas, Enz, and Paiva 2009)	Integration to autonomous agents architecture FAtiMA (Fearnot Affective mind architecture) PSI theory of emotions	Hofstede's dimensions	Teach teenagers the difference between cultures	Two video-based scenarios differ in ritual representation Software simulation evaluated by users (ORIENT)	Greeting, welcoming and dinner rituals	FAtiMA uses goal selections based on a goal utility function Emotional appraisal and reactions Planning capabilities
(Jan et al. 2007)	Extension to work on group simulation system	Social interaction rules	Conversations in three different cultures: Anglo American, Spanish-speaking Mexican and Arab cultures	Video-based scenarios	Proxemics, gaze, and turn taking	No AI techniques used to support agents' behaviors
(Rosis, Pelachaud, and Poggi 2004)	Expansion of GRETA (Intelligent Believable Embodied Conversational Agent)	Hofstede's dimensions and social interaction rules	GRETA role is to engage user in natural conversations (Project Magicster)	Conversation between the user as patient and the agent as doctor to describe the appropriate therapy.	Appropriate verbal and non-verbal communication, including facial expressions, head movements, body posture and/or gestures	There is no specific AI element added for cultural adaptation, but GRETA has a Listener Intent Planner component (Niewiadomski et al. 2009)
(Rehm et al. 2007)	No background theory or model used	Hofstede's dimensions	Detect user's culture from overall activation, spatial extent, speed, and power of movements	The user's culture was detected using Wii sensors and mapped onto the agents' behavior and compared for similarity	Overall activation, spatial extent, speed, and power of movements	A Bayesian network was used as network of probability to link between features in each culture
(Pynadath and Marsella 2005)	Extension to the Com-MTDP model of agent teamwork is based on the theory of mind	Social interaction rules	User creates own set of agents with personal preferences, relationships with other entities, private beliefs, and mental models	Not reported	User built school bully scenario	Partially observable Markov decision problem (POMDP) used to solve problem based on agents' preferences and beliefs
(Nazir et al. 2009)	Based on PSI theory of emotions and the Big Five personality traits	Hofstede's dimensions	Use researcher's own list of key behaviors of people in the culture considered, and positive and negative words	Video-based scenarios	Identify key behavior in the culture	Not reported

Table1 – Agents architectures including cultural aspects

For example, Mascrenhas, Enz, and Paiva (2009) created an agent based on the FAtiMA architecture for emotional agents (Dias et al. 2014) and the PSI theory of emotions (Dörner 2003). Additionally, Nazir et al. (2009) proposed an agent based on the PSI emotional model and the Big Five Factors model of personality (Digman 1990). Other models are an extension of agents' teamwork (e.g., Jan et al. 2007; Pynadath and Marsella 2005).

The cultural aspects are mostly created using Hofstede's model (Rosis, Pelachaud, and Poggi 2004), (Mascrenhas, Enz, and Paiva 2009), (Rehm et al. 2007), (Nazir et al. 2009), while Jan et al. (2007) considers non-verbal communication parameters such as proxemics (i.e., the spatial distance between individuals), gaze, and turn taking. Pynadath and Marsella's (2005) model allowed the user to create their own beliefs and preferences.

The representation of Hofstede's dimensions is not sufficient to portray all aspects of a culture, and the author himself claims that it is necessary to involve cultural symbols and rituals in the agent design (Hofstede 2001), which can be represented as a cultural profile. Symbols are any gestures, words, and pictures that have special meaning in the considered culture, whereas rituals shape the manner in which some social activities are undertaken.
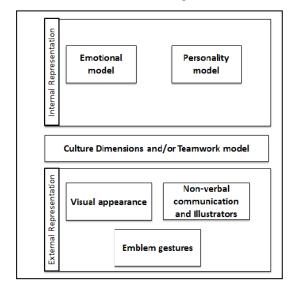
The most common manner to evaluate a computationally portrayed behavior is to create video scenarios in a specific context and ask the users to assess the scenario's cultural representations, or to determine the differences between the cultures portrayed. Some of these agent models have been represented as interactive applications, either to create dynamic scenarios based on the user's culture (Rehm et al. 2007) or cultural training applications (e.g., Mascrenhas, Enz, and Paiva 2009; Thovuttikul et al. 2011).

Different AI techniques have been added to these models to support the agents' behavior. Each model has its own approach on how to employ these techniques to reach model goals in the representation of cultural agents. Some of these techniques have been inherited from the original architectures, which have been extended. For example, the model provided by Mascrenhas, Enz, and Paiva (2009) includes different AI elements from FAtiMA, like goal utility function, emotional appraisal, and reactions, as well as the ability to plan for future actions. Rosis, Pelachaud, and Poggi (2004) used AI components already present in the embodied conversational agent GRETA and extended its capabilities. Finally, some of the architectures have their own independent intelligent components (e.g., Rehm et al. 2007; Pynadath and Marsella 2005; Nazir et al. 2009).

Table 1 above provides a summative overview of the main considerations required when designing culturally appropriate behavior for an agent together with the main features included in the agent's architecture and the role of cultural aspects in the design.

