

Humor and Embodied Conversational Agents

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Abstract

This report surveys the role of humor in human-to-human interaction and the possible role of humor in human-computer interaction. The aim is to see whether it is useful for embodied conversational agents to integrate humor capabilities in their internal model of intelligence, emotions and interaction (verbal and nonverbal) capabilities. A current state of the art of research in embodied conversational agents, affective computing and verbal and nonverbal interaction is presented. The report adheres to the 'Computers Are Social Actors' paradigm to assume that human conversational partners of embodied conversational agents assign human properties to these agents, including humor.

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1 Introduction

When we consider research on the role of human characteristics in the user interface of computers, it is certainly not the case that no attention has been paid to the role of humor. However, when we compare efforts in this area with efforts and experiments that demonstrate the positive role of general emotion modeling in the user interface, then we must conclude that attention is still minimal. As we all know, a computer can be a source to frustration rather than enjoyment. The majority of research is focused on detecting a user’s frustration (Klein et al., 2002; Picard et al., 2002), and not on enjoyment. How to prevent frustration by making interaction with a computer more natural and more enjoyable is the aim of this report.

Embodied conversational agents have been introduced to play, among others, the role of conversational partner for the computer user. Rather than addressing the ‘machine’, the user addresses virtual agents that have particular capabilities and can be made responsible for certain tasks. The user may interact with embodied conversational agents to engage in an information

service dialogue, a transaction dialogue, to solve a problem cooperatively, perform a task, or to engage in a virtual meeting. Other obvious applications can be found in the areas of education (including training and simulation), electronic commerce and teleconferencing. In this interaction with embodied conversational agents, verbal and nonverbal communication is equally important. Multimodal emotion display and detection are among the research issues in this area of human-computer interaction. And so are investigations in the role of humor in human-computer interaction.

In previous years researchers have discussed the potential role of humor in the interface. However, during these years the potential role of embodied conversational agents was not at all clear, and no attention was paid to their possible role in the interface. Useful observations about the positive role of humor in the interface were made by Binsted (1995). Humans use humor to ease communication problems and in a similar way humor can be used to solve communication problems that arise with human-computer interaction. Binsted emphasizes the role of humor in natural language interfaces. Humor can help to make the imperfections of natural language interfaces more acceptable for the users and when humor is sparingly and carefully used it can make natural language interfaces much friendlier.

This report will discuss the role of humor for embodied conversational agents in the interface. It is a discussion on the possible role of humor support in the context of the design and implementation of embodied conversational agents. We start with a short overview of research on embodied conversational agents, including developments in multimodal emotion display. Underlying questions are: Can they be made 'believable', i.e. sufficiently convincing as conversational partner? This survey is followed (in section 3) by a discussion on the CASA ('Computers Are Social Actors') paradigm. In particular we look at the question: Can we expect that humans contribute human-like properties to these agents that can help in obtaining more enjoyable interactions? Next we will look at the role of humor in human-human interaction (section 4). General issues concerning trust and interpersonal attraction will be discussed. Section 5 is about appreciation of humor display for embodied conversational agents. What are the technological possibilities and problems? Section 6 has some preliminary observations on a possible appraisal of events in order to decide, by an agent, that the event is humorous. We make a modest comparison with emotion research. Section 7 contains the conclusions of this report.

2 Embodied Conversational Agents

Embodied conversational agents (ECAs) have become a well-established research area. Embodied agents are agents that are visible in the interface as animated cartoon characters or animated objects resembling human beings. Sometimes they just consist of an animated talking face, displaying facial expressions and, when using speech synthesis, having lip synchronization. These agents are used to inform and explain or even to demonstrate products or sequences of activities in educational, e-commerce or entertainment settings. Experiments have shown that ECAs can increase the motivation of a student or a user interacting with the system. Lester et al. (1997) showed that a display of involvement by an embodied conversational agent motivates a student in doing (and continuing) his or her learning task. Some examples of embodied conversational agents are shown in Figure 1. From left to right we see: Jennifer James, a car saleswoman who attempts to build relationships of affection, trust and loyalty with her

customers, Karin, informing about theatre performances and selling tickets, Steve, educating a student about maintaining complex machinery, and Linda, a learning guide.

