Affective Conversational Models: Interpersonal Stance in a Police Interview Context

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***Abstract*—Building an affective conversational model for a virtual character that can play the role of suspect in a police interview training game comes with challenges. This paper focuses on the response modeling of interpersonal stance of a believable artificial conversational partner. Based on Leary's interpersonal stance theory a computational of model interpersonal stance is created. Other psychological theories and ideas that are proposed to be integrated into the computational stance model are: face and politeness, rapport, and status or role. Proposed evaluation methods for the model use comparison of human behavior with model predicted behavior.**

We have the right to remain silent, yet we do not.

I. Introduction

Interactive virtual agents can provide a means of learning social skills through experience. Autonomous virtual characters can be applied in training tasks that currently require labor-intensive and costly live exercises or role playing. In training for police interviews, actors are used to allow practice for police students. Cost and time constraints prevent some students to experience interviewing in the training. A realistic artificial conversational agent system might help train some skills by playing the suspect in a police interview training game. In this paper we discuss our work on building such a conversational agent. We focus on the modeling of interpersonal stance - which is a major concern in such applications.

The (Dutch) police use Leary's theory of interpersonal stance to train their students in police interviews. Interpersonal stance theory describes interpersonal behavior and the typical patterns that exist in face-to-face interactions between people [9]. These behavior patterns (or interpersonal reflexes as Leary calls them) can be applied strategically by the police in an interview. For example, by taking a cooperative stance a police officer can get a suspect to also take a cooperative stance [18]. The skill to apply this theory might be learned from and practiced with an artificial conversational agent. The creation of such an agent comes with several challenges. The system needs to recognize the stance of the student, reason about this and respond appropriately. The reasoning about the input and calculation of the system's output stance is done in a response model. This paper focuses on the response model for stance. Another question is: what is important for an interpersonal stance model in the context of police interviews.

A lot of research is being done on using virtual worlds and virtual characters for training, but this paper is unique in its focus on interpersonal stance in police interviews. Other work focused on creating a training tool for making critical decisions. The mission rehearsal exercise (MRE) [7] is a training system in use by the military and uses virtual characters in a virtual world to allow trainees to practice high stress interactions and situations only available through simulation. Another example is teaching negotiation skills using artificial conversational agents [15] in a system similar to MRE. These training programs are set in a military context, so their scenarios are not suitable for civilian or police trainees. Additionally, they do not use interpersonal stance theory, which is explicitly used in police training. Work that does use interaction stance theory is the Delearyous project [17]. They developed an interactive conversational agent system for practicing professional conversational skills based on Leary's interaction stance. However, the Delearyous training system is set in a civilian (office) context and not in police training, which makes that their recognition might not be sensitive to the specific dynamics of police interviews. Further, they focused only on stance recognition and not on stance computation and expression. The current work is unique in its focus on interpersonal stance in police interviews and the focus on the computation of stance.

In affective computing, we try to build computational models based on psychological theories, models, and ideas. Psychological theories are often rather unspecific and leave room for interpretation. Humans are able to deal with this under-specification, but computers are not. The underlying assumptions in psychological theories have to be interpreted and made explicit to be able to implement a psychological theory as a computational model. We built a computational model based on Leary's interpersonal stance theory and describe this work in section II. Next, we investigate if there are other social or interactional theories that are useful to incorporate into a training system that teaches Leary's interactional stance theory. We discuss face and politeness, rapport, and status or role and how they might be related to interactional stance in section III. The work in section III is in development and will have to be evaluated: planned evaluation is described in section IV.

II. LearIS

We are developing a toolbox for Learning Interaction Stances (LearIS) in a police context. We started by developing a computational model based on Leary's interpersonal stance

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theory; we discuss this first. The implementation of this computational model is discussed next.

