# Culture for Socially Interactive Agents

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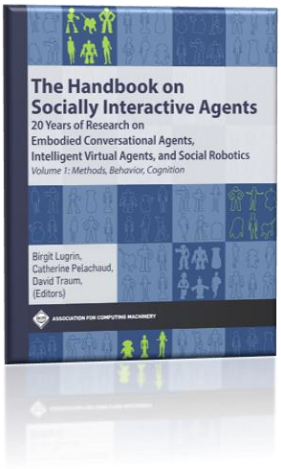


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# 13 Culture for Socially Interactive Agents

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## 13.1 Motivation

Culture is well known to be a driving force in social cognition, e.g. [Aronson et al. 2013, Fiske and Taylor 2016]. Humans tend to construct their schemes and models of the world, as well as evaluate the behaviour of others, based on their cultural upbringing. Although culture might not be the first factor that comes into mind when designing Socially Interactive Agents (SIAs), there are important reasons why it should be considered.

- A SIA cannot be without cultural background. That means, if culture is not explicitly considered, the SIA will unconsciously contain the cultural cues of the designer, as (s)he is the one who judges on the SIA's naturalness. These cues can be on the surface such as clothing style, or manifest themselves more subtly such as choosing an "appropriate" spacial extent of conversational gestures for a young female agent.
- A mismatch of cultural backgrounds between the SIA and the user can cause misunderstandings. Consider, for example, communication management behaviours. In many cultures such as Germany, interruptions of speech are considered impolite, while in others such as Hungary, they are judged positively as an increased interest in the ongoing conversation [Ting-Toomey 1999]. A conversation where the SIA interrupts the speech of its user could be considered impolite by users of certain cultural backgrounds, while not interrupting might leave the impression of not being interested in the user's elaborations in other cultures. Since these judgements usually happen subconsciously, people might not be aware of the reason for their impression, but just feel a general dislike for their interlocutor (and potentially reject to interact with the particular SIA in the future).
- Matching culture-specific cues can, vice versa, raise the acceptance of a SIA. In case a SIA aims at establishing a positive relation with a user, proxemics, for example, might be important. The well known interpersonal distance zones by Hall [Hall 1966] would quite concretely suggest appropriate interpersonal distances, for either a personal zone (often kept by friends and family) or a social zone (commonly kept by acquaintances or during social get-togethers). However, these are not considered culturally universal [Ting-Toomey 1999]. When introducing different interpersonal distances for SIAs, it has


**Figure 13.1** Cultural influences and their potential realization with SIAs.

been shown that observers from different cultural backgrounds judged them differently in their appropriateness for both virtual SIAs [Jan et al. 2007] and physical SIAs [Eresha et al. 2013].

It is also important to define which cultural influences should be realized with a SIA. These can be seen as layers of culture [Trompenaars and Hampden-Turner 1997], ranging from a very concrete explicit layer (e.g. language or cloth), over norms and values (what is right or wrong, and good or bad), to the subconscious implicit layers that constitute one's basic assumptions. When incorporating culture for (the behaviour of) SIAs these can include visible features, conscious interactions, subconscious details, or underlying processes (c.f. Figure 13.1).

Besides the potential to enhance the SIA's acceptance in a target user group, modelling cultural background can serve another purpose: to teach about cultures and culture-specific differences. With it, SIAs can help to foster cross-cultural understanding in a multicultural world, or reduce subconscious biases. Using SIAs to raise cultural awareness can have several advantages, even over human training partners. First, with a SIA as communication partner, the task can be repeated as often as necessary, without the risk of annoying a human training partner or paying for each additional lesson. Another advantage is that an emotional distance is kept. On the one hand, the trainee might feel embarrassed by training behavior routines with a real human, and on the other hand, he or she does not need to be afraid of embarrassing the SIA by treating it in a culturally inappropriate way. Cultural differences are often subtle and thus, hard to recognize. Using SIAs, these differences can be acted out in an exaggerated manner, or can be shown in isolation. In addition, SIAs can simply change their culture. In that way, one and the same agent can simulate the behaviors of different cultures and point out the differences.

This chapter gives an extensive overview of how culture was, and can be, implemented for SIAs. After this general introduction highlighting the potential of this endeavour, the re-

maining chapter is organized as follows: Section 13.2 firstly introduces theories of culture from the social sciences that we find suited for the implementation with SIAs, and secondly provides guidance on which questions to address when aiming at technically realizing culture within a SIA system. Section 13.3 constitutes the core of the chapter, providing an extensive literature review on the various approaches taken by many research groups around the world for the last two decades to implement culture for SIAs. We thereby refer back to the various different theories of culture and approaches for implementation introduced before. Since there has been confusion on the different notions of culture-related studies (e.g. differentiating cross-cultural from inter-cultural or mixed-cultural settings), section 13.4 summarizes potential research settings with SIAs. Subsequently, section 13.5 discusses the role of the SIA's embodiment when implementing culture, highlighting where the research fields of Intelligent Virtual Agents (IVAs) and Social Robots (SRs) can benefit from one another and in which cases complementary studies and computational approaches are needed. Section 13.6 points out some concrete current challenges that we derive from former research and the current state of the art in SIA research, before directing to future perspectives in section 13.7 where we opt for more dynamic and fine-grained approaches. The chapter concludes by giving a brief summary of the various perspectives of culture in SIA research and development that have been introduced in this chapter.

## 13.2 Theories and Approaches

In this section, we first introduce theories of culture from various disciplines that are commonly used in the domain of SIAs, before describing different approaches for the implementation of culture in SIAs.

### 13.2.1 Theories of Culture

When we aim to integrate a social or psychological phenomenon into our systems, we usually base this integration on theories from the corresponding sciences, thus ensuring that we have a theoretical and empirical foundation (c.f. Chapter 10 on emotion for SIAs in this handbook). In the case of culture, we face a challenge here, because many disciplines are to a more or lesser degree dealing with culture. This results in multiple definitions that on top are conflated with a layman's everyday understanding of culture.

A simple yet classical way to distinguish cultures is on a geographical (e.g. Western vs. Eastern cultures) or national (e.g. Italian vs. Chinese) level. However, one needs to pay attention to subcultures (e.g. depending on age, social upbringing, or political interests), or regional variations (e.g. northern Italians vs. Romans vs. Sicilians), particularly when comparing cultures on these levels. Also ethnicity might play a crucial role in some (national) cultures, describing a group with a shared cultural identity based on shared ancestry, language, or traditions.

