"I'm happy if you are happy." A model for emotional contagion in game characters

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ABSTRACT

Emotions play an important role in social interactions and as such, they are critical in creating engaging and believable characters that users can interact with.

Although there has been significant research on emotions, from a computational perspective, one area scarcely explored is the process of Emotional Contagion (EC). Emotional Contagion is the process through which a person's emotional state is influenced by other people's emotions. This process is especially important in group situations where the emotional states of individuals influence the behavior of others.

Our goal was to develop a computational model, based on the Emotional Contagion Scale (ECS), that would enrich group dynamics on virtual environments. This model supports agents with different susceptibilities to contagion, and also the influence of their extroversion personality trait and interpersonal relationships (intimacy and power difference) on the contagion process. It has been also included the process of emotional mood decay, as observed in humans. With these elements characterizing the agents at an individual level, this model can simulate a wide variety of social phenomena.

To evaluate the model, we developed a game prototype where the player (the main character) goes on a journey with two other characters (one with and another without our model).

The results suggest that players perceived differences in the emotional contagion susceptibility between those characters and considered the model-based agent significantly more enjoyable and friendlier.

Categories and Subject Descriptors

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Keywords

Affective computing, computational model, emotional contagion

1. INTRODUCTION

Characters in games are essential for players to have amazing, unforgettable experiences [15]. As such, for the past few years, many techniques have been developed to create engaging characters that, through the use of emotions, achieve more behavior realism and enhance interactions with users. However, in much of the work done, emotion modeling has been used primarily as a diagnostic channel, a way to emotionally describe the characters [16]. Some groundbreaking research is being done on achieving emotional behavior in agents [19, 11, 1], but many emotional processes and their interconnections are still far from explored in the realm of characters for computer games.

Indeed, emotions not only act on a personal level by interacting with numerous aspects of mental processes, like decision-making, planning, memory and attention [3], but they also have a great impact on human relationships and group dynamics. In spite of that, very little research has been done in modeling emotional dynamics in games, disregarding processes like emotional contagion that have been known to influence group behavior [12, 2]. Creating emotion models that can simulate group dynamics on games, not only allow the player to engage in more believable characters but can also promote new game experiences.

With this ideas in mind, we have created a computational model for virtual characters, that allows the simulation of the process of emotional contagion in a group of characters. The process is based on the Emotion Contagion Scale and is influenced by the individual's agents expressiveness and the agent's interpersonal relationships. The model was used successfully in a computer game, and its use has shown to increase the perceived emotional contagion elements in the characters, thus rendering them more natural.

This paper is organized as follows: first we will give a very short background on the process of emotion contagion, and its principal features. Then we describe the model for emotion contagion that was then used in the computer game scenario presented in the next section. Then we present the evaluation done on the model, in the context of the game, and discuss some of the achieved results, drawing some conclusions and proposing future work.

2. BACKGROUND AND RELATED WORK

Emotional Contagion (EC) is a social phenomenon, that stems from the people's ability to automatically and continuously mimic the other's facial, vocal and postural expressions, and consequently, being influenced by other's emotional state, resulting in a conversion of emotions [13, 7]. This process plays an important role in human interaction and personal relationships, because it provides valuable information by allowing people to understand and share each other's feelings [13]. To measure the susceptibility to other's emotions, Doherty [7] created and validated the Emotional Contagion (EC) Scale. With this scale it is possible to quantify the tendency to be influenced by other's emotional states regarding five basic emotions: love, happiness, fear, anger and sadness.

The EC process is especially important in group dynamics and its affects have been presented in several research studies. It was demonstrated that positive emotional contagion between group members increases group's cooperativeness, sense of higher risk performance and decreases the amount of group conflict [2]. Also emotion amplification can occur through a single member's expression of emotion and can provoke a spiral of contagion throughout the group [10, 9]. Such spirals can have both a positive or negative influence on the group and its goals [20].

It has also been suggested that there are external factors which might influence the contagion process [2] and individual's expressiveness [21], such as those of interpersonal relationships (through intimacy and social power) [21, 14, 18] and the personality trait extroversion [6].

