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

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Abstract. Models of affect are used in virtual characters to predict the emotions that can be shown by the character and thus to increase the believability of the character. In some specific situations it may not be clear which appraisals are the most important and thus which emotion should be generated. For example, both anger and sadness can be shown if another person does something blameworthy that is negative for one's own goals. Based on experimental and theoretical findings in emotion psychology, we propose a model using 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 actions of the user. We have a 2×2 experimental setup with agent role (dominant/submissive) and expressed emotion at the end of the scenario (angry/sad) as factors. No significant effect on the believability measure between the different conditions was found so the hypotheses cannot be confirmed. A significant influence of agent role was found on the perception of the emotional expressions, showing that social context influences perception of expressed emotions.

1 Introduction

One of the reasons to use a model of affect in a virtual agent is to enhance human-computer interaction with an agent [25]. A popular way to model affect in a virtual agent is by making use of appraisal based theory [19]. Some well-known examples of such models include EMA [9] and FLAME [7]. 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 [13]. In some situations it is not clear which type of person-environment relationship is most important for emotions at a specific time. In such situations the question

T. Bosse et al. (Eds.): Emotion Modeling, LNAI 8750, pp. 101–114, 2014.
DOI: 10.1007/978-3-319-12973-0_6

remains which of the possible emotions is perceived as more believable and what the factors are that determine believability.

According to all the previously mentioned models of emotion, both sadness and anger can be elicited if another person does something that has negative consequences for your own goals. Anger can be elicited as a result of the blameworthiness of the other person for an event and sadness can be elicited as a result of negative consequences of the event. Which appraisal the most important is, is not clear from the theories mentioned. According to recent research [14], 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 earlier. In this paper we use dominance as the appraisal factor that determines which of the two emotions should be expressed in that situation, with the aim to measure if this will increase the believability of the agent.

In other research about models of affect [1,8,16,22] sadness is related to low dominance or control and anger is related to high dominance or control. Also in research on the perception of emotional expressions the relation is found between anger and high dominance and sadness and low dominance [11]. In this paper we try to validate a simple model that uses dominance 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 reversed.

We test our model with a scenario in which the user acts in a way 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. We test a 2×2 setup with role (boss/candidate) and expression (anger/sadness) as factors. The hypothesis is supported when we observe that a boss who expresses anger and a candidate who expresses sadness both have higher believability than a sad boss and an angry candidate.

The negotiation is done with a virtual character that is able to show different emotions. The perception of these emotions has been evaluated in previous research [3]. We choose for this virtual character instead of a human character, because a virtual character offers much greater flexibility in the virtual training domain, as is also shown in [21]. The character can be manipulated to have different styles end preferences. The user can learn about the different situations that can occur during a negotiation.

In this experiment we evaluate the influence of the dominance variable on the perception of an emotional expression. Perceptions of emotional expressions have been studied before [3,11,12] but not much research has examinated this within a social context [24]. Recent psychological studies [23] show that the processing of a facial expression depends on the observer's information processing and on

social-relational factors, for example dominance. In other research [18] it is argued that for the perception of an emotion it can be important to show the emotion in a sequence of expressions. But since we are interested in the emotional reaction to a very specific action we use only a static response after the action.

The structure of this paper is as follows: first we discuss background research on the difference between sadness and anger. Then we explain our model and 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 of an individual that an event has negatively impacted the individual's goals (see e.g. [19]). 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 [14] 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 [17]. 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 [14] and the dominance from [17] 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 [23]. 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. In this research we manipulate the dominance of the perceiver of the emotion and see if this influences perception. Obviously both emotions make sense to express; however it can very well be that depending on the context one should be expressed, while the other should not. A pilot study is conducted to examine this in a structured way.

3 Method

We test our hypothesis with a scenario in which the users action 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 achieving an agreement at all. 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.

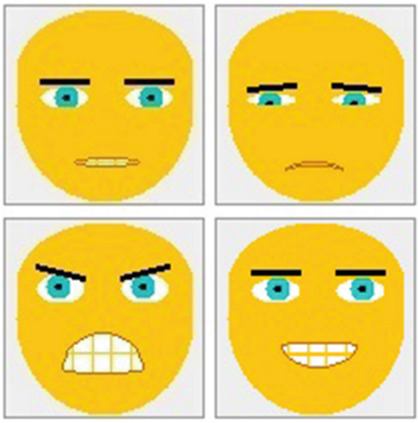

Fig. 1. Different expression of the AffectButton [2]