Leary's theory of interpersonal stance

Leary's rose is a model for human interactional behavior where this interpersonal behavior is represented in categories of interpersonal stance on the dimensions of affect (x-axis) and power (y-axis) [9], see Fig. 1A. This theory is known under different names such as the Interpersonal Checklist [8] and the interpersonal circumplex [13], but the differences are often superficial. The model is often pictured as an ordering of the stances on circle, situated on the two axes. This regular ordering of categories on a circle is called a circumplex. The circumplex is divided in eight areas: these are the interpersonal stances. The circumplex shows that stances that are close together are more related than those that are further apart on the circle, with opposites being negatively related (Fig. 1A). Leary suggests that human stances are modulated by the interaction with the conversational partner. This means that two conversational partners are influencing each other with their stance during a dialog. Leary calls these interactions 'interpersonal reflexes'. Acts on the dominance dimension are complementary and acts on the affect dimension are symmetric. This means that a dominant act (e.g. power display) will elicit submissive acts, whereas an act with positive affect (e.g. cooperative) elicits another positive affect act (see Fig. 1B). For example, if I act dependent to you (submissive and positive), you will feel a tendency to adopt a leading stance (dominant and positive). This theory is taught at the Dutch Police Academy. The police attempt to apply the interpersonal reflexes in police interviewing. Suspects are often uncooperative (on the hostile side of the rose) and the police employ positive stances (e.g. helping or leading) hoping the suspect moves to a more positive stance (e.g. cooperative or depend).

However, Orford [11] pointed out that some empirical evidence shows a slightly more complicated picture. He showed in a meta study that there is empirical evidence that friendly-dominant and friendly-submissive behavior are complementary, but that hostile-dominant behavior leads to more hostile-dominant behavior, and hostile-submissive behavior often leads to dominant-friendly behavior (see Fig. 1C). For example, if you act aggressive to me, I will react aggressive. Currently, the Dutch police does not use this "version" of interpersonal reflexes, but in the future they might. Therefore, in implementing a computational model of Leary's theory it is important to keep in mind that the underlying theory should be easily adaptable.

LearIS system and computational stance model

We implemented Leary's interpersonal stance theory as a computational model for interpersonal stance in a conversational agent: LearIS.This agent is an affective conversational turn-taking agent. LearIS always knows the current conversational situation such as who is speaking and when they are expected to take a turn. LearIS also tracks the interaction stance of the other and updates its own stance according to the response model for stance. With this, LearIS is capable of deciding when to speak, interrupt, or stay silent and how to react when a silence or an overlap of speech occurs. The agent can simulate real-time speaker interrupts based on the interaction stance of the listener.

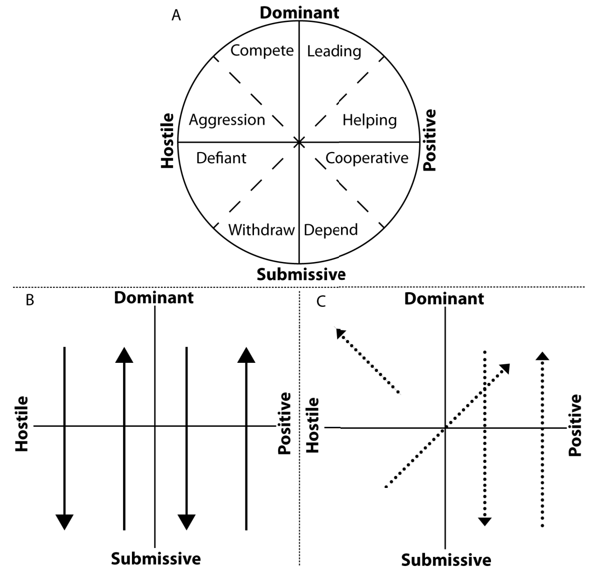

Fig. 1. A: Leary's rose is defined by two axes: a dominance axis (vertical), describing the speaker's dominance or submissiveness towards the listener; and an affect axis (horizontal), describing the speaker's willingness to co-operate with the listener. The rose can be divided into eight areas that each correspond to a stance. B: The solid arrows give the behavior inviting relation between the quadrants according to Leary's theory [9]. C: The dotted arrows give response tendencies as found by Orford [11].

