An Agent Model for the Influence of Culture on Bargaining

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ABSTRACT

Cross-cultural negotiation poses special challenges. In this paper an agent-based simulation model is presented that tackles these challenges. The model represents a trade network for a good with a hidden quality attribute. Agents have culture scripts that are based on Hofstede's dimensions of culture. They have visible group membership and status attributes that are used by their hidden cultural rules of behaviour. They bargain according to the ABMP bargaining model that has a utility function consisting of expected gain, quality, and risk. The paper presents the model and shows results of test runs. These test runs have face validity when compared with real negotiations. Formal tests of correspondence between the model and the trade game on which is it based have yet to be conducted. Extensions will make it a useful tool for training traders who engage in cross-cultural bargaining. The present version is helping to explain the behaviours of actors in international trade networks. It proves that Hofstede's dimensions can be used to generate agents that are believable negotiators.

Keywords
Agent-based model, culture dimensions, bargaining, negotiation, trade network

INTRODUCTION
Anybody with experience in international trade knows that bargaining practices differ across the world. Multinational companies sometimes work with different price lists for different countries: whereas German buyers want to know exactly how much the products cost, Arabs need to have room for bargaining. In order to sell at the same price, the selling company needs to adapt its offer to the varying bargaining practices (Jan Omvlee, personal communication).

This means that a single piece of advice about how to bargain, or a single model to describe bargaining, are obviously not valid across the world unless culture is taken into account.

'Culture' is a notion with many meanings, some of which are contested in some disciplines. However, the leading paradigm today is widely accepted and used in both practice and academia. According to it, culture refers to the *unwritten rules of society*. It is a phenomenon that is specific to a group, not to an individual. And it is transmitted in early youth through example and education.

Within literature various basic dimensions can be found according to which societies differ from one another. Of these, the most widely used is Hofstede (2001, 2005). His work is accessible, sparse, and based on a very large, very well stratified sample that continues to give it great explanatory value. No other model matches society-level variables so well to date (Smith, 2004).

This paper describes an agent-based model for bargaining in the context of trade. The agents follow common sense strategies such as maximizing gain, seeking good quality, and minimizing risk. But they also have models of how to behave in an appropriate manner, and these models are based on Hofstede's five dimensions of culture. The challenge that we take up is the one posed by de Rosis et al. (2004), who suggested to investigate the feasibility of Hofstede's model for building culturally consistent agent characters. An agent-based model of bargaining in which the agents are cultured offers several promises. It can help understand the dynamics of international negotiations in trade. It could also serve as a training tool for aspiring international traders.

The paper first briefly introduces Hofstede's model of five dimensions of culture. Next, the negotiation model that we adopt is presented: ABMP. We show how this model can be used in agent-based simulations. We also discuss the limited subset of negotiation situations that are considered in this article. In the third section we link culture and negotiation by describing the influence of each of Hofstede's dimensions of culture on negotiators' practices and preferences. This section sets the scene for the presentation of the rules for our cultured agents in the fifth section. Section six shows example runs with the model and discusses them.

Finally we discuss the model and how to proceed, since this model forms the basis of future research and tools.

HOFSTEDE'S FIVE DIMENSIONS OF CULTURE

Each human society has found a different pattern of response to the problems of social life. In some societies, groups are permanent and close-knit while in others, group membership is volatile and voluntary. In some, leadership style is usually autocratic and in others, participative. Research (Hofstede and Hofstede, 2005) has shown and repeatedly confirmed that basic tendencies to deal with a few central issues of social life are stable across the generations in societies. They are, because they are instilled into a society's members from birth. As a baby and as a toddler, a child is primed as a social being. Once a child sets foot into the wider society as a teenager, its basic cultural orientation is firmly in place.

This research stream has led to dimension models of culture. One of these is the five-dimension model by Hofstede. The five dimensions are about five issues that relate to our basic drives. They will be introduced briefly in order to use them further on in the text. Note that these are not personality traits, but societal patterns! Also note that the picture drawn here is necessarily simplified. It presents the two caricatured extremes of each dimension. In reality, almost all cultures have intermediate positions on almost all dimensions. The dimensions are introduced in the following sections.

Collectivism versus individualism

This dimension is about affiliation. To a collectivist mindset, fixed membership of a single group in which all members are interdependent is the natural state of being human. No member of the natural group can be cast aside. This means that maintaining a semblance of harmony is crucial.

