A VIRTUAL CHARACTER'S EMOTIONAL PERSUASIVENESS

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ABSTRACT

Most of the researches so far have focused on emotional *impulsive* virtual characters, i.e virtual characters that express their own *felt* emotions without taking into account the socio-emotional context of the interaction. However, research in Human and Social Sciences has shown that during interpersonal interaction, people express very often emotions different from their felt emotions because they have to follow some sociocultural norms or they are pursuing specific goals. In this paper, we address the emotions that a virtual character *should* express to try to convince someone else during a negotiation. A model of an emotional persuasive virtual character and its implementation in the virtual world *Second Life* are presented. Such character is endowed with strategies of emotion expression that enable it to identify dynamically the emotion that it should express, depending on its interlocutor's emotional reaction, to try to influence his opinion during a negotiation. The emotional persuasive virtual character has been evaluated in indirect interaction (i.e. when the user watches a conversation between two virtual characters). The results show than the proposed model of strategic expressions of emotion enables one to significantly improve the virtual character's persuasiveness.

Keywords: Emotional persuasion, expression of emotion, virtual character.

1. INTRODUCTION

A growing interest in using virtual characters expressing emotions and used to embody some roles typically performed by humans (as for example the role of announcer or tutor) has been ob-

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served in recent years. As humans, in some situations, such virtual characters should be persuasive to try to convince their interlocutor during the interaction. Recent research in Human and Social Sciences has shown that the expressions of emotion can be used to convince someone else in a negotiation [1, 2, 3]. The expressions of emotion may then be used to improve virtual character's persuasiveness during an interaction. In the domain of virtual characters, most of the researchers so far have focused on felt emotions of virtual characters [4] while less attention has been paid to the emotions that a virtual character *should* express during an interaction, for instance, to convince its interlocutor. However, some researchers have already highlighted that virtual characters, in certain situations, have to express emotions different from their felt emotions depending on the goals of the interaction [5, 6]. But, few research addresses the type of emotions that virtual characters should express to achieve specific goals. In this paper, we focus on the emotions that virtual characters should express for the purpose of influencing someone else's opinion during a negotiation. Based on Human and Social Sciences theories, a model of strategic expressions of emotion to improve virtual characters' persuasiveness during a negotiation has been constructed (Section 3). This model enables a virtual character to identify the emotion that it should express to try to convince its interlocutor depending on its interlocutor's emotional reactions during the interaction. Based on this model, an emotional persuasive virtual character has been developed in the virtual environment *Second Life* (Section 4.1). An evaluation of this character in an indirect interaction (i.e. when the user observes an interaction between two virtual characters) has enabled us to study the effect of emotional strategies on users' perception of virtual character's persuasiveness (Section 4.2).

2. RELATED WORK

Persuasive communication is "any message that is intended to shape, reinforce or change the responses of another or others" [7]. A persuasive agent attempts to influence someone else's attitudes or behaviors through the use of messages. A persuasive communication implies two parties: a persuader and a receiver. Different elements may influence the effectiveness of a persuasive communication. For instance, the persuader's appearance and his physical attractiveness can positively influence persuasion [8]. Of course, the message itself and its argumentative aspects play an important role during a persuasive communication (for a review of existing computational models of persuasion focusing on arguments and communicative goals, see [9]). As highlighted in [10], the type of interaction can impact a message's effectiveness. For example, in the domain of e-learning, *indirect interaction* (i.e. when the user listens to a conversation between two virtual characters) is more effective than *direct* one. Last but not least, the emotional aspect of the interaction may significantly influence the persuasive communication [1, 2, 3]. Few attention has been paid to this last aspect in the existing computational models of persuasion.

As highlighted in [9], different emotional dimensions may affect the effectiveness of a message: 1. the current emotional state of the receiver (that may influence how the persuader's message is perceived); 2. the emotion expressed by the persuader (that may influence the persuasiveness of a message); 3. the receiver's emotions elicited by the persuader's message; and 4. the current persuader's emotional state (that may influence the choice of the strategy). As an emotional strat-

egy for virtual character's persuasiveness, in [9], the author proposes to use emotional expression that fits with the valence of the message. However, this strategy can be used only for emotional message. In [11], emotional strategies are implemented in a persuasion dialog toolbox to try to convince the user in the healthy eating domain. More precisely, based on Miceli *et al.*'s theory of emotional persuasion [12], the 4th emotional dimension described above is taking into account in the persuasion process. The strategies, represented through a belief network, consist in selecting the appropriate argument to attempt to elicit a specific user's emotion. In this paper, we focus more particularly on the second emotional dimension described above (the emotion expressed by the persuader) to improve the effectiveness of a message. In [13], the authors have more precisely explored the persuasiveness of an empathic virtual character advertising a music player. The results of their study suggest that empathic virtual characters are more convincing that non-empathic one. In this paper, we go further by exploring different strategic expressions of emotion taking into account the receiver's emotional reaction to message.

