

Emotional Actions for Emotional Agents

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Abstract

We introduce the sociological concept of “emotional action” to emotional agents design. In human-computer interaction, the need for advanced interface concepts arises, because an increasing number of untrained users seek access to information systems. Emotions, besides cognition, are considered to be a fundamental part of interactions. Therefore, they should not be neglected in human-computer interface design. Contemporary approaches focus on cognitive theories of emotion. In this article we offer possibilities to extend these approaches by means of sociological emotion theory. It is illustrated how emotional actions can be related to the concept of “perceptual processing” to provide compatibility with existing models. We show how social norms and rules influence the emotion process and how these “*social facts*” are covered by the concept of “emotional action”. It is shown that social norms and rules also apply in human-agent interaction and should not be disregarded. A preliminary architecture that serves as the basis for implementation is mentioned.

1 Introduction

The focus of attention in developing user adaptive interfaces has long been the recognition of certain patterns of user activity. Personalizing the interface according to such patterns may result in an increased user performance and ease of use. But due to the rapidly increasing deployment of computational systems in everyday life, more and more inexperienced users seek access to these systems. Therefore, it has also become a necessity to design interfaces in a way that incorporates characteristics of interpersonal interaction, thus allowing users to fall back on familiar mechanisms of interaction and communication.

The agent-oriented approach to user interface design is generally considered to be one of the most suited means to achieve this goal. Within this approach, “emotional agents” open new perspectives and dimensions of interaction. Emotions are able to transcend the rationality-based context of human-computer interaction in favor of a more interpersonal and human-like level. Emotions help conveying intentionality, may influence users, make interactions more “comfortable”, constitute meaning and serve as a means to establish social relationships. Despite the fact that users consistently anthropomorphize technical artifacts anyway, emotional agents offer the possibil-

ity to respond to and to support these attributions adequately.

Facing the possibilities emotional agents offer in human-computer interaction, we argue to account also for the specific *social* components of the emotion-process that have an effect in interactions. With social components we mean factors that also reside “outside” individual consciousness and are commonly shared by large groups of actors. Such phenomena are, amongst others, social rules and norms. They are social in nature, because actor’s generally share a certain amount of knowledge about these entities (called “*social facts*”). Social facts also play an important role in the elicitation and regulation respectively modulation of emotions. In most interactions, emotions are rarely expressed in the same way as they are felt and experienced. They are subject to a process of coping and regulation, and social norms and rules act as a framework, indicating the necessity, degree and modalities of regulation. The sociological concept of “emotional action” that is introduced here, provides a theoretical background for this process. In section 2 we first briefly outline existing computational models of emotion that use appraisal theory. In section 3 we draw a link between perceptual processing as a part of cognitive appraisal theory on the one hand and “social action” on the other hand. Social action is a fundamental sociological concept on which “emotional action” is based. We

then describe in section 4 the concept of “emotional action” in detail and show how it can be related to perceptual processing. Section 5 sketches possibilities of how emotional action can be applied in human-agent interaction. Finally we give an overview of an agent architecture that is being developed within the “ASKO” project (Acting in Social Contexts) at University of Hamburg. This prototype architecture serves as a basis for future implementations of the illustrated concepts. This paper is a theoretical one in the first place, all we will provide here is an introduction, an analysis, the concept of “emotional action”, and further directions of research.