To an individualist mindset, on the other hand, self-sufficiency is the natural state of being. Everybody should be judged in the same way, whether or not the person is a group member. Honest people speak their minds, even if that means open disagreement.

Hierarchy: large versus small power distance

This dimension is about dominance as an ascribed quality. It has to do with authority as seen from below. Are parents, teachers, priests and bosses held in awe, and is autocratic leadership expected? Then we have a society of large power distance.

Or is leadership a role that could change from one person to another with ease, and are all people equal? In that case, the society is one of small power distance.

Aggression and gender: masculinity vs. femininity

This dimension is about dominance from above, about muscle power, and about the emotional roles of the two sexes. In what is called a masculine society, men in particular are supposed to be fighters. Women are supposed to be cheerleaders to the men's fight – but they have to be tough too. Men are real men and women are real women. These are fighting societies, with strong-handed police and military and with heavy punishment for offenders.

In what is called feminine societies, both men and women are supposed to be peace-loving and consensus seeking and their social behaviours are not strongly different. Both men and women are people, and gender is not supposed to be a big deal. Criminals should be helped, not punished.

Otherness and Truth: uncertainty avoidance

This dimension is about how to cope with the unknowable. Some societies are termed uncertainty avoiding. They tend to have strict rules and rituals about things that are strange or different, such as religious rules and food taboos, or strange sexual practices. In these societies, the distinction between clean and dirty is important. In fact they feel that any distinction should be a sharp one. They are concerned about theory, about arguing for its own sake. They like to show their emotions, particularly anxiety, verbally and non-verbally.

Other societies are termed uncertainty tolerant. They are relaxed and curious about strange things and people, and not worried about establishing strict classification schemes for everything. They value exploratory behaviours and novel experiences, and they do not like an emotional communication style.

Short- versus long-term gratification of needs

This is about all the basic human drives. Which drive should get precedence, one that presses now or one that might become pressing in ten years?

Some societies live for today, and these are termed short-term oriented. Behaving in an appropriate manner and respecting conventions is important in these societies, as well as 'keeping up with the Joneses' as the Americans have it. There are strong opinions about good and bad, and these are believed to be immutable.

Others societies live for the future; these are termed long-term oriented. Reasoning is pragmatic, and principles are adapted to context. Planning, foresight and perseverance are valued. On the downside, this could lead to stinginess and calculation.

Five dimensions, one world

So far, the dimensions of culture have been isolated from one another in an artificial way. In reality, cultures have a recognizable feel to them, a Gestalt that can be described, albeit only roughly, by its combination of dimension scores. The five dimensions are no more than abstractions that capture main behavioural trends. Cultures have 'gestalts' of behaviour. Experienced negotiators know the range of behaviours that they can expect from negotiators from other parts of the world. They also know how gender, age, status and personality can affect the negotiation style of people from these parts of the world.

In previous work, Hofstede et al. (2006, 2008, 2008abc) the influence of each of the dimensions on trade

processes was modelled separately; a slightly artificial, but also necessary intermediate step in our long term research project. Reconciling these dimensional models into one believable model that shows the 'whole negotiator', although still abstracting from personality, is the aim of this article.

NEGOTIATION

In bilateral negotiation, two parties aim at reaching a joint agreement. They do so by exchanging various offers or bids using e.g. an alternating offers protocol (Osborne et al., 1994) called the "negotiation dance" in (Raiffa, 2002). Negotiation is a complex emotional decision-making process aiming to reach an agreement to exchange goods or services, see e.g., (Thompson, 2005).

Agent Models for Negotiation

The literature on automated negotiation contains a number of agent models for negotiation. The focus of that literature is on reaching deals that Pareto-efficient (i.e., neither can improve without making the situation worse for the other). Furthermore, some aim at reaching fair outcomes, i.e., in which the deal is equally good for both parties. The strategies differ in whether or not they take knowledge about the domain, and/or opponent into account. Example of strategies that do not use any domain or opponent knowledge can be found in (Faratin et al., 1998; Jonker et al., 2001). Other strategies try to learn the opponent's preferences, see e.g., (Coehoorn, 2004; Hindriks et al., 2008).

Focus on Interpersonal Bargaining

The present work focuses on a specific type of negotiations: two person bargaining about business transactions. The work aims to develop models of actual human behaviour. It does not aim to develop an optimal bargaining strategy that can outperform human negotiators or other agents.

