Culture and Social Relationship as factors of affecting communicative non-verbal behaviors

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Abstract: The goal of this paper is to link a bridge between social relationship and cultural variation to predict conversants' non-verbal behaviors. This idea serves as a basis of establishing a parameter based socio-cultural model which determines non-verbal expressive parameters that specify the shapes of agent's nonverbal behaviors in HAI. As a first step, comparative multimodal corpus analysis is done for two cultures in two specific social situations. Next by integrating the Hofstede theory of culture and our empirical data from corpus analysis, we found that non-verbal expressive parameters determined by our model successfully demonstrate that both cultural background and social relationship moderate communicative non-verbal behaviors.

1. Introduction

Nowadays, there is a demand of building Embodied agents which can interact with human in more natural form in face to face communication. So, several studies are going on to find factors which influence human behaviors. As understanding human behaviors will enculturate behaviors in Embodied Agent which will enhance building more agent's behaviors in more of natural form.

Research [2] has just begun to consider cultural variation as a reasonable predictor of differences in cognitive or behavioral styles but the term culture is still not clear. Hofstede defines culture using five numerical dimensions ranging from 0 to 100. According to Hofstede [6], nonverbal behavior is strongly affected by cultural affordances. Our current study reveals that, both culture and social relationship shape ones behaviors. We live in a social world, which necessitates interacting with a wide variety of people on a regular basis. There are different social relationships and we behave accordingly. The concept of social relation refers to a multitude of different kinds of social interactions. For example, interaction between a teacher and a student is different from that of two friends. In this study, we try to map a linkage between culture and social relation in determining non-verbal behaviors.

In order to correlate culture and social relationship to behaviors, we need to find enough empirical data of different cultures and various social statuses.

Unfortunately, the information found in literature is not specific enough or does not provide enough statistical evidence .So as the first step, we did a comparative corpus analysis of two different cultures; German and Japanese and studied human behaviors in two different specific social situations; interacting with someone for the first time and interacting with someone of higher status. Next, taking Hofstede dimensions as a baseline, we tried to link human behaviors with culture and social relationship. The reason of choosing Hofstede's theory in defining cultures is Hofstede defines each culture using five dimensions each of which has quantitative nature [6].

So in this paper, we extract empirical data which will provide evidence to map a linkage between culture and social relationship to non-verbal behaviors, and describe how this quantitative data is used to model and predict human behaviors.

The structure of the paper is described as follows. First in section 2, we discuss related work and in section 3 and section 4 we talk about our analyzed data from corpus study. Then, section 5 explains how to design a socio-cultural model linking between culture and social relationship to moderate behaviors. Finally section six we draw our conclusion and present some future work.

2. Related Work

Culture has been neglected so far although it is a crucial aspect of human societies. If we take evidence from

literature study, we see culture and human social interaction are the reason behind differences of behaviors in human. According to Sanchez-Burks [3] cultural differences moderate how individuals experience and perform in workplace interaction. They studied how culture-based differences in relational attunement differentially affect U.S. Anglos and U.S. Latinos perceiving workplace interactions. They focused on behavioral mirroring and found out strong effect of behavioral mirroring on Latinos than Anglo. So they concluded that, not demographic variables but ethnicity and culture are factors and predictors of differences in cognitive styles.

Isbister [10] pointed out the importance of non-verbal communicative behaviors which is largely culture-specific. She reviewed a number of features of nonverbal communication such as eye gaze and gestures. Arabs treat sustained eye contact as a sign of engagement and sincerity where as Japanese interpret sparse use of direct eye contact as a sign of politeness. Another example is a simple head nod which is interpreted as a sign of agreement in Germany, but indicates only attention in Japan.

Samuel et al. [4] emphasized on the cultural aspects, while building embodied agents. Taking Hofstede dimensions of culture as a baseline, they also modeled culture in agent's architecture with the hope of building natural form of interaction with agents. They looked into the factor-goal utility which means what an agent should do at any given movement and emotional appraisal which means simulate emotional response to events. In their study, they found the importance of culture in order to enhance social dynamics of agents.

Hofstede [6] administered standard questionnaire to some 116000 people working for IBM in a variety of profession in over 50 countries in 1968 and again 1972.On the basis of these data, Hofstede defined several dimension of culture. His study clearly indicated that people from different cultures bring different attitudes to their work.

We collected a corpus of two cultural groups [2], German and Japanese and studied their non-verbal behaviors in different social situations and extracted empirical data to build a model where culture and social relationship influence human behaviors.

