Soldiers, robots and local population - modeling cross-cultural values in a peacekeeping scenario

Saad Ahmad Khan
Taranjeet Singh Bhatia
Ladislau Bölöni
Dept. of Electrical Engineering & Computer Science.
University Of Central Florida
4000 Central Florida Blvd, Orlando FL 32816
skhan@eecs.ucf.edu, tsbhatia@eecs.ucf.edu, lboloni@eecs.ucf.edu

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ABSTRACT: *We consider a near-future peacekeeping scenario, where a group of soldiers of various ranks and a robot interact with the local population. The goal is to quantify, analyze and predict the public perception of the soldiers and the robot. Instead of integrative statistical approaches, we develop a model which traces individual interactions. Our model assumes that human beings are considering collections of concrete and intangible values which are not, in general, directly and linearly convertible into each other. We argue that satisfactory modeling accuracy can be achieved by restricting the considered intangibles to a small set of* ***culture sanctioned social values****. For these values, the culture provides a name, calculation methods, as well as associated rules of conduct. We validate our model by comparing the predicted values with the judgment of a large group of human observers cognizant of the modeled culture. We use the model to evaluate the tradeoffs between various long term strategies to maintain security as well as to increase the trust and goodwill of the local population.*

1. Introduction

Soldiers on peacekeeping missions need to balance their own security and military objectives with the need to maintain friendly relationships with the local population. Our goal is to create a quantitative, operational model of the ways in which various actions taken by the soldiers and robots, as well as the members of the local population impact their respective cultural values and perceptions of each other. Some of the obvious challenges of this work include:

- The difficulty to assign numerical metrics and calculations to values dependent on social, cultural and personal perception.
- The need to consider the interaction between multiple players, some of them individuals (soldiers, members of the local population, the robot) while others groups of people (e.g. the participants in a crowd).
- The need to consider the evolution of values (such as gaining of trust) over a longer amount of time and series of interactions while simultaneously considering the fact that single, individual interactions can also have a long lasting impact.

Although the literature on cultural interactions is vast, most models are descriptive in nature and do not generate an *operational* model. Even when explicit numerical values are given (such as in Hofstede's models (Hofstede et al., 2010) the values are averaged over the populations and over specific situations.

In contrast, our model aims to provide automated analysis of specific scenarios with individual participants, and it needs to make predictions not about general trends but about the ongoing scenario. The model had been designed to provide input to the decision making system of a robot (which can be autonomous or tele-operated). The system can be also used as part of a training or assessment tool.

2. The Market Checkpoint Scenario

To anchor our modeling work in a plausible real world scenario, we shall use as a running example a situation frequently encountered in peacekeeping missions. The scenario takes place at a military checkpoint at the entrance of a busy market. We assume the location to be a Middle Eastern country (although the scenarios would unfold roughly similarly in other parts of the world - with the necessary adaptations for the cultural specifics). The checkpoint is manned by a sergeant (S), a private (P) and a robot (R). A street vendor (V) takes advantage of the traffic slowdown by positioning its cart near the checkpoint at one of the four locations L1-L4 (see Figure 1) at which are at an increasing distance from the checkpoint. We are concerned with the interactions among these actors over the course of several weeks. Let us now informally describe the various values, considerations and possible actions which are at stake at this scenario through the point-of-view (POV) of the checkpoint team and the street vendor.

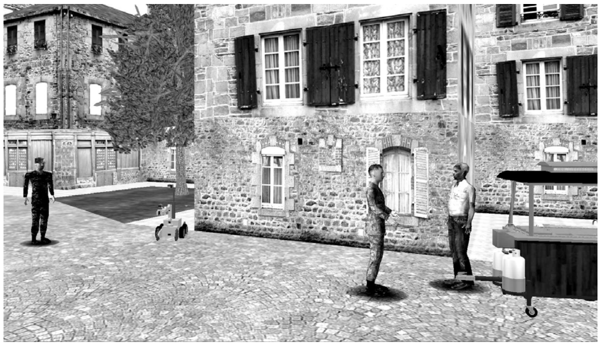

Figure 1. The private P is interacting with vendor V, with the sergeant S and robot R in the background.

