Affective Computing and Interaction:

Psychological, Cognitive and Neuroscientific Perspectives

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Chapter 14
Bringing Affect to Human Computer Interaction

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ABSTRACT

The current chapter focuses on affective issues that impact the success of human computer interaction. Since everybody is a computer user now and interaction is not only a technical activity, users' affective processes cannot be ignored anymore. Therefore, the issues related to these affective processes that enable efficient, effective and satisfactory interaction with computers are explored. An extensive literature review is conducted and studies related with affective aspects of human computer interaction are synthesized. It is observed that there is a need to adapt computers to people and affect is an important aspect of this trend. Likewise, human characteristics have to be reflected to the interaction. The findings of this chapter are especially important for those people who are planning to bring affect into the computerized environments.

INTRODUCTION

As its name implies, Human Computer Interaction (HCI) deals with human physical and cognitive activities that are enacted during the interaction with computers. Even from the very beginning of its history, theories of HCI have been heavily influenced by those in cognitive psychology (Carroll, 1997; Hartson, 1998). Thus, it is not surprising to see that the combined influence from 1950s cognitive revolution and a focus on the individual differences with a neglect of social processes (Voss, Wiles, Carretero, 1995; Nussbaum, 2008) that reigned over cognitive psychology have found its reflections on HCI field. For instance, De Greef and Neerincx (1995) emphasize the significance of the properties such as users' cognitive limitation, ease of learning and cognitive cost of using a system for designing computer-based systems. Scaife and Rogers (1996) focus on the participants'

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ongoing cognitive processes, while interacting with graphical representations in computer-based systems. Papanikolaou et al. (2006) present an experimental study that aims to model the interaction on a web-based learning environment with regard to the cognitive styles, while in Cegarra and Hoc's (2006) study, the notion of cognitive styles is introduced upon establishing a balance between task requirements and cognitive resources in computer-assisted troubleshooting diagnosis. Dalal and Casper (1994) add concepts such as user satisfaction, user confidence and trust in the design to the notion of cognitive style as essential elements of the effectiveness of computer-based systems.

However, as Voss et al. (1995, p.174) indicated, the recent decade has witnessed the "sociocultural revolution" in psychology focusing on acquisition of intellectual skills through social interaction with a growing interest in the role of affective, social and organizational issues. Beside the increase in the number of the studies that are criticizing the lack of consideration of human affective processes in HCI, there has also been an outburst of studies investigating the psychology of emotion (Gross, 1999). Diaper (2004) criticizes the negligence to examine human affective processes in HCI inspired by psychology:

Notwithstanding the need in HCI to consider affective, social, organizational, and other such issues, most of the psychology in HCI and in current approaches to task analysis focuses on human cognition, and it is human cognition that is the main ingredient of user models in HCI. The point to recognize is that cognitive psychology of people is much more complicated than, for example, the information-processing abilities of computer systems and that this creates a fundamental problem for task analysis. If an analyst cannot understand the operation of a basic system component (such as the human element), then it is not impossible to predict how the various things in a system will interact and produce the behavior of the system (p.21).

In line with Diaper's (2004) concern, Lisetti and Schiano (2000) emphasize the importance of affective states for many cognitive processes and further propose that questions such as "is the user satisfied, more confused, frustrated, or simply sleepy?" are indispensable for effective HCI designs. They add that

[w]hile making decisions, users are often influenced by their affective states: for example, reading a text while experiencing a negatively valenced emotional state often leads to a very different interpretation than reading the same text in a positive state. A computer interface aware of the user's current emotional state can tailor the textual information to maximize the user's understanding of the intended meaning of the text (Lisetti and Schiano, 2000, p.199).

