

The Effect of Dominance Manipulation on the Perception and Believability of an Emotional Expression

Wim van der Ham and Joost Broekens

MMI, TU Delft, Mekelweg 4, 2628 CD, Delft, The Netherlands

Abstract. Models of affect are used in virtual characters to increase their believability. In some specific situation the underlying appraisal theory predicts more than one possible emotion. Both anger and sadness are generated if another person does something blameworthy that is negative for your own goals. However, it is not clear which one is more believable to express. Based on experimental and theoretical findings in emotion psychology, we use social dominance as a way to choose between anger and sadness. We hypothesize that anger should be generated (and expressed) in the dominant virtual character and sadness in the non-dominant character. We test this hypothesis with a virtual reality scenario in which a user and an agent negotiate about job options. The negotiation always fails as a result of the user. We have a 2x2 experimental setup with agent role (dominant/submissive) and expressed emotion at the end of the scenario (angry/sad) as factors. The believability and the perception of the expression by the user are measured.

1 Introduction

One of the reasons to use a model of affect in a virtual agent is to increase the believability and thus enhance human-computer interaction with an agent [19]. A popular way to model affect in a virtual agent is by making use of an appraisal based theory [15]. Some well-known examples of models include EMA [8] and FLAME [6]. In appraisal theory, emotion is argued to arise from patterns of individual judgment concerning the relationship between events and an individual's beliefs, desires and intentions, sometimes referred to as the person-environment relationship [10]. In some situations the theories predict the generation of not one but two or more emotions. In such situations the question remains which of the two emotions is perceived as more believable by a human and what this believability depends on.

According to all the previously mentioned theories of emotion, both sadness and anger can be elicited if another person does something that has negative consequences for your own goals. The anger can be elicited as a result of the blameworthiness of the other person for the event and the sadness can be elicited as a result of the negative consequences of the event. According to recent research [11], the affective states sadness and anger have contradicting effects on the

cognition and behavior of the agent and it is thus important to know which of those states is elicited in the specific situation described before. In this paper we try to identify which factor is suitable to predict the emotion that is expressed in that situation.

In other research about models of affect ([13], [16], [1] and [7]) sadness is related to low dominance or control and anger is related to high dominance or control. In this paper we use the dominance appraisal dimension to make a distinction between the expressions of sadness versus anger. We hypothesize that a high dominant character is more believable if it expresses anger instead of sadness, while for a submissive character this is inverted.

We test our hypothesis with a scenario in which the user does something that is negative for the goals of the agent, a situation that would predict both anger and sadness. The scenario used in this experiment is a negotiation between a boss and a candidate. The boss is the high dominant character and the candidate is the low dominant character. Depending on the experimental condition the subject is either the boss or the candidate and the agent expresses itself with either anger or sadness. Subjects received a role description before playing the scenario. As such we test a 2x2 setup with role (boss/candidate) and expression (anger/sadness) as factors. The hypothesis is supported when a boss who expresses anger and a candidate who expresses sadness both have higher believability than a sad boss and an angry candidate.

The structure of this paper is as follows: first we discuss background research into the difference between sadness and anger. Then we explain the experimental setup in more detail, after which we present the results. Finally, we discuss our findings in a broader context.

2 Anger and Sadness Background

Anger and sadness both result from an appraisal that tells an individual that an event has negatively impacted the individual's goals (see e.g. [15]). Anger is the emotion attributed to the acting agent that has responsibility for the event, while sadness is the emotion attributed to the event itself. In other words, anger is the result from the perception of a blameworthy agent while sadness is the result of a loss or anticipated loss. More specific differences between anger and sadness have been studied in the past. According to [11] a general negative emotion (sadness) and the specific negative emotion anger differ from each other because angry people believe that they have control over the situation. This 'control' variable can be found in more literature as a difference between anger and sadness. Probably the most important work that uses control to divide between the two emotions is the PAD scale described in [14]. The D in the PAD scale stands for dominance and is defined as:

Dominance was defined as a feeling of control and influence over one's surroundings and others ... (e.g. anger ...)