The POV of the checkpoint team: the efficiency of the checkpoint and their personal security require maintaining a free and uncluttered area around the checkpoint. On days with a high alert level the perceived security is lower, and due to the more thorough inspections the traffic through the checkpoint slows down. The presence and location of the food vendor affects the security risks. Security threats can come from the street vendor itself, from creating additional crowding near the checkpoint, and from blocking lines of sight (either directly, or through the crowding).

The checkpoint team considers desirable to maintain good relations with the local population (in general), and the food vendor (in particular). Friendly interactions (informal conversations, exchange of gifts) increase friendship and trust. Unfriendly actions (such as ordering around or threatening) negatively impact the relations.

The POV of the street vendor: it is in the financial interest of the vendor to position its cart closely to the checkpoint. He will try to maintain friendly relations with the members of the checkpoint team, and will remember past interactions with the individual soldiers, appropriately reciprocating friendly or unfriendly behavior. Overall, the vendor will use its own cultural norms in assessing the behavior of the soldiers. However, he is aware of factors such as high alarm level (which can mitigate a specific intransigence from the checkpoint team).

3. Modeling Social Values

Our model assumes that the agents explicitly maintain a collection of *values*. These values are *visible* (as opposed to hidden), and the agents can explicitly quantify them if requested. The values are not independent, but are neither, in general, directly and linearly convertible into each other. The actions of the agent and external events change these values through linear addition or subtraction. The vector of these values determine the utility of the agent, through a non-linear utility function.

We group the values into *concrete* values such as financial worth or time as well as *intangibles* such as dignity and politeness. Concrete values have a rigorous definition, come with their native measurement units (e.g. dollars or euros for financial worth, seconds or minutes for time) and they are easily measurable.

Our approach limits the intangible values to *culture sanctioned social values* (CSSVs). We say that a culture *sanctions* a value if it provides for it a *name* and an evaluation *algorithm*. Cultures expect their members to continuously evaluate these values and to obey *rules of conduct* which depend on these values. A person can know more than one culture, and simultaneously evaluate values according to multiple cultures. However, evaluating the CSSVs can be a significant cognitive load, and busy people might not necessarily perform highly detailed evaluations of their ongoing environment. Similarly, there is no guarantee that everybody would obey the rules of conduct associated with CSSVs. Depending on how attentive is *the agent* in the evaluation of the values, and the level of immersion in the culture, an agent might or might not be aware of the transgression.

Different persons, educated in the same culture, would evaluate the values similarly. This has the important implication that in an environment where agents are in the presence of peers and general public, the agents are able to evaluate the CSSVs from the perspective of their peers and the general public. This evaluation can be normally made by evaluating the *epistemic state* of the subjects. An action witnessed by the agent changes the subject's perception of the value only if he *knows* about the action. The rules of conduct associated with a value usually extend to the peer / public values as well.

The algorithms provided by the culture for the calculation of values are obviously not numerical: rather, they rely on certain *keywords* to identify the gradations among the values (e.g. courteous → polite → neutral → rude → offensive). In our work we shall map these values to a scale of 0 to 1.

4. Analysis of the market checkpoint scenario

Let us now analyze and model our scenario using the CSSV model. We shall use the following collection of values:

- **Financial worth (V):** the income of the seller. It is dependent on the location, scaled by the traffic of the given day, and limited by the maximum amount of clients the seller can handle. It is measured in the local currency. It is only relevant to the seller.
- **Perceived security level (S, P, R):** is a metric of the level of threat as perceived by the soldiers. It depends on the alarm level, on the level of traffic, and the crowd created by the vendor.
- **Dignity (S, P, V):** The perception of the personal dignity by the soldiers and the vendor. The two parties apply different evaluation algorithms. The soldiers use a generic Western cultural model adapted to their status as soldiers ("being defied on an open order decreases dignity''). The seller uses its own cultural model - for the actions of this scenario, for instance involves that ("being ordered around decreases dignity", "declining an offered gift is an offense").
- **Politeness (S, P, V)**: The perceived politeness level of the soldiers and the vendor (with appropriate, culture and status specific evaluation algorithms).