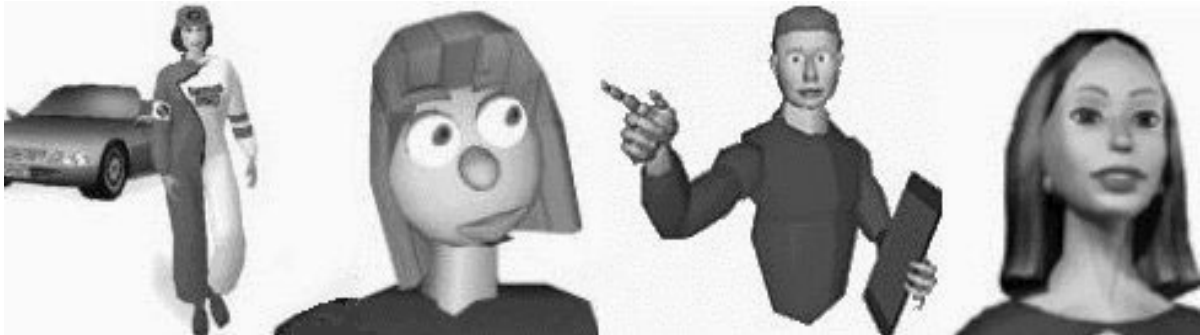


Figure 1 Examples of 2D and 3D embodied agents

2.1 Developments In Embodied Conversational Agents

Current ECA research deals with improving intelligent behavior of these agents, but also with adding emotional behavior and personality. Improving intelligent behavior requires using techniques from artificial intelligence, in particular natural language processing. Domain knowledge and reasoning capabilities have to be modeled. Agent models have been developed that allow separation between the beliefs, desires and intentions of an agent. For systems consisting of multiple agents formal communication languages have been developed that allow the transfer of information from one agent to another. Together with dialogue modeling techniques rudimentary natural language interaction with such agents is becoming possible. Speech input remains difficult to realize, speech output can be of acceptable quality.

Despite improvements it cannot be expected that in the future these agents can match human capabilities. This does not mean they cannot play a useful role. Bates (1992) introduced the notion of ‘believability’ in this field of research. Believability is present in an ECA when despite a lack of realism communication using a multiple of modalities leads to a suspension of disbelief by the human conversational partner.

2.2 Nonverbal and Affective Interaction for Embodied Agents

An embodied agent has a face. It may have a body, arms, hands and legs. We can give it rudimentary intelligence and capabilities to have verbal and nonverbal interaction. Nonverbal signals come from facial expressions, gaze behavior, eyebrow movements, gestures, body posture, and head and body movements. But they are also available in the voice of an ECA. Communicative behavior can be made dependent on the personality that has been modeled in an ECA.

In previous years we have seen the emergence of affective computing. Although many research results on affect are available, it is certainly not the case that a comprehensive theory of affect modeling is available. Reasons to include emotion modeling in intelligent systems are, among others, to enable decision-making in situations where it is difficult, if not impossible, to make rational decisions, to afford recognition of a user’s emotions in order to give better and more natural feedback, and to provide display of emotions. Especially when the interface includes an

ECA, it seems rather obvious that the user expects a display of emotions and some recognition of emotions by the embodied agent. On the other hand, in order to improve the interaction performance of embodied agents they should integrate and use multimodal information obtained from their human conversational partner. Although measurement techniques and technology are becoming available to detect multimodal displayed emotions in human interactants (cameras, microphones, eye and head trackers, expression glasses, face sensors, movement sensors, pressure sensitive devices, haptic devices and physiological sensors) here we will not discuss the display of humor emotions, e.g. enjoyment, by the human interactant (and preferably be perceived by an ECA).