Gaming simulations form the context of the bargaining sessions. The gaming simulations are designed as tools in supply chains and networks research (Meijer et al., 2006). Participants negotiate a transaction of a commodity with quality attributes that are known to the seller and invisible – but testable at some cost – for the buyer. The buyer can either trust the seller's quality statement or spend money on testing. So, the relevant attributes for comparing bids are the economic value of the transaction according to market prices, the valuation of particular quality attributes by the trader, and the risk of deceit introduced by the information asymmetry.

In the models developed in this work, traders are assumed to compare business proposals by applying a utility function as defined by Tykhonov et al. (2008):

$$U(b,a,p) = w_{apP}P_{ap}(b) + w_{apQ}Q_{ap}(b) + w_{apR}R_{ap}(b) \quad (1)$$

$U(b,a)$ stands for the utility that agent a expects from bid b made by agent p. $P_{ap}(b)$ reflects a's belief about the economic value. $Q_{ap}(b,a)$ reflects the subjective valuation of the proposed transaction, e.g. an trader may prefer trading biologically grown food, even if more profit may be made with traditionally grown. $R_{ap}(b)$ reflects a's estimate of the risk involved. It is based on the estimated trustworthiness of the other agent and the opportunity to defect that the proposal offers, e.g. a contract for organically grown food offers the opportunity to deliver the cheaper traditionally grown.

The factors w_{apP}, w_{apQ}, and w_{apR} reflect the weight that agent a attaches to the terms of the utility function when dealing with p. The values of w_{apQ} and w_{apR} relative to w_{apP} may reflect personal preferences, but they are to a great extent influenced by culture. Within a culturally homogeneous society, not all agents have equal preferences, but significant differences between cultures exist in the average values of risk aversion and the appraisal of status associated with high quality products.

ABMP

For our negotiation strategy we chose that of Jonker and Treur (2001), because of its proven similarity to human negotiations, see (Bosse et al., 2004). The ABMP strategy has a number of parameters, with which the behavior of the agent can be tuned. With respect to the influence of culture, the relevant ABMP parameters are concession factor, negotiation speed, utility gap size, and impatience factor. The concession factor determines how far the agent is willing to go in making concessions. Negotiation speed determines the extent of concessions to its own utility the agent would typically make per negotiation round. The utility gap size expresses what is acceptable to the agent when comparing its own bid with that of the opponent. If the difference in utility falls within the utility gap size, the agent will accept the opponent's offer. The impatience factor determines when the agent becomes impatient with the opponent. For example, for some agents it is OK if the other makes a concession within 4 rounds, for another, the other should make concessions every round. The following section explains how culture influences these parameters.

CULTURE AND BARGAINING

Hofstede et al. (2006, 2008, 2008abc) modeled the influence of culture on trade processes for each of the five dimensions separately. Negotiation is one of the trade processes they define. From these papers, the narrative descriptions of the influences on trade negotiations – i.e. the bargaining about transactions – are cited below.

Masculinity versus femininity

Hofstede et al. (2006) treat the dimension of masculinity versus femininity as a preference for performance versus cooperation. A performance oriented trader (masculine culture) is interested in fast trades, with as many goods as possible in one trade. This trader is rather impatient, and if bids are too far off from his profile, he will walk away quickly. The performance oriented sticks to the contract of the deal, deceive the

trade partner to the limits of the contract without any compunction, and expects the partner to do so too. As a consequence, the performance oriented trader sees no problems in dealing again with a trader that conned him in the past: "It's all in the game". Each subsequent negotiation will be dealt with without taking past trustworthiness into account. Each new contract will be set up from scratch. The trader learns from mistakes to make sure that the contract will not lead to new and uncomfortable surprises on his side.

A cooperation oriented trader (feminine culture) is interested in the relationship with the trade partner; building trust is important. The amount of goods is not of the most interest, because the relationship built during negotiation might pay off in future negotiations. Given the interest in the relationship with the trade partner, a first negotiation with a trade partner will take time that is willingly spent by the trader. During such negotiations, the trader appreciates a negotiation process in which both partners show a willingness to accommodate the other over time. Past negotiations do play an important role in subsequent negotiations. The trader is perfectly willing to see the current negotiation as a kind of continuation of the previous one. If the trade is about the same kind of commodity, the trader will start the negotiation from the deal of the last one. If the other accepts, then the deal can be made in one round and in seconds, whereas the first deal might have taken a lot of rounds and lots of time. If conned, then the cooperation oriented trader will avoid the conman if possible, or give him one more chance. In the human games we observed that he then asks for a very good new deal to reaffirm the relationship.