It is thus important to define very precisely how the concept of culture is understood when it should be integrated into a system. We can safely assume that there is no one-fits-all cultural theory that covers the full spectrum. In the following we describe some theories that are used in SIA research, or that might be worth a closer look for future implementations.

***Dimensional theories of culture*** are descriptive frameworks whose essential perspective lies in the identification of dimensions, value systems and various constructs which help categorizing cultures and thus facilitate a systematic comparisons between cultural groups.

One of the most used theories is *Hofstede's system of values* [Hofstede 1980]: Culture is defined by 6 dimensions[1]; a given culture is thus a point in a 6-dimensional space. The current six dimensions are Power Distance, Individualism/Collectivism, Uncertainty Avoidance, Masculinity/Femininity, Long-term/Short-term Orientation, Indulgence/Restraint. All dimensions are linked to specific ways of thinking, interpreting, and managing interactions between people. If a culture is, for example, high on the uncertainty avoidance dimension, one can expect live being governed by an intricate system of rules that minimize uncertainty in new situations.

Another theory frequently used relies on *Hall's anthropological work* [Hall 1959, 1966] that defines different dichotomies on the dimensions of space, context, and time. The space dimension is highly linked with Hall's concept of proxemics that refers to human spatial behavior, where immediacy is interpreted differently across cultures and influences communication patterns. On the space dimension we can distinguish between high- and low-contact cultures, where the latter can be defined by being more comfortable with larger distances in interpersonal encounters. The context dimension distinguishes between high- and low-context cultures. Context refers to the amount of information that has to be encoded explicitly in a communication. Members of high-context cultures thus are good in inferring meaning without being explicitly told. The time dimension refers to the perception of time and ordering of actions. Monochronic cultures value clock time and prefer finishing tasks before starting new ones, whereas polychronic cultures are comfortable with multitasking and might have different time perceptions.

Other popular theories apart from Hofstede and Hall include Kluckhohn and Strodtbeck's values orientation theory [Kluckhohn and Strodtbeck 1961] that assumes a stable core of universal adaptations to social interaction, and that cultures can differ in their preferences on which of those to adapt, and Trompenaars and Hampden-Turner's [Trompenaars and Hampden-Turner 1997] dimensional theory that features seven dimensions including e.g. individualism versus communitarianism, and neutral versus emotional.

Developing SIAs based on dimensional theories: Dimensional theories are frequently used as theoretical background for SIAs that behave in a culture-specific manner. Culture in these

[1] The original study presented four dimensions. Later extensions with additional data resulted in two more dimension (long-term/short-term orienation and indulgence/restraint).

theories can be described as a point in an n-dimensional space or in some cases as vector with binary values for each dimension. Thus, they offer a computationally friendly design and some empirical evidence for behaviors connected with the dimensions, e.g. by Hall where spatial behavior or amount and detail of necessary information in communication can be linked to the end points of the corresponding dimensions. But as the theories are descriptive, they do not allow for precise predictions of behavior from a culture's position on the dimensions. Another challenge is the uncertainty about precedence of dimensions if a culture's position on different dimensions suggests conflicting behavior. Therefore, some systems use only one dimension to demonstrate prototypical differences, rather than implementing the whole multi-dimensional space.

***Cognitive theories of culture*** discuss the innate nature of culture, its emergence in groups, as well as its epigenetic evolution.

*Dual Inheritance Theory* [Boyd and Richerson 1985, Cavalli-Sforza and Feldman 1981] poses that there exits a similarity between human biological and cultural evolution and define three characteristics in their theory. (1) Cultural adaptation means that the current cultural capacities of human beings (i.e. abilities to socially acquire ideas, beliefs, values, practices, mental models, and strategies by observations and inferences) are the result of genetically evolved psychological adaptations. (2) Cultural evolution is a system of inheritance based on human cultural learning, human cognition, and human social interactions. (3) Culture-gene co-evolution assumes that cultural evolution produces distinctive effects on social and physiological environments (e.g. cultural norms influence the perception of aesthetic beauty, which in turn influence the spread of genes among populations).

*Sperber's epidemiology of representations* [Sperber 1985, 1996, 2012] shifts the focus from the general question of cultural evolution to the more specific one of how culture manifests in an individual and – through interaction – in the group in which the individual is embedded. He thus gives an account of how culture is an emergent phenomenon of a group of individual members. From Sperber's standpoint, this emergence is explained by the intertwining of mental representations and cultural productions by transformation processes such as imitation and communication. These processes must not be understood as replication processes since the resulting element is very likely to differ from the original element (i.e. it is transformed). A main element of this theory is the learning processes that allow an individual to build up mental representations that are similar to the social group s/he is embedded in. Thus, while belonging to the same cultural group, the mental representations of individual group members are likely to be different to a larger or lesser degree.

Developing SIAs based on cognitive theories: While such cognitive theories have so far not been employed for the development of SIAs, they offer great potential in explaining the emergence of shared, or at least similar, knowledge in groups (see also communities of practice below) and could be simulated with appropriate machine learning methods. The

integration of cognitive theories of culture could foster long term interactions, transmission of (cultural) knowledge, as well as dynamic adaptation to different cultural environments. While descriptive theories such as dimensional approaches lack a dynamic component to explain an individual's idiosyncratic cultural expression due to the individual experiential history, e.g. as an expat, or as a member of a specific subculture, e.g. a scientist, cognitive theories provide this dynamic component through the described learning mechanisms.

***Theories for cultural training*** focus on the acquisition of intercultural skills, capabilities that are especially sought after in the globalized world we are living in.

Bennett presents a theory for *training intercultural sensitivity*, which has been developed from a practitioners point of view [Bennett 1986]. Trainees progress from an ethnocentric perspective (taking one's own culture as the gold standard) to an ethnorelative one (being sensitive about different value systems). There are three stages in each perspective that a trainee is supposed to pass through, denial, defence and minimization in the ethnocentric perspective, and acceptance, adaptation and integration in the ethnorelative perspective.

*Cultural intelligence* [Earley 2002, Earley and Ang 2003, Earley and Mosakowski 2004] refers to the ability to accurately assess a cultural situation and determine a culturally-adequate way to respond to it. Improving cultural intelligence (through experience or training) will lower the risk of improper cultural adaptation. Cultural intelligence consists of three building blocks (called facets): a cognitive component (having knowledge about cultural differences), a motivational component (wanting to overcome intercultural communication problems), and a behavioral component (being able to act in a culturally appropriate way). Research on cultural intelligence shifts the focus from specific differences between cultures to a more general understanding of strategies underlying the discovery of knowledge, the acquisition of behavior and the skills for problem solving that allow an individual to adjust to intercultural situations over time.