Speech and facial expressions are the primary sources for obtaining information of the affective state of an interactant. Therefore an ECA needs to be able to display emotions through facial expressions and the voice. In speech, emotion changes can be detected by looking at deviations from personal, habitual vocal settings of a speaker because of emotional arousal. Cues come from loudness, pitch, vibrato, precision of articulation, etc. (Kappas et al., 1991).

To describe emotions and their visible facial actions, facial (movement) coding systems have been introduced. In these systems facial units have been selected to make up configurations of muscle groups associated with particular emotions. The timing of facial actions is also described. Using these systems, the relation between emotions and facial movements can be studied and it can be described how emotion representations can be mapped on the contraction levels of muscle configurations. Modalities in the face that show affect also include movements of lips, eyebrows, color changes in the face, eye movement and blinking rate. Cues combine into expressions of anger, into smiles, grimaces or frowns, into yawns, jaw-droop, etc. Happiness, for example, may show in increasing blinking rate. Obviously, a designer can deliberately put emphasis on particular facial actions during interaction. In Figure 2 we display a face that uses a fuzzy-rule based system to map an emotional state on muscle contraction values (Bui et al., 2001). The fuzzy system allows the display of intensities and blends of emotions in the face.

3 Computers and Embodied Conversational Agents as Social Actors

Embodied agents are, among others, meant to act as conversational partners for computer users. An obvious question is whether they, despite available verbal and nonverbal communication

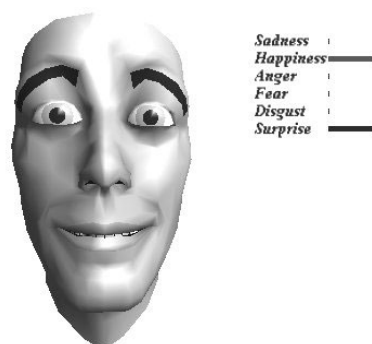


Figure 2 Blending of happiness and surprise

capabilities, will be accepted as conversational partners. Can we replace one of the humans in a human-to-human interaction by an embodied conversational agent without being able to observe serious changes in the interaction behavior of the remaining human? Can we model human communication characteristics in an embodied conversational agent that

guarantee or improve natural interaction between artificial agent and human partner? Obviously, whether something is an improvement or more natural depends very much on the context of the interaction, but being able to model such characteristics allows a designer of an interface containing embodied agents to make decisions about desired interactions.

In the research on the 'computers are social actors' (CASA) paradigm (Reeves & Nass, 1996) it has been convincingly demonstrated that people interact with computers as they were social actors. Due to the way we can let a computer interact, people may find the computer polite, dominant, extrovert, introvert, or whatever attitudes or personality (traits) we can display in a computer. Moreover, they react to these attitudes and traits as if a human being displayed them. As an example, consider the situation where a person interacts with the computer in order to perform a certain task. When, after completing the task, the person is asked by the same computer about its (i.e., the computer's) behavior, the user is much more positive than when asked this question while sitting behind an other computer.

In Friedman (1997) research is reported where in the interaction with computer users the computer is represented as a talking face. Again, the starting point is how human facial appearance influences behavior and expectations in face-to-face conversations. For example, a happy, friendly face predicts an enjoyable interaction. In experiments people were asked to talk to different synthetic faces and comparisons were made with a situation where the information was presented by text. General observation were that people behave more socially when communicating with a talking face, they are more attentive, they present themselves in a more positive light and they attribute personality characteristics to the talking face. It was shown that different faces and facial expressions have impact on the way the user conceives the computer and also on the interaction behavior of the user.