This paper discusses the response model for interaction stance and not LearIS as a whole. However, a short description of the whole LearIS system is in order for perspective. The architecture and the flow of data to, from, and in the system can be seen Figure 2. A message bus connects the agent to the 'outside world', which is its embodiment (e.g. an avatar and text-to-speech engine) and the modules that sense its conversational partner (e.g. speech recognizer, stance interpreter, or a Wizard of Oz). This means that the agent can communicate with anyone (users via GUIs) or anything (other artificial characters or different visualizations), as long as they send/receive the same messages (messages the system 'knows and understands'). The incoming messages are handled by the Input Handler, which sends them to the turn-taking manager (TTM) and the stance manager (SM). The TTM keeps track of the conversational state, such as who is speaking. The SM tracks the stance the conversational partner takes and from this computes the stance the agent takes. The response model for interaction stance is located in the SM. Every turn, the decision maker (DM) makes a decision on the appropriate turn-taking strategy based on the stance from the SM and the current state of the conversation from the TTM. When the decision to talk is made (e.g. interrupt), this and the current stance are used to

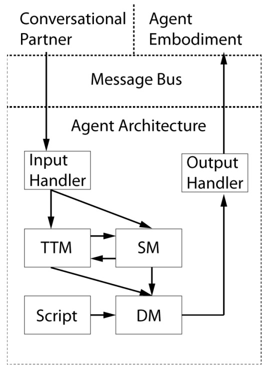

Fig. 2. Global architecture for the LearIs conversational agent. TTM = Turn Taking Manager, SM = Stance Manager, DM = Decision Maker.

A

Current Self \ Other	Leading	Helping	...	...	Compete
Leading	Depend	Coop.	...	...	Withdrawn
Helping	Depend	Coop.	...	...	Withdrawn
...	...	...	...	...	...
...	...	...	...	...	...
Compete	Depend	Coop.	...	...	Withdrawn

B

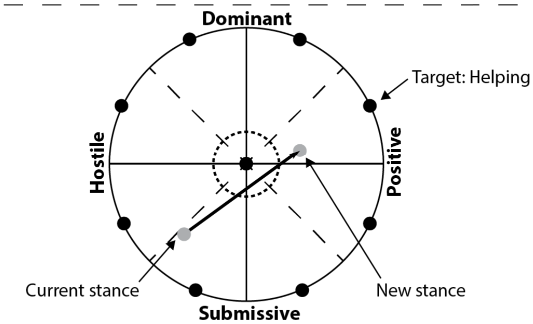

Fig. 3. A: Table of goal stances dependent on the current self-stance and the other's stance. B: Vector calculation of the new stance. The direction of the vector is angle from the current stance to the goal stance. The length of the vector determines the speed of change in the agent's stance.

select an appropriate response from a conversation script and send the Output Handler the next utterance.

The SM is responsible for tracking and updating the interaction stance of the agent. A stance consists of a point with two coordinates on Leary's rose (with the axes affect and dominance). The location of this point and the 'area' (an octant from Fig. 1A) it falls in determine the stance of the agent. The initial stance of the agent can be specified before starting the interaction. The interaction stance of the agent is updated with every new utterance from the conversational partner. The SM receives the stance of the conversational partner from the input handler. We currently have no online stance recognizer, although we are aware of advances in this area (e.g. [16]). In the current version of LearIS, the stance is retrieved from a script or an annotated corpus (these include the utterances for both conversation parties and the corresponding stances during the dialogue).

The stance of the other influences the stance of the agent following the rules of Leary's interpersonal theory (see Fig. 1B). This response model is implemented in a vector system and a direction table (see Fig. 3). The agent's stance and the other's stance are looked up in the table, where the cross gives the resulting new stance for the agent (Fig. 3A). An advantage of such a table is that it is insightful: it is obvious from the table how stance changes. Also, if the theory evolves, for example by the work by Orford [11], a different table, compliant with the new insights, can be inserted. The implementation of these two theories in the computational model would change the goal table. For example, in the case of Orford at the cross where both parties have an aggressive stance, there would be another aggressive as the goal stance. Or if a theory is added to the computational model, such as the theory of face (see section III), the table can be updated or dynamically altered.