3. A MODEL OF STRATEGIC EXPRESSIONS OF EMOTION

Theoretical background.   Recent research in Human and Social Sciences has shown that one's expression of emotion influences other's decision in a negotiation process [1, 2, 3]. To *game emotions* means to deliberately choose to express a specific emotion (not necessarily felt) for strategic reasons [1]. As shown in [1], people game emotions during a negotiation. Indeed, to game emotions in an appropriate way may change the course of a negotiation. Several studies have highlighted that *happy*, *anger* and *empathic* emotion expressions have beneficial effects on negotiation. As shown in [14, 3], people are perceived likable when they express happy or empathy. Persons who express anger are perceived as more dominant but less likable [14]. The effect of emotion expression depends also on the receiver's power. People with low power concede more to an angry persuader than to a happy one [15]. Accordingly, the type of emotion expressed by a persuasive virtual character should depend on its interlocutor's dominance. Consequently, first of all, an emotional persuasive virtual character should be able to determine its interlocutor' dominance toward it in order to identify the appropriate emotion to express.

Emotion-based inference of other's dominance.   As highlighted in [3, 16], one's expression of emotion may reflect his feeling of dominance toward his interlocutor. The expression of high-power emotion (such as anger) traduces a dominance whereas low-power emotion (such as sadness) illustrates submissiveness [16]. Consequently, one may infer other' dominance or submissiveness with him depending on the emotional reaction of the latter to his expressed emotion. In this work, we consider three types of emotion: anger, sadness, and joy. Indeed, in the literature on emotion in negotiation, those emotions are the most studied, showing a visible impact on the persuasiveness of a message [1, 2, 3]. In order to give the capability to the virtual character to determine its interlocutor's dominance, we introduce the two following rules: (1) if the virtual character's interlocutor expresses anger, the virtual character infers that its interlocutor feels dominant; (2) on the contrary, if the virtual character's interlocutor expresses sadness, the virtual character infers that its interlocutor feels submissive. These rules enable a virtual character to

deduce its interlocutor's dominance depending on the emotional reaction of the latter. From the inferred dominance, the virtual character can identify the suitable emotion to express to try to convince its interlocutor, given the fact that the persuasive impact of an expressed emotion depends on the target's dominance [15].

Strategic expressions of emotion. Based on the literature in Human and Social Sciences [3, 15, 17, 14] presented above, we have identified three strategies of emotion expression: (1) the expression of joy; (2) the expression of anger; and (3) the expression of empathy. We present in more details each of these strategies in the following.

1. The joy strategy. As highlighted in [3], people strategically choose to express happiness and to suppress sadness and anger to others to elicit liking from them. Indeed, as shown in [14], people are perceived likable when they express joy. In the context of a negotiation, positive emotions can signal cooperativeness and trustworthiness and elicit cooperation, trust, and concession from others [3]. Consequently, a virtual character may express joy to try to convince its interlocutor. In our model, this strategy is the one by default: at the beginning of the negotiation or if its interlocutor does not express emotion, the persuasive virtual character expresses joy to try to elicit liking.

2. The anger strategy. Anger expression of emotion impresses the other party as aggressive and competitive. People who express anger are perceived as more dominant but less likable [14]. But, people with low power are strongly affected by their opponent's emotions (anger emotion), whereas those with high power are unaffected [15]. Accordingly, in our model, the virtual character uses this strategy when its interlocutor seems submissive. This information is deduced based on the rules to infer other's dominance introduced previously.

3. The empathy strategy. Another way to elicit liking is to express empathy. Indeed, the emotion expression of another in response to one's expression of emotion traduces the likability of the other. If the emotion expressed by another in response to one's emotion is congruent, the degree of liking increases [17]. The expression of empathy corresponds to the display of congruent emotion. The virtual character uses this strategy by expressing *happy-for* emotion (*resp. sorry-for* emotion) in response to the expression of positive (*resp.* negative) emotion of its interlocutor.