The control from [11] and the dominance from [14] have essentially the same meaning. The way humans process an emotional expression of another human

depends on the motivation to process the information from that expression [17]. This motivation depends on the dominance of the perceiver of the expression. A dominant character does not care much about the information of the expression of the submissive character and responds to this expression using its gut feelings. The submissive character on the contrary is interested in the information from the expression of the dominant character and changes its behavior accordingly. This means that there could be a big difference in the believability of the first generated affective reaction of a virtual character, when choosing between sadness and anger. Obviously both emotions make sense; however it can very well be that depending on the context one should be expressed, while the other should not. In this research, we study this in a structured way.

3 Method

We test our hypothesis with a scenario in which the user does something that is negative for the goals of the agent (he/she cuts of a negotiation), a situation that would predict both anger, as a result of the blameworthiness for the quitting of the negotiation, and sadness, as a result of not getting the job. The scenario used in this experiment is a negotiation between a boss and a candidate. The boss is the high dominant character and the candidate is the low dominant character. Depending on the experimental condition the subject is either the boss or the candidate and the agent expresses itself with either anger or sadness.

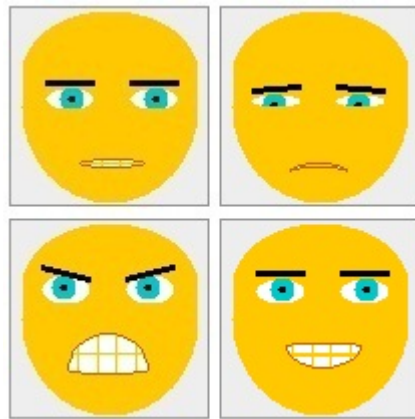


Fig. 1. Different expression of the AffectButton [2]

The experiment is conducted using an online questionnaire and downloadable virtual reality scenario. A subject is semi-randomly allocated to one of the four experimental conditions; the user can be the boss or the candidate and the

reaction of the virtual agent can be either sad or angry (2x2 between subject design). The experiment starts off with some general questions and some explanation about the affect button and the procedure of the experiment in general. After that, the subject reads a short story explaining the role of the subject in the negotiation. The subject is asked to read this thoroughly and to immerse him/herself as much as possible. Immediately after the story we checked our initial dominance manipulation by asking subjects to rate perceived dominance of both the user and the agent with the AffectButton [2]. The AffectButton is a button with a face that changes depending on the position of the cursor on the button. An example of a few different expression of the button is given in figure 1. If the button is pressed the face remains fixed and a value for each of the PAD dimensions [14] is selected. The subject has to use the AffectButton to evaluate his own feeling at that moment and how he thinks the agent is feeling. Now the subject plays the virtual reality scenario. Then the subject again rates his/her feeling and that of the virtual character using the AffectButton. Further, after playing the scenario, we asked subjects to rate (a) the expression of the agent, (b) the user's typical feeling as well as (c) expression in the presented situation. Rating was done by selecting on a 5-point scale the emotion intensity for 6 basic emotions [5]. Finally we asked the subjects about the believability of the virtual character's reaction using the following 5-item questionnaire (Cronbach's $\alpha=0.73$):

- The reaction of the agent was normal for this situation.
- I would have reacted in the same way as the agent.
- The reaction of the agent was believable.
- The reaction of the agent was human like. [9], [4]
- The reaction of the agent was predictable. [9]

The answers on these question are given on a 1 to 5 Likert scale [12], where 1 means totally disagree and 5 means totally agree.

In total we therefore have as output measures (a) an AffectButton rating after the scenario, (b) three basic emotion intensity ratings, and (c) a believability rating.

3.1 Scenario Material

During the scenario the user has to negotiate with an agent in a virtual environment about a new job, or more specifically, about the amount of working hours for the candidate. The boss wants the candidate to work for five days in a week so he can pay enough attention to the customers, while the candidate wants to work for four days in a week so he can spend time with his daughter. The scenario is scripted in such a way that the interview always fails and the user is the cause of the failure, in other words the user can be blamed for the failure. This situation has negative consequences for the goals of the agent and produces sadness or anger in the agent according to the models of affect. To avoid biases in the scenario itself, other than our experimental ones, the scenario has been created

by a professional scenario developer without knowledge of the experiment's goal and the voice of the virtual character has been recorded by a colleague without knowledge of the experiment. The character's expression used in this experiment has been validated in previous research [3].