2 Computational Models of Emotion

Until now, the main interest in research on emotional agents has either been to model an agent’s consistent emotional behavior or the emotional state of a computer user. Yet, not much attention has been paid to the question *how* an agent should *react* on a perceived emotional user state. “Once an agent has recognized the emotions of a person with whom it is interacting, what should it do with this information? The answer to this question depends on many things: the situation in which the emotions arise, the relationship of the computer to that person, knowledge about the person’s goals, standards, preferences, and many other factors” (Picard 1998, 1). Psychological appraisal theory (see e.g. Ortony et al. 1988; Scherer 1993) as the most widespread approach within the agents’ community offers a framework for emotion elicitation and coping that mainly relies on criteria inherent to individuals. Events, acts or objects of the physical world are evaluated in accordance to actors’ individual goals, intentions or desires. External factors influence the appraisal process mainly on a sensory-perceptual basis, for example the perception of changes in the environment and the individual evaluation (valence) of such an event. More abstract factors that are external to individual consciousness, like social norms, rules or moral standards, are also regarded, but in a fairly indirect fashion. They may elicit emotions in relation to actors’ actions or beliefs by socially legitimating them or not. Social norms and rules bias appraisal of the more concrete external factors, for example what an actor actually *has* achieved in relation to what he *expected* or is *normally used* to achieve (see e.g. Elliot 1992/1993). Thus, they have no *direct* influence on the emotion process.

Our approach is to extend and to specify the more “abstract” external factors, that have an influence on the emotion process. Because actors are not only situated in a physical reality but also in a social reality, we will examine the role of those factors external to individual con-

sciousness that are subject to a process of social construction: norms and rules. To make our approach more compatible with existing models, we will tie on to a concept from cognitive psychology, that incorporates perceptual processing in the appraisal process (Leventhal/Scherer 1987) and has shown to be suited and robust enough for the inclusion of social norms (Staller/Petta 2000).

3 Perceptual Processing and Social Action

According to Leventhal and Scherer (1987) perceptual processing is divided into three domains: sensory-motor, schematic and conceptual. Processing on the sensory-motor level refers to innate, instinct-like emotional reactions to perceived stimuli. Schematic processing is based on schema-maps, which may be learned, socialized and internalized. Conceptual processing requires reasoning and inferring, it is “abstract, active, and reflective” (Staller/Petta 2000). In view of emotion elicitation and coping, common agent architectures often neglect the conceptual processing domain and treat the schematic domain like the sensory-motor domain. That means on the one hand, agents are not endowed with the capabilities to “actively reflect” upon their emotional states and upon the conditions of the physical and social reality that elicit emotions. Emotions result more the less automatically without a chance of being *actively* and *consciously* regulated, elicited or suppressed. But particularly these processes are of utmost importance in social interactions. On the other hand the twofold nature of schematic processing should be regarded as well: schema-maps are internalized to different degrees, they can be learned from earliest childhood on (cultural, religious or habitual norms), having nearly the quality of innate (sensory-motor) mechanisms with little chances of becoming conscious (and thus alterable) in an event (1st order schema-maps). But, they also may be adopted later on in life, whereas the process of adoption is itself a conscious event. These 2nd order schema-maps may vary, alter, become conscious and may therefore be subject to perceptual processing in order to be risen, changed or suppressed.

We argue that in order to model advanced and social emotional human-agent interaction it is crucial to understand and to incorporate (1) the mechanisms (concepts, subjective meanings, categorizations, attributions, emotions themselves, other mind-states) that guide conceptual processing in social interactions and (2) the way social norms and rules – represented in individuals as 1st or 2nd order schema-maps – directly influence the process

of conceptual processing, resulting in the elicitation or regulation of an emotion (coping).

It is important to note that conceptual processing is similar to the sociological definition of “action”. Action in a sociological sense is human behavior that has a subjective *meaning* attached to it, whereas actions may be internal (thoughts) or external (physical). Meaning refers to the “subjective factual or historical” case of an actor (Weber 1979). To constitute a subjective meaning, a minimum of schematic or conceptual processing is necessary, otherwise it would be mere instinct-like behavior based on sensory-motor processing. The difference between meaningful action based on schematic processing and that based on conceptual processing is the level of emerging consciousness. Actions based on schematic-processing may be meaningful although the meaning may not *necessarily* become conscious. Because conceptual processing involves reasoning and inferring it is always active and reflective, thus conscious (see Staller/Petta 2000).