3. Analysis of non-verbal behaviors

based on Culture

In our study, we did a multimodal corpus analysis of two countries Germany and Japan by focusing on non-verbal behavioral movements; posture in dyadic conversations. To define parameters that characterize postures, we reviewed previous studies. To describe cultural differences in gestures, Efron [15] proposed parameters such as spatio-temporal aspects, interlocution aspects, and co-verbal aspects. Using a factor analysis, Gallahar [16] revealed four dimensions; expressiveness, expansiveness, coordination, and animation. Based on these previous studies, Hartmann et al. [17] defined gestural expressivity using six parameters such as repetition, activation, spatial extent, speed, strength, and fluidity. So, based on our literature study, we came up with five parameters which define the characteristics of postures. The five parameters are frequency, duration, spatial extent, rigidness and mirroring.

In this section, we analyzed statistical information to prove how cultures affect all the five parameters of posture.

3.1 Study Design

We took two cultural group; 10 Japanese corpus data and 8 German corpus data of CUBE-G Project [2], where two people met for the first time. We annotated non-verbal behaviors; posture using Bull's coding scheme [18] and looked into frequency, duration, spatial extent, rigidness and mirroring behavior.

3.2 Results

Frequency and Duration: Frequency and duration is assigned by referring the results of our previous empirical study [13]. We looked at, how cultural variation affects frequency and duration of each posture shift.

Table 1: Frequency and Duration of posture shift

Nonverbal Parameter	Culture	Head	Arm	Leg
Frequency	Japanese	4.4	4.6	3.2
	German	7.34	8.075	1.65
Duration	Japanese	2.54	12	15.39
	German	2.18	7.79	20

Table 1 shows that, German make more frequent arm and head posture shifts than Japanese but Japanese change their leg postures more often. And then Japanese people

like to stay one posture longer than German people. However, German stay in the same leg posture for longer duration than Japanese.

Spatial Extent and Rigidness: Shape of posture tells us if it is big or small, relax or rigid. Since, we found the cultural difference in arm posture shape only, not in leg and head posture shape, so for spatial extent and rigidity we only looked at arm postures. Posture types frequently observed in Japanese culture are JHs(join hands), PHFe(put hand on face) and PHB (put hand back), and in German culture the frequently observed posture shapers are PHIPt (Put hands in pocket), FAs (Folded arms) and PHEw (Put hands on elbow). Next, we estimated the scores of each culture-specific posture shapes by tallying with the rating scale of spatial extent and rigidness shown in Figure 1 and 2. Figure 1 plot some frequently observed postures with respect to their ratings of Spatial Extent and figure 2 is frequently observed postures with respect to their ratings of rigidity [1].
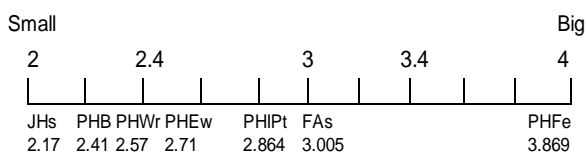

Figure 1: Spatial Extent ratings

After comparing each posture shape with rating scales, we found that, German do more relaxed postures than Japanese, and Japanese do smaller postures than German.
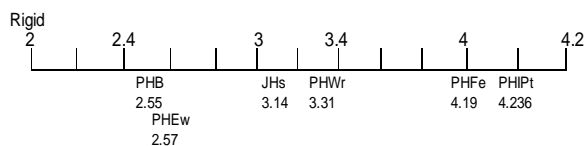

Figure 2: Rigidity ratings

Mirroring: Mirroring is an interpersonal phenomenon in which people unknowingly adjust the timing and content of their behavioral movements such that they mirror the behavioral cues exhibited by their social interaction partner [3].

To check this impression, we took both speaker and listener data of CUBE-G project [2] and annotated posture shifts of both speaker and listener and start and end of each turn. By a turn, we mean a period of speech by one speaker without verbal contribution from the other. Then, we counted the total number of common posture shapes of arm and leg in each turn.

The average number of mirroring for Japanese arm and leg postures is 5.5 and 1.11 consecutively and for German arm posture is 0.857 while no mirroring occurred in leg posture shift. These results suggest that, Japanese are more likely to synchronize with the conversation partner than German people. High levels of mirroring by an interaction partner are perceived as a reassuring signal that the encounter is proceeding well [7].

Japanese like to be in a group and more collective in nature. Literature study tells us, that members of cultural group who are collectivistic tend to experience more behavioral mirroring than the members of cultural group who are individualistic [3]. So we got significant results that collectivistic culture (Japanese) has higher mirroring value than individualistic culture (German).