The scenario is a turn based negotiation in which the human has two different options to choose from at every turn. For the scenario it does not matter which option the user chooses, the two options contain the same information but different text. They are only there to give the user the idea that he actually has some influence on the scenario and to immerse the user more in the scenario. The agent selects one of the two options randomly. At the end of the scenario the user can only choose to reject the offer and to quit the negotiation. The agent expresses either sadness or anger in reaction to the action of the user as shown in figure 2. During the rest of the scenario the expression of the agent is neutral.



Fig. 2. The expressions of the virtual agent from left to right: neutral, angry and sad

4 Results

In total 36 primarily Dutch participants, 8 (22%) women and 28 (78%) man participated, with an education level equal to high school or university. The average age was 25,8 with a range between 18 and 60 years. The average experience with virtual environments of the participants was 3.4 on a scale from 1 to 5 where 1 means no experience and 5 means a lot of experience.

4.1 Manipulation Check

The result of a multivariate ANOVA, with the role of the agent as independent variable and the PAD-values rated with the AffectButton about the expected feelings of the virtual agent as dependent variables, was significant ($f(3,44)=0,028$). From the univariate analysis we conclude that the dominance dimension differed

significantly ($f(1,46)=0,011$) between the two roles. The effect of role on the pleasure dimension is nearly significant ($f(1,46)=0,054$). The dominance and the pleasure are higher if the agent is the boss (mean=0,275 std=0,103 and mean=0,36 std=0,106), than if the agent is the candidate (mean=-0,109 std=0,103 and mean=0,063 std=0,106). The multivariate ANOVA with the role of the agent as the independent variable and the PAD-values for the feeling of the self as dependent variables did not result in a significant difference ($f(3,44)=0,216$). This means that dominance manipulation was successful with respect to the perceived dominance of the virtual character, but not with respect to the subject’s own feeling of dominance.

4.2 Evaluation of the Reaction

The matrix containing the intensity values of the six basic emotions was used to measure the perception of the reaction (expression) of the agent. We did a multivariate ANOVA with the expression as the independent variable and the intensity values for the six emotions as the dependent variables. This test resulted in significant difference ($f(6,27)=0,026$). The results are shown in table 1 and confirm that the subjects perceived the expressions as intended.

Table 1. Intensities of the perceived sadness and anger depending on the expression of the agent

Expression of the agent	Perceived anger		Perceived sadness	
	mean	std	mean	std
Expressed anger	3,389	0,288	2,389	0,278
Expressed sadness	2,056	0,288	3,444	0,278

The ANOVA with the role as the independent variable and the intensity values for the six emotions as the dependent variables showed a significant effect between the roles ($f(6,27)=0,013$). The univariate analysis showed that role significantly influences the perceived intensity of expressed surprise ($f(1,32)=0,003$) and expressed anxiety ($f(1,32)=0,022$). Other emotions did not produce a significant difference. Expressed anxiety was perceived stronger if the agent was the candidate (mean= 1,889 std=0,195) than if the agent was the boss (mean=1,222 std=0,195). Expressed surprise was perceived to be of higher intensity if the agent was the boss (mean= 2,556 std=0,193) than if the agent was the candidate (mean=1,667 std=0,193). As this is a role effect, this means subjects interpreted the basic expressions differently depending on social context. The effect of role on the perceived intensity of expressed happiness approached significance ($f(1,32)=0,082$) The agent’s reaction is perceived to be happier if he plays the role of the boss (mean=1,333 std=0,109) than if he plays the role of the candidate (mean=1,056 std=0,109).

The observation is in accordance with the results from the AffectButton. After the scenario was completed, the subject rated their own feeling and that

of the agent again using the AffectButton. The multivariate ANOVA on the PAD-values as dependent values and the role as the independent variables was significant ($f(3,41)=0,007$) if the question is about the feelings of the other and not significance ($f(3,41)=0,582$) if the question was about the feeling of the user himself. According to the between subjects test this significance was caused by the pleasure dimension ($f(1,43) < 0,001$). Although the pleasure was below zero in both cases, it is higher if the agent was the boss (mean=-0,144 std=0,084) and lower if the agent was the candidate (mean=-0,560 std=0,082).