In spite of these findings associated with the process of emotional contagion, there is still a lack of various computational models that allow for the simulation of this phenomenon, in particular in games. Research efforts in creating better game characters through emotion modeling have provided us with interesting results. For example, in FearNot! [1] the emotional status of an agent affects their motivations, priorities and relationships, and in particular it affects the relation established with the user/player. Other landmark systems such as [11], where appraisal is used for the emotional processing of the agents, have demonstrated very good results in terms of characters behavior generation.

On the other hand, there are a few computational models that try to capture the emotional contagion process, in particular the work by Bosse *et al.* [5] that created a model which could simulate the occurrence of emotion contagion spirals in groups. This model aimed at supporting the avoidance of negative spirals in teams. Their "Emotion Contagion Spiral Model" is based on the characterization of a dyadic relationship defined by the current level of emotion from both sender and receiver of an emotional expression. A different computational model of EC based on the EC scale (ECS) was proposed by Bispo *et al.* [4] where an individual agent is characterized by its "emotional status" which represent an emotion used as the input of the individual's perception when another agent's expression is absent and an "ECS Score" which determines its basic susceptibility. Yet, none of these models have been explored as a way to endow more believable social interactions between characters in computer games. Further, both of these systems are limited in the way they handle the emotional susceptibility of the individual characters, in particular, in relation to interpersonal relations.

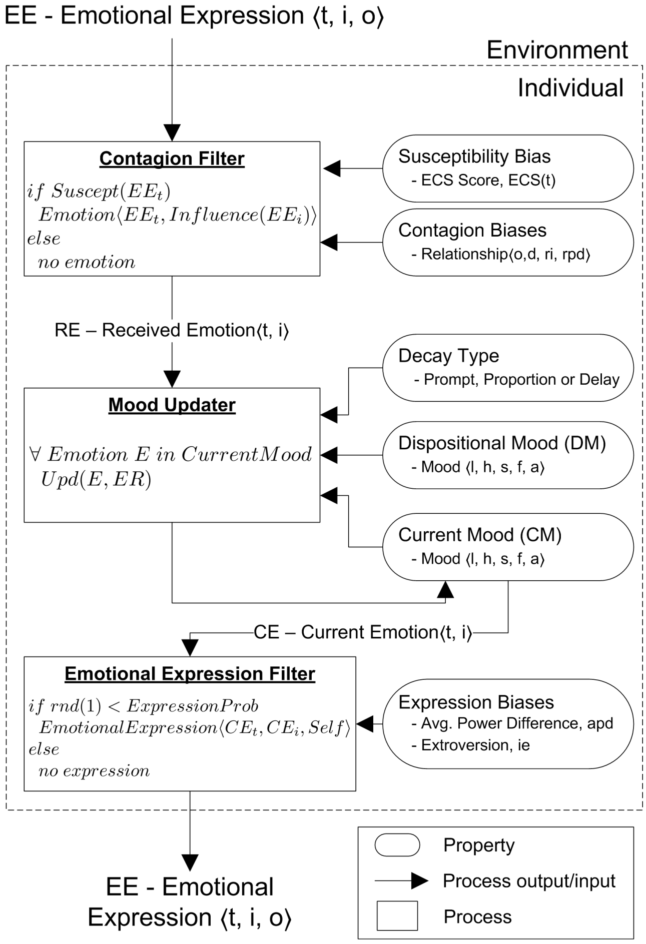

Figure 1: A generic EC model diagram.

Our aim was thus to develop a computational model for this type of simulations, and integrate it into a group of virtual characters in a computer game. The research question addressed in the paper investigates if the presence of such a computational model embedded in a computer game will endow the perception by the player of natural emotional contagion processes found in humans.

