Creating a World for Socio-Cultural Agents

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Abstract. Creating agents that are capable of emulating similar socio-cultural dynamics to those found in human interaction remains as one of the hardest challenges of artificial intelligence. This problem becomes particularly important when considering embodied agents that are meant to interact with humans in a believable and empathic manner. In this article, we introduce a conceptual model for socio-cultural agents, and, based on this model, we present a set of requirements for these agents to be capable of showing appropriate socio-cultural behaviour. Our model differentiates between three levels of instantiation: the interaction level, consisting of elements that may change depending on the people involved, the group level, consisting of elements that may change depending on the group affiliation of the people involved, and the society level, consisting of elements that may change depending on the cultural background of those involved. As such, we are able to have culture alter agents' social relationships rather than directly determining actions, allowing for virtual agents to act more appropriately in any social or cultural context.

1 Introduction

Horatio finds himself lost in an unknown city, looking for a place to sleep. Some people are about on the streets, in shops and cafés. What should he do?

Based on the information above, people would have almost no difficulty trying to describe what Horatio could do. This is because we are able to make assumptions about the social relationship between Horatio and the various kinds of people he might try to ask for help. While these assumptions are based on implicit expectations of the context Horatio is in, they do help to make predictions about how others would respond.

For an intelligent agent to be able to make the same assumptions and predictions, it needs operationalized parameters of the social world. What is the relationship between Horatio and people that pass him by on the street? Who

would be willing to help him with his predicament? Without being able to discriminate between people, he would expect to be treated the same by every person.

Besides being able to make assumptions about the intentions of the characters, one also needs to consider the difference between 'right' and 'wrong'. Changing just a few elements in an interaction might easily change our perception of right and wrong; what if Horatio demanded of a stranger to take him to a hotel? Without being able to discriminate between actions, he would expect every action to be equally appropriate.

Modelling social behaviour is already quite challenging, as there are many ways in which our behaviour is influenced by our perceptions of the social world (as can be read in Brown's [1] treatise on group dynamics). This modelling exercise becomes even more complicated when you start considering the effect of culture. What if ignoring a stranger is a normal thing to do in the country that Horatio is visiting? Including culture adds an extra level of complexity to the already quite challenging level of social behaviour.

The questions posed above require certain concepts to be present in the mind of an agent. Without them, Horatio has no way to determine what he should do in this foreign place. In this article, we aim to describe how these concepts should be incorporated in the design of a socio-cultural agent. We consider a socio-cultural agent to be one that is able to make assumptions about the social world, and is able to show believable culturally-varying behaviour. Therefore a socio-cultural agent needs a conceptual model of the social world. That model should be as simple as possible, while still being rich enough to allow for short emergent interactions between agents with different cultural configurations. The model presented here will be not be defined in a technical manner, and will still need to be instantiated for specific application domains.

The paper is organized in the following manner. We will start by describing related work on cultural agents. The next section will focus on the notion of rituals, a construct through which behaviour gains social meaning for a group of agents that have shared attention. After that, we focus on different interpretations of these actions by having different social components active in the mind of an agent based on the ritual. In the last part of the paper, we will look at how culture can modify these rituals and moral circles to create culturally-varying behaviour in agents.

Throughout the article, the conceptual model and the concepts therein will be introduced from the perspective of Horatio, who is still in search of directions. He will meet another agent, the elderly Claudius whom he has not met previously, and will interact with him.

2   Related Work

The increasing need for embodied agents to interact in a social and empathic manner has led researchers to address different aspects of social interaction. Particularly related to the work presented in this paper is the Synthetic Group

Dynamics (SGD) model, proposed by Prada and Paiva [2], as it aims to create believable interactions in social groups formed by autonomous agents. In order to achieve this, agents build social relations of power and interpersonal attraction with each other. They also have the notion of belonging to a group in which they are regarded as more or less important, according to their status and/or level of expertise.

Similarly to the SGD model, our proposed model also places a strong emphasis on embedding group dynamics and social relationships in the agent's mind. Differently from SGD, we also address the relationship between culture and the dynamics of groups.

