

The Influence of Culture on ABMP Negotiation Parameters

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ABSTRACT

Negotiations proceed differently across cultures. For realistic modeling of agents in multicultural negotiations, the agents have to display culturally differentiated behavior. This paper presents an agent-based simulation model that tackles these challenges. The context is a trade network for goods with a hidden quality attribute. The negotiation model is based on the ABMP negotiation architecture and applies a utility function that includes market value, quality preference and risk attitude. Hofstede's model of national cultures is introduced. The five dimensions of Hofstede's model are the basis for the modification of weight factors in the utility function and ABMP parameters. The agents can observe each other's group membership and status. This information is used, along with the indices of the Hofstede dimensions, to differentiate behavior in different cultural situations. The paper presents the model and shows results of test runs. The test runs verify the implementation of the model. The present version helps to explain the behaviors of actors in international trade networks. It proves that Hofstede's dimensions can be used to generate culturally differentiated agents. Formal validation of the model with case studies from literature and correspondence between the model and the trade game on which it is based have yet to be conducted. Extensions can make it a useful tool for training traders who engage in cross-cultural negotiation and for implementation in negotiation support systems.

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1. INTRODUCTION¹

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.. 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. As a result it is stable across centuries in spite of huge changes in environment and technology. Cultural differences show no signs of diminishing in the Information Age.

Within the literature various basic dimensions can be found according to which societies differ from one another. Of these, the most widely used is Hofstede [1], [2]. 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 [3].

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. 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. [4], 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 ABMP (Agent-Based Market Place, [5]) negotiation model that we adopt is presented. We show

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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 fourth section. Section five 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.

2. 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 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 [2]. 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. The most widely used 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 subsections.

2.1 Collectivism versus individualism

This dimension is about affiliation. To a collectivist (e.g., East Asian, most non-Western countries) 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 harmony is crucial.

To an individualist (e.g., North-American) mindset, 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.

2.2 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 (e.g., Russia, Malaysia).

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 (e.g., Anglo and Germanic countries).

2.3 Aggression and gender: masculinity versus femininity

This dimension is about assertive dominance, about muscle power, and about the emotional roles of the two sexes. In what is called a masculine society (e.g., Japan, Anglo countries), 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 tough societies, with strong-handed police and military and with heavy punishment for offenders.

In what is called feminine societies (e.g., Scandinavian countries), both men and women are supposed to be peace-loving and consensus seeking and their social behaviors 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.

2.4 Otherness and Truth: uncertainty avoidance

This dimension is about how to cope with the unknowable. Some societies are termed uncertainty avoiding (e.g., Arab, Latin and Slavic countries). 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 (e.g., China, Vietnam). They are relaxed and curious about strange things and people, and not worried about establishing strict classification schemes for everything. They value exploratory behaviors and novel experiences, and they do not like an emotional communication style.

2.5 Short-term versus long-term gratification of needs

This dimension 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.

Other societies live for the future; these are termed long-term oriented (e.g. China, Japan). 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.

2.6 Five dimensions, one world

So far in this text, 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 behavioral trends. Cultures have 'gestalts' of behavior. Experienced negotiators know the range of behaviors 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 [6], [7], [8], [9], [10], the influence of each of the dimensions on trade processes was modeled separately; a slightly artificial, but also necessary intermediate step to model agents differentiated along the Hofstede dimensions. Reconciling these dimensional models into one believable model that shows the ‘whole negotiator’, although still abstracting from personality, is the aim of this article.

3. 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 [11] called the “negotiation dance” in [12]. Negotiation is a complex emotional decision-making process aiming to reach an agreement to exchange goods or services [13].

3.1 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 [14] and [5]. Other strategies try to learn the opponent’s preferences, see e.g., [15] and [16].

3.2 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 behavior. 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 [17]. 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.

The valuations of quality and risk have a rational component and a subjective valuation that is influenced by a trader’s personality and culture. The rational component of a quality attribute is the difference in market price that a trader expects as a result of the quality difference. The rational component of the risk is the product of the amount of the damage and the probability that the damage occurs. The subjective valuation comes in addition to the rational value. For quality, it is the trader’s quality preference, for instance because of the societal status that results from trading high quality products. For risk, it is an agent’s risk aversion, a cost in excess of *damage*×*probability*, that a trader is willing to make in order to avoid risk.

In the models developed in this work, traders are assumed to compare business proposals by applying a utility function as proposed by Tykhonov et al. [18]:

$$U(b,a,p) = w_{P,ap}P(b,a,p) + w_{Q,ap}Q(b,a) + w_{R,ap}R(b,a,p) \quad (1)$$

$U(b,a,p)$ stands for the utility that agent a expects from bid b made by agent p .