3. A GENERIC MODEL FOR EMOTIONAL CONTAGION

Our EC computer model builds upon the work of Bispo *et al.* [4] and keeps its core relationship with the ECS. In our work we focused on modeling aspects of an emotional expression mechanism and an emotional decay mechanism. Indeed, emotional expressions are the basis of emotional communication for EC and as such need to be properly modeled in order to create an EC interaction dynamics based on group properties instead of an unrealistic random based approach [4]. Furthermore, we introduced the influence of interpersonal relationships with the characteristics of intimacy and power difference. This is found to be an important bias in

EC group dynamics [18, 14]. In our model an agent has a "Current Mood" (CM) that represents his emotional state and he can communicate the CM's "Current Emotion" (CE) to others through the creation of an "Emotional Expression" (EE). Other agents capture this EE from the environment and filter it in the "Contagion Filter" to create a "Received Emotion" (RE) then used to update its "Current Mood" (CM) by the "Mood Updater". The conceptual map of an agent with our model is presented in Figure 1.

3.1 Fundamental Concepts

In order to describe our model there are four fundamental concepts: emotion, EE, mood and relationship. An emotion is represented by the tuple $\langle t, i \rangle$ where t represents its type and can be one of the five emotions our model uses based on the ECS[7, 8]: Love, Happiness, Sadness, Fear, Anger. The i property represents its intensity and is a positive real value with a parameterizable maximum value. An EE, the basis of emotional communication, is represented by the tuple $\langle t, i, o \rangle$ where the t and i represent the type and intensity of the associated emotion. The o identifies the transmitter of the expression. A mood is represented in our model by the tuple $\langle l, h, s, f, a \rangle$, where l, h, s, f and a are represented by an emotion tuple $\langle t, i \rangle$ for each type of emotion considered. The agent's current emotional state, CM, and his natural emotional state, "Dispositional Mood" DM, are represented by such a tuple. Finally, a relationship is represented with the tuple $\langle o, d, ri, rpd \rangle$ where o and d are the origin and target of the relationship. The ri is the relationship intimacy property and rpd the power difference.

3.2 Emotional Expression Filtering

The process of emotional communication has a deep impact on EC since EEs are the conveyors of emotion between individuals. Our process of emotional communication is modeled in the "Emotional Expression Filter" which uses two "Expression Biases". The ones used are the power difference of the agent in the group and personality. The agent decides if he expresses himself based on a probability calculated by equation 2 that combines both biases into single probability value. The power difference of the agent's relationships is used to calculate its power position in the group. An individual with a higher social power is more expressive [21]. It is calculated by equation 1 as the average power difference (apd) from the N relationships the agent has. The maximum influence this bias can have in expressiveness is controlled by the e_range parameter. This parameter is a percentage.

$$apd = (\sum_{i=1}^{N} Ri_{rpd})/N \quad (1)$$

For personality we model extroversion (ie) as it is the trait that influences the most emotional expression. An agent's expressiveness is proportional to ie, a value of 0 represents him as inexpressive and a value of 1 as very expressive.

$$BiasedExp = ie + apd * (1 - ie) * e\_range$$

$$ExpressionProb = \begin{cases} BiasedExp, & \text{if } BiasedExp \geq 0 \\ 0, & \text{if } BiasedExp < 0 \end{cases} \quad (2)$$

If it is decided that the agent will express an emotion, then an EE is created based on his CE. The CE is the highest valued emotion in the CM. The new expression is created as an EE tuple with the values $\langle CE_t, CE_i, Self \rangle$. The value $Self$ represents the identification of the agent where this process is occurring.

3.3 Contagion Filtering

We now understand how an agent expresses himself in the group. Next we address how based on an EE the agent can simulate the process of EC and be affected by others' emotional expressions.

In the "Contagion Filter" we retrieve a RE from the captured EE by applying perception biases. The first bias applied is the "Susceptibility Bias" which based on a received EE_t and the agent's own ECS score decides probabilistically if it is affected by the captured expression or not. Each agent has his own ECS score for each emotion type, obtained as a probability with the function $ECS(E_t)$. The decision process of this bias is formalized in equation 3 where $rnd(1)$ is a function that returns a random value between 0 and 1.

$$Suscept(EE_t) = \begin{cases} true & \text{if } rnd(1) \leq ECS(EE_t) \\ false & \text{if } rnd(1) > ECS(EE_t) \end{cases} \quad (3)$$