When designing social agents, culture has often been overlooked despite its huge influence on human behaviour [3]. We argue that without taking culture into account, the social richness of agent-based simulations is significantly limited. For instance, it becomes difficult for agents to empathise with users from different cultures if they lack the ability to interpret actions from different cultural perspectives. Moreover, modelling culture has been an essential endeavour when considering agent-based applications for intercultural training such as ORIENT [4], ELECT BiLAT [5], or TLTS [6].

Research on cultural agents is steadily rising. So far, several systems have focused on the adaptation of directly observable features of conversational behaviour to specific cultures. For instance, the work of Jan et al. [7] addresses differences in proxemics, gaze and speech overlap between the North American, Mexican and Arabic cultures. Similarly, the work of Endrass et al. [8] addresses the integration of non-verbal behaviour and communication management aspects, considering differences between the German and Japanese cultures.

While the aforementioned models focus on modelling the effects of culture on communication aspects, the research presented in this paper addresses another important facet of culture, namely, how it influences decision-making and behaviour selection.

In the model proposed in Mascarenhas et al. [9], two of Hofstede's dimensions of culture, individualism and power distance, are directly used to influence the agent's decision-making and appraisal processes. This is done only at the individual level without considering important elements from the social context such as an ongoing ritual, group membership and other relational variables. As a result the agents seem, to the human observer, to be obsessed with their own goals, and to lack social awareness.

Another agent model where culture affects decision-making is the model proposed by Solomon et al. [10], which concerns the definition of specific cultural norms. The model allows defining links between specific actions (e.g. show-picture-of-wife) and one or more cultural norms (e.g. respectful-of-modesty). An association link can either be positive in the case where the action promotes the norm or negative in the opposite case. One drawback of this model is that it requires a great deal of manual configuration as it tries to associate culture directly to individual actions.

One step towards generating culturally appropriate behaviour within an agent model was taken by Mc Breen et al. [11] who propose the concept of cultural meta-norms to operationalize culture. These meta-norms use Hofstede's dimensions of unconscious cultural values to explain how you can create a set of generic rules that give agents a propensity to behave in a certain way in certain relational contexts.

In our proposed model, we follow [12] in arguing that actions are often selected not because of their instrumental effects but because they are an important symbolic step of an ongoing ritual, thus making rituals an essential part of social interaction.

The idea that rituals are important to model cultural differences in embodied agents was also explored in Mascarenhas et al. [12], where a computational model of rituals was implemented and integrated into an affective agent architecture, developed by Dias and Paiva [13]. One limitation of the model proposed by Mascarenhas et al. is that it assumes that agents have a shared knowledge of rituals, which is not true when considering scenarios where agents from different cultures may meet, as exemplified in this paper.

3   Modelling Socio-Cultural Agents

To start discussing the conceptual model for socio-cultural agents, it is necessary to specify in overview the simulated social world in which our agents live. In Fig. 1, we have identified three different levels of instantiation.

They range from the more specified (interaction) to the more abstract (culture):

– The 'interaction' level is comprised mostly of elements that are visible to outsiders, and that may change depending on the people involved;
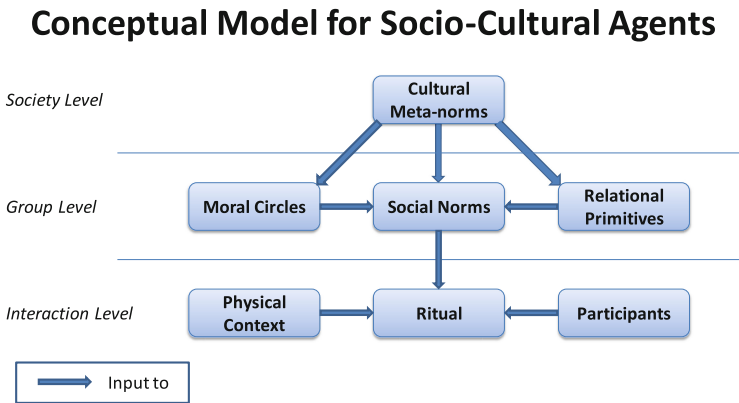

Fig. 1. From culture to actions: a conceptual model for socio-cultural agents

– The 'group' level is comprised mostly of elements that are not necessarily visible to outsiders, and that may change depending on the group affiliation of the people involved;
– The 'society' level is comprised mostly of elements that are invisible to outsiders, and that may change depending on the cultural background of those involved.