Culturally Appropriate Behavior in Agents

Given the findings in the literature, it appears that a culturally appropriate agent might need some or all of the elements described in the schema in Figure 1.

Figure 1 – Schema for Culturally Appropriate Embodied Agent

It is not necessary for an agent to consider all the components illustrated in Figure 1, but such components should be determined based on the agent architecture's context of use and applications. In particular, we have highlighted the need for the culture dimension module to be independent form the internal and external elements of the agent.

These elements can be divided into two parts, where some are internal elements drive the external representation of the agent. Internal elements are related to the computational aspects of generating agents' behavior to provide a high degree of social interaction. These can be achieved by considering the psychological factors that play important roles in driving social interaction: emotions and personality. There are two main emotional theories cited in the literature: OCC (Ortony, Clore, and Collins, 1988) and PSI (Dörner 2003). OCC has been embedded in several emotional models, such as FAtiMA (Dias, Mascarenhas, and Paiva 2014) and BASIC (Romano et al. 2005). PSI is part of some proposed models that have integrated culture into their design, such as Nazir et al. (2009) and Mascrenhas, Enz, and Paiva (2009). The five factors model of personality is the most used model integrated into agents' architectures.

Recognizing the differences between agents' cultures during the social interactions only from the computational aspect is difficult. Consequently, the agents' behavior gen-

eration often illustrates the differences through an embodiment of external representation of the agent's behavior. Examples of external representations that manifest agents' interactions have been pointed out by Vinayagamoorthy et al. (2006). In particular, the authors report the need to consider specific classes of non-verbal behavior, such as:

Emblems: refer to the standardized gestures and signals that are well understood in a particular culture. They are used intentionally and consciously in situations when verbal communication is not possible or to augment a verbal concept using abstract representation of the concept, e.g., a gesture that represents a swear word. Gestures in the Southern Italian culture have been developed to bridge the gap across the various local dialects spoken in the land, explicating concepts using commonly agreed upon emblems.

Illustrators: are signals that are created on the spur of the moment, and while are not often pre-conceived, are still voluntary, have a clear meaning, and are used to further explain the speech. An example might be using a gesture to show the shape of an object.

Conclusion

As discussed earlier in this paper, considering cultural aspects can increase the believability of synthetic social agents. Culture drives humans' internal expressions and emotions as well as their physical activities and appearance. Examples of these external representations were discussed in addition to a state of the art review on the models and methods used to generate cultural expressive virtual characters, considering in particular the computational generation of behavior and the non-verbal behavioral aspects; the latter depends on the specific culture and interpersonal relationships in the context. Moreover, if the agents belong to a specific social group or have to interact within a group, the display of such behavior allows human users to recognize the culturally appropriate emotions and personalities portrayed in a more believable manner. This explains the involvement of the cultural and teamwork models as a central control and independent component in culturally believable agent architecture.

Acknowledgments

References

Bainbridge, W. S. 2007. The Scientific Research Potential of Virtual Worlds. Science (New York, N.Y.) 317(5837): 472–76.

Bates, Joseph. 1994. "The Role of Emotion in Believable Agents." Communications of the ACM 37(7): 122–25.

Blanchard, Emmanuel G, W Lewis Johnson, and Amy Ogan. 2015. "Third International Workshop on Culturally-Aware Tutoring Systems." (June).

Burkitt, M., and Romano, D. M. 2008. The Mood and Memory of Believable Adaptable Socially Intelligent Characters. In Intelligent Virtual Agents, Springer Berlin Heidelberg. 5208 LNAI: 372–79.

Deaton, J.E. et al., 2005. Virtual environment cultural training for operational readiness (VECTOR). Virtual Reality, 8(3), pp.156–167.

Dias, J., Mascarenhas S., and Paiva, A. 2014. Fatima Modular: Towards Agent Architecture with a Generic Appraisal Framework. In Emotion Modeling, Springer International Publishing 44-56.

Digman, J. M. 1990. "Personality Structure: Emergence of the Five Factor." Annu. Rev. Psychol 41: 417–40.

Dörner, D. 2003. The Mathematics of Emotions. In Proceedings of the Fifth International Conference on Cognitive Modelling, 75–79. Bamberg, Germany.

Gupta, S., Walker, M. A. and Romano, D. M. 2008. Using a Shared Representation to Generate Action and Social Language for a Virtual Dialogue Environment. Proceedings of the AAAI Spring Symposium on Emotion, Personality and Social Behaviour,49-54,

Gupta, S., Romano D. M. and Walker, M. A. 2005. Politeness and Variation in Synthetic Social Interaction. In H-ACI Human-Animated Characters Interaction Workshop in conjunction with the 19th British HCI Group Annual Conference.

Hofstede, G. J. 2005. Role Playing with Synthetic Cultures: The Evasive Rules of the Game. In Proceedings of the 9th International Workshop of the IFIP, 49–56.

Hofstede, G. 2001. Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations across Nations. Second. Business & Economics.

Jan, D., Herrera, D., Martinovski, B., Novick , D., Traum, D. 2007. A Computational Model of Culture-Specific Conversational behavior. Intelligent Virtual Agents Springer Berlin Heidelberg: 45–56.