After being decided if an agent is affected by the received expression the application of the "Contagion Biases" determines how the EE's associated emotion is influenced in terms of intensity. Some biases can make the perception more or less intense, the ones included in our model are two relationship characteristics: intimacy[18] and power difference[18, 14]. In our relationship tuple, these influences are modeled through ri and rpd parameters. The ri can have no influence if $ri = 0$ (not intimate) to a proportionally increasing positive influence until the maximum for $ri = 1$ (very intimate). The rpd can have a negative influence when $rpd < 0$ (the agent is inferior), no influence when $rpd = 0$ (no power difference) to a positive influence when $rpd > 0$ (the agent is superior). These influences on a received EE_i are given by equation 4. The maximum influence either ri or rpd of a relationship can have is controlled by the percentage parameters i_range and p_range respectively.

$$Influence(EE_i) = EE_i(1 + i\_range * ri + p\_range * rpd) \quad (4)$$

If $Suscept(EE_t) = true$ then the "Contagion Filter" creates a RE with the values $\langle EE_t, Influence(EE_i) \rangle$ otherwise no emotion is created.

3.4 Mood Updater

Finally the agent's "Mood Updater" process uses the RE, CM, DM and a decay type to update the CM as given by equation 5. The DM is described by a mood tuple representing the agent's natural emotional status to which it tends when unstimulated emotionally.

If a RE is effectively received as an input for the "Mood Updater" the EC mechanism of emotional experience is simulated. This is done by adding RE_i to the intensity of the emotion in CM with a type corresponding to RE_t.

Any emotion in CM that is unaffected simulates the emotional decay mechanism. It changes the intensity of the emotion by interpolating between its original intensity in CM and that of the emotion in DM with the corresponding type. This mechanism is formalized in the $Decay$ function and the interpolation decays used in our model follow previous work [17]: prompt (exponential), proportion (linear) or delay (logarithmic). These different types of interpolation enable our model to create agents with different rates of emotional decay as it happens in people [17]. As such, an agent only uses one type of interpolation in its decay process. This process enables the application of the model in domains such as games where interaction between agents are not continuous and we need to simulate the decay of emotional levels to represent situations where agents are not interacting.

$$\forall\ Emotion\ E\ in\ Mood\langle l, h, s, f, a \rangle$$

$$Upd(E, ER) = \begin{cases} E_i = E_i + ER_i, & \text{if } E_t \equiv ER_t \\ E_i = Decay(E_i, DM), & \text{otherwise} \end{cases} \quad (5)$$

Figure 2: Prototype game screenshot

4. GAME SCENARIO

4.1 Game Description

Dragon Protectors is a prototype turn based role-playing computer game where our model was implemented. The game begins with an introduction screen where the story is explained, engaging the player to embark on a journey helping three heroes to save their dragon friends that once protected their village.

The player controls a party of three characters that is initially placed on a map. Several event places are marked and the player must visit all of them in order to find all the monsters and finish the game.

During the game, the player can encounter three types of events: find itens, talk to a non-player character (NPC) or engage in combat with a monster. In each event the characters are always presented in the same order: the first named Joe, followed by Ben and Ace. In our scenario, our model was implemented in Joe and Ben, but not on Ace, our control agent. All three are visually distinguishable by their hair color and clothing (see Figure 2).

Each character has a set of stats which are:

Health Points - the amount of life points that characters still has;

Attack - is the average of life points that characters can take from the enemy, each time he attacks;

Defense - the number of points subtracted from the damage taken in a monster's attack;

Modifiers - an attribute that changes his current stats - adding or subtracting points;

As a hidden stat, characters also had **Health Regeneration Points** which are the number of life points that will increase per tick, when he's not taking damage.

On each event screen, the player has a set of possible actions that he or she can use. When the player is presented with an NPC he or she can choose to talk to it. The player can also open treasure chests, or use different attacks while fighting monsters. In all events it is always possible to leave the screen except when characters are on a combat.

All the events can trigger an emotion on Joe, the first character, and if triggered he can then express that emotion, using our model's expression component. That emotional expression can then affect the mood of our model-based agent Ben by using our EC component. The affected agent can emotionally express or not, in response of that initial expression. In every Ace's turns, the character without the model, he had a probability to express a random emotion.