In the coming sections, we will discuss each of these three levels in detail, and explain how they relate to each other. Through these explanations, we will specifically name requirements that are necessary to create believable socio-cultural agents.

3.1 'Interaction' Level

. . . After walking around for a while, Horatio is unsure in which direction to continue and decides that it would be best to ask somebody on the street for more information. At that moment, Claudius, who is on his way to work, is walking in the opposite direction of Horatio. Horatio decides to draw the attention of Claudius. . .

Some actions may be purely instrumental, e.g. picking up an object that has fallen to the floor. However, in a social world, such actions usually have a symbolic effect as well. For instance, what objects would you pick off the floor, in which places, and with which people present? It is important to be able to understand the social consequences of actions.

These symbolic actions may have some effect on the relationship between yourself and others. However, such an effect only occurs if the other is paying attention; if not, the social meaning of the action might be lost on her.

This process of exchanging symbolic actions can be seen as a ritual, as defined by Rothenbuhler [14]. He states that rituals range from the ceremonial and memorable to the mundane and transient. In fact, any group of people that has a degree of shared attention can be said to be engaged in a ritual. This is reinforced by Bell [15], who claims that rituals are a way through which people can act in the world. We call those people that are part of a ritual its participants and its location the physical context. In our story, the participants would be Claudius and Horatio, and the physical context would be the street.

There are two sides to a ritual, a visible side, i.e. the behaviours of individuals that can be seen by outsiders, and a non-visible side, i.e. the symbolic meaning of the actions as they are being interpreted by participants. This symbolic meaning is impossible to separate from how a community conceives the world [15].

Rituals help mediate changes in social order, and are thus an essential element of social behaviour. As Hofstede et al. [3] say in their work, rituals are "Collective activities that are technically superfluous to reach desired ends but that, within a culture, are considered socially essential."

. . . In Horatio's mind there is a certain structure to asking a favour of a stranger. First you would politely greet him or her, and after enquiring whether

they know the place, and exchanging pleasantries, you would then proceed to ask the other for help. Doing so would make the stranger feel obliged to help you. . .

In a further operationalization of the ritual, Hofstede [16] explains that a ritual consists of three elements: a beginning, the body, and an end.

The beginning is characterized by an initiating move and a response. This initiating response carries the social meaning of the ritual. The response can be classified as running along two dimensions: direction (going along or opposing), and strength of the response (ranging from low to high). Depending on the response, a ritual is either initiated or aborted; if the purpose of the ritual is clear to both parties and agreed upon, they proceed to the body of the ritual.

Within the body of the ritual, the actual social change is put into action. For the ritual to be effective, the participants of the ritual must act in an appropriate manner.

The last stage of the ritual would be the end, in which the social change is reinforced in the appropriate manner and the ritual is brought to its conclusion. This will free the agent's attention for other activities.

The first two requirements for socio-cultural agents are:

1. They need to be aware of their physical context, and whether they are taking part in a ritual with other participants;
2. They must be able to decode the social meaning of a perceived ritual;

. . . On his way to work, Claudius sees a stranger walk up to him with an uncertain look on his face. This kind of behaviour is typical of people who need directions, and need somebody to help them on their way. . .

A ritual can help to decode the social meaning of certain actions. For example, in the USA, when a long-time boyfriend drops down on one knee in front of his girlfriend, few compatriots would not understand the social meaning of the action.

Not all behaviour will be interpreted in the same manner; the same ritual might mean something different depending on the physical context and the participants. This issue is particularly true when the participants are from different cultures, but even within the same culture, there is no guarantee that you 'speak' the same language. The meaning of a ritual may even change over time [15].

In the example above, Claudius recognizes that when Horatio walks up to him in a certain way, it means that he needs some help. What if somebody did that at night in a shady part of town? What if Horatio and Claudius had been old friends? Would Horatio still have walked up to Claudius in the same manner, and if so, would it have meant the same thing?