The experiment is conducted using an online questionnaire and a downloadable virtual reality scenario. A subject is semi-randomly allocated to one of 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 (2×2 between subject design). The experiment starts with some general questions and explanation of 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 Fig. 1. If the button is pressed the face remains fixed and a value for each of the PAD dimensions [17] is selected. The subject has to use the AffectButton to evaluate his/her own feeling at that moment and to evaluate how he/she thinks the agent is feeling. Next 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 1 to 5 point scale the emotional intensity for 6

basic emotions [6], where 1 stands for not present and 5 stands for very present. Finally we asked the subjects about the believability of the virtual character's reaction using the following 5-item questionnaire (Cronbach's alfa = 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. [4,12]
- The reaction of the agent was predictable. [12]

The answers on these question are given on a 1 to 5 Likert scale [15], where 1 means totally disagree and 5 means totally agree.

In total we 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 to spend relatively more 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 potential 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 participant 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 Fig. 2. During the rest of the scenario the expression of the agent is neutral.

4 Results

The experiment was conducted with in total 36 primarily Dutch participants, 8 (22 %) women and 28 (78 %) men not distributed equally between the groups,

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

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 Affect Measured with the AffectButton

A MANOVA was run to test the statistical significance of the results. The result of the 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 before the negotiation scenario as dependent variables, was significant ($p = 0{,}028$). From the univariate analysis it appeared that the dominance dimension differed significantly ($p = 0{,}011$) between the two roles. The effect of role on the pleasure dimension is nearly significant ($p = 0{,}054$). Mean dominance and pleasure are higher if the agent is the boss (mean $= 0{,}275$ STD $= 0{,}103$ and mean $= 0{,}360$ 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 before the scenario as dependent variables did not result in a significant difference ($p = 0{,}216$). This means that dominance manipulation was successful with respect to the perceived dominance of the virtual character before the scenario, but not with respect to the subject's own feeling of dominance before the scenario.

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 ($p = 0{,}007$) if the question is about the feelings of the other and not significance ($p = 0{,}582$) 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 ($p < 0{,}001$). 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 $= 0{,}082$). The

difference in the dominance dimensions was not different anymore as was the case with the measurement before the negotiation.

We also did a univariate analysis with the perceived dominance of the agent obtained through the AffectButton after the negotiation as independent variable and the expression of the agent as dependent variable. This produces a significant result ($p = 0{,}039$) where the perceived dominance is higher when the agent expresses anger and lower when the agent expresses sadness (mean $= 0{,}155$ STD $= 0{,}580$ and mean $= -0{,}255$ STD $= 0{,}552$).

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 ($p = 0{,}026$). 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 ($p = 0{,}013$). The univariate analysis showed that role significantly influences the perceived intensity of expressed surprise ($p = 0{,}003$) and expressed anxiety ($p = 0{,}022$). Other emotions did not produce a significant difference. Expressed anxiety was perceived stronger if the agent was the candidate (mean $= 1{,}889$ STD $= 0{,}195$) as compared to when 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 $= 0{,}193$) as compared to 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 ($p = 0{,}082$). 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 $= 0{,}109$). This observation is in accordance with the results from the AffectButton on the pleasure dimension.

4.3 Believability

A multivariate ANOVA (2×2) 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. A significant effect of role ($p < 0{,}001$) was observed. 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 ($p = 0{,}025$). 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[a]	0,126	2,611[b]	0,274	2,833[a]	0,213	2,777[a]	0,261	1,111[a]	0,190
Candidate	1,056[a]	0,126	2,778[b]	0,274	2,166[a]	0,213	3,888[a]	0,261	2,222[a]	0,190

[a] Significant difference, $p < .05$
[b] No significant difference, $p > .05$

5 Discussion

From these results several conclusions can be drawn. Manipulating the dominance dimensions did not result in an increase of the believability according to the participants. No significant difference between the four groups was found. There was however a difference in perception measured between the four groups. More surprise was perceived if the agent was the boss and more anxiety if the agent was the candidate. This result was true after seeing an expression of anger

and after seeing an expression of sadness. It is interesting that the virtual agent's role in a negotiation, the social context, has an impact on the perception of the virtual agent's emotional expression.

Anxiety and surprise are perceived in the same way as how people think the agent should normally feel after the negotiation scenario. Subjects project their own expectations on the expression of the agent. The dominance of the agent was perceived differently during the two measurements, using the AffectButton, conducted during the experiment. Before the negotiation scenario the boss agent was perceived as dominant but after the scenario the agent that expressed anger was perceived as dominant, regardless if that agent played the role of the boss or the candidate. These two findings result in the notion that emotional expressions as well as social context influence the internal model a person has about someone, and that this model in turn influences the perception of the emotional expression.