Both performance oriented traders and cooperation oriented traders prefer reaching a deal after a satisfying negotiation over a deal that was reached on the basis of a bad negotiation. Not reaching a deal after a satisfying negotiation is better than having no deal after a bad negotiation. Bear in mind that the traders differ strongly in what is considered a satisfying negotiation. Furthermore, note that their cultural scripting will also lead them to behave differently during the negotiations. A performance oriented trader might very well walk away (no deal) as soon as he receives a first bid that is very far off the expected price. The cooperation oriented trader might be put off by steadfastness, and certainly by the partner walking away after few rounds. However, he will be forgiving and willing to negotiate with P one more time, although he will trust less and avoid risk in the next deal.

Uncertainty avoidance
According to Hofstede et al. (2008), the first bid of an uncertainty avoiding trader tends to be modest in the sense that it is a price he thinks is right. The uncertainty avoiding have an emotional style of negotiation, making sure that the opponents understand their feelings (see row 2 in table 1). They will not adapt their behaviour to their opponent's. In the bargaining that follows they will not easily give in nor will much time be spent. After a

few unsuccessful iterations, the uncertainty avoiding trader will break off the negotiation.

The uncertainty tolerant traders on the other hand have a relaxed style of negotiation. They try to adapt their behaviour to their counterparty's, although they are not prepared to come to an agreement at all cost. They do not show their emotions and may be disconcerted if their opponents do. They are careful not be more yielding than their counterparts are, not especially modest, and are ready to break off negotiations in case of insufficient progress.

Power distance
According to Hofstede et al. (2008a), traders from egalitarian cultures may have different ways to negotiate, but they will always negotiate. Traders from large power distance cultures on the other hand are not used to negotiating seriously. The powerful dictate the conditions. The less powerful have to accept. In feminine or collectivist cultures the powerful may exercise restraint, or the lower ranked may successfully plead for compassion, but this is not a common decision making process, like a negotiation. The most powerful decides. When people from hierarchical cultures are forced to negotiate, because they are in a position of equal status or trade with foreigners, the negotiations often end in a game of power.

A trader from a culture with large power distance expects a lower ranked business partner to accept his conditions rapidly. If the lower ranked partner has the same cultural background, there is no problem and the rights of the higher ranked will be recognized and respected: the lower ranked will be modest and give in easily. However, a trader from an egalitarian culture will not give in to the pressure if his status is lower, but will either react furiously (e.g., break off negotiations) or simply ignore the pressure (make a counterproposal), in which case the opponent will be furious (and e.g., break off negotiations).

If a trader from a culture with large power distance negotiates with a foreigner and assumes the foreigner to have a higher status, he may give in more easily than the foreigner expected. In that case the foreigner will be happy, but his opponent will have "left money on the table". If both are from hierarchical cultures but do not perceive one another's hierarchical position they may make misattributions resulting in one of them being dominated or stopping the negotiations.

Individualism versus collectivism
According to Hofstede et al. (2008b), to a collectivist mindset, negotiation has to be preceded by the formation of a relationship. If that goes wrong there will be no negotiation. During the negotiation, collectivist traders discriminate between in-group and out-group partners. They feel obliged to be more modest (or realistic, following their in-group's rules) in their first proposal to an in-group partner, are more hesitant to break off negotiations with in-group partners, and will try to maintain harmony as long as the opponent follows

the in-group rules. When doing business with individualist traders the collectivists may be shocked by their opponent's explicit communication. Breaking the rules asks for a reaction. The style of that reaction may be furious, or they might never explicitly say anything, but just avoid the other from now on. The first reply to a new proposal from an in-group partner will be modest, but there is no need to be modest to an out-group partner. If an out-group partner replies with no or small concession, negotiation is likely to be broken off, where an in-group partner or an acquainted relation would get a second chance.

In a collectivist mind the responsibility for in-group welfare and the compliance with in-group rules always play a prominent role. A collectivist will accept benefits for his in-group rather than his personal advantage as a convincing argument.