The third requirement for socio-cultural agents is:

3. The symbolic meaning of a ritual needs to be able to change depending on the people involved (participants) and the environment (physical context).

3.2 'Group' Level

Tajfel and Turner [17] posit that there is a difference between interpersonal situations (in which behaviour is primarily influenced by personological variables) and group situations (in which behaviour is primarily influenced by category-based processes). As such, on a group level, it becomes important to take into account more elements than just those present in the interaction. Behaviour may be influenced by people that are not present ('would your parents approve of your behaviour?'), and previous interactions may have an impact on your current behaviour. On this level, we discriminate between three different elements: moral circles, relational variables, and social norms.

Moral Circles. In the past section, we talked about the concept of 'social order'. By this we mean that there may be pre-existing social relations between the participants of a ritual. Sometimes there may be a connection between individuals, without having previously met, such as while watching a football match together with other spectators. These relations might not always be visible to all during an interaction between agents; they may only exist in the minds of the individual. To describe these relations, we use the concept of moral circles. A moral circle can be considered "the boundary drawn around those entities in the world deemed worthy of moral consideration" [18]. This concept is similar to what Singer [19] alludes to in his work on the evolution of moral progress and ethics: a large part of social interaction is influenced by who we let into our moral circle. Only then can we build meaningful relationships.

In our work, we formalize a moral circle to consist of three elements: the people to whom it applies, their mutual perceptions of social attributes (or relational primitives), and the social norms that regulate their behaviour. Both relational primitives and social norms are discussed in the following sections.

In Kemper's status-power theory [20] moral circles are called reference groups. These reference groups are always present in the mind of an individual in the form of the 'reference group committee' that helps the individual make decisions.

Why use the concept of a moral circle? To begin with, it is generic. Hofstede et al. [3] use it as a general indication of a human unit of social agency, ranging from a few people to all of humanity, taking inspiration from evolutionary biologist David Sloan Wilson [21], who describes humans as a 'eusocial' species, i.e. one in which the group has supplanted the individual as the main level of evolution.

Now, while in most eusocial species it is rather simple to determine the unit of evolution it would be the colony of bees, for instance this is not so in humans. Yet the assumption is that we have a biological propensity, including moral sentiments, to act as group members. In other words, acting for the survival and prosperity of our moral circles is in our nature. And it is this propensity that is the main justification for our concept of moral circle which we shall often abbreviate 'MC' from this point onwards.

The concept of a moral circle leads to our fourth requirement:

4. Each agent must categorize each individual into moral circles.

> *. . . Claudius wonders if he has time to help this stranger. He has an important deadline at work today, and he still has some things left to prepare. Therefore, he is left with a choice: he can either stop for a few seconds and talk to the stranger, or he can choose to ignore the stranger and carry on to work. . .*

Each context shapes its own MC typology, which depends on who is involved and what MCs they perceive to be relevant to the situation. A person can belong to many different MCs at the same time. It is thus that several MCs can affect the actions of any one person at any time, but one MC is usually more salient than others. For instance, in most cultures, leaving work duties to marry or bury a family member would be allowable, or even endorsed. The priority between events is itself symbolic of a prioritisation among MCs.

MCs come in different types. They can range from the default MC of "all people who count as people", to which strangers may or may not belong, to long-lasting organised groups, such as families or ethnic communities or companies, to the relatively informal, such as groups of acquaintances, or even two people meeting in the street by chance.

A more formal MC has both more specific social norms (rules of appropriate behaviour) and a strong inertia in membership; whether you're in or out is usually determined by clear attributes e.g. employment or club membership. Membership changes in more formal MCs are usually mediated by formal rituals, often denoting a change in status.

More informal MCs can be, for example, groups of specific friends (some you might know from your studies, others from your sports club). These more informal MCs still develop guides to appropriate behaviour. Membership of such an informal MC is often not as clearly defined as in more formal MCs. The relevant social norms for an informal MC will not be stated in any text, and can evolve more freely through an emergent consensual process, than is usual in formal MCs.

A particularly difficult social issue is how to behave when more than one MC could be relevant. For example, this would be the case when you fall in love with a colleague from work, or have to operate on a family member. Thus, context codetermines which MC prevails.