We will now discuss our findings in greater detail and give suggestions for future research as well as improvements to the current experimental set-up.

5.1 Perceived and Felt Dominance

Our analysis showed that subjects interpreted the boss agent to be more dominant than the candidate before the scenario, which was exactly the purpose of the manipulation. However, when the subjects rated the dominance of themselves, this was not significantly different between the two roles. It is probably harder to change the way you feel than to imagine how somebody else is feeling. The feeling of the self can also be influenced by experiences before the experiment. Since the agent is only introduced during the experiment, previous feelings do not have any influence on the dominance of the agent. After the negotiation scenario the perceived dominance of the agent was measured again using the AffectButton. Now there was a significant difference in this dominance based on the expressed emotion of the agent and not based on the role of the agent in the scenario. When anger is expressed, the perceived dominance of the agent is high and when sadness is expressed, the perceived dominance is low. This is in line with the reverse appraisal work as presented in [5]. The expression of the agent is interpreted as showing information about the mental state of the agent, in this case specifically the dominance.

The gender ratio was different between the conditions, but as shown in other research about the perception of emotional expressions [11] gender does not seem to influence the perception of emotional expressions.

5.2 Evaluation of the Reaction

The expression of the agent in the virtual scenario was 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 explained due to the agent's role. If the agent is the boss, the expression is perceived to contain more surprise and

happiness and less anxiety than if the agent is the candidate. The difference in happiness is also found using the AffectButton 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 [24] 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. As such, the result of this experiment also helps us 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 normally expected feeling is predicted to contain 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

An important potential explanation for the absence of a difference in believability between the groups is the changed perception of dominance. Before the scenario the boss agent is perceived as the most dominant one, but after the scenario the agent who expresses anger is perceived as the most dominant one, independent of the role of the agent in the scenario. This can be explained using the theory of mind [20]. People construct an internal model about the goals and the feelings of the agent. For this model they use all the information that is available to them; the introductory story (or context of the negotiation), the behavior during the negotiation and the final emotional reaction of the agent. The internal model of the agent is constantly updated to match the reality as closely as possible. This 'reverse engineering' of the internal model of the agent [10] or reverse appraisal [5] is in line with findings in other research. The fact that the pleasure and dominance values as derived from the AffectButton are significantly different before and after the negotiation, implies that the user changes his internal model of the agent depending on the negotiation and the final emotional expression.

Interesting future research that could confirm this theory could be to ask why people think the agent expressed a certain emotion. This way the internal model the user has about the agent can be retrieved and it can also be determined if the users interpret the situation in a broader context or in a narrow *negotiation goals not achieved* context. In the broader context it 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). This points towards another important notion for future research: a very detailed, well validated scenario is required to test hypotheses about computational models of appraisal theory. A small change of perspective can change the interpretation of the situation by subjects.

5.4 Normal Feeling of the Agent

Now we look at what subjects think is normal for the agent to feel. It interesting to see 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 the agent is expected to feel anger in equal amounts, this probably means that the blameworthiness of the user is more or less the same in both situations and thus independent of the role of the agent. However, the intensity of the expected anger felt 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 for the user 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. This manipulation should also be checked by asking the user who he thinks is responsible for the failure of the negotiation.

The expected intensity of the sadness felt 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 anxiety felt by the agent is also dependent 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 [9,19].

5.5 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 himself. 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 a clear effect on how one should express oneself can possible be explained by the presumption that subjects had different norms on which emotions to express in a situation, or by the presumption that in this situation one typically does not express a clear emotion. In future research it will be required to ask the participants why they think it is normal to express a certain

emotion. This way it can be identified how the scenario is interpreted by different users and a step forward can be made towards an unambiguous and validated scenario.

Beside the absence of a benchmark scenario, methodological issues could also explain for the absence of an effect. The study contained a large number of variables which from a methodological and statistical perspective ideally should have a larger number of subjects. One interesting idea for follow up is to do a conceptual replication with a larger number of subjects.

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. It is an important finding that perception of a facial expression is not fixed for a specific graphical representation, but is influenced by the scenario and social context in which the expression is shown.

The expression of anger by a dominant character is not perceived as in 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.

Finally, to validate this model one should ask the subject to explain the expression of the agent. This explanation can then be compared to the explanations offered by appraisal theories. From this it can be concluded if dominance is a factor in the perception of the emotional expressions.

Our research shows the importance of a tight relation between emotion psychology and virtual character evaluation, as well as the need for well-validated test scenarios to evaluated 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.

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