From these experiments we conclude that it is possible, at least in principle, to design systems and more in particular embodied agents that are perceived as social actors and that can display characteristics that elicit positive feelings about an interaction, even though the interaction is not considered as perfect from the user's point of view. In the next section we will study in some more detail the role of humor in interpersonal interaction with the now obvious aim to see whether it is useful to introduce humor characteristics that are known to improve interaction in human-human interaction in the model of agent-human interaction.

4 The Role of Humor In Interpersonal Interaction

In interpersonal interactions humans use humor, humans smile and humans laugh. Humor can be spontaneous, but it can also serve a social role and be used deliberately. A smile can be the effect of appreciating a humorous event, but it can also be used to regulate the conversation. A laugh can be spontaneous but can also mask disagreement or be cynical. Research has shown that laughs are related to topic shifts in a conversation and phases in negotiations or problem solving tasks. In an educational situation humor can be used by the teacher to catch students' attention but also to foster critical thinking. Humor allows criticism to be smoothed, stress can be relieved and students can become more involved in joint classroom activities by the use of humor. Humor can also help when it comes to frustration. In an (E-)commerce situation negotiators use humor to induce trust.

Here we discuss the role of humor in human-human interaction. Results from experimental research are surveyed. First we are concerned with general issues, not necessarily connected to a particular domain, but playing a role in human-human interaction in general: trust, interpersonal attraction and humor support in a conversation. More topics could have been chosen, but some of these arise naturally when later in this section domains are discussed where in the near future embodied conversational agents will play the roles of one or more of the conversational partners in the current real-life situations. The domains that are chosen are education, information services and commerce, meetings, and negotiations.

4.1 General Issues: Support, Trust, and Attraction

It is possible to look at preconceived aims of conversational partners to create humor during a conversation or discussion. However, this report rather looks at situations where humor occurs spontaneously during an interaction or where it occurs in a supporting role, for example to hide embarrassment, to dominate the discussion or to change the topic. Some of these roles will get more attention in the next section. The emphasis here is on the role of humor to induce trust, interpersonal attraction and the appreciation of humor during a conversation.

Humans employ a wide range of humor in conversations. Humor support, or the reaction to humor is an important aspect of personal interaction and the given support shows the understanding and appreciation of humor. In Hay (2001) it is pointed out that there are many different support strategies. Which strategy can be used in a certain situation is mainly determined by the context of the humorous event. The strategy can include smiles and laughter, the contribution of more humor, echoing the humor, offering sympathy or contradicting self-deprecating humor. There are also situations in which no support is necessary. In order to give full humor support, humor has to be recognized, understood and appreciated. These factors determine our level of agreement on a humorous event and how we want to support the humor.

Humor support may show our involvement in a discussion, our motivation to continue and how much we enjoy the conversation or interaction. Similarity in appreciation also supports interpersonal attraction (Cann et al., 1997). This observation is of interest when later we discuss the use of embodied conversational agents in user interfaces. Sense of humor is generally considered a highly valued characteristic of self and others. Nearly everybody claims to have an average to above average sense of humor. Perceived similarity in humor appreciation can therefore be an important dimension when designing for interpersonal attraction. In Cann's experiments participants had to interact with an unseen stranger. Before the interaction ratings were made of the attitudes of the participants and they were led to believe that the stranger had similar or dissimilar attitudes. The stranger responded either positively or neutrally to a participant's attempt to humor. The results tell us that similarity in humor appreciation is able to negate the negative effects of dissimilarity for other attitudes when looking at interpersonal attraction. Other studies show how similarity in attitudes is related to the development of a friendship relationship. The development of a friendship relationship requires time, but especially in the initiation phase the kinds of similarities mentioned above can be exploited.