One will treat close friends and family differently from strangers. Sometimes you might give them a preferential treatment, while other times you might judge them more harshly than you would others. In other words, each MC has its own centrality; this is defined as Moral Circle Centrality (MCC).

MCC deals with "Those who matter to me" and defines the position of that MC within the entire set of MCs. The most central MCs include groups such as your family or close friends. Less central groups are those groups including strangers and acquaintances. Since each MC only exists in the mind of an individual, perceptions might differ across people. You might consider somebody a part of a 'close friend' MC, but they might not consider you part of theirs.

Based on our examples above, MCC is probably best represented on a sliding scale. As a first step though, we can identify a limited set of categories, e.g. 'in-group' and 'out-group', or 'stranger', 'acquaintance', and 'family member'.

The fifth requirement:

5. Agents must be able to differentiate between types of moral circles; the salience of these moral circles is dependent on their centrality

Relational Primitives. Relational primitives are social variables that exist within the mind of the individual and describe the relational properties of other individuals. In our work, we differentiate between two relational primitives: status and reputation. More can be identified, such as the power dimension identified in Kemper's work [20]; depending on the instantiation in specific applications, additional primitives may need to be defined.

Status
...Horatio walks up to Claudius and recognizes that he's dealing with an older man who is wearing a very formal suit. The old man is looking at his watch and Horatio realizes that the older man is probably in a hurry...

Many difficulties between individuals arise because there are differences in perceived status ("You're not in charge, I am!"). To avoid such conflicts, formal MCs usually have formal roles with explicit rights and obligations, which can range from that of a managing director of a multinational company to a junior trainee. In our model, we have instantiated this concept as moral circle status (MCS).

In the example above, Horatio is able to make an assumption about the status of Claudius because of two factors: his age, and the suit he is wearing. Note that Horatio might be wrong in his appreciation of these attributes; these symbols might mean something different to Claudius than they do to Horatio.

The sixth requirement:

6. Agents must be able to infer the status of characters, either through public variables, the observation and interpretation of symbols or through information gained from previous interactions.

Reputation
...Claudius has also had bad experiences with strangers in the past. Once, while he was helping a stranger, that stranger actually took his wallet...

Previous interactions with people will influence the way you treat them at a later stage; you will treat a 'good' friend differently from a 'bad' friend. In our model we have instantiated this as moral circle reputation (MCR).

Reputation can be seen as a social 'standing': an agent could be 'in good standing' versus 'in bad standing' with its fellows [22]. Reputation is essential for agents that interact with each other multiple times; it is likely that they will act differently depending on how previous interactions with that agent have played out.

Each MC has certain rights and obligations conferred on its members, depending on their roles in the MC. MCR can thus be used as a measure of how well a person lives up to their MC derived obligations and their respect for the rights of other MC members; whether a MC member follows or deviates from the norm will have an effect on their MCR.

Each member of the MC has a perception of the MCR of other known members and of their own. So you might think less of yourself if you have done something wrong, and others might also think less of you. This action can then be sanctioned by another member of the MC, and, depending on the level of MCR change, be attenuated by an appropriate atonement. Not wanting to lose reputation can be an important reason for an agent to respect a norm [23].

Two important elements need to be present within our model: actions have to be judged as to whether they deviate or follow the norm, and members of the moral circle need a perceived level of reputation (with unknown people these will be based on cultural meta-norms, see Sect. 3.3).

This leads to the seventh requirement:

7. Appropriate or inappropriate behaviour of other agents should lead to a respective change in Moral Circle Reputation.

Social Norms

. . . Claudius has no idea where the hotel is that Horatio is looking for. In his eyes, a young person like Horatio was probably not well prepared in planning his trip and it is his own fault. Claudius tells the man that he has no idea where the hotel is, wishes him good luck, says he has to go, and rushes to work. . .

Social norms help to identify how one should behave in a ritual. These norms reflect underlying value structures, but they are not fully determined by them. They evolve in path-dependent ways, depending on contextual contingencies, to be accepted by a society as a short-term guide to appropriate behaviour. Parts of society may evolve their own social norms, and as such, social norms are present on a group level. Therborn [24] makes the case for the importance of normative questions to the discipline of sociology.