*Intercultural communication abilities* can be obtained in three steps following Hofstede's training model [Hofstede 1991].

1. Awareness: The first step includes being aware of culture-related differences, and the acceptance that there are differences but that one's own behavior routines are not superior to others.
2. Knowledge: Gaining knowledge implies learning about the target culture's symbols and rituals. This does not necessarily include to share the values of a culture, but to have an idea of where these values differ from one's owns.
3. Skills: Acquiring skills includes recognizing the symbols of the other culture, and practicing their rituals. While (1) and (2) might be sufficient to avoid most of the obvious misunderstandings in inter-cultural communication, the last step requires practice.

Developing SIAs based on theories for cultural training: In intercultural or educational contexts theories of cultural training present a good basis for developing mechanisms for adapting to the user's perspective. These theories encompass different layers in a SIAs architecture including knowledge, goals, and behavior routines. For example, SIAs can be employed in all three steps of Hofstede's training model described above: The first step, gaining a general awareness, can simply be achieved by observing SIAs that demonstrate certain culture-specific routines. For gaining knowledge about another culture, additional information is required about the culture-specific differences demonstrated by the SIAs. These explanations can either be given before observing the SIAs, or afterwards in a debriefing. For the third step of obtaining cultural skills, the learner needs to be able to interact with the SIAs that represent members of another culture. Through their reactions and behavioral suggestions, learning can be implemented in an interesting, interactive way, making SIAs a powerful medium in gaining intercultural competencies.

***Other theories*** are mentioned here that are useful in the domain of culture. These theories offer alternative views on culture but do not necessarily focus thereon, or investigate very specific cultural features.

The *similarity-attraction principle* [Byrne 1971] suggests that communication partners who perceive themselves as being similar are more likely to like each other. This principle has, among many other factors, been successfully applied for ethnical similarity (e.g. [Hu et al. 2008]).

Similarly, *in-group favoritism* (also known as "ingroup bias" or "ingroup/outgroup bias") describes the phenomenon that people evaluate and treat others preferential if they are perceived to be in the same ingroup. This effect has been widely researched and often been applied to cultural or ethical groups (e.g. [Efferson et al. 2008]).

*Politeness theory* [Brown and Levinson 1987] is not developed as a theory of culture but addresses an important aspect, that is how politeness is linguistically realized in different language groups. A central notion of the theory is the face threatening act (FTA). Brown and Levinson describe a universal hierarchy of politeness strategies that are tailored to the different types of FTAs. Cultural variations occur in the way different language groups have developed different ways of expressing these strategies. Additionally, they describe cultural parameters that have an influence on the realization of strategies such as social distance, power relation, and ranking of the imposition.

*Communities of practice* [Lave and Wenger 1991, Wenger 1998] are centered on the question of what leads an arbitrary group to turn into a community with shared goals and practices, which could be called a (sub-)culture. They describe three steps in constituting a community of practice: (1) Mutual engagement: The members of a community of practice have to engage together in the practices that are the constituting elements of the community's culture. (2) Joint enterprise: Communities of practice self-develop to achieve their joint goals.

(3) Shared repertoire: In order to create a common meaning of practices, a shared repertoire evolves over time for a community.

Developing SIAs based on these other theories of culture: The similarity attraction principle and in-group favoritism have widely been used to motivate the implementation of culture in SIAs, and to evaluate these SIAs with certain user groups suggesting that agents that simulate the cultural background of the observer are preferred. Politeness is an important feature in interpersonal communication and an element of each interaction of a SIA with a user. It describes, e.g. how to realize requests and commands and when and how to apologize. Communities of practice are well-suited to describe cultural phenomena that are encountered in enculturated technologies, which are designed for a certain task, or to achieve a certain goal.

### 13.2.2 Approaches for the Implementation of Culture in SIAs

In the previous subsection, we have introduced theories of culture alongside each theory's potential to be integrated into SIA systems. However, the theoretical foundation is only one question that needs to be addressed when aiming at integrating culture into SIAs. To give an overview on the different approaches, we introduce cornerstones to provide guidance for the various potential technical realizations alongside with examples:

***Theory of culture*** As outlined above, culture can be defined and understood in several different ways. So, the first decision that needs to be taken, is based on which theoretical foundation culture should be implemented: e.g. as a specific national culture's subgroup, or abstract culture based on one or more cultural dimensions.

Culture on a national level has, for example, be addressed by Rehm et al. [Rehm et al. 2007], who pointed out behavioural differences between German and Japanese interactants. Such an approach can be useful when aiming to raise awareness on prototypical behaviour in a certain culture that one wants to visit, e.g. to understand the typical conversational flow of a first-time meeting [Endrass et al. 2011b]. Thereby it might be useful to model a certain subgroup within that national culture, for example, typical small talk conversations among undergraduate students [Endrass et al. 2011a], or appropriate behaviour during a military negotiation [Johnson et al. 2011].

Within a national culture, ethnicity can further be addressed. Finkelstein et al. [Finkelstein et al. 2013], for example, modelled different dialects spoken by different US American subgroups such as African American Vernacular English. Such an approach can be particularly useful to support socially deprived groups, e.g. by reducing the gap between supervisor and learner. To avert stereotyping, avoiding existing cultures is another approach. Aylett et al. [Aylett et al. 2014], for example, implemented fantasy cultures based on a theoretical model, to raise a general cultural awareness and demonstrate that "different is not dangerous".

***Foundation of approach*** Another fundamental question is what the implementation of culture will be based on, and with it, what determines how cultural background and resulting

culture-specific output are linked. In principle, there are two approaches: theory-based or data-driven. Theory-based approaches model culture-specific behaviours based on theories from the literature. The TRAVELLER application [Mascarenhas et al. 2013], for example, models different cultures based on Hofstede's dimensional model. Dependent on the assigned cultural background, an agent evaluates the behaviour of others differently. If, for example, an interlocutor is considered out-group his or her behaviour might be judged inappropriate by a collectivistic agent, although the same behaviour is considered reasonable if conducted by someone from the in-group. Data-driven approaches extract culture-specific patterns from human behavioural data to inform empirically grounded computational models. A multimodal video corpus was, for example, analysed in [Endrass et al. 2010], where participants from different cultures interacted in a standardized scenario to allow later comparison. There are also attempts that follow a hybrid approach, combining the advances of theory-based and data-driven approaches. In [Lugrin et al. 2018c], for example, a probabilistic model for culture-specific behaviour for SIAs was developed for which the dependencies were modelled based on theory, while the weighing was based on empirical data.