$P(b,a,p)$ reflects a ’s belief about the economic value of the transaction in the interval $[0, 1]$. It is calculated as the profit expected from the transaction in case of cooperation, minus the estimated risk of the transaction. The expected profit is based on a ’s beliefs about the market, taking product quality into account. The estimated risk equals $1-R(b,a,p)$.

$Q(b,a)$ reflects the subjective valuation of the quality attribute of the proposed transaction, in addition to the market value, in the interval $[0, 1]$, e.g. a trader may prefer trading biologically grown food, even if more profit may be made with traditionally grown.

$R(b,a,p)$ reflects a ’s valuation of the risk involved in the interval $[0, 1]$, with 1 representing no risk. It is based on the product of three factors, all normalized values in the interval $[0, 1]$. The first factor is a ’s experience-based estimate of probability that p ’s will defect. The second factor is the opportunity to defect that the contract leaves for p , e.g. a contract for organically grown food offers the opportunity to deliver the cheaper traditionally grown, but a contract for traditionally grown food does not. The third factor is the damage that a expects to suffer in case of defection by p , normalized in the interval $[0, 1]$ with 1 representing maximal damage. R is computed as 1 minus the product of the three factors. It should be noted that the risk evaluation R is also included in the economic value P . The third term of U represents an agent’s risk aversion.

The factors $w_{P,ap}$, $w_{Q,ap}$, and $w_{R,ap}$, with $w_{P,ap}+w_{Q,ap}+w_{R,ap}=1$, reflect the weight that agent a attaches to the terms of the utility function when dealing with p . For a perfectly rational agent, $w_{Q,ap}=w_{R,ap}=0$. The values of $w_{Q,ap}$ and $w_{R,ap}$ 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.

3.3 Agent-Based Market Place (ABMP)

For the agents’ negotiation strategy we chose ABMP of Jonker and Treur [5], because of its proven similarity to human negotiations [19]. 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 agent it is OK if the other makes a concession within 4 rounds, for another, the

opponent should make concessions every round. The following section explains how culture influences these parameters.

4. CULTURE AND BARGAINING

[6], [7], [8], [9], and [10] model the influence of culture on trade processes for each of the five dimensions separately. Negotiation is one of the trade processes. From these papers, the narrative descriptions of the influences on trade negotiations – i.e. the bargaining about transactions – are cited below.

4.1 Individualism versus collectivism

According to [6], to a collectivistic trader, 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 collectivistic culture 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. Depending on their personality and incentives, this might be the material advantage of the deal in question, or the development of new long-term trusting 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 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.

4.2 Power distance

According to [7], 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 joint decision making process like a negotiation is. The most powerful partner 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.

4.3 Masculinity versus femininity

[8] 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, asking for a very good new deal to reaffirm the relationship.

4.4 Uncertainty avoidance

According to [9], the first bid of an uncertainty avoiding trader tends to be modest in the sense that it is a price he thinks is right.

Uncertainty avoiding traders have an emotional style of negotiation, making sure that the opponents understand their feelings. They will not adapt their behavior 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.

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	Typical value					
			weight of quality q_a ³⁾	weight of risk r_a ³⁾	concession factor γ_a	negotiation speed β_a	utility gap v_a	impatience factor π_a
Hier	Self status:		0.2	0.1	0.7	0.2	0.02	0.4
	- high	+						
	- low	-						
	Partner st.:							
Egal	- higher		+	+			+	-
	- lower		-					
U.av	Partner is:							
	- different	+	++		+			+
U.tol	- similar	+	+		+			+
	Indiv							
Coll	Partner: ²⁾							
	- in-group			+				-
Mas	- out-group		+		-			-
	Mas	+	+		+			+
Femi	Femi	-			-			-
	LTO	-						-
STO	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⁾ An out-group partner can become in-group by repetitive confirmation of the relation

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

Uncertainty tolerant traders on the other hand have a relaxed style of negotiation. They try to adapt their behavior to their counterparts, 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 to be more yielding than their counterparts are, not especially modest, and are ready to break off negotiations in case of insufficient progress.

4.5 Long term versus short term orientation

According to [10], 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 behavior, 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.

5. MODELING CULTURE IN ABMP

Based on the narrative description in the previous section, the influence of the cultural dimensions on ABMP parameters can be modeled. The same applies to the weight that subjective terms for quality preference and risk aversion get in an agent's utility evaluation. The descriptions in section 4 are qualitative. They indicate if a parameter may be increased or decreased along each of Hofstede's dimensions. The direction of the influences (increasing versus decreasing) is indicated in Table 1.