As stated by Hollander and Wu [25] in their review of norms in agent-based simulations "The literature is populated with numerous definitions and uses of the term norm". However, norms are widely understood as rules that specify which behaviours are to be displayed, allowed, or prohibited when in a given context. This is how we conceive of them in this article.

Let us define more precisely how social norms are related to moral circles and the relational primitives (in this case, status MCS and reputation MCR). Operationally, each moral circle can have its own social norms, for example a company, a club or a family. As such, there are often multiple moral circles active at the same time (sometimes without a member even being present; 'what would your mother think of your behaviour'). Knowing the most salient MC in any context indicates to an agent which set of social norms take precedence.

Both the interpretation of the appropriateness of behaviour and the translation of intentions into actions, are mediated by the current social norms. These social norms are the most malleable part of MC rules. A population can come to believe that drunk driving or smoking indoors in the presence of non-smokers is normatively wrong, in a relatively short period of time. People actually use norm-related behaviours (adherence, violation, attempts to change) as a means of maintaining or changing the MC. However, the underlying cultural meta-norm structure and MC dynamics will not have altered significantly, if at all. The detailed functioning of MCs in practice reflects the underlying cultural values.

Let us examine how MCS and MCR within a MC could affect which social norms apply. Some social norms will define how to behave towards those of differing status. Here MCS within a MC determines which norms are applicable. For example, should greater respect be shown to high status family members or colleagues, and if so how? If more than one MC is active, the centrality of these MCs and the status and reputation of the individuals present help to establish the most salient MC (and which social norms take precedence).

In our example, Claudius believes that Horatio should have been more prepared. As a result, Claudius believes that it is more important for him to carry on to work than to help this undeserving youth.

This is the eight requirement:

8. Agents should determine which Social Norms are applicable and when they conflict, which take precedence. This process should be dependent on the salient Moral Circles, and the Relational Primitives of the participants.

3.3 'Society' Level

In their work, Mc Breen et al. [11] defined the notion of 'cultural meta-norm'. A cultural meta-norm has as its pre-conditions (1) the culture of agents in a situation, (2) a relational setting between agents. The culture acts as a perception and interpretation filter on the relational setting. The post-condition of a meta-norm is a tendency to create, strengthen, or weaken a relational goal. This is the reason for the epithet 'meta-', since a norm has specific behaviour as its post-condition. In the case of a cultural meta-norm, the relational goal change might not lead to any behaviour. For instance, depending on the specifics of the situation, the agent might not be empowered to act. Typically, a simulation would take the relational goal change into account alongside specific context factors, such as instrumental goals, to determine the actual behaviour of the agents.

Cultural Meta-Norms
. . . Horatio is left feeling bad and confused: where he is from, you usually help strangers, even if you are in a hurry. He decides to carry on, and continues on his journey. . .

Cultural meta-norms as defined by Mc Breen et al. [11] model agents' propensity to behave in a certain way in certain relational contexts, such as 'meeting a stranger' or 'meeting a person in need' or 'dealing with older people'. In contrast

to social norms (middle level of Fig. 1), meta-norms are non-instantiated guides to social behaviour (upper level in Fig. 1). They are about the relational fundamentals of social life, and they are shared within any society that has the same culture. They deal with the basic question of how people should behave with respect to each other depending on who they are. They are close to the values of a culture, in the Hofstede sense of 'cultural programming of the mind', shared tendencies to perceive the social world, and act in it, in certain ways.

In our example, Horatio has a different cultural meta-norm regarding helping a younger stranger in need, than Claudius; Horatio expects Claudius to have a relational goal of providing help, while Claudius has no such goal, as a stranger receives less MCS and MCR in his culture. For Horatio is it unthinkable that you would leave a stranger needing help on the street to go to work. Thus, cultural meta-norms model how culture influences the behaviour of agents.