Similarly, Norman (2004) emphasizes the importance of emotions for HCI and how cognition and emotions are intertwined, along with his regret for investigating only the cognitive aspect throughout years, despite his early identification of emotion as being one of the twelve challenges of cognitive science in the 1980s (Norman, 1980). He further contended that study of emotion is important, since it would likely to provide researchers with critical findings for the study of cognition. The designated critical role of wide range of emotions enacted on every computer-related, goal-directed activity is now better understood, whether it is as simple as sending an e-mail or more complicated as creating a three-dimensional computer-aided design model (Brave & Nass, 2008).

As this brief literature review revealed, there seems to be a major transformation in HCI, where there seems to be a convergence among theorists and researchers who argue the impossibility of having a thought or performing an action without the engagement of one's own emotional systems,

or briefly, without emotion and affect (Izard 2007, 2009; Lewis, 2005; Phelps, 2006; Picard, 1997; Russell, 2003; Picard, 2010). In order to provide better understanding concerning the role of affect and emotions on cognitive processes from HCI perspective, the authors analyzed the existing literature to present emotions and the relationship between cognition and emotion as well as affect, which is followed by the conclusion comprising a humble set of suggestions for affective design and projections on the trends and future of the field.

EMOTIONS

Insomuch as William James asked the question of what emotion is in 1884, a vast number of different definitions for emotion had been produced (Kleinginna & Kleinginna, 1981; Larsen & Frederickson, 1999). Yet, the attempts to generate a widely acceptable definition of emotion have failed (Panksepp, 2003). Nevertheless, the idea that emotion is a reaction given to the actions driven by an individual's needs, goals, or concerns and that emotions have many aspects involving feelings, experience, physiology, behavior and cognition are generally accepted by most of the researchers (Ortony, Clore, & Collins, 1988; Brave & Nass, 2008; Izard, 2009). Izard (2009) defines two broad types of emotions, which are "basic emotions" such as joy, anger, disgust, etc. and "emotion schemas" such as shame, anxiety, etc., which are dynamic interactions of emotion with perceptual and cognitive processes to influence mind and behavior (p. 8). He claims that basic emotions can also be assumed as fundamental in the sense that "they are fundamental to human evolution, normative development, human mentality, and effective adaptation" (p. 8). Similar to Ortony, Clore and Collins' (1988) statement that while some emotions, (e.g. disgust), require much less cognitive processing, others involve much more (e.g. shame) cognitive processing; Izard (2009) agrees that emotion schemas involve higher-order cognition and culture-related cognitive components (Tangney, Stuewig & Mashek, 2007), once the language acquisition occurs. Regardless of this difference in the levels of cognitive processing, emotions always involve some degree of cognition. Ekman (1999), who stresses the influence of emotions on thoughts, describes certain characteristics, which differentiate 'basic emotions' from other affective phenomena. One of these characteristics is 'distinctive universal signals' such as distinctive facial expressions. According to Ekman (1971, 1992) the existence of common facial expressions across cultures supports the notion of the universality of facial displays of emotions, which led him to propose six basic, universal emotions: surprise, anger, fear, disgust, sadness and enjoyment (Ekman 1993), which are referred to as primary emotions (Damasio, 1994).

On the contrary, Ortony, Clore and Collins (1988) refuse Ekman's proposal for a set of 'basic' emotions. According to them, there are more than six emotions, which are distinct and equally basic. They state that some emotions (e.g. fear, anger, sadness, and enjoyment) can be found in all cultures but this does not make them basic emotions similar to the fact that "toe nails might be found in all cultures too, but that would not be sufficient to render them anatomically basic" (Ortony, Clore, & Collins, 1988, p. 25). While they refuse the notion of six basic emotions, they support the idea that some emotions are more basic than others. The reason behind this idea is that "some emotions have less complex specifications and eliciting conditions than others." (Ortony, Clore, & Collins, 1988, p. 28). Eliciting conditions are specified in terms of variables, which can modulate the intensity of emotions, such as the global variables affecting all emotions and the local variables that influence a certain subset of emotions. Based on these variables, O'Rorke and Ortony (1994) provide the following emotion types (see Table 1).