Individualists have one thing in mind during negotiations: their own personal interest. This might be the material advantage of the deal in question, or the development of new trust relations with perspectives of future deals, or just the pleasant conversation during the negotiations, or the satisfaction of winning the game, but one thing stands for sure: individualists only pursue private interests. So individualist traders are not very modest in their negotiations, nor will they give in for the purpose of maintaining harmony. If they are not aware of the cultural differences when trading with collectivists, they may be upset by the lack of explicit communication, or they may upset their opponents by being too explicit, or by talking business before the relationship has been established and acknowledged. They are not particularly patient or impatient negotiators, but behave patiently as long as it serves their interest.

Long term versus short term orientation
According to Hofstede et al. (2008c), long term oriented negotiators are pragmatic and take the bigger picture. They tend to see one bargaining instance as a small step in a long process, and their decisions will be led by their estimation of the profitability or other success chances of that longer process.

Short term oriented negotiators, on the other hand, think in terms of moral principles and apply them to the situation that is before them here and now. They are very reliable when it comes to following standards of appropriateness of behaviour, but this can make them disregard the ulterior consequences of their actions.

Long-term oriented traders show patience. They do not break off negotiations. They do not overcharge. A first proposal may be modest, but they do not rapidly give in.

Extremely short term traders are impatient. They want rapid deals. If they give in they do it quickly and with substantial concessions. If partners do not make concessions too, they break off easily and try their luck elsewhere.

MODELLING CULTURE IN ABMP
Based on the narrative description in the previous section, the influence of the cultural dimensions on ABMP parameters can be modelled. The same applies to the weight that subjective terms for quality preference and risk aversion get in an agent's utility evaluation. The direction of the influences (increasing versus decreasing) is indicated in Table 1. Table 1 also presents typical parameter values for cultures that are not on the extremes of the Hofstede dimensions.

Table 1: Influence of culture on the utility weight factors and ABMP parameters (+ increased parameter value; - decreased; +! increased every negotiation round)

Culture [1]	Conditions	Parameter	weight of quality q_a [3]	weight of risk r_a [3]	concession factor γ_a [4]	negotiation speed β_a	utility gap v_a	impatience factor π_a
		Typical value	0.2	0.1	0.7	0.2	0.02	0.4
Hier	Self status:							
	- high		+					
	- low		-					
	Partner st.:							
	- higher			+	+		+!	-
	- lower			-				
Egal								
U.av	Partner is:							
	- different		+	++		+		+
	- similar		+	+		+		+
U.tol								
Indiv								
Coll	Partner: [2]							
	- in-group				+			-
	- out-group			+	-			
Mas			+	+		+		+
Femi			-			-		-
LTO			-					-
STO			+	+				
	- high status partner		+	+				-

[1])Hier: hierarchical, high value of PDI;
Egal: egalitarian, low value of PDI;
U.av: uncertainty avoiding, high value of UAI;
U.tol: uncertainty tolerant, low value of UAI;
Indiv: individualist, high value of IND;
Coll: collectivist, low value of IND;
Mas: masculine, performance oriented, high value of MAS;
Fem: feminine, cooperation oriented, low value of MAS;
LTO: long term oriented, high value of LTO;
STO: short term oriented, low value of LTO.

[2])Out-group partner can become in-group by repetitive confirmation of relation

[3])q_a and r_a are relative to the weight of economic value, which is set equal to 1.

[4])Also influenced indirectly, see equation (4).

Table 1 presents qualitative directions for the influence of cultural dimensions on parameters in the agent negotiation model. However, it is based on a narrative analysis. Data to quantify the influence or to assess the influence of the dimensions relative to each other is not available. Until evidence is available, a simple model can be assumed, giving all dimensions equal influence.

Equations that have been implemented for the test runs presented in the next section of this paper are given below. The principle applied in combining the dimensions, is that in both positive and negative direction of influence, the cultural influence having the maximal value determines the extent of the parameter.