Within our conceptual model, culture will influence the social structure of MCs, and their social norms. The culturally modifiable parameters are the weight of the relational primitives, the salience of MCs, and the salience of social norms. The most salient MC and the most salient social norms can be established using this operationalization of meta-norms, e.g. "the work MC prevails over others" perhaps qualified by time of the week, or "what a senior person (could be parent, teacher, priest, boss) wants of me is more important than what anybody else wants of me". There should be room to add culture as a weighting and salience mechanism for MCs and social norms.

Every culture, through the different modifications it brings to the content and salience of MCs and social norms, will cause agents to behave differently, and to judge the behaviour of others differently as well.

The final requirement is thus:

9. Cultural Meta-Norms should be used to create weighting and salience mechanisms for moral circles, social norms, and relational primitives.

How can we begin to represent these varying behaviours and judgements in agent architectures? We propose to do this using Hofstede's dimensional model of culture [3].

Operationalizing Culture. We give an example of modifying the behaviour of agents based on their cultural background by linking elements of our conceptual model to Hofstede's dimensions of culture.

Hierarchy: Large Power Distance versus Small Power Distance. The importance given by agents to status depends on the dimension of power distance. This dimension represents the extent to which the less powerful members of a society expect and accept that power and rights are distributed unequally. Large power distance splits up the society into MCs of people with equal status that are not permeable, and depend on position in society. Agents in cultures of large power distance will respond differently to others depending on how they perceive their MCS relative to their own. Status differences will be effective barriers to communication, and particularly to volitional behaviour travelling upwards.

Horatio would feel that the behaviour of Claudius was appropriate if he was from a culture of large power distance. Indeed, if he was from a culture of very large power distance culture he would never have approached Claudius in the first place.

Aggression and Gender: Masculinity versus Femininity. The importance given to reputation depends on the cultural dimension of masculinity. This dimension is about assertive dominance and emotional gender roles. It contrasts a strong-handed, competitive orientation in 'masculine' cultures, in which people in general do not assume others to be trustworthy, men are supposed to be tough and women subservient and tender, versus a consensus-seeking and care-taking orientation for both women and men in 'feminine' cultures. For our relational primitives in masculine cultures, MCR will be very unequally divided across the MC, with a tendency to blame the weak and admire the strong. MCR will be more evenly distributed in feminine cultures, and will not change so radically with poor behaviour.

In our example, if both are from a masculine culture, Horatio would tend to judge Claudius harshly for not helping him, just as Claudius would be likely to judge Horatio harshly for being ill-prepared. In a feminine culture both would be more forgiving of the apparent faults of the other, and would expect this same forgiveness of others for their own mistakes; and Claudius would be more likely to actually help Horatio.

Identity: Individualism versus Collectivism. The importance given to MC centrality depends on the cultural dimension of individualism. An individualistic culture is one in which its members are supposed to be independent, self-motivated individuals. Its opposite, a collectivistic culture, is one in which everyone feels interdependent, and people act based on the social norms that come with their specific role in society.

In our example, Claudius didn't consider helping Horatio because he was a stranger. This is more likely in a collectivist culture, as out-group members are considered less 'my business' than in-group members. In an individualistic culture, helping Horatio would have been more likely, as the divide between in- and out group members is less great than in collectivistic cultures. On the other hand, if a collectivistic Claudius decided to 'adopt' a stranger, he would probably go to greater lengths in helping him.

4   Discussion

4.1   Design Choices

Our design principles were threefold:

1. Re-use simple, broad-range theory from the social sciences;
2. Re-use good properties of existing agent models;
3. Be unconcerned with implementation architecture.

It is our conviction that social sciences have theories on offer that have not yet been used in socio-cultural agents, simply because of a combination of the field's youth, the lack of contact between islands in the 'ivory archipelago' of social science, and the absence of systematic attempts to find such theories.

Theories that could be used are those that are parsimonious, so that they will not tend to create explosive complexity of agent models, and that have proven to be valid across a wide range of circumstances. Theories at different levels of abstraction could be eligible: the individual, the dyad, the group, or the society.