Considered as activation mechanisms for emotions, appraisal processes help providing a cogni-

tive framework for emotions (Ellsworth & Scherer, 2003). As Table 1 shows, where appraisal of an event leads to joy and distress, the appraisal of a prospective event results in hope, satisfaction, relief, fear and disappointment. Similarly, where appraisal of an object causes love and hate; appraisal of the agent's action leads to 'attribution emotions' such as pride, admiration, reproach and shame. While shame occurs when people disapprove of their own actions and attribute the negative effects of their actions to themselves, reproach occurs when people disapprove of others' actions and attribute the negative effects of the actions to others. Therefore, as Lazarus (1999) stated, cognitive appraisal processes play a key role in emotion. He further contends that although cognition, motivation and emotion are always associated and interdependent, within the trilogy of mind, there is a real difference between emotion and the other two functions,

Table 1. Emotion Types

Emotion Types		
Group	Specification	Types(name)
well-being	Appraisal of event	pleased (joy)
		displeased (distress)
Fortunes-of-others	Presumed value of an event affecting another	pleased about an event desirable for another (happy-for)
		pleased about an event undesirable for another (gloating)
		displeased about an event desirable for another (resentment)
		displeased about an event undesirable for another (sorry for)
Prospect-based	Appraisal of a prospective event	pleased about a prospective desirable event (hope)
		pleased about a confirmed desirable event (satisfaction)
		pleased about a disconfirmed undesirable event (relief)
		displeased about a confirmed undesirable event (fears-confirmed)
Attribution	Appraisal of an agent's action	approving of one's own action (pride)
		approving of another's action (admiration)
		disapproving of one's own action (shame)
		disapproving of another's action (reproach)
Attraction	Appraisal of an object	liking an appealing object (love)
		disliking an unappealing object (hate)
Well-being/ attribution	Compound emotions	admiration + joy -- gratitude
		reproach + distress -- anger
		pride + joy -- gratification
		shame + distress -- remorse

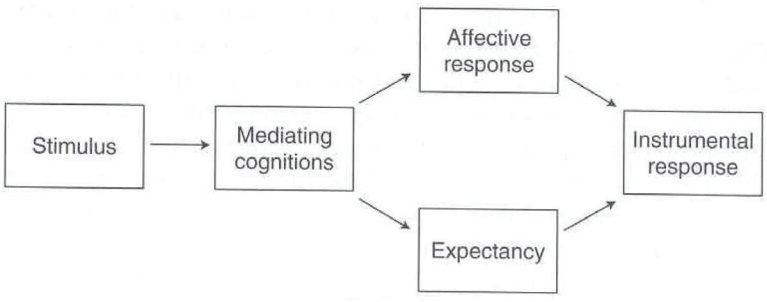
cognition and motivation: "Thought without motivation is emotionless" (p.10). Lazarus (1999) claims that thinking can occur without emotion, but emotion is not independent from meaning. In addition, emotion occurs after the previous emotional state in the continuous flow of cognitive, motivational and emotional processes. In other words, from Lazarus's point of view (1999), cognition is always involved in emotion.

On the other hand, Lewis and Granic (1999) claim that the relationship between cognition and emotion is not linear. The relationship begins with the interpretation of the event encountered, followed by the appraisal process, and the consequences of the evaluation process give rise to emotions. The emotions people have after the first appraisal leads to a new appraisal process and its consequences are enhanced by emotions, whereby emotions are continuously enhanced by changes in appraisal, which shows that the relation between cognition and emotion is a two-way causal relation. They further suggest that the increase in the number of appraisal chains evokes simultaneous coordination of cognitive and emotional processes, which means that cognitive and emotional processes become synchronized through a recursive loop. Briefly, Lewis and Granic (1999) assert that cognition and emotion are inseparable.