Finally, in our model, the persuasive virtual character starts by using the joy strategy to try to elicit liking. During the negotiation, if the persuasive virtual character infers that its interlocutor is submissive (based on the rules introduced above), it will change its strategy to the anger strategy to try to improve its dominance. On the contrary, if its interlocutor seems dominant, the persuasive virtual character will use the empathy strategy to try to elicit liking. By influencing its interlocutor's social relation, the objective of the virtual character is to persuade the latter.

To summarize, the reasoning of the emotional persuasive character during an interaction with another agent A (human or virtual) is the following: (1) the emotional persuasive character expresses a joy emotion at the beginning, (2) the emotional persuasive character waits to see what is the emotional reaction of agent A to its expression, (3) from agent A's emotional reaction, the emotional

persuasive character infers agent A's dominance toward it, (4) from the inferred dominance of A, the emotional persuasive character decides which emotion to express to try to persuade agent A. Then, the emotional persuasive character waits to see what is the emotional reaction of agent A to its expression (step 2).

4. IMPLEMENTATION AND EVALUATION

4.1. Implementation

We have developed an *emotional persuasive virtual character* in the 3D online virtual world "Second Life" [18]. Second Life is a free networked multi-user world-like environment in which users are represented as avatars that can communicate with others and interact with objects in the virtual environment. The architecture of the emotional persuasive virtual character is illustrated Figure 1.

The emotional persuasive character is endowed with *emotion-based rules* to infer its interlocutor's dominance and *strategies of emotion expression* in order to identify the appropriate emotion to display (Section 3). The *Listener Module* determines the emotion expressed by the virtual character's interlocutor, from the information received from Second Life on the events which occur in the envi-
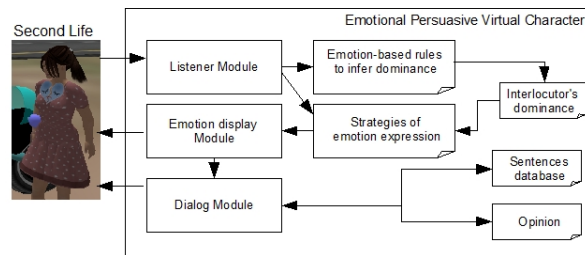

Figure 1: Architecture of the emotional persuasive virtual character

ronment [2]. This emotional information enables the virtual character to update its representation of its *interlocutor's dominance*. Based on this inferred dominance, the virtual character selects the strategy of emotion expression and transfers the emotion to express to the *Emotion Display Module*. The *Emotion Display Module* sends this emotional information to *Second Life* for the display. The *Dialog Module* selects the text response of the virtual character from the sentences database depending on its predefined opinion. Currently, the *sentences database* contains predefined neutral sentences for a pros or cons opinion given a specific subject (for instance, "I don't want to give this box" or "we should give this box"). The *Emotion Display Module* sends the information on the emotion to express to the *Dialog Module*. The *Dialog Module* adds at the beginning of the sentence a smiley corresponding to the emotion to express: ":-D" for joy, ":-(" for sadness or sorry-for, and "[-X" for anger[3]. In Second Life, the virtual characters that we have developed express emotions graphically through two ways: their facial expressions and an object attached

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[2]The listener module handles the computer-controlled character's emotions expressed through the object *EmoHeart* (Figure 2), and the human-controlled character's emotions expressed directly through the chat channel by typing the type of the emotion.

[3]In future works, we aim at connecting the *Dialog Module* to an argumentative computational model to improve the effectiveness of the persuasive message.

to their chest called *EmoHeart*. *EmoHeart* appears when the virtual characters express emotions, and its texture depends on the type of the expressed emotion (Figure 2). *EmoHeart* [19] provides an additional channel for visualizing emotions easily in a vivid way while the facial expression of emotion in Second Life may be elusive. To express empathy, the emotional persuasive virtual character uses additionally predefined sentences, such as "You look sad, I'm sorry for you ".

In order to evaluate the persuasiveness of the emotional persuasive virtual character, we have conducted a user evaluation in an indirect interaction, i.e. when the users watch an interaction between two virtual characters.