Negotiation parameters are modified for culture by equations (2…7), where p_a, u_a, i_a, m_a, and l_a represent agent a's cultural dimensions, i.e. the Hofstede indices scaled to the interval [0…1]; s_a and s_p represent a's and partner's status; d_{ap} is group difference, valued 0 or 1.

weight of quality:

$$w'_{apQ} = q_a [1 + \max\{\sqrt{(p_a s_a)}, u_a, m_a, 1\text{-}l_a\} - \max\{1\text{-}\sqrt{(p_a s_a)}, 1\text{-}m_a, l_a\}] \quad (2)$$

weight of risk:

$$w'_{apR} = r_a [1 + \max\{p_a (s_p\text{-}s_a), u_a(1+d_{ap}), (1\text{-}i_a)d_{ap}, m_a, 1\text{-}l_a\} - (s_a\text{-}s_p)] \quad (3)$$

The weight of rational economic value $w'_{apP} = 1$. w'_{apQ} and w'_{apR} are measured relative to w'_{apP} . These three factors are normalized in order to add up to 1 as weights w_{apP}, w_{apQ}, and w_{apR} in equation (1).

concession factor:

$$c_{ap} = \gamma_a + 0.5(1\text{-}\gamma_a) \max\{p_a (s_a\text{-}s_p), (1\text{-}i_a)(1\text{-}d_{ap})\} \quad (4)$$

Where z_a represents the maximal value of the normalized risk function $R(b,a)$ in equation 1. In the model presented in this paper there is no other risk than the risk of defection by the supplier; z_a reflects the information asymmetry: $z_a = 1$ if a acts as a customer and $0 \le z_a \le 0.25$, depending on a's probability to defect, if a acts as a supplier.

negotiation speed:

$$b_{ap} = \max[0.1, \beta_a\{1 + \max(m_a, u_a) - \max(1\text{-}m_a, d_{ap}\text{-}i_a d_{ap})\}] \quad (5)$$

utility gap size:

$$g_{ap} = v_a\{1 + x p_a \max(0, s_p\text{-}s_a)\} \quad (6)$$

where x is the round number in the current negotiation.

Impatience factor:

$$h_{ap} = \pi_a [1 + \max(m_a, u_a) - \max\{p_a(s_p\text{-}s_a), (1\text{-}i_a)(1\text{-}d_{ap}), 1\text{-}m_a, l_a, (1\text{-}l_a)(s_p\text{-}s_a)\}] \quad (7)$$

TEST RUNS

Table 2 presents results of negotiations performed in the environment developed for simulation of commercial transactions, applied by Hofstede et al. (2008, 2008abc). Trade agents are assigned roles of either suppliers or customers. They may select a partner in the opposite role and negotiate about the sale of a commodity that has either high or basic quality. However, the quality is not visible without third-party testing, so the buyer has to accept a risk, i.e. has to trust the partner. In the current simulation, agents are set to be neutral with respect to trust, i.e. neither trust nor distrust their trade partners. If they agree on high quality, they implicitly accept the risk of deceit.

Table 2: Results of simulated negotiations for extreme settings of culture parameters, i.e. the value for the particular dimension is set to either 0.1 or 0.9, the values for the other dimensions are set to 0.5. Parameters q_a, r_a, γ_a, β_a, v_a, and π_a are set to the typical values presented in table 1.

Culture [1]	Conditions	Successful transactions	Failed negotiations	Percentage failed	Average number of rounds	Percentage high quality
Hier	Self status:					
	- high	56	38	40	3.6	24
	- low	60	41	41	3.2	0
	Partner st.:					
	-higher buyer	61	33	35	3.3	25
	-higher seller	76	39	34	3.1	25
Egal		58	56	49	3.2	2
U.av	Partner is:					
	- different	39	85	69	2.6	0
	- similar	65	46	41	2.9	22
U.tol		48	76	61	2.9	1
Indiv		56	63	53	3.0	0
Coll	Partner:					
	- in-group	81	23	22	3.4	14
	- out-group	35	77	69	3.1	0
Mas		57	55	49	3.0	18
Femi		48	43	47	3.7	10
LTO		71	27	28	3.6	16
STO		40	72	64	3.1	13
	- high status buyer	68	51	43	3.0	13

[1]) see footnote Table 1

As a first comment to Table 2 it should be noted that the results are not tuned to realistic situations. The figures should not be taken as absolute values. They show tendencies that emerge from the model.

The results in Table 2 show that in a hierarchical agent society, negotiations succeed more frequently if there is status difference: the higher ranking force the transaction and take risk (high rate of high quality transactions) or force the lower ranking to do so. Egalitarian agents do not accept the risk of deceit.