Friendship and intimacy are also closely related. Trust is an essential aspect of intimacy and the hypothesis that there also exists a correlation between humor and trust has been confirmed (Hampes, 1999). There are three key-factors that help us to understand this relationship. The most important factor is the demonstrated relation between humor and extroversion (Ruch, 1994). When we break up extroversion into basic components like warmth, gregariousness,

assertiveness and positive emotions it becomes obvious that extroversion involves trust. Another factor, mentioned above, is the fact that humor is closely related to a high self-esteem. People who are proud of who they are, are more likely to trust other persons and to reveal themselves to them. A third factor is that humorous persons are effective in dealing with stress (Fry, 1995). They are well qualified to deal with the stress or anxieties involved in interpersonal relationships and therefore more willing to enter relationships.

4.2 Conversations and Goal-Directed Dialogues

Humor plays a role in daily conversations. People smile and laugh, certainly not necessarily because someone pursues the goal of being funny or tells a joke, but because the conversational partners recognize the possibility to make a funny remark fully deliberately, fully spontaneously, or something in between, taking into account social (display) rules. We will not go deeply into the role of humor in daily conversations, small talk or in entertainment situations. In daily conversations humor very often plays a social role. Not only in conversations with friends and relatives, but also in the interaction with a real estate agent, a saleswoman, a tourist guide, a receptionist or a bartender. It is difficult to design experiments intended to find the role played by humor in human-to-human interactions, when no specific goals are defined. Even experiments related to rather straightforward business-to-consumer relationships are difficult to find. Rather we have to deal in these situations with regulations protecting a customer from humor by a salesman (never use sarcasm; don't make jokes at the expense of the customer, etc.).

When looking at the more goal-directed situations teaching seems to be one field where the use of humor has received reasonable attention. Many benefits have been mentioned regarding humor in the teaching or learning process and sometimes made explicit in experiments. Humor contributes to motivation attention, promotion of comprehension and retention of information, a more pleasurable learning experience, a development of affective feelings toward content, fostering of creative thinking, reducing anxiety, etc. The role of humor during instruction, its social and affective functions for teaching and the implications for classroom practice has been discussed in several papers. However, despite the many experiments, it seems to be hard to generalize from the experiments that are conducted (Ziv, 1988).

The role of humor and laughter during negotiation processes is another issue that has received attention. In (Adelswärd et al., 1998) several tape recordings made during international negotiations have been analyzed. One of their research questions concerned the interactional position of laughter: When do we laugh during interaction? Different phases during negotiation can be distinguished. Laughing events turned out to be related to the phase boundaries and also to discourse boundaries (topic shifts). Hence, laughter serves interactional goals. The distinction between unilateral and joint laughter is also important. Mutual laughter often reflects consensus, unilateral laughter often serves the same function as intonation.

Describing and explaining humor in small task-oriented meetings is the topic of a study conducted by Consalvo (1989). An interesting and unforeseen finding was the patterned occurrence of laughter associated with the different phases of the meeting. The opening phase is characterized by its stiffness and serious tone and the atmosphere of distrust. Humor in this phase is infrequent. This contrasts with the second, transitional phase that lasts only a couple of minutes and the humorous interactions are frequent and for the first time during the meeting all participants laugh. Their laughter conveys the agreement that the problem can be solved and the commitment of the individual participants. The last phase, the problem-solving phase contains a

lot more humorous events than the opening phase, but still less than the transitional phase. In this way humor echoes the progression of a meeting.

5 Humor and Emotion in Embodied Conversational Agents

As illustrated in the previous section, humor plays an important role in interpersonal interactions. From the many CASA experiments we may extrapolate that humor will play a similar role in human-computer interactions. This has been confirmed with some specially designed experiments (Morkes et al., 2000) to examine the effects of humor in task-oriented computer-mediated communication and in human-computer interaction. It was shown that humor could have many positive effects. For example, participants who received jokes during the interaction rated a system as more likable and competent. They smiled and laughed more; they responded in a more sociable manner and reported greater cooperation. According to the authors the study provided strong evidence that humor should be incorporated in computer mediated communication and human-computer interaction systems.