4.1. Beliefs and public perception

The impact of an action on a CSSV is not a constant. Rather, it is modulated by the beliefs of the agent about specific aspects of the current context. A culture requires its members to maintain these beliefs as accurate as possible - the correctness of beliefs is necessary for the culture to operate as expected. Nevertheless, it is quite possible for an agent to have incorrect beliefs, especially in inter-cultural exchanges, when the agent might misinterpret the social signals (computers are especially bad at this, see (Vinciarelli, 2009)). As agents will act and calculate CSSVs according to the beliefs, we need to trace the belief values even when they are not correct. If an agent considers another one a friend, it will act accordingly and judge the actions of the other agent in this context, regardless of the fact that if the friendship is mutual or not.

In the agent literature, the beliefs of the agent are frequently considered to be a "model of the world". Creating such a model, for human participants, is clearly impossible. We argue, however, that by carefully choosing a small number of numerical belief values we can adequately model the influence of beliefs on the CSSVs.

Beliefs are higher level conscious judgments, and we posit that they are less subjected to the phenomena *psychological adaptation* than the values. For instance values such as politeness or dignity perception will tend to return to their average values over time spans of days. Beliefs, however, evolve more slowly, and they do not have natural trends towards average values. This does not mean, however, that beliefs are not affected by time spans without other actions - for instance, the perception of friendship might diminish in the presence of long spans of time without actions reconfirming this friendship.

We model the agent's beliefs using the Dempster-Shafer theory of evidence (Shafer, 1976; Yager, 1987) in the following way:

- The agent's current beliefs are fully encoded in the mass function - no previous evidences are remembered.
- The incoming evidence is be weighted by significance.
- For every incoming piece of evidence, the belief is updated using the standard Dempster's rule of combination (conjunctive merge).
- The value for the positive belief is used as the indicator of the belief.

Although, in general, the semantics of the Dempster-Shafer model is controversial, the results obtained with this model represent a good match to our intuitive understanding of the scene -- which, in fact, is what it is exactly what our objective was. We do not want the real probabilities of the events, rather to simulate the algorithms used by humans to maintain their beliefs.

We will use the following beliefs in the modeling of the checkpoint scenario. As with CSSVs, beliefs can be perceived from the self, peer or public perspective.

B^{SPR}_{threat} the soldiers belief that the vendor itself represents a threat (this does not include the belief that the congestion created by the vendor's presence can represent a threat). The perceived threat level starts up at a constant value, dependent on the soldier's training and personal perception. In general, the passing of time and human interactions decrease this belief. This belief affects the soldier's judgement of the security level function of the vendor location.

$B^{V \rightarrow x}_{friend}$ the vendor's belief that the soldier x is a friend. Friendly actions (casual conversation, exchange of gifts, requests delivered with high mitigation level, lenience in accepting reactions to commands) increase the friendship belief. Actions which are considered rude (unmitigated commands, refusal of gifts) decrease the belief of friendship. The belief also decreases (albeit more slowly) in the absence of friendship maintenance actions (e.g. casual conversation).

4.2. Action repertoire

We model the possible scenarios using a series of possible actions. An action is performed either by a single actor (e.g. the vendor V moving from L1 to L3) or is the interaction between an actor and a recipient (the vendor V giving a gift to sergeant S). From the point of view of our model, the actions are fully described by their impact on the values of the actor and (if applicable) the recipient. Our modeling approach here is to define a relatively small number of actions, but to characterize them with parameters which describe, for instance, the destination of a movement or the verbal style in which a request or command is delivered. These actions are listed in Table 1.

	Action	Actors	Targets	Param.
A1	moves	V		Location
A2	declines-to move	V		Loudness, Offensiveness
A3	offers-gift	V	S,P	
A4	initiates conversation	V,S,P	V,S,P	
A5	accepts-conversation	V,S,P		
A6	orders-to-move	S,P,R	V	Loudness, Offensiveness
A7	passes-order	S,P	P, R	
A8	accepts-gift	S,P	V	
A9	declines gift	S,P	V	Offensiveness
A10	pushes	S,P,R	V	Loudness, Offensiveness
A11	overnight	S,P,R,V		

Table 1. Possible actions for the participants in the Market Checkpoint scenario (with specific possibilities for actor and target)

4.3. Case study: the impact model of action A6

One of the most critical and interesting actions is A6, where the one of the members of the checkpoint team (S, P or R) requests the vendor V to move the cart to a farther location (which is against the financial interests of the vendor). The request can be delivered in a number of different manners, which the impact on the values both of the request, and the possible responses (which can be A1 or A2).