In uncertainty avoiding agent societies, negotiations fail frequently if the partner is different, i.e. partners do not have common group membership. Negotiations are broken off after a few rounds, because the uncertainty avoiding agents have an urge to proceed ("time is money"). They have a strong preference for high quality commodities. They are willing to take a calculated risk to that end, but only with familiar partners. The uncertainty tolerant agents are more balanced in their judgement of transaction value and risk.

Individualistic agents also do not accept proposals that have to little value or too much risk. Collectivistic agents fail more frequently if they negotiate with out-group partners. With in-group partners, they take their time to negotiate and accept the risk of deceit.

Masculine agents are impatient, break-off frequently, and go for high quality. Feminine agents try to finish the negotiations and take their time for it. Nevertheless, they do not succeed more frequently, because the step size of their concessions is too small.

Long term oriented agents show patience in their negotiations and frequently succeed, but they do not accept risk. Yet they accept high quality transactions, because they take their time to negotiate a price that covers the risk. The sort term oriented are less patient and break off more frequently, but this effect is reduced when they trade with high status partners. They accept risk if they are trading high quality products.

These result comply with the expected behaviour of the agents and verify the implementation. However, they do not validate that the implemented model generates believable culturally differentiated agent behaviour.

For validation of the model, results of extensive simulations with realistic values of cultural parameters should be compared with empirical results from literature. A host of literature on negotiation in particular countries is available, for instance Adair et al. (2004) compare negotiations in France, Russia, Japan, Hong Kong, Brazil, and the United States; Kumar and Worm (2004) compare negotiations in China and India. The remaining part of this section presents an example of data generated by the model. An agent society of 8 suppliers and 8 customers is given time to trade and negotiate about approximately 100 transactions. All suppliers have equal cultural settings and all customers have equal settings. If agents have equal cultural settings, they are considered in-group. All agents have equal status. Table 3 displays the cultural settings. Culture 1 is modelled after North-American cultures, culture 2 is inspired by China, culture 3 by East-European cultures and culture 4 has similarity with India. Table 4 presents results of the simulations.

Table 3: Example cultures used in simulations.

culture	p_a	u_a	i_a	m_a	l_a
1	0.5	0.5	0.9	0.7	0.3
2	0.7	0.3	0.1	0.7	0.9
3	0.9	0.9	0.3	0.3	0.3
4	0.7	0.5	0.5	0.5	0.7

Table 4: Example results of a simulation run with typical parameter settings from Table 1 and cultures from Table 3.

Variable	Supplier culture	Customer culture 1	2	3	4
Successful transactions					
	1	61	45	37	69
	2	65	90	37	53
	3	49	56	59	63
	4	58	61	39	69
Percentage failed					
	1	49	57	69	43
	2	45	17	70	41
	3	61	47	51	41
	4	41	41	66	32
Performance [1]					
	1		0.00	0.08	0.05
	2	0.06		0.09	0.10
	3	0.02	-0.07		0.02
	4	0.11	0.05	0.07	

1) Performance is computed as average normalized price minus average normalized quality. A high value is an advantage for the suppliers; a low value is advantage for the customers.

The results demonstrate that in the simulation model, the cultural dimension parameters have their influence. They differentiate aggregate performance in monocultural settings as well as intercultural interactions. However, extensive validation is required on the basis of culture and negotiation literature.

DISCUSSION AND CONCLUSIONS

Negotiation can be approached as a rational process of collaborative decision making, as advocated by Raiffa (2002). However, it is observed that negotiation outcomes differ across the world and that people from different countries differ with respect to the way they negotiate and the results they obtain (Gelfand and Brett, 2004). As to all forms of negotiations, this applies to business negotiations and the bargaining about commercial transactions. Kumar and Worm (2004) relate differences in business negotiation processes with differences in economic institutions. According to Hofstede (2001), the efficiency of different organizational structures and institutions depend on culture. So, there is ubiquitous evidence that the result of decision making in business is influenced by the cultural background of the decision makers. As a consequence, realistic business simulation models of international supply chains and networks that take the

interaction between business partners into account, should incorporate culture.

This paper contributes to the understanding of culture's influence on decision making in business by exploring the feasibility of Hofstede's five-dimensional model for simulating believable agents in business. The model has been tested on imaginary cultures that differ on only one of the dimensions. Furthermore, preliminary results of the simulation of more complex, reality-based cultures give evidence that culture in agents can be simulated by applying Hofstede's model, as suggested by de Rosis et al. (2004). Extensive validations remain for future research.

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