In a simple system with a table where the resulting stance is looked up and executed immediately, the interaction is very 'jerky'. If the user displays a different stance, the system would immediately respond with a different stance without any respect for the previous stance. It would be better to see the stance as a point that can move on the circumplex and change the stance of the agent when it enters a new stance "area". To allow for smooth movement over the stance dimensions, we chose to include a vector system. The stance from the other and the current stance from the agent are looked up in the table and this goal stance is set as the target. A vector is drawn from the current stance towards this goal stance. The vector length determines where the new stance will be placed (see Fig. 3B). The length also determines the number of steps, or utterances by the conversational partner, that are needed before the agent arrives in the target stance. It can be seen as the ease with which the agent changes his stance or 'mind'. In an educational setting, the vector length can be seen as the difficulty setting [17]. For example, if the vector is long, the character's stance responds very quickly to the user's stance but if the vector is short, it takes patience to get the agent to change its stance.

Note that a neutral category is added around the center of the rose. This is to prevent strange (schizophrenic) behavior when the characters stance moves close to the center of the rose. The closeness of the different stances can make the agent switch between different stances rapidly without such a 'neutral zone'. This effect would only occur when the vector length is small.

The computational implementation of the interaction stance model (M) can be seen as a family of functions $M = (T, \delta)$, where T is the table of goals stances (Fig. 3A) and δ is the length of the vector. Both T and δ can be changed, for example if we want to switch between the interpersonal reflex theory as proposed by Leary [9] and the response tendencies found in empirical evidence by Orford [11] (see Fig. 1B and 1C).

III. Other social interaction theories

A single psychological theory like Leary's interpersonal stance theory is not the whole truth. More (contextual) factors might be of influence on the course of a conversation or a police interview. These other factors should be included in our computational model to make it a more accurate model of reality. This section describes several interesting social interaction theories that will be investigated and incorporated into a computational model for our conversational tutoring agent: face and politeness, rapport, and status.

Face and politeness

The term face is defined by Goffman [5] as "the positive social value a person claims for himself by the line others assume he has taken during a particular contact". It is the concern for the *image* a person has about himself and about how he thinks the other(s) views him. This means people try to maintain their own face in the presence of others, but also to maintain the other's face. People have a need for approval by others: this is *positive face*. On the other hand, people have a need for autonomy and not be impeded by others in their autonomy: this is *negative face* [2].

This notion of face can be under threat. For such face concerns to occur there needs to be an interaction in which participants are recruited as "self-regulating participants in a social encounter". Goffman states that this recruitment can occur through ritual: people are "taught to be perceptive, to have feelings attached to self and a self expressed through face, to have pride, honor, and dignity, to have considerateness, to have tact and a certain amount of poise."([5], p44). These rituals can be divided in presentation rituals and avoidance rituals. The first aims to maintain the face through the preservation of self-value, where the second aims to save face by maintaining autonomy [3].

The face can be threatened, by face threatening acts (FTAs). Positive face is threatened when one does not care about their interactors feelings, wants, or does not want what the other wants. Negative face is threatened when one does not (intend to) avoid the obstruction of their interlocutor's freedom of action [2]. FTAs will result in an unpleasant feeling and a drive to reduce the threat through defensive acts. Such defensive acts might take the form of avoiding the unpleasant situation or person in the future, or attacking the person who 'threatens you' [1]. The strength of FTAs is dependent on the social distance, status differences between interactants, and for example cultural differences [6]. Face becomes threatened easily in everyday situations. For example, a request is an FTA as it imposes negative face: you want someone to give up some autonomy to do your bidding. "People do things with words -they offer, they command, they threaten, they proposition- and the things they do necessarily affect the relationships they have. We choose our words carefully because they have to accomplish two tasks at once: convey our intentions, and maintain or renegotiate our ties with our fellows," ([12], p423). Going through life without threatening anyone's face is impossible. Fortunately, humans have social mechanisms to reduce the threat some FTAs have: an important one is politeness. There are four types of politeness strategies: bald on-record, negative politeness, positive politeness, and off-record [2]. When it comes to artificial conversational characters, politeness strategies can provide a motivation for behavior for the agent when the agent does (or has to do) something face threatening. In other words, when the agent wants to be polite or impolite, it can be (e.g. [19]).

A relation between face and Leary's rose seems obvious. I hypothesize that the dominance axis (y-axis) of Leary's rose is related to the autonomy factor of face. It is a negative face threat if someone forces you to be submissive: specifically, it concerns your autonomy. Whereas, if you are allowed to be dominant, you have no face threat related to autonomy. The affective component (x-axis) of Leary's rose might be related to approval or positive face. If two partners approve of each other's work, they are cooperative. If they are critical, without concern for the other's feelings, they are opposed. Whether these relations exist in police interviews and what the exact nature and the level of effect of these relations will be, will have to be investigated (see section IV).