3.3 Discussions

To sum up, the results above suggest that, non-verbal parameters are affected due to cultural variation. The result is more distinctly shown by using the graph shown in Figure 3. Since we found that the cultural difference in posture shifts is very clear in arm postures [11], we focus on taking arm postures values for each behavioral parameter.
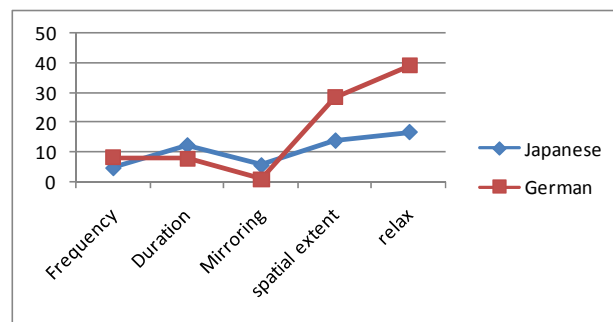

Figure 3: Behavioral parameter affected due to culture

4. Analysis of non-verbal behaviors based on Social Relationship

Literature study says that posture is an indicator of the degree of involvement, the degree of status relative to the other participants, or the degree of liking for the other interactants [11]. For example, in Japan rigid postures indicate an influential person. Thus, posture is used to determine relationship between people. Depending on

their social relations, people will orient themselves differently when joining others in public places [14].

In this section, we set up a study to find out if social relationships shape up non-verbal behaviors.

4.1 Design of the Study

For this study also, we took CUBE-G [2] corpus data of two social situations 1) Interaction with someone for the first time 2) Interaction with a high-credential person. Total 10 pairs of Japanese video data of first time meeting scenario where two people met first time and 9 pairs of Japanese video data where dyadic conversation with a credential person were taken. We wanted to see if social relationships affect other culture, too. So, we took 8 pairs of German video data interacting in two different social situations. We followed the same annotation scheme [18] as our first analysis explained in section 3 and looked into behavioral parameters; frequency, duration, spatial extent, rigidness and mirroring of each posture.

4.2 Results

Frequency

Table2: Result of frequency in different Social Situation

Culture	Social Relationship	Head	Arm	Leg
Japanese	First time Meeting	4.4	4.6	3.31
	Higher Status	2.46	1.32	0.34
German	First time Meeting	7.31	8.075	1.9
	Higher Status	3.325	2.375	0.75

Table 2 shows the frequency of head, arm, and leg postures per conversation. The results suggest that, in both cultures, the frequency of posture shifts decreases in interaction with high status person compared to that with someone for the first time.

Duration

Table 3: Result of duration in different Social Situation

Culture	Social Relationship	Head	Arm	Leg
Japanese	First time Meeting	2.54	12.26	15.39
	Higher Status	2.4	43.52	66.13
German	First time Meeting	2.18	7.79	20.09
	Higher Status	1.73	20.43	36.17

Next, Table 3 shows duration of both cultures. We see both groups remain in the same posture for longer duration when interacting with high credential person than with someone for the first time. So Japanese and German are submissive as they tended to maintain the same postures [9] for extended lengths of time.

Rigidness and Spatial Extent: Looking at posture shapes, we see Japanese do JHs, PHB, PHFe and German do JHs, PHIPt, FAs. Comparing with spatial extent rating scale given in Figure 1 and rigidity rating scale given in Figure 2, we see both Japanese and German make smaller postures and the postures become more rigid when interacting with high credential person than meeting someone for the first time. According to literature study, rigid posture indicate influential person [11] and Japanese influential people maintain postural rigidity [10].

Mirroring: The average number of mirroring for Japanese is 6.2 and for German is 0.57 per conversation when interacting with someone for the first time. However, no mirroring in both culture when interacting with high credential person since person of higher status remained in rigid leg posture throughout dyadic conversation.

4.3 Discussion

Table 4: Parameters affected by Social Relationship

Culture	Social Relationship	Frequency	Duration	Mirroring	Spatial extent	Relax
Japanese	First time	4.6	12.26	5.5	13.84	16.71
	Higher status	1.32	43.52	0	3.81	5.075
	Ratio	3.48	0.28	0	3.63	3.29
German	First time	8.075	7.79	0.875	28.3	38.93
	Higher status	2.375	20.43	0	6.9	10.09
	Ratio	3.4	0.38	0	4.1	3.85

We summarized the affect of social relationships to non-verbal behavioral parameters in Table 4. We took the results of arm postures because the results are clearer and more significant. Table 4 shows that, in both culture German and Japanese, frequency is decreased, duration is longer, no mirroring occurs, posture made is smaller and more rigid when interaction is going on with high credential person than with someone for the first time. Then, we calculated ratio (ratio=first time/higher status)

and found that, social relationships uniformly affect behavioral parameters in both cultures. Thus, our results prove that social relationships also shape ones non-verbal behavioral parameters. As a consequence, it seems inevitable to take social aspects in to account.