4.2. Evaluation

The evaluation we have conducted, aimed at testing the persuasiveness of the emotional persuasive character in an indirect interact, i.e. when the user watches an interaction between the emotional persuasive virtual character and another virtual character. In order to illustrate the behavior of the emotional persuasive virtual character in an indirect interaction, we have developed another virtual character called *impulsive emotional virtual character*[4]. The *impulsive virtual character* is a very simple emotional character that, contrary to the emotional persuasive one, expresses its *felt* emotions. The impulsive virtual character has a predefined dominance value toward its interlocutor. This value evolves dynamically during the interaction. If its interlocutor has opposite opinion, the impulsive character expresses a negative emotion[5]. Depending on its dominance value, it displays sadness (low value) or anger (high value) (distinction based on [20]). The emotions expressed by its interlocutor influence directly its dominance with the latter. For instance, based on the work of Knutson [14], its dominance decreases (*resp.* increases) when its interlocutors expresses anger (*resp.* sadness). For the evaluation in an indirect interaction, we have simulated a negotiation between the emotional persuasive virtual character and the emotional impulsive one in Second Life (Figure 2). At the beginning of the interaction, the dominance of the emotional impulsive character toward the persuasive one is predefined. Then, the two characters discuss about a predefined subject. They negotiate on whether to give away the motorcycle that they won together at the fair. They have opposite opinions. The impulsive character's emotional behavior during the interaction depends on its level of dominance. For instance, if it is submissive (resp. dominant), it expresses sadness (resp. anger). Accordingly, the emotional persuasive character adopts different strategies depending on the inferred dominance of the impulsive character deduced from its emotional behavior. For instance, it expresses empathy to response to anger, and anger to response to sadness. The impulsive character uses the same Dialog Module that the emotional persuasive character. Consequently, the virtual characters do not use specific arguments to convince, but only their emotions.

Method. In order to evaluate the persuasiveness of the emotional persuasive character, 14 subjects have participated to the experiment (seven women, seven men). The subjects' ages ranged

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[4]To evaluate the anger and empathy strategies, an emotional character is required

[5]The fact that its interlocutor has an opposite opinion is seen as an undesirable event.

Figure 2: (a) Screen shot of the negotiation between the impulsive emotional character (left) and the emotional persuasive one (right) in Second Life and (b) Examples of virtual characters' facial expressions and EmoHeart textures

between 21 and 35 years old. They have in average few experience using Second Life (in average 2 on a Likert scale of 7 points). To study the effect of each emotional strategy, we have simulated three different versions of interactions between the persuasive emotional character and the impulsive one: (1) *Anger strategy version*: in this version, the impulsive virtual character has been implemented as submissive. Accordingly, it expresses sadness during all the interaction, whatever the emotions expressed by the persuasive character. Consequently, the persuasive virtual character adopts the *anger strategy* during this interaction to try to convince its interlocutor (the impulsive virtual character); (2) *Empathy strategy version*: in this version, the impulsive virtual character has been defined as dominant. It expresses anger during all the interaction. Consequently, the persuasive virtual character adopts the *empathy strategy* during the interaction; and (3) *Joy strategy version*: in this version, the impulsive character has been implemented as non-emotional: it does not express any emotion whatever its level of dominance and the persuasive character's expressions of emotion. Then, the emotional persuasive character keeps the *joy strategy* during all the interaction. In these three versions, the subject of the negotiation between the virtual characters is to give away a motorcycle they won together at a fair. The virtual characters do not use specific arguments to convince but only their emotions. The predefined sentences used by the virtual characters during the dialog are voluntary simple in order to evaluate specifically the effect of emotions. An example of sentences is "we should keep this motorcycle for us"[6]. In each version, five dialog turn occur. The conversation stops before they reach an agreement. In the three versions, the subject of the negotiation, the interface, and the way to express emotions are the same. Only the types of emotion expressed by the two characters vary. The evaluation took place directly in Second Life. Each participant has observed interactions between the virtual characters in Second Life through an avatar. First of all, an example of interaction between the virtual characters has been presented to the participants in order to show them how the virtual characters' emotions are expressed. Then,

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[6]The sentences were selected randomly whatever the emotions expressed by the characters

the participants have watched the three versions of interactions described above[7]. The order of the versions and the opinions of virtual characters (pros or cons) have been counterbalanced to avoid an effect of the order of the versions and of the opinions of virtual characters on the results. The subjects have received 1000 Japanese yen at the end of the experimentation for their participation.