We describe the manner in which the request is delivered through a parameter specifying the *mitigation level* of the order - according to the classification recently popularized by Malcolm Gladwell (Gladwell, 2008)[1]. To the six mitigation levels discussed by Gladwell, which culminate in command, we add three more levels which model the threat of a physical action and actual physical actions, respectively.

Note that the values in the table have been calibrated (using a survey) from a Middle Eastern perspective. Certain cultures such as Korean or Japanese, would put a significantly higher penalty on unmitigated speech. On the other hand, Northern European cultures would put no penalty on direct speech (and high levels of mitigation would probably be incomprehensible).

[1] Note however, that similar ideas are present in the literature for a long time - e.g. in Brown and Levinson's politeness model (Brown, 1987)

Name	Example	$P_{S/P}$	D^V
L1: Hint	Seems like the tree at position X would provide you with a better shade	1.0	1.0
L2: Preference	I would prefer you to use the position X today.	0.81	1.0
L3: Query	Shouldn't you be moving to position X?	0.68	1.0
L4: Suggestion	You should push the cart to position X.	0.56	0.91
L5: Obligation statement	You must move the cart to position X.	0.44	0.73
L6: Command	Move to position X!	0.36	0.63
L7: Threat of physical action	Move to position X or else I'll take action!	0.22	0.49
L8: Minor physical action	Pushing the cart manually away	0.11	0.28
L9: Major physical action	Taking the vendor in custody	0	0

Table 2. The impact of action A6 on the politeness of soldiers S or P and the dignity of the vendor using various levels of mitigated speech

These values are only the starting point for the calculation of the impact, which is further qualified by the performing agent, the relationship to the target, as well as the loudness of voice (which affects the knowledge of the bystanders of the interaction). To illustrate the type of expressions we reach, the peer-politeness of the sergeant due to action A6 is:

$$f(s5, a6)\ v = -H(x - 5)\ e^{0.1(x+y)}$$

while the effect on the dignity of the kebab-seller due to action A6 is:

$$f(s3, a6)\ v = -H(x - 4)\ e^{0.1(x+y+z)}$$

where x is the level of mitigated speech, y is the loudness level and z is offensiveness. Here, H() is the Heaviside step function, which is zero for negative and 1.0 for positive values.

A special situation applies when the actor of action A16 is the robot. The robot is not expected to know the subtleties of polite conversation, thus its use of direct command mode carries less offense - and its own politeness is irrelevant and not measured. This fact opens interesting possibilities for action strategies from the point of view of the team.

5. Survey based calibration of the model

Our model relies on the fact that the culture enforces a uniform method to calculate each CSSV. From this, it results that there will not be a significant difference between the peer-CSSV of the external observer and the self-CSSV of the direct participant, as long as they are immersed in the same culture. This means that we can validate (and, if necessary calibrate) the action impact models by performing a *survey* in which persons cognizant with the respective culture will judge the impact on the social values from an external, peer-perspective.

5.1. Representativeness of the survey

One of the important considerations is the representativeness of the survey: are the results of the survey representative of the CSSVs of the target population? It is well known that many academic surveys suffer from the problem of using respondents who are in many ways divergent from the general population and are, in certain ways, "weird" (Henrich et al., 2010).

In the following we will discuss some of the obstacles we perceive in the representativeness of our results.