“Social action” is an action that takes account of the behaviors and properties (objective physical properties or subjective attributions) of other individuals “and is thereby oriented in its course” (Weber 1979). If we want to achieve “social action” in human-computer interaction it is necessary to involve schematic or conceptual processing and find a way that lets actions be oriented in the courses of a user’s behaviors.

4 The Concept of “Emotional Action”

The sociological concept of “emotional action” exactly ties on to these issues and shows how social norms and rules (represented as schema maps of different orders), social action (relying on schematic and/or conceptual processing) and emotions are interrelated. Schimank (2000) defines “emotional action” as social action that is directed towards regulating and adapting one’s emotions and emotional expressions according to valid norms and rules, so called *feeling rules* (Hochschild 1979).

4.1 The Relationship between Social and Emotional Action

Emotional action is meaningful because the meaning attached to it is constituted in the factual case of the situation (taking into consideration the type of situation, the properties of interaction partners, applying norms and rules, etc.) and the historical case of the interaction (dis-course- and interaction-history, relationship maintained

with interaction partners, etc.). It is social because it is oriented in the course of the other individual’s (emotional) behaviors. Without the presence of another individual, it would not be possible (and also make no sense) to account for situational-specific feeling rules.¹

The problem now is: how do actors characterize situations and interaction partners? Before this is not done, no rules or norms and corresponding schema-maps can be identified and activated, nor can a process of conceptual processing be initiated that has specific schema-maps (feeling rules) as its “modus operandi”.

Defining the physical situation is difficult enough, but we will focus on the definition of the social components of a situation here. Since social interaction, that means reciprocal social action, is often characterized by a lack of informational clues about an interaction partner, it can be difficult to understand and predict actions and underlying intentions of others. Generally, in order to understand and to constitute socially situated (“objective”) meaning, shared knowledge about common symbols and beliefs is mandatory. Actors who are unfamiliar with each other will interact in a different way than actors who know each other quite well. If the first is the case, Ego has to rely on the assumption, that Alter Ego follows conventional and standardized courses of actions (norms and rules that are also known to Ego to be identifiable) and that Alter Ego thinks the same of Ego.

Therefore, to ease interactions and to reduce complexity, actors may fall back on social categorizations of situations and other actors. Categorizations include, but are not limited to social roles, class, gender, religious or cultural background, occupation, status, prestige, etc. Actors benefit from these categorizations in two ways: First they allow the attribution of intentions. This does not necessarily make the actions of others understandable (in a deeper sense) but at least predictable and to some extent comprehensible. Second, social categorizations also have corresponding rules and norms attached that act as a framework guiding interactions. Social norms and rules, that means rules that are shared by groups, communities or societies, are enforced by sanctions of others and - on an individual level - by emotions. E.g. deviant behavior of an individual may lead to unpleasant emotions, indicating deviance or inappropriateness of actions or behaviors. This way, norms and rules indirectly influence the elicitation of emotions. Feeling rules,

¹ Actors could imagine the presence of others and act *as if* another individual was present. But since there would be none to interpret this behavior, it would be a pure self-exercise.

on the contrary, may directly influence emotions and emotion expressions. According to the situation and the interacting individuals they constitute which emotions are considered to be adequate or inadequate. This may lead to the regulation of an emotional expression (“surface acting”) as well as to the elicitation of an actually felt emotion (“deep acting”) (Hochschild 1979).

4.2 Perceptual Processing and Emotional Action

Now that we have described the concepts of social action and perceptual processing, we illustrate how emotional action is based on schematic and conceptual processing. Let us consider a hypothetical interaction situation: Actor (A) (male, 35 years old) is at a cinema watching a movie. The cinema is relatively empty and he sits in a row all alone. The movie has its most tragic moment, and (A) suddenly starts to cry. The reason why he starts to cry is not of primary interest here; let us assume the scene reminds him of a recent and tragic episode in his own life. Then, some people (male, the same age) enter the cinema and sit down in the same row as (A). Now, (A) is in serious trouble. The social norm, a feeling rule, states: Men of his age never cry in the public when watching a movie. He is simply not expected to start crying, his behavior is deviant. If he was a woman, the case would be slightly different. (A) assumes (for a good reason, because the people are male and of the same age) that the people next to him who just entered the cinema also know this norm. As an evidence, they start grinning and whispering. Although (A) does not know these people at all, and most probably will never in his life meet them again, he will try to stop crying by all means. He will regulate his emotions (trying to think of something completely different) and his emotional expressions (stop the tears, set up a normal facial expression).