In this model, we have concentrated on three theories. The first is the work of Kemper [20] that models how individuals deal with status and power in their moral circles which he calls reference groups. The second is the work of Rothenbuhler [14] on rituals in groups, in which he generalizes the notion of ritual to include all social interaction in which a group of people have shared attention. There is also a clear conceptual link with Kemper: rituals serve to maintain moral circles, or if they are big rituals, to modify status hierarchies and membership in those moral circles. The third major theory is Hofstede's model of national culture [3], that can explain why similar dynamics, with slightly different parameterizations, lead to such stable differences across national patterns in social reality.

To our knowledge, outside of our work, Kemper and Rothenbuhler have not been used in agent architectures before, although [9] discusses rituals in agent architectures. Hofstede's dimensions have been used in virtual agents before [9,12]. Those attempts showed that culture was not very successful as a direct driver of behaviour; more basic social behaviour was found to be needed for culture to build on. This prompted the search for new theory that led to incorporating Kemper's status-power theory and reference groups.

4.2   Simplified Version

Our design choices imply that we do not believe a simplified version of the model could still plausibly produce equivalent behaviour. In fact we rather expect the opposite: user testing will quickly show model elements that are too simplistic to capture social reality.

Directly instantiating goals for virtual agents based on culture, without what social psychologists would call group dynamics, proved unsatisfactory, as argued above. Excluding culture would preclude making cross-cultural encounters virtual, and is therefore not desirable.

Figure 1 does show a way to simplify our model, though. The bottom layer concepts could largely be left out if the agents were non-embodied. There would still be a simulated process of course, implied by the box 'ritual'. But there would not be any physical context. That also removes the need for model properties that come with embodiment of agents: visible age, gender, status-carrying attributes, non-verbal behaviour, and personality. Actually, simulations have been carried out on this principle. In applications of trade negotiation [26] and consumer behaviour in car choice [27], culture as operationalized by Hofstede dimension scores was used to modify agent behaviour in agent-based models. In the case of

trade negotiations, face validity was achieved, and in the case of car selection, the model reproduced cross-national purchase patterns.

Another way to simplify the model, admittedly reducing its allure, would be to limit the number of cultures, or the number of moral circles. For purposes of testing and sensitivity analysis, such steps could certainly be taken.

4.3   Validation Scheme

There are two components to the validation of the model described in this article. The first is the validation of social norms and cultural meta-norms. This can be done using simulations with instantiated agent behaviour based on the model presented here. These rules of behaviour need to be validated by running simulations with a large number of participants from different cultures, to ensure that the behaviour described in these norms is actually representative of realistic differences in behaviour across cultures and groups.

The second is the validation of the model itself. This is a more difficult process. The evaluation of designed scenarios would just test the instantiation of the model, not the model itself. However, through a design-based approach, the model could be tested for its generalizability against a corpus of real-world stories: 'Can you describe every situation in terms of the elements of the model'. This helps to establish the boundaries of the model. There will be obvious boundaries to the model in terms of instantiated virtual worlds available. In future work we aim to instantiate this work for specific application domains and existing agent-based architectures. This will help us to identify if additional elements are needed.

5   Conclusion

The series of requirements that we have presented during the interaction between Horatio and Claudius represent elements that are important to consider when designing socio-cultural virtual agents. Taking these requirements as a starting point, we have discussed elements of our model that will help show realistic social behaviour that can be modified by culture.

Through rituals, in which a set of agents have shared attention in a certain environment, agents are able to act appropriately by applying the relevant moral circles and their social norms. This selection mechanism allows for different interpretations in different contexts.

Culture can then be applied through the use of cultural meta-norms, which, in turn, affect the weighting and salience of the other model components. This allows us to have culture influence social relationships rather than act directly on behaviour. Also, in the absence of familiar moral circles, cultural meta-norms can provide guidance. This is particularly important when meeting with strangers (from different cultures).

We believe that this paper makes some necessary conceptual steps to make virtual agents act more appropriately in any social or cultural context. Agents

created with such a model can be used within (existing) agent architectures. Besides their practical use, they can also be used as tools to better understand how people perceive and interact with characters from different cultures.

In future and on-going work, we aim to put the concepts presented in this paper into existing agent architectures to create believable culturally-varying behaviour in agents for educational purposes. The translation of the concepts will allow us to discover flaws and additional modelling requirements for socio-cultural agents.

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