***Features of culture*** Culture can manifest itself in many different ways. So one also needs to decide which features of culture should actually be implemented. Basically, these features can be grouped in external features that are observable on the surface, and internal features that constitute one's basic assumptions such as whether all people are equal (e.g. [Trompenaars and Hampden-Turner 1997]).

External features contain all aspects of appearance of the SIA such as skin colour, eye-shape, clothing and the like (c.f. Chapter 4 on Appearance in this handbook for an overview). Also the language the SIA speaks constitutes a cultural factor. Please note, that factors of expressive speech, e.g. intonation or emotional speech, and dialogue behaviour such as turn taking are also dependent on cultural background (see Chapters 6 and 15 on Expressive speech and Dialogue in this and the second volume of this handbook).

Similarly, non-verbal behaviours are external features of culture. Thus, all aspects described in chapters 7 and 8 of this volume such as gaze, facial expressions, and conversational gestures, vary with cultural background, and can help scaffold mutual understanding (or might lead to misinterpretations). External features have largely been addressed in various systems including [Koda et al. 2008], [Finkelstein et al. 2013], [Eresha et al. 2013] or [Endrass et al. 2013].

Internal features of culture are included in the decision making process of the SIA. In that vein, meanings and values might be manipulated, how emotions are evoked, or the behaviour of others is interpreted. [Mascarenhas et al. 2013] or [Nouri and Traum 2014] are examples of integrating culture into the decision making process of the agent's mind. Particularly the decision of which features of culture should be integrated is heavily intertwined with the method of implementation.

***Method of implementation*** Outwardly observable features of culture can be manipulated to demonstrate cultural-differences. Features such as facial expressions [Koda et al. 2009], gesture performance or typical body postures [Endrass et al. 2013] have been investigated. In that manner, an SIA can be designed that implicitly communicates its cultural background, for example, by taking a tight body posture with folded hands, performing fewer gestures with a small spacial extent, or showing frequent smiles.

While external features of culture can be implemented in a behavioural way of thinking, the internal features need a cognitive approach. For their technical implementation, several methods from artificial intelligence have been applied. Approaches that aim to modulate behaviours based on culture-specific norms and values, typically start from existing BDI (Believe, Desire, Intention) architectures and extend them by adding culture-driven interpretations of actions and their appraisal.

Mascarenhas et al. [Mascarenhas et al. 2009], for example, extended their agent mind architecture FAtiMA that implements a cognitive model of appraisal (see chapter 10 on emotion of this volume, for further details) by representations of Hofstede's cultural dimensions. In their model, an agent's alleged culture determines its decision processes (the selection of goals and plans) and its appraisal processes (how an action is evaluated). For example, an action that is of benefit to others, is more praiseworthy for members of a collectivistic culture. Other approaches have used Bayesian networks to select the most probable non-verbal behaviours based on the cultural background of the speaker and the current verbal utterance [Lugrin et al. 2018c]. The use of Bayesian Networks bears a number of advantages such as making predictions based on conditional probabilities (e.g. to model how likely it is that a person makes use of very large gestures given the cultural background), or mitigating the risk of over stereotyping (e.g. by not continuously repeating the same non-verbal behaviour for a given cultural background and behavioural sequence). Another example is work by Nouri and Traum [Nouri and Traum 2014] that makes use of a data-driven approach to map statistical data onto culture-specific computational models for decision making. In particular, culture-specific decision making is simulated based on values such as selfishness. Bruno et al. [Bruno et al. 2019] make use of ontologies to represent knowledge of cultural information. The resulting framework shall be used to allow robots to adapt to the user's culture-driven habits.

## 13.3 History

Investigating culture in SIA research started with virtually embodied SIAs, while integrating culture in physically embodied SIAs was considered somewhat later. Thus, this review section starts with work on Intelligent Virtual Agents (IVAs), before summarizing work on Social Robots (SRs).

At the very origin of IVAs, Cassell discussed the impact of cultural background on (non-verbal) behaviour and on user's estimations of IVAs in the introductory chapter [Cassell 2000]

of her book on Embodied Conversational Agents [Cassell et al. 2000]. At that early stage, other factors such as display of emotion were in the focus of IVA research. However, cultural differences were highlighted as ”an important one for future research” ([Cassell 2000], page 17).

In 2004, the first comprehensive book on ”Agent Culture” appeared that discussed human-agent interaction in a multicultural world [Payr and Trappl 2004]. In three parts, containing of 12 chapters, the book discusses 1) that technology is always embedded in culture and thus an agent cannot be without culture, 2) the potential of adaptive agents while maintaining consistency, and 3) the potential of agents as mediators in inter-cultural communication. Particularly the second part of the book includes concrete and innovative directions for potential implementations of culture in SIAs (e.g. [Allbeck and Badler 2004, de Rossis et al. 2004]).

One of the earliest systems that implements cultural background and models culture-specific behaviours for IVAs is the Tactical Language Training System [Johnson et al. 2004a,b]. The system originally focused on the acquisition of basic communicative skills for US American soldiers in foreign languages and cultures. Learners communicate via a multi-modal interface, which permits them to speak and choose gestures for their character. Different technologies such as speech recognition, motivational dialogue, learner modeling, or multi-agent simulations are implemented. Tactical Language is based on an architecture for social behaviour that implements a version of theory of mind and supports IVAs that understand and follow culture-specific social norms. While the user converses with an IVA, the underlying architecture Thespian tracks the affinity between the IVA and the human user depending on the appropriateness of the user’s behaviour. To date, it has formed the basis of a variety of products for language and culture training, including Iraqi, Chinese or Danish [Alelo Inc.]. In the same line of research, the VECTOR system aimed to teach face-to-face intercultural communication skills in the Arab culture in the military domain [Barba et al. 2005], and the BiLaT system focuses on negotiation skills where the learner has to adapt to some Iraqi interaction rules for a successful negotiation [Kim et al. 2009]. Both use internal features of culture to drive the interpretation of actions and decision for reactions of the IVAs. For example, a character might be more willing to interact in a simulated mission, if the user removes his/her sunglasses for the communication.