In combat events the model-based character as well as the control agent can react emotionally to the impact of seeing a monster which may cause fear and the damage impact inflicted by the monsters to himself, which may cause anger. When fighting a monster Ben can also be influenced by the emotional contagion process as normal.

In each turn the mood decays, and because it's a turn based game, even while traveling on the map, characters mood will decrease of intensity.

In order to promote interaction between emotions and the game, we introduced the concept of modifiers, that will act as consequences of the emotions experienced by a character. Emotions act as modifiers to character's current stats:

Happiness - adds Health Regeneration Points;

Sadness - removes Health Regeneration Points;

Love - increases character's Defense;

Angry - unlocks the Berserk Attack (a stronger attack than the default one);

Fear - unlocks Fearful Attack (a weaker attack than the default one);

Some items found in treasure chests can also act as modifiers:

Sword - adds Attack points to whatever attack the players choose;

Potion - increases character's Defense;

Although the player was unaware, all the events were presented in the same order (see Table 1).

4.2 Implementation

The previously described game scenario that incorporates the developed EC model was implemented in a game prototype in order to perform our user tests. The EC model was implemented as a generic C# library so that it can be used in applications other than ours. The game prototype was implemented in a C# Microsoft XNA Framework (version 3.1) game application using Microsoft .NET Framework version 3.5 and integrated the developed EC library in order to add the EC behaviors to our agents.

Table 1: Order of events and emotions impact.

#	Event	Emotions
1	Found a dragon already dead	Sadness
2	Find his girlfriend picking up some flowers	Love
3	Lose an item with sentimental value	Sadness
4	Find a sword in a treasure chest	Happiness
5	Combat with a monster	Fear, Anger
6	Find trash in a treasure chest	Sadness
7	Receive a letter from his little brother	Love
8	Find a potion in a treasure chest	Happy
9	Combat with a monster	Fear, Anger

5. EVALUATION

The goal of this experiment was to evaluate if users perceived differences in emotional contagion susceptibility between a agent with a model and an agent without a model, namely Ben and Ace. For that, participants had to play the prototype game and fill up a questionnaire.

5.1 Participants

The study had the participation of 34 students from two universities. The sample consisted of 28 males and 6 females, and their ages vary between 20 and 30 years old (M= 25; SD = 3). Participants had on average some experience with games (M = 2; SD = 1, on a scale from 0 to 4). They had never interacted with our prototype game before and had no previous knowledge of the experiment objectives.

5.2 Material

The questionnaire presented to the participants, consisted of two parts. The first part had an introduction, where players were asked to answer all the questions and alerted to pay attention to the emotions in the game. Following that, were presented the game instructions, that explained the gameplay and game interface. Next it asked about gender and age and a scale measuring what type of player they were, from 0 do 4, 0 being not a player, 1 being casual and 4 being hardcore. The second part of the questionnaire had an Emotional Contagion Scale applied to both agents.

In order to assess the player's perception of the characters susceptibility to emotional contagions a 12-item Emotional Contagion Scale adaptation was used. The Emotional Contagion Scale was created and validated by Doherty [7]. It was designed to measure the susceptibility regarding the contagion of five basic emotions (happiness, love, fear, anger and sadness) and a general awareness and sensitivity to emotions of others. Two affirmations were used to measure each dimension.

The scale used in our study was adapted from the Doherty's Emotional Contagion Scale [7] to our scenario. Participants were asked to indicate their responses on a four-point scale, ranged from 1 - never to 4 - always, for each two characters. Higher scores indicate that players perceived that character to be more susceptibility to emotional contagion on that dimension. We also asked participants if they enjoy having that character in the party, and also if that character is a friendly member.

5.3 Procedure

At the beginning of the experiment, participants were instructed to read and fill the first part of the questionnaire before playing Dragon Protectors. They were also informed to fill out the second part of the questionnaire after finishing the game.