Kim, Julia M et al. 2009. "BiLAT: A Game-Based Environment for Practicing Negotiation in a Cultural Context." International Journal of Artificial Intelligence in Education 19(3).

Louchart, S., Romano, D., Aylett, A. and Pickering, J. 2004. Speaking and Acting - Interacting Language and Action for an Expressive Character. In Proceedings of the IVEVA 2004 Workshop. Technical University of Aachen (RWTH).

Loyall, B., and Bates, J. 1997. Personality- Rich Believable Agents That Use Languages, Proceedings of the First International Conference on Autonomous Agents (Agents'97), 106–13, ACM.

Mascarenhas, S., Dias, J., Afonso, N., Enz, S., & Paiva, A 2009. Using Rituals to Express Cultural Differences in Synthetic Categories and Subject Descriptors. In Proceeding of 8th Int. Conf. on Autonomous Agents and Multi-agent Systems (AAMAS 2009), 305–12. International Foundation for Autonomous Agents and Multiagent Systems.

Mascarenhas, Samuel Francisco et al. 2013. "'Can I Ask You a Favor ?' - A Relational Model of Socio-Cultural Behavior." 12th

International Conference on Autonomous Agents and Multiagent Systems: 1335–36.

Nazir, A., Enz, S., Lim, M. Y., Aylett, R., and Cawsey, A.. "Culture-Personality Based Affective Model." AI and Society 24(3): 281–93.

Niewiadomski, R., Bevacqua, E., Mancini,M and Pelachaud, C. 2009. Greta: An Interactive Expressive ECA System.. In Proceedings of the 8th International Conference on Autonomous Agents and Multi-agent Systems-Volume 2. Inter-national Foundation for Autonomous Agents and Multiagent Systems: 1399–1400.

O'Neill-Brown, P. 2007. Setting the Stage for the Culturally Adaptive Agent. In Proc. AAAI Fall Symposium, http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.54.613.

Pynadath, D. V., and Marsella, S. C. 2005. PsychSim: Modeling Theory of Mind with Decision-Theoretic Agents. In IJCAI International Joint Conference on Artificial Intelligence, 1181–86.

Ortony, A., Clore, G. and Collins, A. 1990. The Cognitive Structure of Emotions. Cambridge university press.

Reeves, Byron, and Nass, C. 1998. The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places, 19–36.Cambridge University Press.

Rehm, M., Bee, N., Endrass, B., Wissner, M., and André, E. 2007. Too Close for Comfort?: adapting to the user's cultural background In Proceedings of the International Workshop on Human-Centered Multimedia - HCM '07, Germany, 85-94:ACM.

Romano, D. M., Sheppard, G., Hall, J., Miller, A., and Ma, Z 2005. BASIC: A Believable Adaptable Socially Intelligent Character for Social Presence. In PRESENCE 2005, the 8th Annual International Workshop on Presence, University College London, London.

Romano, D. 2005. Synthetic Social Interactions. In H-ACI Human-Animated Characters Interaction Workshop the 19th British HCI Group Annual Conference Napier University, Edinburgh.

Romano, D. M., and Wong, A.K.L. 2004. Personality Model of a Social Character. In In 18th British HCI Group Annual Conference.

Romano, D. M. 2010. Look, Emotion, Language and Behavior in a Believable Virtual Companion. In In Close Engagements with Artificial Companions: Key Social, Psychological, Ethical and Design, ed. Yorick Wilks. John Benjamins Publishing, 315.

Rosis, F., Pelachaud, C. and Poggi. I 2004. Transcultural Believability in Embodied Agents: A Matter of Consistent Adaptation. Agent Culture: Human-Agent Interaction in a Multicultural World: 75–106.

Shaarani, A. S, and Romano, M. D. 2007. Perception of Emotions from Static Postures. Springer-Verlag Berlin Heidelberg: 761–62.

Shaarani, A.S., Romano, D. M. 2006. Basic Emotions from Body Movements. In The First International Symposium on Culture, Creativity and Interaction Design, HCI.

Shaarani, A. S., and Romano M. D. 2008. The Intensity of Perceived Emotions in 3D Virtual Humans. In Proceedings of the 7th International Joint Conference of AAMAS, 1261–64, Portugal: International Foundation for Autonomous Agents and Multi-agent Systems.

Thovuttikul, S., Lala, D., Ohashi, H., Okada, S., Ohmoto, Y., and Nishida, T. 2011. Simulated Crowd : Towards a Synthetic Culture for Engaging a Learner in Culture-Dependent Nonverbal Interaction. In In 2nd Workshop on Eye Gaze in Intelligent Human Machine Interaction, Stanford University, USA.

Wagner, Daniel, Mark Billinghurst, and Dieter Schmalstieg. 2006. "How Real Should Virtual Characters Be?" Proceedings of the 2006 ACM SIGCHI international conference on Advances in computer entertainment technology - ACE '06: 57.

Vinayagamoorthy, V., Gillies, M., Steed, A., Tanguy, E., Pan, X., Loscos, C., and Slater, M. 2006. Building Expression into Virtual Characters Building Expression into Virtual Characters.