Modelling and studying culture in the domain of IVAs gained increasing interest in 2006/2007, with a number of research groups and international projects investigating culture from different angles, be it national cultures, ethnicity, or synthetic cultures, using different approaches regarding their foundation and methods of implementation. Most of the approaches initiated then, were continued for a long time (if not up to now) in follow-up projects and further studies.

In 2006, the German-Japanese bi-nationally funded project Cube-G started and explored whether and how the non-verbal behaviour of IVAs can be generated from a parametrized

computational model [Rehm et al. 2007]. In the scope of the project, a multi-cultural corpus for the German and Japanese cultures was recorded [Rehm et al. 2008] and a computational model initialized [Rehm et al. 2009]. Based on the data of the corpus analysis different aspects of behaviour such as the use of gestures and postures [Endrass et al. 2011c], communication management [Endrass et al. 2009], or choice of conversational topics [Endrass et al. 2011a] were modelled for IVAs, and tested in isolation in perception studies [Endrass et al. 2013]. Their results suggest that users seem to prefer agent dialogues that reflect behavioural patterns observed for their own cultural background. The (scripted) agent behaviour was also transferred to interactive settings and evaluated in interaction studies [Kistler et al. 2012]. At a later stage, an extended computational model that was learned from the annotated video data was implemented [Lugrin et al. 2015] and combined the various behavioural differences in a demonstrator with IVA dialogues [Lugrin et al. 2018c].

Also investigating non-verbal behaviour for national cultures, Jan and colleagues [Jan et al. 2007] modeled differences in gaze, proxemics, and turn-taking behaviors, and simulated these using a group of IVAs for the US American and Arabic cultures. An evaluation of their demonstrator suggests that observers are able to distinguish the differences in relation to cultural appropriateness.

Also in 2006, the European project eCIRCUS was initiated that featured IVAs with emotional intelligence and role-playing capabilities, with a focus on social interaction. Their educational application ORIENT [Aylett et al. 2009] aims to develop inter-cultural empathy for 13-14 year old students. To avoid cultural stereotyping, their demonstrator makes use of fantasy cultures and developed a culture-specific agent architecture based on theories of cultural dimensions. Following up on the ORIENT application, the European Project eCute (2010-2013) developed two applications that aim at increasing cultural awareness through role-play with IVAs. Therefore, the agent architecture FAtiMA was enriched by culture-sensitive theory of mind (c.f. chapter 9 in this volume for detailed information on theory of mind) mechanisms [Mascarenhas et al. 2009] that determine both, the agent's decisions as well as its appraisal processes (how the actions of others are evaluated) dependent on the agent's allocated culture. In the MIXER [Aylett et al. 2014, Hall et al. 2015] and TRAVELLER [Mascarenhas et al. 2013] applications, IVAs with synthetic cultures are employed in virtual learning environments to establish empathy and raise cultural awareness in 9-11 year old school children, and young adults from 18-25, respectively. In 2011, the group organized a workshop on "Culturally Motivated Virtual Characters" in the International Conference on Intelligent Virtual Agents (IVA), bringing together researchers from different disciplines to drive the topic further.

Focusing on the expression of emotion via facial expressions of IVAs, Koda and colleagues performed a number of cross-cultural studies. In these studies, they showed that facial expressions of IVAs are interpreted differently in different cultures [Koda and Ishida 2006], independent whether the agent was designed in Asian [Koda 2007] or Western countries [Koda

et al. 2008]. Overall their results indicate that there is an in-group favoritism for the correct interpretation of emotional displays, e.g. emotions designed by a Japanese designer are more likely to be interpreted correctly by Japanese participants. They further found that positive emotional display has a wider cultural variance in interpretation than negative ones [Koda et al. 2009] and that, albeit the mouth region seems to be more effective for conveying the emotions of facial expressions than the eye region, Japanese observers weighted facial cues more heavily in the eye region compared to Hungarians, who vice versa weighed facial cues in the mouth region more heavily [Koda et al. 2010]. In a later investigation, the authors investigated culture-specific gaze-patterns and found that Japanese participants preferred agents that showed familiar gaze [Koda et al. 2017].

Instead of using fantasy cultures or modelling stereotypical behavioural patterns for national cultures, Iacobelli and Cassell focus on the impact of ethnicity on verbal and non-verbal behaviour within the US American national culture [Iacobelli and Cassell 2007]. Children were able to identify an agent's ethnic identity correctly when interacting with it. Thus it appeared possible to alter an agent's perceived background by changing its behaviour only. In a later approach [Finkelstein et al. 2013], the authors showed that speakers of African American Vernacular English (AAVE) benefited from an IVA that consistently showed linguistic features of AAVE, resulting in better performance in a science class.

Work by Nouri and Traum [Nouri and Traum 2014] investigates culture-specific decision making in negotiations. They make use of a data-driven approach to integrate statistical data on the Ultimatum Game into a computational model based on values, such as selfishness. Evaluating their model with IVAs that engage with different verbal strategies in the Ultimatum Game based on their model, Nouri et al. [Nouri et al. 2017] show that weights learned for one culture outperform weights learned for other cultures when playing against opponents of the first culture.

In the domain of Social Robots (SRs), research on culture started around 2005 by exploring attitudes of members from different cultural backgrounds toward robots, showing that the attitudes differ noticeably across cultures [Bartneck et al. 2005, 2007]. For example, the authors found that American participants were least negative towards robots. Interestingly, even less than the Japanese participants who did not report a particularly positive attitude towards robots.

Manipulating the behaviour or appearance of the robots in a culture-specific manner, by manipulating individual aspects, started in 2009. Rau et al. [Rau et al. 2009] investigated the communication style (i.e. implicit or explicit) of a robot and found that Chinese participants preferred an implicit communication style and rated this version more positively, while German participants rated this version more negatively. In another study, the authors demonstrated that the different communication styles of a robot influenced the decision making of

users with a Chinese or US American cultural background in the intended direction [Wang et al. 2010].

The ingroup advantage for SRs was investigated in 2012 by Trovato et al. [Trovato et al. 2012] who created different versions of emotional expressions for the Western or the Japanese cultures, and showed that the emotional expressions are recognized better when the culture of the observer matches the simulated culture of the SR. Eyssel and Kuchenbrandt [Eyssel and Kuchenbrandt 2012] simply changed the name and background story (being implemented in Germany or in Turkey) of a robot, and found that the German robot was evaluated more positively by German participants.

Looking into cultural differences in proxemics behaviour, Eresha et al. [Eresha et al. 2013] found that Arabs and Germans have different expectations on the interpersonal distance between themselves and robots. These expectations are in line with culture-specific proxemics behaviour known from the literature on human-human interaction.