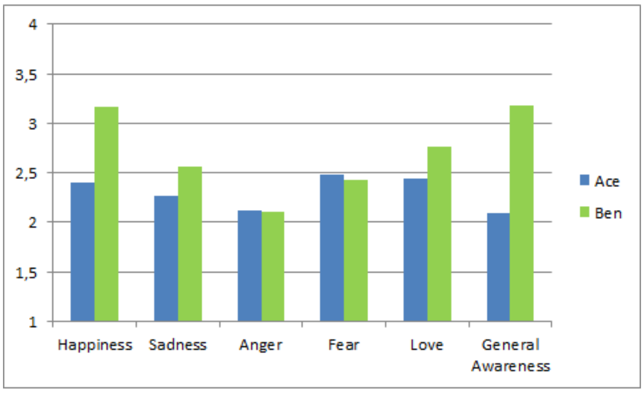

Figure 3: Averages of dimensions of the emotional contagion scale for each character.

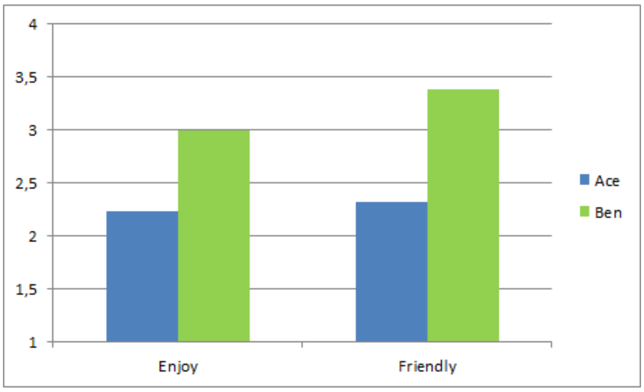

Figure 4: Average of enjoyment and friendliness for each character.

5.4 Results

For each character's emotional dimension and for each participant we calculated the mean of the two items that composed that dimension.

Since some dimensions did not follow a normal distribution, homocedasticity is not met and as such we used an non-parametric test. A Wilcoxon Signed Ranks Test was then conducted to evaluate whether participants observed greater emotional contagion on the agent with the model than the agent without it as well as which agent would they enjoy most and considered more friendly.

Ben was rated significantly higher than Ace in the dimensions Happiness (Mdn = 3 vs 2, Z = -2.53, p = 0.011) and in the General Awareness dimension (Mdn = 3.5 vs 2, Z = -2.67, p = 0.008), Ben was also rated higher, although not significantly, in the dimensions Sadness (Mdn = 2.5 vs 2, Z = -1.55, p = 0.122) and Love (Mdn = 3 vs 2.5, Z = -1.17, p = 0.241). They were rated the same way in Anger (Mdn = 2, Z = -1.81, p = 0.071) and Fear (Mdn = 2.5, Z = -.57, p = 0.570) (See Figure 3). Participants also enjoyed Ben significantly more (Mdn = 3 vs 2, Z = -2.59, p = 0.010) and considered as being significantly more friendly (Mdn = 4 vs

2, Z = -2.51, p = 0.012) than Ace (See Figure 4).

6. FUTURE WORK

As future work we intend to perform further user tests in order to determine if the influence of interpersonal relationships can be perceived by players, creating richer group dynamics, that our model can presently simulate.

Another suggestion is the integration of this model with an Emotion based Architecture, that could take care of the mood interpretation as well as all appraisal mechanisms, allowing greater fidelity and better use of this model in other domains. A possible feature would also be the implementation of mixture emotions and their effect, allowing a better use of the moods.

7. CONCLUSION

We presented a Generic Model of Emotional Contagion able to simulate the process of EC with interpersonal relationships and personality influence. With this model is possible to simulate different kinds of emotional enriched group situations, to have dynamics in mixed groups like superiors versus subordinates, extroverts versus intimates, or even mixed scenarios with difficult to predict dynamics.

Our evaluation showed that users perceived differences between the two agents, considering the agent with the model as being more susceptible to emotional contagion than the agent without the model regarding all dimensions except Anger and Fear. The fact that those two dimensions were rated similar can be due to the fact that they were the only two that were also induced to the control agent as well as the model-based agent. In the beginning of combat, all agents could feel and express Fear when first faced the monster, and every time an agent was attacked he could also express Anger. Even with the randomness of the control agent, participants may had been sensible to this consistency of behavior in this character, as such he was rated higher in those two dimensions, probably not because the agent was really considered as being emotionally contagioned but because he expressed those feelings in a consistent way. Although participants rated the model-based agent higher in almost every dimension, those differences where not significant, and that may have been caused by the randomness of the control agent. Even with his randomness sometimes the emotion expressed by him went accordingly to the actual event, and because the game has only few events, to make the experiment shorter, participants may not have had the time needed to perceive him as more inconsistent.