Attribution theory goes one-step beyond the appraisal theories of emotion. Appraisal theories propose that people evaluate whether or not they achieved the pre-determined goal as a first step. The interpretation of the performance leads to outcome-dependent emotions, which are classified as failure-dependent emotions (displeased and unhappy) and success-dependent emotions (satisfaction, happiness, and "feeling good"). As a second step, people make an attribution to the outcome, which triggers the attribution-dependent emotions. Attribution of a resulting failure to the ability makes people feel "incompetent," whereas attribution to "task difficulty" leads to the emotion of surprise. Finally, determining the dimension of the attribution gives rise to another kind of emotion. During the attribution process, cognitive processes are activated especially in the course of evaluating the performance and determining the dimension of the attribution. Figure 1 shows the cognitive (attributional) model of achievement behavior.

Another important concept where attribution and cognition meet in the same line is the concept of 'self'. The meaning of 'self' is very crucial in terms of cognition. In order to realize one's own action, to evaluate its consequences, and to attribute a responsibility of the action; an individual must be capable of owning his or her behavior (Lewis, 1999). Being capable of taking responsibility for behaviors requires self-evaluation, through which certain cognitive processes are enacted. The results of self-evaluation lead to emotions, the type of which depends on the direc-

Figure 1. The cognitive (attributional) model of achievement behavior (Reprinted from Försterling, 2001, p.119)



tion of the attribution. In line with O'Rorke and Ortony (1994)'s study, taking the responsibility for an action is an occasion of internally directed attribution, which, in turn, causes feelings of shame; whereas refusing to accept the responsibility is an occasion of externally directed attribution, which does not cause any feelings of shame.

Although emotions are often elicited with appraisal processes, Izard (2009) states that there are also other factors influencing emotions such as images, memories and thoughts, as well as noncognitive factors such as changes in neurotransmitters and levels of hormones (Izard, 1993). He further acknowledges that especially cognitive aspects of emotions are influenced by individual differences, learning, and social and cultural contexts (Izard, 2009, p. 9). This acknowledgment is important, since it is an indication of a possible compromise to one of the classic debates in emotion theory whether emotions are innate or learned. Along with Izard's previous studies (e.g. 1992), researches such as Neese (1990), Tooby and Cosmides (1990) and Ekman (1994) at the evolutionary side of this debate argue that all emotions, regardless of their complexity levels, are evolved in response to a specific environmental concern and inherited from our ancestors. On the other hand, theorists such as Averill (1980), Ortony and Turner (1990), Schweder (1994) and Wierzbicka (1992) argue that emotions are learned social constructs with a few exceptions that are considered as pre-emotions rather than emotions, which raises the probability of varying kinds of emotions across cultures transferred from generation to generation based on common social structures not on biology. However, recently these two sides might be finding a middle ground that there are different forms of emotions, such as basic emotions stemming from evolution and biology and more complex emotions involving various cognitive components that differ across individuals and cultures (Izard 2007, Panksepp 2007).

HUMAN-LIKE INTERFACES

Consistent with the purpose of HCI to create human-like computer interfaces enabling the transparent, seamless, and fluid interaction; users expect properties of human-human interaction (HHI) to be also valid for computer interfaces. Suchman (1987) mentions the term "sociability of computers" and points out that properties of HHI (e.g., dialogue, conversation, etc.) should be considered while describing the interaction between people and machines. Regarding this view, she stated "…the artifact should not only be intelligible to the user as a tool, but that it should be *intelligent* – that is, able to understand the actions of the user, and to provide for the rationality of its own. (p. 17)" Along the lines of this development in HCI, Lisetti and Schiano (2000) point out a conspicuous trend from 'adapting people to computers' to 'adapting computers to people' approach, which occurred in terms of interface design methods. The paradigm of utilizing design-centered approaches focusing on the efficiency of the interface without regarding the user profile shifted towards the use of user-centered approach concentrating on the users' characteristics in interface design. Furthermore, researchers and designers have long been discussing the appropriateness of reflecting human characteristics via the computer interface. Many studies have shown that people apply social rules regulating their interactions with other people to their interaction with machines and more specifically computers. For example, Fogg and Nass (1997) showed that users who received flattery from a computer perceived the interaction more enjoyable and had much greater interest for continuing working with the computer than those who received plain computer feedback. Klein, Moon and Picard (2002) echoed the same results.