In 2017, the European-Japanese Project CARESSES started, which aimed at designing the first socially assistive robot to support ageing, that is able to adapt to the cultural background of their users. In the scope of the project, Sgorbissa et al. developed guidelines for culturally competent robots in elderly care [Sgorbissa et al. 2018], and a knowledge representation framework that aims to help robots adapt their behaviour [Bruno et al. 2019]. In 2018, the group initiated a special session on ”Cultural Factors in Human-Robot Interaction” on the International Conference on Intelligent Robots and Systems (IROS), where different contributions focusing on culture for robots were discussed, including embedding ethics in robot design [Battistuzzi et al. 2018], implementing local cultural practices [Rehm et al. 2018], transferring the similarity-attraction principle for cultural background on HRI [Lugrin et al. 2018a], or adapting greeting rituals [Khaliq et al. 2018].

## 13.4 Evaluation of SIAs that are based on Cultural Information

This section has to start with a disambiguation of several notions regarding the use of culture in interactive systems. Some notions relate to the whole system (culturally-aware, enculturated), some relate to the interaction with the system (multicultural, cross-cultural, intercultural). Unfortunately, these notions are often not defined or are used interchangeably. This makes it difficult to talk about the different elements of a SIA system that are affected by culture.

***System specific*** We often read about culturally-aware systems, meaning systems that have integrated culture in one way or another. The term cultural awareness though is a concept from the social sciences, where it is used to describe a process an individual goes through to become aware of one’s own value system and then, as a subsequent result, be able to recognize own biases, prejudices and assumptions in interactions with members of other cultures (e.g. [Campinha-Bacote 2002]). Thus, it entails self-reflection as a necessary ingredient. Therefore using the term for describing systems, in which we have integrated culture as one parameter

for the interaction with the user, as ”culture-aware” might be a bit overselling the system. Thus, we suggested the term enculturated system earlier [Rehm 2010], which is used to describe any system where culture has been part of the design and/or development process, influences the decision making process, or affects the observable interaction with the user.

***Interaction specific*** When SIAs are evaluated we can often find claims about multicultural, cross-cultural, or intercultural communication. Again, it might be a good idea to try to disambiguate the different notions as they actually signify different concepts [Gudykunst 2003]. Multicultural is used in relation to societies that contain more than one cultural group, and where the different cultural groups live in co-existence, but not necessarily engage in interactions. Cross-cultural is used when cultural norms, values or behaviors are compared between two or more cultural groups. Thus, it makes sense to speak of a cross-cultural study, when we test a SIA with two different cultural groups. Intercultural at last is used to denote interaction between members of different cultural groups. Thus, a SIA system might e.g. train intercultural competences or act as a mediator in intercultural communication between users from different cultures.

Evaluating enculturated SIAs is a challenging task. In principle, we have to answer two questions for setting up an evaluation study in this domain: (1) What is the experimental design? (2) Who are the participants?

***What is the experimental design?*** In general, the following experimental designs are possible, where the first two designs aim at verifying that the SIA behaves in a culturally appropriate way, and the latter two designs aim at evaluating SIAs in the context of their application:

1. Testing a SIA with a target culture: In this case, we would be interested in the effect of culturally appropriate behavior and the experiment would thus compare behaviours of a SIA that is based on cultural information with a SIA without this characteristic, or different cultural characteristics.
2. Comparing SIA performance in two different cultures (cross-cultural study): Main goal of a cross-cultural study is to measure the differences in perception or interaction of members of different cultures for the same system. In general, three different types of comparisons are possible:
   (a) comparing performance of a ”standard” or universal behavior in two different cultures;
   (b) comparing performance of the culturally adequate behavior in each target culture (in-group comparison); and/or
   (c) comparing performance of a culturally inadequate behavior in each target culture.
3. Evaluating a SIA in intercultural training: If the SIA’s behavior has been shown to be culturally appropriate, it can be employed for training purposes, where the experimental

design then aims at evaluating the learning effect of training with the SIA as compared to traditional methods.

4. Testing a SIA simultaneously with more than one target culture (intercultural study): In case of an intercultural study, the agent might serve as moderator in intercultural communication, or it might adapt to the different target cultures for enhancing efficiency.

***Who are the participants?*** Depending on the experimental design, you will require to test in one particular or more target cultures. But in the section on cultural models, we have seen that it might be too simple to just equate culture with country. It might, for example, be troublesome to test a guiding robot on two university campus in Japan and Germany, and attribute any difference to culture. In this context, the target culture might actually be university students and the nationality might not play a crucial role in the interaction with the robot, as student culture may not be so different in the two countries. In a more extreme example, you might unconsciously test in a school in a low income area in one country, while testing in a highly ranked facility in the other, and attribute behavioural differences to culture, where they in fact might be attributed on other demographical factors of your participants.

## 13.5 Role of Embodiment

As can be concluded from the history section, the implementation of culture in SRs seems relatively new, especially in larger or long-term endeavours, in comparison to research on culture with IVAs. This might be partly due to the fact that a SR cannot be animated as subtly as an IVA and thus the sometimes subtle differences in the external features such as appearance or non-verbal behaviour of culture are difficult to demonstrate (see Table 13.1 for a comparison). However, for both types of embodiment culture should be considered in their decision making and execution of their behaviors to avoid a cultural clash between the robot's (implicitly) implemented culture and the user's culture-inclined preferences (see also Section 13.1).

| Feature of Culture | IVAs | SRs |
|---|---|---|
| Appearance | arbitrarily configurable incl. subtle expressive features | limited modifications through attached accessories (e.g. stickers) |
| Cognition | Same models apply for both embodiments | |
| Verbal Behaviour | Same models apply for both embodiments | |
| Non-verbal Behaviour | arbitrarily configurable, restricted spatial behaviour and collaboration | limited degrees of freedom and expressive features, shared space and collaboration |

**Table 13.1** Similarities and differences caused by embodiment when implementing culture for SIAs.

Particularly, in the various implementations of internal features of culture, e.g. a cognitive architecture that models how an action of another agent or human is evaluated based on cultural settings, the two fields can largely benefit from one another, as these models are based on theoretical knowledge or human data, and are not dependent on the hardware and the externalisation of culture. The work by Correia et al., is one of the few examples, that have made use of their agent architecture FAtiMA that was extended for cultural factors for IVAs, for re-usage with SRs that makes use of in-group factors to model group emotion [Correia et al. 2018].