Participants also rated Ben as being more enjoyable and friendly, and although those differences were not significant, these with other results show that this model may improve the player experience.

8. REFERENCES

[1] R. Aylett, S. Louchart, J. Dias, A. Paiva, and M. Vala. FearNot!-an experiment in emergent narrative. In *Intelligent Virtual Agents*, pages 305–316. Springer, 2005.

[2] S. Barsade. The Ripple Effect: Emotional Contagion and Its Influence on Group Behavior. *Administrative Science Quarterly*, 47(4):644–677, 2002.

[3] L. Berkowitz. *Causes and consequences of feelings.* Cambridge Univ Pr, 2000.

[4] J. Bispo and A. Paiva. A model for Emotional Contagion Based on the Emotional Contagion Scale. In *Affective Computing and Intelligent Interaction and Workshops, 2009. ACII 2009. 3rd International Conference*, pages 1–6. IEEE, 2009.

[5] T. Bosse, R. Duell, Z. Memon, J. Treur, and C. van der Wal. A Multi-agent Model for Emotion Contagion Spirals Integrated within a Supporting Ambient Agent Model. *Principles of Practice in Multi-Agent Systems*, pages 48–67, 2009.

[6] R. Buck. *The communication of emotion.* Guilford Press New York, 1984.

[7] R. Doherty. The emotional contagion scale: A measure of individual differences. *Journal of Nonverbal Behavior*, 21(2):131–154, 1997.

[8] K. Fischer, P. Shaver, and P. Carnochan. How emotions develop and how they organise development. *Cognition & Emotion*, 4(2):81–127, 1990.

[9] B. Fredrickson. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American psychologist*, 56(3):218–226, 2001.

[10] B. Fredrickson and T. Joiner. Positive emotions trigger upward spirals toward emotional well-being. *Psychological Science*, 13(2):172, 2002.

[11] J. Gratch and S. Marsella. A domain-independent framework for modeling emotion. *Cognitive Systems Research*, 5(4):269–306, 2004.

[12] E. Hatfield, J. Cacioppo, and R. Rapson. Primitive emotional contagion. *Review of personality and social psychology*, 14:151–177, 1992.

[13] E. Hatfield, J. Cacioppo, and R. Rapson. Emotional contagion. *Current Directions in Psychological Science*, 2:96–99, 1993.

[14] C. Hsee, E. Hatfield, J. Carlson, and C. Chemtob. The effect of power on susceptibility to emotional contagion. *Cognition & Emotion*, 4(4):327–340, 1990.

[15] K. Isbister. *Better game characters by design: A psychological approach.* Morgan Kaufmann Pub, 2006.

[16] D. Isla and B. Blumberg. New challenges for character-based ai for games. In *AAAI Spring-Symposium on AI and Interactive Entertainment*, 2002.

[17] H. Junseok, J. Chansun, P. Junhyung, R. Jihye, and K. Ilju. An artificial emotion model for visualizing emotion of characters. *Proceedings of World Academy of Science: Engineering & Technology*, 50:567 – 573, 2009.

[18] M. Kimura, I. Daibo, and M. Yogo. The study of emotional contagion from the perspective of interpersonal relationships. *Social Behavior and Personality: an international journal*, 36(1):27–42, 2008.

[19] M. Mateas and A. Stern. Façade: An experiment in building a fully-realized interactive drama. In *Game Developers Conference, Game Design track.* Citeseer, 2003.

[20] I. Poggi. Enthusiasm and Its Contagion: Nature and Function. *Affective Computing and Intelligent Interaction*, pages 410–421, 2007.

[21] S. Snodgrass. Women's intuition: The effect of

subordinate role on interpersonal sensitivity. *Journal of Personality and Social Psychology*, 49(1):146–155, 1985.