Further influences

Face and politeness seem related to interactional stance. However, there are many more possible factors that could to be taken into account in an artificial interactional agent for it to appear truly natural. Some of these factors are: rapport, status, interpersonal closeness, personality, proxemics, affect, and cognitive factors such as the goals or strategy an agent has. Not all can be addressed in the current paper due to space limits. However, two other theories (rapport and status) warrant a short description, as an investigation of these factors is planned for the future.

Rapport

Rapport is a measure of the synchronization or 'same wavelength' people report in interactions. Rapport can be described in three related components: mutual attentiveness, positivity, and coordination [14]. The importance for rapport of these components changes over time in interaction. At early moments in interaction, positivity is of greater importance relative to the coordination in the interaction in the creation of rapport. Over time, coordination becomes more relevant while positivity becomes less important to maintain rapport. Attention is important for rapport, irrelevant of the time in interactions [14], see Fig. 4.

Rapport in itself might not be related to stance or face directly. However, independently the factors of rapport might have a strong relation to face. The absence of attention for 'your story' might be perceived as face-threatening: the other does not find your story interesting enough and you feel under-appreciated. In addition, the stances on the *hostile* side of the rose might be related to lack of attention. Being positive

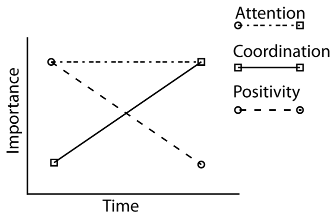

Fig. 4. Importance of factors for rapport over time of interaction, from [14].

becomes less important over time for rapport. When a good friend tells you "you're getting fat, you really need to work out", you feel less threatened than when a stranger calls you fat. An officer that builds rapport with the suspect during an interview might be able to ask questions that would otherwise be considered face threatening.

The notion of rapport adds a time factor to the interaction and relation. An agent might use rapport to create a sense of depth of character, with rapport the relation with the agent can evolve.

Status and role

Status and role are important in interaction. They are strongly related as a position or role often comes with status: they influence each other. For example being boss gives you a higher status than your employees. Intriguing about status is that one's status can make one 'obliged' to choose an interaction stance that is 'fitting' for the current interaction. For example, a receptionist is obliged by their status as a front-person for the company to act cooperatively: this might even be explicitly stated in their contract. Additionally, they might socially be 'expected' to be submissive to the customer. The context of status or role has a large influence on the interaction.

The social component of role and status is also very relevant for police interviews. Apart from the power component the police have as they dictate whether or not a suspect can leave, there is a social component. A police officer is a representative and the personification of the authorities. Therefore, he might feel he needs to be dominant and be in charge of the conversation. On the other hand, a criminal street kid might feel exactly the same urge for a different reason. He might feel the need to be dominant to appear strong and not be a 'sissy'. Leary's interaction theory states in this case that one of the participants would move to a submissive stance (see Fig. 1B), although empirical evidence seems to suggest this might result in an explosion of aggressiveness (see Fig. 1C). Whatever their tendencies might be, the police officer needs to get the suspect to cooperate (get him in a cooperative stance). This is more important than winning the 'who is boss' contest. The police officer has to learn to sometimes be submissive and cooperative to lure the suspect into a dominant and cooperative stance when the situation calls for it [18].

The status or role seems entirely defined by the context of an interaction. In our domain this means that status is related to the scenario that the agent is playing. Status should perhaps not be modeled on a general level, but the response model should be adaptable to the status prescribed by the scenario. In the current implementation this would mean a change in the stance table (see Fig. 3A).

IV. Model Evaluation

To test the match of the computational theories with natural human behavior, we will use two methods: using scenarios to compare predictions by the model to predictions by humans, and comparing an annotated corpus with system-generated responses. Additionally, the educational value of the affective conversational model needs to be tested: for this we plan expert evaluations.