With the results of our corpus analysis, the next section describes in detail how these statistical information will be employed to model culture-specific nonverbal behaviors for embodied conversational agents.

5. Linking a bridge between social and cultural factors with nonverbal behaviors

Analyzing corpus data explained in section 3 and section 4, results suggest that both cultural variation and social relationships moderate cognitive styles. We need to modify our socio-cultural model proposed in our previous paper [1]. Previously we mentioned that, Hofstede explains culture using five parameters and these parameters predicts non-verbal behaviors, but our recent study with promising results proves that, there is another factor called social relationship also affects non-verbal behaviors. This information is utilized to set up a Bayesian network in order to model the causal relation between culture's position on Hofstede's dimensions and social relationships in correlating with non-verbal behaviors.

In order to build a Bayesian network for predicting socio-cultural aspects in posture expressiveness, the GeNIe [5] modeling environment was used. Figure 4 depicts a version of such a network.

The Top Layer consist of two nodes culture and Social relationship where names of culture such as Japanese and German are the input and two social situations such as meeting someone for the first time and higher status are inputs for social relationship nodes.

The middle layer defines Hofstede's[6] five dimensions; hierarchy, identity, gender, uncertainty, and orientation. The value of each dimension is affected by both culture and social relationship node.

The lowest layer consists of behavioral parameters. We draw a connection between the Hofstede dimensions and the nonverbal behavioral parameters [1]. We will not go into details here but give an example on possible correlations between dimensions and behavioral parameters. We linked identity dimension (individualism

vs. collectivism) with mirroring because previous study reveals that, members of cultural group who are collectivistic tend to experience more behavioral mirroring than the members of cultural group who are individualistic [3].

Finally, our Socio-cultural model generates culturally adequate behaviors based on the information provided. For instance, as shown in Figure 4, when *Japanese* is chosen as an evidence for Culture and *First time Meeting* as an evidence for Social Relationship, the results of estimations are; spatial extent is small (51%), rigidness is extreme (51%), mirroring is most (54%), frequency is low (59%), duration is long (56%).

Then keeping *Japanese* is as an evidence for culture and selecting *Higher Status* as an evidence for Social Relationship, the estimation results are; spatial extent is smaller (53%), rigidness is extreme (52%), mirroring is least (52%), frequency is lower (62%), and duration is longer (59%). The same way, our model predicts non-verbal behavioral parameters for German culture as well.
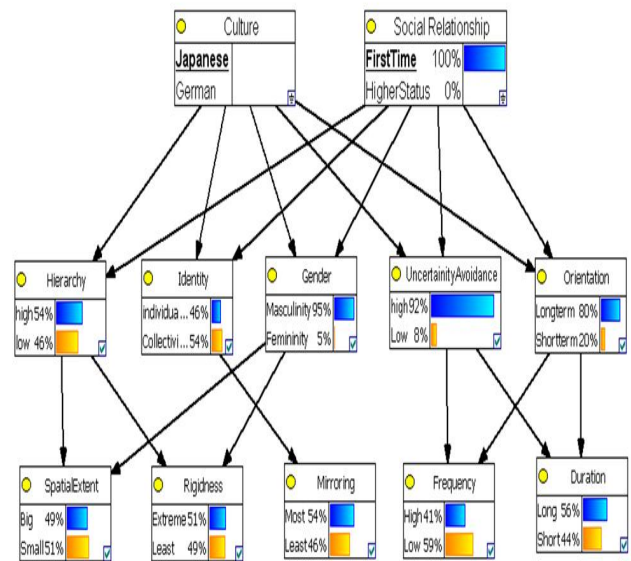

Figure 4: Network model of relations between cultural and social factors with non-verbal behaviors

6. Conclusion and Future work

This research sheds light on how non-verbal behaviors are moderated by culture and social relationship. Cultural variation and social relationship were so far neglected factors but our study has found satisfactory evidences that these two factors are reasonable predictors of

cognitive or behavior styles. In our study, we took two cultures and extracted statistical information about non-verbal behaviors in two different social situations and used this information to set up a network which links culture's position on Hofstede's dimensions and Social Relationship with non-verbal behaviors.

As a future direction, we will employ this model in our distance-learning system on the web where two users from different countries log on the service, and teach their own language to the partner, and learn a foreign language from her or his partner. So in this application, the system not only helps the user learn a language, but also makes the learner familiar with the culture-specific nonverbal behaviors.

Thus, this research is a pre-requisitioned step in order to develop a virtual learning scenario that allows users to experience culturally determined differences in communicative behaviors, and our proposed model will predict non-verbal behavioral parameters for various cultures in different social situations.

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