Being able to look at computers as social actors allows us to have more natural interaction (when desired) and it allows us to influence the interaction on aspects like emotions, trust, personality, attraction and enjoyment. Many of these issues are already subject of research in human-computer interaction and especially in research on ECAs. For example, the role of small talk in inducing trust in an embodied real estate agent is discussed in (Bickmore & Cassell, 2001) and a discussion on friendship in the context of the design and implementation of ECAs has been presented in (Stronks et al., 2002).

Especially emotion display has become a well-established area, very much stimulated by available theories of emotions on the one hand and theories of human facial expressions and speech characteristics on the other hand. When discussing the display of emotions in speech, Cowie (2000) mentioned,

“A major topic is raised here for want of a better place. It is humor. Humor appears to have strong links to both control and emotional mixture. It may express anger or bleakness or happiness, and our explorations suggest that it is very often used as the preferred way of signaling these emotions without violating display rules. A useful way of making the point is in terms of artificial agents. If they are going to show emotion, we surely hope that they would show a little humor too.”

Although, as we have seen in the previous section, humor is very much related to many natural interaction issues, there is not yet much research going on into embodied agents that interpret or generate humor in the interface. We will return to that later in this report. Displaying appreciation of humor in face or voice is an issue that, however, has received attention.

5.1 Displaying Humor Appreciation In The Face and In The Voice

Smiles and laughs are the usual responses to humor. As mentioned in previous sections, laughs and smiles also serve social and (discourse) interactional goals. Laughs, smiles or more subtle expressions of enjoyment can be modeled in the expressions an ECA can display in the face and in the voice. See e.g. (Kappas et al., 1991) for a discussion on cues that are related to detecting and generating enjoyment in the voice. From the speech point of view the vocalization of laughter is another interesting issue for ECAs.

In (Ekman, 1985) eighteen different smiles are distinguished. A smile can be a greeting; it can mean incredulity, affection, embarrassment or discomfort, to mention a few. Smiling does not always accompany positive feelings. That makes it important to be able to display the right kinds of smiles at the right time on the face of an ECA. Frank and Ekman (1993) discuss the ‘enjoyment’ smile, the particular type of smile that accompanies happiness, pleasure, or enjoyment. The facial movements that are involved in this smile are involuntary; they originate from other parts in the brain than the voluntary movements and have a different manifestation. Morphological and dynamic markers have been found to distinguish enjoyment smiles from others. The main, best-validated marker is known as the Duchenne marker or Duchenne’s smile, the presence of *orbicular oculi* action (the muscle surrounding the eyes) in conjunction with zygomatic major action (muscles on both sides of the face that pull up the mouth corners). The Duchenne smile can reliably be identified visually. Although some people can produce it consciously, it probably is the best facial cue for deciding enjoyment and therefore an ECA should show it in the case of sharing humorous events with its human partner. For a survey of hypotheses and empirical findings regarding the involvement of muscles in the laughter facial expression see (Ruch and Ekman, 2001). Laughter also involves changes in posture and body movements. Again, we need to distinguish between different types of laughter (spontaneous, social, suppressed).

5.2 Showing Feigned or Felt Emotions and Enjoyment?

In applications using ECAs we have to decide which smiles and laughs to use while interacting with a human conversational partner. When a virtual teacher smiles, should it be a Duchenne smile? Is the embodied agent ‘really’ amused or does it only display a polite smile because it does not really like the joke made by its human conversational partner. Or should it not laugh or smile at all because of a politically incorrect joke? As mentioned by Cowie (2000):

“People respond negatively to displays of emotion that are perceived as simulated, and that is a real issue for agents that are intended to convey emotion.”

Will our attempts to introduce believability not be hampered by the impossibility to convey emotions in a believable way? Maybe we accept poor quality speech synthesis, maybe we accept poor quality facial expression (compared with human speech and human facial expressions), but will we accept the same for emotion display, in particular display related to an appreciation of a humorous event conveyed through these channels? Note, that when we talk about a humorous event, we include events that appear in a story being told by a virtual agent in interaction with a human conversational partner, events that are interpreted from a sequence of utterances in a dialogue, events that are visualized in a virtual environment, or events that need interpretation of integrated virtual and real-life interactions.