- The culture of the survey takers (Pakistan) might not be an exact match of the target culture. This is an unavoidable bias - for a perfect localization, one would need to use respondents from the exact geographical location we model.
- There might be a possible misunderstanding between the culture sanctioned values covered by the specific names. Our modeling target was a hypothetical, Arabic speaking Middle-Eastern environment. Our respondents have been primarily Urdu speaking, with a good knowledge of English, and many with at least some level of Arabic. We are confident that the use of English names, together with the Urdu and Arabic translations, have provided a sufficiently clear definitions of the values considered (see Table 3 for some of translations used).
- The distorting factor of social class: the survey subjects have been drawn from significantly higher social strata (students, engineers, doctors) than the average composition of the market we considered. Our conjecture is that people can accurately adapt their peer-CSSV assessment to the social strata and power positions of the actors in a narration.
- The impact of persons cognizant of multiple cultures. Many of the respondents have received some level of Western or Western-style education. It is to be determined whether this impacts their evaluation of the CSSVs – *i.e.* would they judge according to a western cultural model or can they estimate from the local perspective (as instructed). Our conjecture is that people cognizant of multiple cultures are able to evaluate separate CSSVs (within the limit of the cognitive load they can handle). Then, they decide which CSSV dependent rules of conduct apply in the current situation (which might be a combination of rules), then plan their actions in function of (not necessarily in obeisance to) these rules. This behavior model implies that even people who do not follow rules according to these CSSV settings, will still be able to calculate them.

5.2. Survey results

The methodology of the survey was as follows:

- The participants were presented with the scenario in a story-board style, with screenshots and explanation of the ongoing action.
- The participants scored the value of the perceived social value from the point of view of the seller (answering of questions of the type: rate the perceived politeness of the X on a scale of 0 to 10). The storyboard referred to CSSVs in English, with appropriate Urdu and Arabic translations provided (see Table 3).

The participants were 91 persons from various regions in Pakistan. While space limits us from analyzing the full output of the survey here, Figure 2 shows a representative case. The figure shows the histogram of answers for the public and peer politeness values for action A6(6, 5) - order to move using mitigation level 6 (L6) and moderate voice level and A6(1, 5) using maximally mitigated speech (L1). The graph shows that there is a remarkable consistency in the estimated CSSV, but also some level of distribution around mean values.

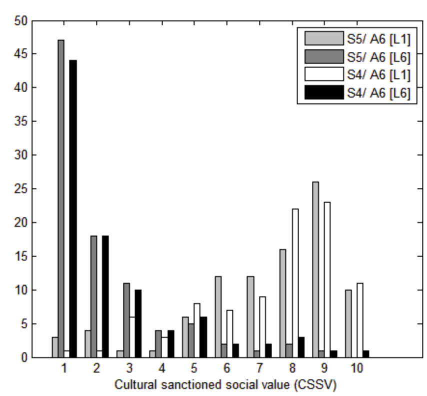

Figure 2. The survey histogram for public politeness [S4] and peer politeness [S5] in view of the vendor when the sergeant performs action [A6] (order to move)

Social Values	Urdu	Arabic
Politeness	مہذب , شائستہ	التهذيب والسلوك
Dignity	وقار, عزت	احترام الذات
Friendship	دوست	صداقة
Security	محفوظ	أمن

Table 3. Names of CSSVs in English, Urdu and Arabic colloquial terminologies

The validation of the effect of actions on CSSVs have been done as follows. We have fitted normal distribution curves to the histograms of the values. Figure 3 shows these curves and vertical lines corresponding to the values which had been predicted by our model. While the match is not perfect, there is a very good correlation between the center of weight of the curve and the predicted values, which validates the predictive power of our model.

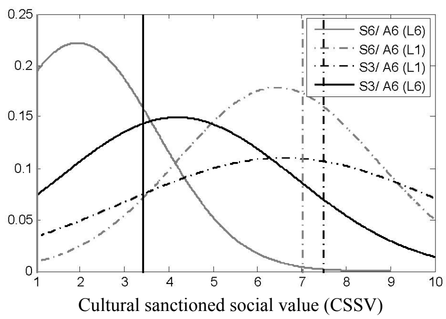

Figure 3. Normal distribution for dignity (S3) and friendship (S8) due to actions of order-to-move (A6) with mitigated level of speech L1 and L6

6. Experimental Study

In the following scenario, we describe the results of a simulation study, which traces the CSSV of the Market Checkpoint scenario in a 3D virtual world simulation. The CSSV action and belief models have been implemented using the YAES simulation environment (Bölöni, 2005). The participants have been placed in a 3D virtual environment based on OpenWonderland and collection of third part tools. As the objective had been to trace the CSSV of specific strategies, all the participants have been controlled by human players or scripted.