Social Norms

Media equation research that employs the standpoint, where 'media equals to real life' is one of

the important views, which shapes the human-like interfaces. The body of research focuses on social rules and norms, such as politeness, reciprocity, flattery and assignment of roles; price; and criticism (Reeves & Nass, 1996). This is in accord with the CASA paradigm that stands for "Computers Are Social Actors," which is coined by Nass, Steuer and Tauber (1994) based on their finding that people tend to treat computers as social actors. CASA studies demonstrate that the social rules and dynamics guiding human-human interactions are applied equally well to human-computer interaction. Nass, Steuer and Tauber (1994) showed that the nature of users' interactions with computers was indeed social and this was not because of a conscious belief that computers are human-like. It was because users treat computers as if they were human during their interaction despite their knowledge that computers have no human motivations such as feelings. Furthermore, Nass and Moon (2000) revealed that people tend to rely on social categories and apply social rules to computers unconsciously.

Social norms have important impact on both arousal of emotions and appropriateness of emotional expressions to a given situation (Shott, 1979). Studies investigating the role of apologies in interpersonal interaction offer important findings on the relation between politeness and emotions. While Brown and Levinson (1987) consider it as an act of negative politeness, Bharuthram (2003) regards an apology as an issue of social norms. For instance, when an agent performs a 'blameworthy' act, which causes her/his disapproval of the action afterwards; the feeling of shame (Ortony, Clore, & Collins, 1988) or regret for this undesirable event is explained by using apologies, which are admissions of 'blameworthiness' (Leech, 1983; Schlenker & Darby, 1981). Similarly, when an agent feels reproach upon disapproval of others' 'blameworthy' actions (Ortony, Clore, & Collins, 1988), which causes feelings of anger; apology is offered to the agent as a way to alleviate his/her anger (Leech, 1983; Schlenker & Darby, 1981).

Apologetic Feedbacks

The projection of these relationships in HCI found implementations in many studies investigating the effect of apologetic feedbacks on user performances. Using human-centered interfaces instead of traditional computer-centered interfaces, Nielsen (1998) and Tzeng (2004) present error messages including emotional expressions such as apologies for failure in execution of a command and sympathy for a user's possible frustration. Nielsen (1998) argued that when a user encounters a problem and receives an error message, it should include a simple apologetic statement that the reason of the error is the limitation of the interface to execute the command for the intended task, not user's action. However, most of the error messages embedded in computer interfaces are short and inhuman, which glaringly unfold the nature of computer-centered design in case of a problem while interacting with the interface (Tzeng, 2004).

Investigating the effect of apologetic feedbacks on computer users' perception of their performance, Tzeng (2004) showed that the subjects in apologetic feedback groups did not perceive their performance and ability as better than those in non-apologetic groups. He further demonstrated that computer users might not expect computers to be polite; yet apologetic statements make subjects feel better about their interaction with the program. Based on the idea that participants' politeness orientations might have an influence on their perceptions of apologetic computer error messages, Tzeng (2006) conducted another study investigating users' perceptions about online systems containing three different error messages, each of which includes different politeness strategies. He elicited users' politeness orientations and asked them to interact with websites, each of which contains pre-determined problems. Upon encountering problems, users are provided with certain error messages representing three different politeness strategies, which were positive

politeness strategy (i.e. joke), negative politeness strategy (i.e. a simple apology), and a mechanical message for the error (i.e. the page is temporarily unavailable). The findings revealed that users, who use polite expressions while dealing with social events, preferred apologetic messages significantly more than both other mechanical or joke messages and other users, who are less oriented to polite expressions