In our view these issues are not different from other observations on believability of embodied agents. In some situations, assuming that quality allows it, a synthesized voice or face may express acted pleasure (or anger), in other situations genuine pleasure (or anger). Whether it sounds or looks sincere depends on being able to suspend disbelief in the human partner of the agent. Interesting in this respect is the work of Marquis and Elliott (1994) who discuss research on embodied poker-playing agents (with a human partner) that can deliberately display false emotions in the face and in the voice.

6 Appraisal of Humorous Events

Graphics, animation and speech synthesis technology make it possible to have embodied agents that can display smiles, laughs and other signs of appreciation of the interaction or explicitly presented or generated humor. There are many applications that can profit from being able to employ such embodied agents. The designer of the interface can decide when in certain scenarios of interaction agents should display such behavior. However, much more in the line of research on autonomous (intelligent and emotional) agents we rather have an agent understand why the events that take place generate enjoyment by its conversational partner and why it should display enjoyment because of its appreciation of a humorous situation. That is, models are needed that allow generation, prediction, detection and interpretation of humorous events. There is also a need to be able to generate, display and interpret smiles and laughs in a context that is not necessarily found humorous by an embodied conversational agent, but that nevertheless may lead to smiles and laughs, for example to keep a conversation going.

With autonomous agents display of, for example, enjoyment, should follow from some emotional state that has been computed from an appraisal of the events that happen or have happened simultaneously or very recently in the interaction. This may include sensory inputs to the system of a human interactant. Facial expressions and other display of emotions should be generated from an emotional state. A usual standpoint in emotion research is that of appraisal theory, the evaluation of situations followed by categorizing arising affective states.

It seems quite natural to make a step from event appraisal theories for emotion to appraisal theories for humorous events, in order to obtain ECAs that smile or laugh at the right moment, making them more believable. Some of these theories have been designed with computation in mind. How can we elicit and display emotions using a computational model? A mature theory for calculating cognitive aspects of emotions is the OCC model (Ortony et al., 1988), a framework of 22 distinct emotion types. In several (mostly, stripped-down) versions, the model has been used. Examples are the OZ-project (Reilly & Bates, 1992), concerned with the development of a theatre world inhabited by emotional agents, and the Carmen project (Marsella et al., 2000), where event appraisal is used to recognize feelings of guilt and anger in a setting where an embodied agent talks with a mother of children with leukemia.

It is useful to review existing theories and observations concerning the appraisal of (humorous) situations (available as events, in conversations, in verbal descriptions or stories) in terms of possible agent models that include explicit modules for beliefs, desires, intentions and emotions. For example, how can the model include reasoning mechanisms about situations where there is the feeling that on the one hand the situation is normal, while at the same time there is a violation of a certain commitment of the agent about how things ought to be. With this view in mind it is useful to look at the violation theory discussed in (Veatch, 1998), attempts to define degrees of incongruity (Deckers, 2001), attempts to define humor in terms of violations of Grice's conversational maxims (Attardo, 1993) and proposals to define and explain humor or laughter in terms of perceptual, affective, and response patterns (Russell, 2000), but also 'measures' made possible by a Situational Humor Response Questionnaire (this questionnaire is used to measure the propensity to laugh in a variety of verbally described situations). Annotated verbally described situations can be the basis for (supervised) learning of humorous situations similar as in our model of agent emotions learning discussed in (Poel et al., 2002).

7 Conclusions

This report touches upon the state of the art of embodied conversational agents, humor modeling and affective computing. Using the ‘computers are social actors’ paradigm we made clear that it is useful for natural interaction between human and computer to introduce characteristics of human-human interaction in agent-human interaction, including the display of appreciation of humor.

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