Scenario based evaluation

Every theory incorporated in the computational model adds a piece of the complex puzzle of human interaction. Each theory adds some contextual factor to the model. From the presence of such factors the model can hypothesize a change in behavior (e.g. a face threatening act will lead to an opposed stance). These predictions can be tested against what humans would do in the presence of these factors. For this, scenarios where every factor in the interactional model is present (e.g. a face threat) are planned. The scenarios give an introduction into a situation but no resolution. People will be asked to complete these scenarios. Their answers can be compared to what the model predicts. This approach will show whether the theoretical relations and assumptions in the model are correct. This can be done for every 'piece of the puzzle' (every contextual factor).

For example, the *dominance* of the interactant is predicted to be important in conversations and thus it is incorporated in the model. So, two open-ended scenarios where only the dominance of the other is varied will be created: one where the other is dominant and one where he is submissive. The dominant scenario could be: *"You are just arrested by the police and you are placed in an interview room. A friendly officer comes in. He is concerned about you and asks you if he can make you feel comfortable, but makes it very clear he will not take any crap from you. You speak for the first time and say: ..."* The submissive scenario would vary slightly: *"... and asks you if you can please help him by remaining calm. You speak for the first time and say: ..."*.

Based on this scenario the computational model can predict what the actor will do next. According to Leary's interaction theory, friendly begets friendly and dominance begets submission: in the first scenario the actor will respond friendly and submissive, and in the second he will respond friendly and dominant. We also ask humans to predict what they think they would do in the scenario. However, it is unlikely they will present us with terms like the model (terms like dominant and friendly). Asking them directly for these terms might influence their decision and thus seems inappropriate. By asking them open questions first, they can give their own response (as they would in a natural interaction) without influencing them. Next, we ask closed questions in the terms of the model so we can compare their responses directly to the model's predictions. The comparison shows the correctness of the theoretical relations in the model.

Annotated corpus based evaluation

Another approach is to evaluate system generated conversations with annotated corpora. First, we need a corpus annotated on the things we want to evaluate (e.g. stance). We are currently annotating a police interview corpus (to be submitted to [10]) where stance is annotated for every utterance. When we go through the corpus, we ask the system to predict the stance for the next utterance. It takes the annotated stance of the person it is 'playing' as its own current stance and the stance of the other as the incoming stance. From this it calculates its new stance. This is effectively what the stance response model would do in an interactive agent: compute its next stance based on the previous utterances. Comparing this predicted stance with the annotated 'next' stance gives a fit for the model and this annotator. The comparison also shows the accuracy of the predictions of the model in a quantitative way. We will use Cohen's kappa [4] as a measure of fit between model and the annotator.

Evaluation of tutor application

The response model will be applied in a conversational agent in a tutoring system for police interviews. The effectiveness of the response model in this tutoring context needs to be evaluated. We are planning to let teachers from the police academy play with the tutoring system and ask them for an informal evaluation. Their expert opinion can help us develop a more quantitative evaluation of the system's tutoring abilities and the appropriateness of the response model. This test will be used with students from the police academy to evaluate the educative value of the tutoring agent.

Believable model

The discussed methods of evaluation can show the fit of the model to the real world. However, an agent that is *not* a good model of the real world might still be considered believable. In the end, this is what we aim to accomplish, building a believable artificial conversational character.

We can test whether humans are able to detect the difference between humans and the model. We present our participants with a scenario and two responses: one from a human and one from the model. The question is if a human participant can discern the two. If not, the model can pass for a human and is believable.

Improvements

Evaluation of the computational response model will undoubtedly show room for improvement. Some factors and theories might prove not to be important or the relation between the factors might prove to be wrongly interpreted. Analysis will have to show the cause of inconsistencies between human data and model generated data. If we can observe such causes, we might be able to improve the computational model.

V. Conclusion

Modeling interaction stance requires more than a computational model of interaction stance. We need to include the contextual factors that influence interactions and interaction stance. Including these contextual factors creates a response model that can respond appropriately in different contexts.

We do not claim that the theories described in this paper cover the entire span of possible human interactions. It is a start. The implementation of the response model and its evaluation will give us insight in both the validity of the psychological theories in the police domain and the relation between the theories. Eventually, this work is expected to yield a useful tutoring application for training police interviews.

Acknowledgment

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