4.3 Believability

A multivariate ANOVA (2x2) with role and expression as independent factors and the questions about the believability as dependent values did not produce any significant differences between the groups. The believability was not significantly different for the four conditions, not on the total combined scale, nor for any of the individual items.

4.4 Normal Feelings and Expressions

We did a multivariate ANOVA with role and expression as independent variables and the intensity on the six basic emotions of the normal feelings a subject reported in such a situation as the dependent variables. We found a significant effect of role ($f(6,27) < 0,001$). The result of the univariate analysis can be found in table 2. If the agent is the boss the normal feeling attributed to the agent is more happy and surprised and less sad and anxious than if the agent is the candidate.

A multivariate ANOVA with role and expression as independent variables and the intensities on the six basic emotions of the normal reaction in such a situation as the dependent variables did not show a significant main effect. However, univariate analysis showed an effect of role of the agent on the emotion anxiety ($f(1,32)=0,025$). The value for the intensity of the normal expression for the agent is higher if the agent is the candidate (mean=1,833 std=0,183) than if the agent is the boss (mean=1,222 std=0,183).

Table 2. Intensities for the emotions the agent should feel normally in a specific condition according to the subjects

Role of the agent	Happiness		Anger		Surprise		Sadness		Anxiety	
	mean	std	mean	std	mean	std	mean	std	mean	std
Boss	1,558 ¹	0,126	2,611 ²	0,274	2,833 ¹	0,213	2,777 ¹	0,261	1,111 ¹	0,190
Candidate	1,056 ¹	0,126	2,778 ²	0,274	2,166 ¹	0,213	3,888 ¹	0,261	2,222 ¹	0,190

¹ Significant difference, $p < .05$

² No significant difference, $p > .05$

5 Discussion

5.1 Manipulation Check

Our analysis showed that subjects interpreted the boss agent to be more dominant than the candidate, which was exactly the purpose of the manipulation. However, when the subjects rated the dominance of themselves this is not significantly different between the two roles. This is probably because the influence on the own feelings of reading the story is too small compared with the general feelings of the person at that moment. In the experiment there was no baseline measurement conducted so we cannot say existing feelings of the subjects were influenced by the story or vice versa. As the believability questions are about the agent's role (and agent role influenced the interpretation of the agent's expression), we conclude that the manipulation succeeded.

5.2 Evaluation of the Reaction

The expression of the agent in the virtual scenario is perceived by the subjects. If the agent expresses anger the intensity of perceived anger is higher while if the agent expresses sadness the intensity of the sadness is higher. Interestingly, part of the effect on the interpretation of the expression of the agent is not dependent on the actual expression, but can only be due to the agent's role. If the agent is the boss the expression contains more surprise and happiness and less anxiety than if the agent is the candidate. The difference in happiness is also found using the affect button directly after the scenario; the pleasure dimension is higher if the agent plays the boss than if the agent plays the candidate. Because of this difference it can be concluded that the perception of an emotional expression is dependent on the context of the expression. Even very strong basic emotions (anger and sadness) are perceived differently if the context of the expression is different. This effect was also shown in [18] where the same facial expression is judged differently depending on the clip that was shown before the expression.

The character's expressions used in this experiment have been validated in previous research [3]. However these expressions have not been validated when used in a social context. Recent psychological studies [17] show that the processing of a facial expression depends on the observer's information processing and on social-relational factors, for example dominance. As such, the result of this experiment also helps us to understand the influence of social context on the perception of basic emotions. The expression is perceived in the direction of the reported normal feeling of the subject. The normal expected feeling predicts higher happiness and surprise for the agent if he plays the role of the boss and a high sadness and anxiety if the agent plays the role of the candidate. The intensity values for the emotions that are not expressed by the agent, happiness, anxiety and surprise, are rated by the subjects in agreement with what they think is normal to feel in such a situation.

5.3 Believability

The results from the believability measurement were very clear; there was no significant difference between the four conditions. The hypothesis, that the addition of a dominance dimension to decide between sadness and anger in order to increase the believability of the reaction of the agent can not be confirmed. However, believability is a difficult concept to measure and there is no standard scale to measure believability. To avoid the construct believability one can take a closer look at the individual items of the believability scale. We believe that those items should be able to measure a difference when used to distinguish between emotions that have a bigger difference like, for example, joy and sadness. It is not sure if this scale can measure the smaller difference between anger and sadness in the specific situation.