Table 1 also presents typical parameter values of ABMP parameters. These typical values have been assessed by a sensitivity analysis of the multi-agent simulations in [6], [7], [8], [9], and [10], varying the cultural dimensions at random and aiming at parameter values such that all cultural dimensions have their influence on the aggregated observables of the simulation.

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.

The weight factors of the utility function and the ABMP parameters are modified to represent the influence of culture as follows.

Equations that have been implemented for the test runs presented in the next section of this paper are given below. The equations implement the influences of Hofstede's dimensions represented in Table 1. A simple principle is applied to combine the influences of the individual dimensions: in both the positive and the negative direction of influence, the cultural dimension index having the

maximal value determines the extent of the parameter modification. For instance, in equation (2) the weight of quality is increased to the extent that an agent's culture is either hierarchical (and the agent has a high status), or uncertainty avoiding, or masculine, or short-term oriented; it is decreased to the extent that the agent's culture is either egalitarian or hierarchical combined with low status, or is feminine, or is long-term oriented.

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 for power distance, uncertainty avoidance, individualism, masculinity, and long term orientation, respectively, scaled to the interval $[0...1]$; s_a and s_p represent a 's and partner's societal status as a real number in $[0...1]$; d_{ap} is group difference, valued 0 or 1.

weight of quality:

$$w'_{Q,ap} = q_a [1 + \max\{\sqrt[3]{(p_a s_a)}, u_a, m_a, 1-l_a\} - \max\{1-\sqrt[3]{(p_a s_a)}, 1-m_a, l_a\}] \quad (2)$$

weight of risk:

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

$w'_{Q,ap}$ and $w'_{R,ap}$ are measured relative to the weight of rational economic value $w'_{P,ap}$, which is always set $w'_{P,ap} = 1$. These three factors are subsequently normalized in order to add up to 1 as weights $w_{P,ap}$, $w_{Q,ap}$, and $w_{R,ap}$ in equation (1).

concession factor:

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

negotiation speed:

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

utility gap size:

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

where x_{ap} is the round number in the current negotiation between a and b .

impatience factor:

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

6. TEST RUNS

Table 2 presents results of simulated negotiations, applying Jonker and Treur's ABMP architecture [5]. The negotiations are performed in the simulation environment for of commercial transactions, applied in [6], [7], [9], and [10]. The agents are assigned roles of either suppliers or customers. Agents may select a partner in the opposite role and negotiate about the sale of a commodity that has either high or basic quality. However, quality is not visible without third-party testing, so the buyer of a high quality product has to accept risk, i.e. trust the seller. In the current simulation, agents are 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. The percentage of high quality transactions reflects the level of risk that the agents are willing to take. 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.

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.:					
Egal	-higher buyer	61	33	35	3.3	25
	-higher seller	76	39	34	3.1	25
U.av	Partner is:					
	- different	39	85	69	2.6	0
U.tol	- similar	65	46	41	2.9	22
		48	76	61	2.9	1
Indiv		56	63	53	3.0	0
	Partner:					
Coll	- 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

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 judgment of transaction value and risk.

Individualistic agents also do not accept proposals that have too 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 short 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 results comply with the expected behavior of the agents and verify the implementation. However, they do not validate that the implemented model generates believable culturally differentiated agent behavior. 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. [20] compare negotiations in France, Russia, Japan, Hong Kong, Brazil, and the United States; Kumar and Worm [21] 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 modeled 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 in table 4 demonstrate that in the simulation model, the cultural dimension parameters have their influence. They differentiate aggregate performance in mono-cultural settings as well as in intercultural interactions. However, extensive validation is required on the basis of culture and negotiation literature and experimental data. This paper does not cover such validation. It is subject of the authors’ current research.

7. DISCUSSION AND CONCLUSIONS

Negotiation can be approached as a rational process of collaborative decision making, as advocated by Raiffa [12]. 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 [22]. As to all forms of negotiations, this applies to business negotiations and the bargaining about commercial transactions. Kumar and Worm [21] relate differences in business negotiation processes with differences in economic institutions. According to Hofstede [1], 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.

Culturally differentiated behavior is not relevant in agent-to-agent negotiations, or other situations where the main purpose of application of intelligent agents is to outperform people by rational decision making, like advocated by Raiffa [12].

Culturally differentiated negotiating agents are useful in a context where human factors play a role. Social simulation is an example of such a context. [18] report a multi-agent simulation that is

intended for use in combination with a gaming simulation, as a data gathering tool in supply chain research. Other application areas may be training and education, and decision support systems for human negotiations.

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 to simulate 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 was originally suggested by de Rosis et al. [4]. However, extensive validations remain for future research. A first source of validation data are the numerous papers reporting differences in negotiations across cultures, e.g. [20], [21]. Gaming simulations like [17] could be used as a tool to collect data for more precise tuning of the model.

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