What has happened here? The primary event that elicited the emotion that drove (A) to cry may well be explained by appraisal theory. Whether this has been a process of schematic or conceptual processing can be neglected. For the approach proposed here it is of importance what happened thereafter. The fact that (A) started crying was of no importance to him, although he knew the norm that says “men do not start crying when watching a movie in a cinema”.² This is because the situation

² To be more specific we could assume that (A) already felt uncomfortable because he knew that he was violating a norm. However, he did not pay much attention to this violation and his emotional expression because chances for possible sanctions through others were quite low.

he was in was not a *social* situation. As long as the other people did not sit down next to him, (A) could neglect this norm because it was not valid. The norm became valid exactly when the other people entered the room. From this moment on, (A) was in a completely different, because social situation. The physical situation, despite the presence of other individuals, did not change at all. Relying on the most obvious visible clues, age and gender, (A) categorized the other people. Age and gender as pieces of circumstantial evidence were sufficient to let (A) assume, that both parties share a certain amount of knowledge about symbols, beliefs and social facts (norms and rules). (A) therefore attributed “mental” properties and social knowledge similar to his own (if the others were female (A) might have even tried harder to regulate his emotions in order to appear as a “real man”). From this moment on (A) could have chosen between two options: First he could have ignored the other people, taking the risk of being stamped as a wimp and being “sanctioned” by laughter and shame. Instead, he took the second option to avoid shame and laughter.

This is exactly how conceptual processing, norms and rules, emotions and emotional action are interrelated. In order to behave “normally” according to valid norms, (A) regulated his own emotions and emotional expressions. Conceptual processing is involved from the point on, when (A) compares his actual emotional state and expressions with valid norms and rules. Conceptual processing is furthermore involved, when (A) performs emotional actions in order to regulate his own emotional state. By means of emotional action (A) adapted his behavior according to the situation, the interaction partners and the corresponding norms in order to be “socially accepted”.

5 Emotional Actions in Agent-based Interactions

Staller/Petta (2000) have shown the importance to include social norms and rules into agent’s behavior routines, but from a perspective that focuses on the role of emotions in sustaining social norms (see the example in the above section: shame forces (A) to follow a norm). We take a slightly different point of view here. The proposed approach is to include feeling rules and the concept of “emotional action” into the design of emotional interface agents, in order to improve their ability to socially interact with users (Moldt/von Scheve 2000/2001).

Although, in anticipation of others showing up, he could have precautionary regulated his emotional expression.

The assumption underlying this approach is that the same rules and norms that guide interpersonal interactions are also applicable to human-computer interaction. A study by Bellamy/Hanewicz (1999) gives evidence, that at least in computer-mediated communication the same rules apply. The degree to which rules are considered in computer-mediated communication (CMC) depends on the amount of informational clues that allow for a definition of an interaction situation.

Despite the fact, that CMC differs significantly from face-to-face interactions, it is to some extent comparable to human-agent interaction. This is because in CMC actors *know* that they are interacting with human subjects rather than with a technical artifact. On the other hand, in human-computer interaction, users often behave *as if* an agent was an intelligent and intentional entity with human-like qualities. It is our aim to support and to shape this “intentional stance” (or anthropomorphism) by equipping agents with the ability to perform emotional actions that have a socially situated meaning. The concept of “emotional action” serves this approach quite well, since it depicts preconditions to successfully perform socially situated conceptual processing (that is social action), and also incorporates rules and norms and their influence on the emotion process. In any case, our proposed model has to be seen as an extension of respectively an addition to (*not* a substitution of) existing approaches that use appraisal theory.