Since a major difference between SR and IVAs lies in the fact that SRs inhabit the same physical space as their human users, it is not surprising that proxemics was among the first culture-specific aspects that were subject of studies in SRs, while in the domain of IVAs facial expressions and differences in the execution of gestures were in focus first. The concrete implementation of external features of culture can only partly be transferred: while the preparation of the underlying knowledge of the culture-specific differences, e.g. in gestural expressivity, can be reused, the concrete translation into animations or joint movements need to be redeveloped (e.g. [Rehm 2018]). Moreover, the appearance of the SR including crucial features such as height or movement characteristics, are static and determined by the hardware design of the robot. Thus, it might be impossible to adjust such external features to mimic a given target culture. Also the movement quality might stay unnatural, and asymmetrical to the user, in their non-verbal abilities due to different degrees of freedom, movement characteristics (e.g. omnidirectional with wheels), or rigidity of the body of the robot.

Another difference between SR and IVAs regarding culture, is the perception thereof by human users. As pointed out by previous research (c.f. Section 13.3), there are on the one hand different a priori attitude towards SIAs across cultures, on the other hand one and the same behaviour of SIAs might be evaluated differently across cultures.

## 13.6 Current Challenges

We have seen in the history section that culture has been in the focus of attention in SIA research for over two decades. While there has been impressive progress during that time, research is still far from being able to present a common solution to integrating culture into the interactive behaviour of SIAs, or to provide a general computational model that would be available to include external and internal features of culture, and is applicable over different socio-cultural contexts.

From our perspective there are three main challenges that should be further addressed to help in advancing the current state-of-the art in enculturating SIAs.

1. External features: Part II of this handbook is focusing on Appearance and Behavior (Chapters 4, 5, 6, 7, 8), which is closely related to what we call external factors in this chapter. We have not written much on the appearance of enculturated agents, but

some projects tried to prevent stereotyping by specifically using non-human characters [Aylett et al. 2009], others tried to depict ethnic diversity [Cassell 2009]. The design of the agent obviously plays an important role, if we do not want to just reproduce cultural stereotypes. But is it better to have an agent that looks similar to citizens from the target culture or should it be a ”neutral” agent? Which role does the gender of the agent play in relation to the culture-specific application? Or maybe it's better to use a non-human design instead? Thus all aspects discussed in the ”appearance” chapter of this handbook (Chapter 4) should be considered in culture-related context as well. Similarly, observable behaviour, as discussed in Chapter 5 (natural language generation), Chapter 6 (expressive speech), Chapter 7 (gesture generation) and Chapter 8 (multimodal behavior), are culture-specific and has been in focus of research in enculturating the observable behavior of SIAs, both verbally (e.g. accent, grammar) and nonverbally (proxemics, gestures). To this end, research had to rely on (often incomplete) information from the literature, or on specifically collected data. In particular the second approach is restricted to specific cultures and contexts for which there happen to be the necessary information available to model the SIA's behavior.

2. Internal features: Interacting with enculturated SIAs means that the system has to interpret the behavior of the user and generate appropriate cultural reactions for the agents. This relates strongly to work presented in Part III (Social cognition and Phenomena) and IV (Interaction) of this handbook. Both tasks (interpretation and generation) are highly contextual and dependent on the application. The behavior of a SIA used for cultural training purposes, for instance, should be different from one that serves as a museum guide for international visitors. Some approaches that integrate culture as an internal feature, work with underlying universal representations of interaction and interpret and translate incoming data [Mascarenhas et al. 2009]. Others model this knowledge explicitly making it difficult to extend the system to new cultures [Rehm et al. 2009]. The challenge that remains is to integrate cultural knowledge in the system that remains flexible enough to handle several cultural backgrounds or to be able to extend it to other cultural backgrounds.

3. Applications with enculturated SIAs: Learning about appropriate behavior in a given target culture has been at the core of research in enculturated systems, with a number of different motivations ranging from military training for expatriate missions [Johnson et al. 2011], over increasing cultural awareness of school children [Aylett et al. 2009], to preventing in-class discrimination [Cassell 2009]. While there are a number of prototypes described in the history section of this chapter, there is limited generalizability and validity for these approaches. We frankly do not know exactly what users learn from these systems, or which aspects were responsible for the learning. What would be needed are comparative longitudinal studies, which of course are costly and difficult to organize.

A major challenge is thus to show the effect of these systems in a statistically valid manner.

It is also very likely that systems that focus on learning and training in other domains, e.g. health-related systems (see also Part V of this handbook on Applications), could benefit from integrating internal and external features of culture to their SIAs, e.g. to meet the basic assumptions and preferences of the users of a certain cultural background, or to simulate (cultural) similarity with the user to increase acceptance. Culture should thus be a part of the research and development cycles of many systems that do not explicitly address culture.

The challenges described in this section are based on the work that has been conducted so far. In summary, one could say that all of the presented approaches that aim at enculturating SIAs, serve as great basis for further research to address internal or external features, and to build interactive applications. Existing work can be extended to simulate a broader spectrum of culture-related features in several socio-cultural contexts. Therefore a combination of methods used for the implementation of different aspects of culture becomes paramount to be able to be integrated into complete interactive systems that address the whole range of potential enculturated SIAs, from recognizing (culture-specific) user input, internally interpreting actions in a culture-related manner, reasoning on appropriate reactions, externalizing these into concrete verbal and non-verbal actions, and to measuring their impact on the perception, behaviour and learning of users.

## 13.7 Future Perspectives

In this section, we look into future perspectives for enculturated systems, challenging the notion of culture and opting for more dynamic approaches. We argue that national culture might not be the right level of granularity, that culture is not a monolithic stable concept, and that individuals cannot easily be classified by a single cultural background.