The modeled scenario represents instances of the Market Checkpoint scenario and its associated actions over the course of 14 days. The scenario also models the existence of external factors beyond the control of the soldiers and population: we assume that a medium (orange) alert happens on Day 8 and high (red) alert on Day 12. In the model we also include action A11 (overnight), that would shift the peer politeness and dignity back to the normal value. We assume that over the weekend, action A11 happens which justifies the rational that a person's dignity is less affected as an accumulative results of bygone days. But the belief is still affected and it maintains the value over the course of interaction.

In the following we will the evolution of CSSVs for five possible strategies of the soldiers at the checkpoint.

1. *Strict rule following*. In this scenario, the soldiers consistently use unmitigated command language (L6) and do not react positively to social interaction openings by the vendor. As Figure 4 shows, this lack of human interaction is perceived as rude by the vendor and is propagated to the beliefs of the general population. The positive side of this scenario is that the perceived security level remains high. However, the perceived politeness is low, the vendor is offended in his dignity, and the public belief is that the soldier and the vendor are not friends. The vendor is incurring some level of financial losses as it will regularly need to occupy unfavorable locations.

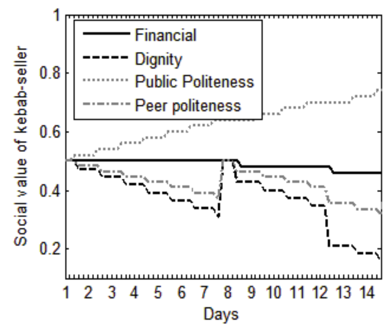

Figure 4: Strict rule following strategy.

2. *Consistent friendliness strategy*. In this scenario the soldiers consistently make choices to maximize their perceived friendliness. They achieve this by consistently using highly mitigated speech (L1-L2) when performing action A6, and responding positively to openings of social interactions. As at this mitigation level, the seller can often ignore the command, the scenario is financially advantageous to the seller. It leads, however to a low level of perceived security. Figure 5 shows that the rude behavior of vendor affect the dignity of the seller, and creates the perception of that the vendor is impolite. Naturally, that such a strategy is not a realistic option for a checkpoint due to low level of perceived security, and it is considered here only as a reference.

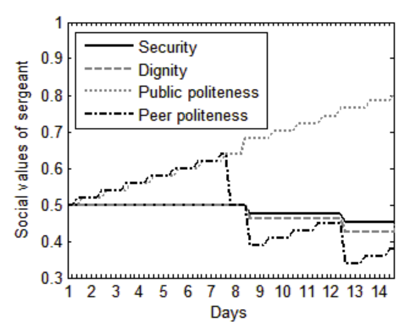

Figure 5: Consistent friendliness strategy

3. *Radical adaptation to alarm level.* In this scenario the members of the checkpoint team use consistent friendly behavior on days without alerts, with strict rule following behavior on days with orange and red

alerts (Day 8 and Day 12, respectively). The objective is to acquire a perception of polite and friendly behavior, while achieving a high perceived security on high alarm days. The simulation (some output values presented in Figure 6) shows, however, that the strategy is problematic. The overall politeness perception is lower than expected from the fact that the soldiers are following a friendship maximizing strategy on most days. The reason for this is that the cost of actions depends on the beliefs: commanding behavior from persons considered to be friends is more damaging to dignity than commanding behavior from a stranger.

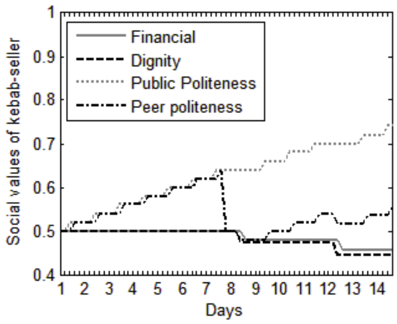

Figure 6: Radical adaptation to alarm level strategy.

4. *Adaptation by escalation*. In this strategy, the soldiers are trying to minimize cost of alarm level adaptation by starting with a high mitigation level on alarm days as well, but escalating the commands until the seller complies with the request.

Figure 7 shows the result of the scenario. We notice that the politeness loss is lower, however the necessity to escalate requests over time reduces the perceived security level.