As we have illustrated above, there are some basic principles that have to be regarded in order to model emotional actions. The first one is that an emotional agent has to define situations of the external world. In the first place it has to identify whether it is an interaction situation or not. In case of an interaction situation, the type of interaction has to be recognized: is it an argument, a discussion, a ritually performed interaction, a simple request, etc.? Second, the agent should build up a sociologically founded user model by analyzing its interaction partner: is it a known or unknown user, what kind of relationship (if any) is maintained with the user, what is the discourse and interaction history like, can the user be categorized in “social terms” (e.g. status, prestige, gender, occupation, social class or milieu, roles, etc.) and what properties can be attributed toward the user according to this categorization (intentions, beliefs, desires)? In order to depict corresponding feeling rules for this situation, the agent has to have a model of its own “social self”, containing information about the above mentioned categories, beliefs, desires and intentions. By bringing together and synthesizing information about the situation, the user and its own social self, valid feeling rules

may be extracted and realized, building the background for emotional actions.

In view of agent-based interactions that treat emotions as an active and reflective part of interactions, emotional actions are mandatory to address emotions or emotion elicitors themselves. Klein and colleagues have divided emotion regulation into two domains: active and passive regulation (Klein et al. 1999). Passive regulation occurs, when emotion expressions are used to evoke specific moods or to let others “participate” in a feeling. In this case, the methods claimed by Bates and others seem to be an appropriate means to achieve *empathy* in one way or another way (Bates 1994; Elliot/Brzezinski 1998). For their believable and synthetic characters they propose to express emotional states straightforward, unregulated and also maybe exaggerated (according to the principles of Walt Disney: show it all and show it clear). To convey intentionality and emotional states this is surely an appropriate way, as long as the user is supposed to follow a plot or storyline like in animated cartoons or virtual theatre. In such applications, the user participates by means of *identification* and empathy with the protagonists. That means the user imagines and anticipates how he would feel if he was the protagonist.

The case is slightly different when a user is engaged in social interactions and participates as *himself* and not just by means of identification and empathy.³ Here the user wants to be treated as a unique entity and will expect active emotion regulation from others and is also expected to regulate his own emotions. Therefore, emotion regulation that is performed by means of emotional action is needed to behave adequately when engaged in an interaction. Furthermore, it may also be used to make agent-user relationships more demanding. For example an agent could try to suppress emotion expressions in an obvious and visible way. This would let the user think that the agent somehow cares about him and the course of interaction.

Consequently, emotional action can be seen as a concept that allows to design interface agents’ behaviors in a way that makes interactions for the user more demanding and lifelike. It can form the impression of a unique and user-centered interaction.

³ Empathy, as stated earlier, is also vital in social interactions to some degree, but mainly in order to be able to make interaction-relevant attributions.

6 The Architectural Approach

In the following section we will briefly illustrate an architectural approach that is planned as an implementation of the above-introduced models. We have implemented first prototypes for generic multi-agent systems. The architectures concentrate on traditional artificial intelligence and software engineering concepts up to now. It is planned to extend the architecture for our sociological concepts of emotion. First models of sociological concepts implemented by Petri nets have been introduced by Heitsch and colleagues (Heitsch et al. 2000) and can be found in some technical reports on the ASKO homepage.⁴ On top of these approaches a new kind of architecture is developed to include sociological emotional aspects.

The research project “ASKO” (Acting in Social Contexts), that is part of the German Research Foundation (DFG) financed interdisciplinary research project “Socionics”⁵ (Müller et al. 1998) is a cooperation between the Institute for Sociology and the Computer Science Department at University of Hamburg. Within this project Petri net based multi-agent systems are designed. Specifications are made according to an agent oriented, high-level Petri net formalism that allows implementation of most fundamental agent and multi-agent system (MAS) concepts in an intuitive, precise, graphical and directly executable way (Köhler et al. 2001; Heitsch et al. 2000; Moldt/Wienberg 1997).