***Granularity*** Many approaches to integrate culture into SIAs have focused on national culture or cultural dichotomies modelling decisions or behavior. But SIAs are supposed to be used in specific contexts, e.g. training for business negotiations, support of well-being, or as personal care assistants. Thus, they are embedded in specific social contexts with their own accepted behavior and practices, which might or might not be similar to the heuristics derived from the underlying (national) cultural concept. More fine grained notions of culture, e.g. on a regional, social or institutional level, might thus be necessary. The following two examples illustrate this point. 1) Rehm et al. have worked on assistive technologies in institutional care in Denmark [Rehm et al. 2018]. What became apparent was that the workplace culture at the individual institutions was the determining factor on the success or failure of their system. Thus, they needed to employ individual development processes for socially assistive robots that were rooted in the (cultural) practices of the respective institutions. 2) Even in

contexts where a national culture would be assumed, the challenge of granularity can be found. Schank [Schank 1975] used a birthday party scenario to make the point that there exists a ”predetermined causal chain of conceptualizations that describe the normal sequence of things”. Arguing with Sperber [Sperber 1996] and Wenger [Wenger 1998] (see Section 1.2.1 Theories of Culture), we could instead claim that there is no normal sequence of things and no predetermined causal chain. Instead there is constant negotiation and re-assuring of dynamic sequences of action and behavior, which could be called cultural practices. In Denmark, for example, it is customary that the Danish flag is shown when someone celebrates a birthday. Children are expected to invite the whole class as an anti-bullying strategy, there are specific songs, and a ”cake man” is served that is covered with sweets. This seems to be a cultural practice across the whole of Denmark, but at the same time there are a lot of aspects of the birthday practice that are negotiated locally, e.g. the maximum amount of money the present is supposed to cost, if it should be money (so the child can buy something bigger afterwards), or individual small presents or a present from the class as a whole. Other aspects are where the party takes place, how long a party usually lasts, if it takes place after school or on the weekend, etc. These practices emerge in each class context out of the negotiation of the group of parents. Current models of culture do not take this difference of granularity into account and do not distinguish between more stable and more fluid aspects of (sub-)cultural phenomena.

***Dynamics*** Apart from local or sub-cultural realities, culture is also a moving target that changes over time and generations. Looking back 30 years, to a time without internet and mobile phones, many cultural practices that we are taking for granted now, did not exist. For instance while people were very vigilant toward governmental surveillance and privacy violations, nowadays there seem to be fewer barriers to provide sensitive information to private companies. While these changes happen gradually and are often only noticed in hindsight, we are currently experiencing a more radical change in cultural behavior through the Corona crisis. Typical examples of culturally adequate, and expected, behaviours are suddenly challenged and have changed basically over night, e.g. banning hand shakes when greeting, or standing close together in social interactions. To date, there are no solutions provided for SIAs on how to handle these gradual or disruptive changes in cultural behavior. Quite to the contrary, research on enculturated SIAs has concentrated on identifying cultural behavior to be modeled as a stable aspect of the SIAs behavioral repertoire.

This dynamic nature of culture is both a challenge and an opportunity for SIAs. The challenge lies in how models can be created that keep adapting to changing cultural practices. One obvious direction to look at are current machine learning trends, that will allow the SIA to become an actual member of the cultural group it is supposed to represent, and will result in behavior tailored to this specific subgroup. In such a scenario, the focus would be on culturally (or practically) appropriate behavior in a given (sub-)cultural group. In order to achieve such a vision, it will be necessary to define relevant learning mechanisms for the interpretation of

events, accumulation of knowledge, and selection and performance of actions to allow the SIA to adapt to its host culture.

The fact that culture constantly reshapes itself, and in the long run might lead to culture-specific details getting outdated, another scope for the application of enculturated SIAs becomes plausible: cultural heritage. While most applications using virtual environments target tangible cultural heritage, and aim at simulating places, buildings, or artefacts, SIAs could be used for intangible cultural heritage applications, and demonstrate culture-specific behaviors, rituals, or social practices.

***Mixed-cultural membership*** Globalization and immigration have led to increased contact with people from different cultural backgrounds [Ting-Toomey 1999]. For instance in 2014 the number of first and second generation immigrants in the EU was 55 million[2] with an overall population of 507 million. Due to long-term or close contact with a new culture, often customs are adopted and communication is adapted. Thus, a large number of people today have mixed-cultural memberships, which means that different cultural believes, values and communication styles might be present in one and the same person at the same time. Thus in the future, SIAs should be able to recognize and display not only culturally appropriate behavior for an assumed national culture, but must be able to reflect and react to cultural behavioural traits from several origins.

Few research with SIAs has taken mixed-cultural settings into account. IVAs speaking different accents within the English language were, for example, considered by Khooshabbeh et al. [Khooshabeh et al. 2017]. They found that the cultural background of the user plays a crucial role in the perception of these agents. IVAs that speak an accent (e.g. Middle Eastern English) were perceived as being foreign by people that do not share the agent's simulated mixed background. Vice versa, a positive impact was observed on people who share a mixed background (e.g. being bi-cultural), resulting in an increased perceived shared social identity.

Work by Obremski et al. [Obremski et al. 2019] has implemented IVAs that speak the language of one country (German), but include grammatical mistakes typically made by foreign speakers of that language. Native speakers of German categorized these IVAs as being foreign. The same finding held true for a re-implementation and follow up study in the English language [Obremski et al. 2021]. In an interaction study, they observed that human communication partners also adapted their verbal and non-verbal behaviour toward the non-native IVA, compared to interacting with a native speaking IVA [Lugrin et al. 2018b]. In particular, interlocutors spoke slower and used more gestures in conversations with the agent that was perceived as being foreign.

Triggering the impression of foreign/non-native SIAs can serve several purposes. They can enhance tools of cultural training, by allowing a SIA to speak the language of the learner while

[2] https://ec.europa.eu/eurostat/statistics-explained/index.php/First_and_second-generation_immigrants_-_statistics_on_main_characteristics

consistently behaving non-native. They can also be employed to further study the social phenomena occurring in typical interactions with non-native interlocutors, potentially reducing cultural bias through guided (positive) interaction. Last but not least, the implementation of convincing mixed-cultural SIAs would foster the cultural diversity of enculturated systems and better reflect members of our modern society.

## 13.8 Summary

In this chapter, we have investigated culture for SIAs. We first motivated that when not actively modelling culture, the SIA will still have a culture, which is based on the background of the designer/programmer. We introduced a variety of theories from different disciplines that explain culture from different angles. With it, we outlined the possible approaches that can be taken to computationally implement culture for SIAs. We then summarized the research field of culture for SIAs by providing a historical overview on the major systems, applications and approaches that focused on enculturating SIAs over the last two decades. We have considered the different types of embodiment for SIAs and outlined that the modelling of internal features of culture can be (partly) reused between IVAs and SRs, while external features as well as the perception of SIAs cannot be transferred directly. We complemented this review chapter by outlining some current challenges and mainly unaddressed future perspectives when aiming at modelling the dynamic phenomenon of culture. As a concluding remark, we believe that implementing culture for SIAs has great potential to not only increase their acceptance, but also to teach about cultural differences, scaffold cultural diversity, and support cultural understanding.

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