To measure the user's perception of the virtual characters' persuasiveness, we have used a questionnaire composed of three affirmations: two concerning the persuasiveness of each character: "The virtual character Loula on the left is more persuasive than the virtual character Lucie on the right" (noted Q1) and "The virtual character Lucie on the right is more able to convince her interlocutor than the virtual character Loula on the left" (noted Q2), and one concerning the users' preferences: "You would prefer to interact with the virtual character Loula on the left than the virtual character Lucie on the right." (noted Q3). The participants have indicated their agreement or disagreement for each affirmation by checking the box corresponding to their opinion on a Likert scale of 7 points (from 1 not agree at all to 7 fully agree). They have filled the same questionnaire after each watched version. In total, the duration of the test for each participant did not exceed 20 minutes.

Evaluation results.   Globally, the virtual character endowed with emotional strategies is perceived as more persuasive than the impulsive one. Moreover, the results reveal that the users prefer to interact with the persuasive one (Figure 3).

A T-test has been used to analyze the significant differences between the question Q1 and Q2. The results show that the emotional virtual character endowed with emotional strategies is perceived as *significantly* more persuasive that the impulsive one (with $p < .01$). We have also analyzed the results depending on the opinion (pros versus cons) of the characters and the gender of the user, but no significant difference is appeared ($p > .05$). To study more particularly the effect of each strategy on users' perception of virtual

Figure 3: Average of the users' responses for each condition

characters, we have analyzed separately the results for each strategy. No significant difference appears concerning the perception of each character's persuasiveness depending on the strategy used. However, the results show a significant effect of the strategies on the user's preferences (with $p < .01$). The users would prefer to interact with the persuasive emotional virtual character when the latter adopts the empathy strategy than the anger one. Moreover, whereas the emotional persuasive character is perceived as *significantly* more persuasive than the impulsive one for the empathy and joy strategies (with $p < .05$), no significant difference appears for the anger strategy.
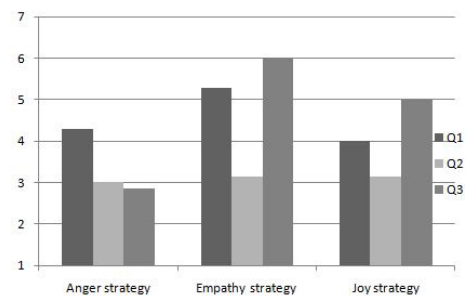
Discussion   Firstly, the evaluation enables us to study the user's perception of an emotional virtual character's persuasiveness in an indirect interaction. The results show that the virtual character

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[7]Note that the participants have not directly interacted with the virtual characters

endowed with the model of strategic expressions of emotion is perceived *significantly* more persuasive than the other character. Therefore, the results of the evaluation reveal that the proposed model of emotional strategies can be used to improve the persuasiveness of a virtual character in an indirect interaction. However, by taking a closer look at the results for each strategy, it appears that some strategies seem more efficient to improve virtual characters' persuasiveness than others. More precisely, whereas the empathy and joy strategies clearly improve the virtual character's persuasiveness, the anger strategy does not lead to significant differences with the other character. Consequently, a virtual character expressing empathy in response to anger, or joy in response to a non-emotional character, is perceived as being more able to convince its interlocutor. However, we cannot conclude that a virtual character expressing anger in response to a virtual character's expression of sadness is more persuasive than its interlocutor. These results are consistent with the previous finding on the effectiveness of a virtual character's expression of empathy to persuade [13]. The results of our evaluation also highlight another emotional strategy (the joy strategy) to convince for a virtual character facing a non-emotional situation. Secondly, the evaluation enables us to study the preferences of users concerning a direct interaction with an emotional virtual character during a negotiation. The results show that the users would prefer to interact with the virtual character expressing empathy compared to virtual characters expressing anger or no emotion. These results are consistent with existing works on affective interaction showing the positive impact of empathic virtual agents [21].

5. CONCLUSION

In this paper, we have proposed a model of strategic expressions of emotion that enables a virtual character to identify the most appropriate emotion to express during a negotiation to improve its persuasiveness. These strategies are based on interlocutor's dominance, inferred dynamically during the interaction from the expressed emotion. An emotional persuasive virtual character endowed with the proposed model has been developed in the virtual environment Second Life. The results of the performed evaluation show that some of the proposed strategies (the expression of empathy in response to sadness and the expression of joy when no emotion is expressed by the interlocutor) enable to improve a virtual character's persuasiveness in an indirect interaction (i.e. when the user watches a conversation between two virtual characters). By asking directly the users their preferences, it appears that in a direct interaction (i.e. when the user interacts directly with the virtual characters), the users would prefer to negotiate with the virtual character expressing empathy. However, another evaluation with direct interaction should be performed to analyze more particularly the capacity of a virtual character to convince a user through emotions.

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