Petri nets are a means to model actions and states and to reveal system deadlocks and other system concepts and properties in a way that is also comprehensible for social scientists. One of the goals of the ASKO project is to specify and verify sociological theories and to improve computational support systems for administration and organizational management. Specifically, it is aimed at developing a middle range theory for decision making in public service institutions by using general and organizational sociological theories. The main conceptual focus is on knowledge about courses of actions (in organizations), which are being represented in the form of protocols. The concept of Petri nets as active tokens of Petri nets allows for a dynamic generation and adaptation of knowledge. This way an agent will be able to learn from and to adapt itself to the environment. The representation

of adaptation and learning is based on formal and informal process knowledge.

Within this approach, until now, emotions are neglected. By means of formalization by Petri nets (Heitsch et al. 2000) have shown that contemporary organizational theories are insufficient with respect to informal structures, especially emotions. Therefore, we suppose on the one hand, that in the near future there will be a growing need to incorporate the potential of emotions and emotional action into this architectural approach. As can be seen from a variety of work from the field of artificial intelligence, emotions are considered not only of importance in human-computer interaction, but also to improve intelligent systems design in general (e.g. Ray et al. 2000; Velásquez 1999; Ventura/Pinto-Ferreira 1999). In view of the ASKO approach, the role of emotions in social-structural configurations, that has not been investigated outside sociological theory at all, is of a special interest in the context of organizational behavior, multi-agent system dynamics, negotiation and co-operation as well as co-operative action.

On the other hand, the ASKO architecture may serve as means to realize improved emotional human-agent interaction by using emotional actions based on socially situated conceptual processing. Both approaches (the ASKO architecture and the use of sociologically founded emotions in human-computer interaction) seem to complement one another in a way, which calls for a further investigation of the possibilities emerging from this interrelation.

7 Conclusion

We have shown in which way sociological theory can contribute to the field of emotional agents design. In order to achieve “advanced” social emotional interactions with users the sociological concept of “emotional action” seems to be a reasonable starting point. The concept takes into account the factors that are external to individuals; social norms and rules are made up by individuals in the last instance, but they still have an influence on actors, even if those who “invented” these norms and rules have disappeared. They are shared and generally accepted, thus not following these rules may not only lead to severe irritations but also to inefficient, misinterpreted communication and interaction. Often, in situations where individuals are unfamiliar with each other, norms and rules are most important clues that guide behavior, action, and interaction. Most approaches that have been built today model the “pure emotional man” whereas, as H. Flam has stated, the “constrained emo-

⁴ See the “ASKO” homepage:

<http://www.informatik.uni-hamburg.de/TGI/forschung/projekte/sozionik/index.html>

⁵ See the “Socionics” homepage:

http://www.tu-harburg.de/tbg/SPP/Start_SPP.html

tional man” is the model that has its counterpart in real life (Flam 1990/1990a).

Our approach to emotional action gives a brief overview on how a “constrained emotional agent” can possibly be achieved. It seems to be especially suited for two reasons: First, because it can be tied on to approaches that use appraisal theory by relating it to processes of schematic and conceptual processing. On the other hand, the topic of (emergent) norms in multi-agents systems is gaining more and more attention, several approaches have already been made to include social norms in multi-agent systems design (e.g. Conte/Castelfranchi 1995). Although there is a fundamental difference between the emergence of norms in artificial societies and the application of norms (feeling rules) from the social world, the mechanisms to deal with norms could be adopted. Furthermore, research is already carried out on the role of emotions in sustaining social norms (Staller/Petta 2001). Despite the fact that the perspective taken here is the reverse, it shows the importance of this matter. Interrelating the emergence of norms, the problem of sustaining norms and the role of norms in emotion elicitation and coping offers perspectives not only for human-computer interaction but also for multi-agent systems design.

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