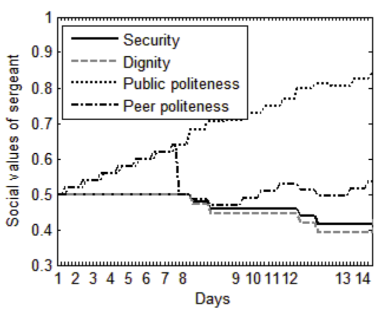

Figure 7: Adaptation by escalation strategy.

5. *Delegation of unpleasant tasks.* In this case the soldiers are following a strategy which tries to shift the socialization versus stability behavior by involving the robot in the interaction with the vendor. In most no-alarm days the soldiers will act socially and be, in general, permissive. In some days however, they will delegate the task to request the vendor to move to a farther position to the robot. The robot will deliver messages using non-mitigated speech (L6 and L7), and will (naturally) not participate in social interaction. In high alarm days, the soldiers will use the robot. The simulation of this model is shown in Figure 8. The results are in general positive (high level of perceived politeness, and high security).

Note, however, that the realism of this simulation is dependent on how accurate we are in inferring the transfer of perception of the robot to the soldiers. This depends on the perception of the autonomy of the robot – if the perception is that the robot is remotely operated by the soldiers, its social action impacts are directly transferred to them.

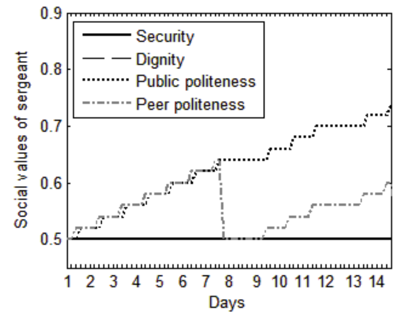

Figure 8: Delegation to the robot.

7. Related Work

There is an extensive body of work which analyzes population sentiment in reaction to the presence of foreign military forces. Many of these body of work assumes general, high level policies, involving overall directives, and had been done in the context of policy decisions, sociology and integrative simulations. Our work involves a direction which had been much less thoroughly investigated, which involves the action of individual soldiers, over the course of several weeks.

Famously, general Petreaus said that the american soldiers have to "drink a lot of tea" with local Afghan leaders, to establish normal relations. In recent years, a number of approaches, similar in spirit to ours, are working towards modeling individual interactions. In contrast to this approach which formalizes neurological theories of emotion, Miller et al. (Miller, 2008) propose to operationalize the Brown and Levinson politeness model (Brown, 1987). The implementation, the Etiquette Engine, is used to assess the politeness of a number of custom crafted social-interaction vignettes involving common culture but different rank (the interaction between a corporal and a mayor). The values were compared against the evaluation by human observers (unfamiliar with the Brown and Levinson model).

The discrete event social simulator DESS (Alt & Lieberman, 2010) provides a generic overview to social simulation with idea of embedding multi-agent system within a DES framework. The same authors explore the implications of applying TPB (Theory of Planned Behavior) and show the importance of using representative survey data for such action choice models (Alt & Lieberman, 2010). The authors of HCA (Holon cognitive architecture) model the culture as an epidemiology of representations and discuss the modeling of cultural frame shifting using the example of Swedish model (Young & Patterson, 2011). The authors in (Miller et al., 2007) propose an approach to produce culture specific, politeness-appropriate utterances and perceptions of utterances in a game setting, in aspect of culture specific language interpretation based etiquette generation

8. Conclusions

In this paper we described a method to model the impact of the actions of soldiers and robots through the model of culture sanctioned social values. Through a number of simulations involving a realistic near-future peacekeeping scenario, we had shown that is possible to develop a model which gives realistic predictions over a wide range of scenarios, and we have shown how the components of the model can be calibrated using surveys. One of the interesting findings of the research had been the importance that robots with real or partial / perceived autonomy can play in social interactions, a topic which is the focus of our future work.

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Author biographies

SAAD AHMAD KHAN is a Ph.D student at the Dept of Electrical Engineering and Computer Science of University of Central Florida.

TARANJEET SINGH BHATIA is a Ph.D student at the Dept of Electrical Engineering and Computer Science of University of Central Florida.

LADISLAU BÖLÖNI is an Associate Professor at the Dept of Electrical Engineering and Computer Science of University of Central Florida.