Another way to say something about the believability is by looking at what subjects think is normal in this situation to feel for the agent. Interesting to see is that for the intensity of anger, the agent is expected to feel, it does not matter if the agent plays the role of the boss or the candidate. Since in both situations it is equally expected to feel anger this probably means that the blameworthiness of the user is in both situation about the same and thus independent on the role of the agent. However, the intensity of the expected felt anger by the agent is low relative to the intensity of the expected felt sadness. An explanation for this can be that it is not clear who is to blame for the failure of the negotiation. The negotiation is always ended by the user but it can be argued that this is not sufficient to be deemed blameworthy. If one of the sides is not giving in at all and leaves no option to the other side than to quit the negotiation, this side can be deemed blameworthy as well. To simulate the situation in which anger is elicited in a future scenario it must be made very clear that one of the sides is responsible for the failure of the negotiation.

Another explanation might be that subjects thought that surprise would have been an emotion to expect for the boss, when the user rejected the offer (which equally makes sense from an appraisal theoretic principle, as it would not be expected from a candidate in need to reject a job offer). Apparently, subjects interpret the situation in a broader context, not in a narrow *negotiation goals not achieved* context. This point again towards the need to have very detailed, well validated scenarios to test hypotheses about computational models of appraisal theory, as a small change of perspective can change the interpretation of the situation as seen by subjects.

The intensity of the felt sadness by the agent is dependent on the role of the agent. If the agent is the boss he is expected to feel less sadness than if the agent is the candidate. So the perception of loss is dependent on the context of the negotiation, where the loss is bigger for the candidate than for the boss. This makes sense if one takes into account the position of the candidate and of the boss before the negotiation, not achieving agreement is much worse for the candidate than for the boss. The intensity of the felt anxiety by the agent is dependent too on the role of the agent. In the candidate role the felt anxiety is much higher than in the role of the boss. This is probably because the perceived

future loss for the candidate is higher than for the boss. Anxiety is the result of a negatively valenced event in the future [15] [8].

5.4 Normal Expression of the Agent

Although subjects clearly indicate different felt emotions for the dominant and submissive roles, they do not show a clear preference for how an agent should express itself. The subjects only agree that the agent should express more anxiety if he plays the role of the candidate than if he plays the role of the boss. This lack of clear effect on how one should express itself can only be explained by the fact that subjects had different norms on which emotions to express in a situation, or by the fact that in this situation one typically does not express a clear emotion. This could also be the reason why the believability of the reaction of the agent does not significantly differ across the conditions. Subjects evaluate the believability in relation to what they think is normal to express by the agent. And since this norm is different for every subject, or the situation does not trigger the clear expression of an emotion the perceived believability is as well. More research on the influence of social norms on the expectations about the behavior of the agent is required.

6 Conclusion

We have conducted an experiment to investigate the effect of social dominance on perceived emotion expression of a virtual character that expresses anger or sadness. We hypothesized that the believability of the character depended on the correct selection of anger versus sadness depending on social dominance. When a character is in a high dominant role, anger was hypothesized to be more believable; while in a submissive role sadness would be the preferred reaction.

The believability measure did not produce a significant difference in the four conditions. The hypothesis that dominant character are more believable when expressing anger and submissive characters are more believable when expressing sadness cannot be confirmed for this scenario. However, the intensity of the felt anger by the agent in the described scenario was not different depending on the role the agent plays according to the subjects. In future research a scenario should be used where there is a difference in intensity of felt anger between the roles, to see if the believability is not dependent on the dominance in all situations. Subjects do not agree with each other on what they think is normal to express in a specific situation. This difference could also explain why the believability is not different for the conditions.

Further, we showed that social role influences how the agent's perception is interpreted. A dominant agent's expression is perceived to be more surprised while a submissive character's expression is perceived to be more anxious.

Finally, the expression of anger by a dominant character is not perceived as an indication of negative affect, while the expression of a submissive character is.

This effect does not exist for the expression of sadness which is always interpreted as an indication of negative affect.

Our research shows the importance of a tight relation between emotion psychology and virtual character evolution, as well as the need for well-validated test scenarios to evaluate virtual characters and appraisal theories. Further, we showed that even basic emotions like sadness and anger are perceived differently when in different social contexts. People perceive an expression in agreement with what they think is normal to feel in such a situation.

References

1. BECKER-ASANO, C., AND WACHSMUTH, I. Affect simulation with primary and secondary emotions. In *IVA '08: Proceedings of the 8th international conference on Intelligent Virtual Agents* (Berlin, Heidelberg, 2008), Springer-Verlag, pp. 15–28.
2. BROEKENS, J., AND BRINKMAN, W.-P. Affectbutton: Towards a standard for dynamic affective user feedback. In *Affective Computing and Intelligent Interaction and Workshops, 2009. ACII 2009. 3rd International Conference on* (sept. 2009), pp. 1–8.
3. BROEKENS, J., QU, C., AND BRINKMAN, W.-P. Factors influencing user perception of affective facial expressions in virtual characters. *Submitted* (submitted).
4. DE MELO, C., CARNEVALE, P., AND GRATCH, J. The influence of emotions in embodied agents on human decision-making. In *Intelligent Virtual Agents*, J. Allbeck, N. Badler, T. Bickmore, C. Pelachaud, and A. Safonova, Eds., vol. 6356 of *Lecture Notes in Computer Science*. Springer Berlin / Heidelberg, 2010, pp. 357–370.
5. EKMAN, P. *Basic Emotions*. John Wiley & Sons, Ltd, 2005, pp. 45–60.
6. EL-NASR, M. S., YEN, J., AND IOERGER, T. R. Flame-fuzzy logic adaptive model of emotions. *Autonomous Agents and Multi-Agent Systems 3* (September 2000), 219–257.
7. GEBHARD, P. Alma: a layered model of affect. In *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems* (New York, NY, USA, 2005), AAMAS '05, ACM, pp. 29–36.
8. GRATCH, J., AND MARSELLA, S. A domain-independent framework for modeling emotion. *Journal of Cognitive Systems Research 5* (2004), 269–306.
9. HÖÖK, K., PERSSON, P., AND SJÖLINDER, M. Evaluating users' experience of a character-enhanced information space. *AI Commun. 13* (November 2000), 195–212.
10. LAZARUS, R. *Emotion and adaptation*. Oxford University Press, New York, 1991.
11. LERNER, J. S., AND TIEDENS, L. Z. Portrait of the angry decision maker: how appraisal tendencies shape anger's influence on cognition. *Journal of Behavioral Decision Making 19*, 2 (2006), 115–137.
12. LIKERT, R. A technique for the measurement of attitudes. *Archives of Psychology 22*, 140 (1932), 1–55.
13. MARINIER, R. P., LAIRD, J. E., AND LEWIS, R. L. A computational unification of cognitive behavior and emotion. *Cognitive Systems Research 10*, 1 (2009), 48–69. Modeling the Cognitive Antecedents and Consequences of Emotion.
14. MEHRABIAN, A. Pleasure-arousal-dominance: A general framework for describing and measuring individual differences in temperament. *Current Psychology 14* (1996), 261–292. 10.1007/BF02686918.

15. ORTONY, A., CLORE, G. L., AND COLLINS, A. *The cognitive structure of emotions*. Cambridge University Press, 1984.
16. SANDER, D., GRANDJEAN, D., AND SCHERER, K. R. A systems approach to appraisal mechanisms in emotion. *Neural Networks* 18, 4 (2005), 317 – 352. *Emotion and Brain*.
17. VAN KLEEF, G. A. Emotion in conflict and negotiation: Introducing the emotions as social information (easi) model. In *Research companion to emotion in organizations*, N. M. Ashkanasy and C. L. Cooper, Eds. Edward Elgar, London, 2008, pp. 392–404.
18. WALLBOTT, H. G. In and out of context: Influences of facial expression and context information on emotion attributions. *British Journal of Social Psychology* (1988).
19. WEHRLE, T. Motivations behind modeling emotional agents: Whose emotion does your robot have?, 1998.