Inspired by Hatipoglu's (2004) findings pointing to the difference between the type and form of apologies used in e-mails and in spoken and written languages, a more current study by Akgun, Cagiltay and Zeyrek (in press) investigated the similarities and differences between the apologies used in Human-Human Interaction (HHI) and those preferred by the users during their interaction with the computer (HCI). Designing a genuine problem state caused by computer's inability to carry out a requested task, they elicit users' preferences for types of apology messages for the designated problem. The feedback from users were consistent with Nass, Steuer and Tauber's (1994) CASA paradigm that the social dynamics of HHI can be applied equally well to HCI. In the light of these findings, they further investigated the effect of different apologetic error messages on self-appraisal of performance and the interaction effect of message type and mood state on self-appraisal of performance. The results showed that even though the use of apologetic error messages in the computerized environment did not influence users' self-appraisals of performance; the interaction effect of message type and mood state on self-appraisal of performance was significant, i.e. the influence of apologetic messages on self-appraisal of performance depended on participants' mood state. Forgas (1999) found that the individuals in negative affect demonstrated greater politeness than those in positive affect while making requests, which showed that the level of politeness use depends on individuals' affective state. In light of his findings, Akgun et al. (in press) concluded that the use of apologetic error messages to influence users' self-appraisals of performance in a computerized environment may not be enough by itself, thus, users' affective state should also be considered.

Emotionally Supportive Interactions

Based on the idea of the importance of human emotional expressions in interpersonal communications regarding individuals' relationships with others (Mongrain & Vettese, 2003), interactive computer systems with emotionally supportive interactions have been built to respond to users' negative emotional experiences, such as frustration. There are many studies aiming at how to improve human-computer interaction by investigating the ways to relieve users' negative emotional states caused by a computer application, such as frustration, confusion, and anger. User frustration with information and computing technology is a pervasive problem caused by factors such as crashing of computers and poor user interfaces (Lazar et al., 2005). Lazar and colleagues (2005) investigated whether there were commonalities between student and workplace user frustration during their interaction with computers. Their study showed that there are three important factors influencing the frustration levels of users; the time lost, the time to fix, and the importance of the task and that these three factors were relevant for both students and work place users. This means that the more time is wasted, while dealing with a task of higher importance, the higher the frustration level of both student and work place user gets. Another important finding of the study was that when the participants were asked to write down the specific causes of frustration, the most cited cause was the way computer error messages was presented. In another study, Klein, Moon and Picard (2002) investigated whether an interactive affect-support agent helps users to recover from their negative emotional states. The agent, which was text-based, used 'active listening (e.g. "Hmmm. It sounds like you felt really frustrated playing this game. Is

that about right?"), empathy (e.g., "Sorry to hear things didn't go so well"), and sympathy statements (e.g., "It sounds like you didn't have the best experience, then. That's not much fun"). The researchers' prediction was that alleviating users' frustration would make users feel more positive towards the task and therefore make them continue to interact with the system for longer. Similar to Picard's (2000) previous finding that participants' interaction with an emotion-support agent yield to significantly longer playtime than those interacted with similar agents that ignored their emotions; they demonstrated that after interacting with the affect-support agent, users interacted with the system significantly longer in comparison to the two control groups. This is in line with Hone's (2006) finding that text-based agents can be effective in reducing user frustration. In addition, Hone (2006) also examined the effect of embodied agents and found that embodied agents providing emotional feedbacks can be more effective than text-based agents for reducing users' frustration caused by the computer. Correspondingly, Brave, Nass and Hutchinson (2005) investigated whether an embodied agent showing empathy had an influence on users. The results indicated that users found an emphatic agent more caring, more likable, more trustworthy, and more submissive than agents lacking emphatic emotion.

Emphatic Agents

Other recent studies investigating the use of different emphatic agents with different modalities also reported similar results. For instance, Nguyen and Masthoff (2009) investigated the effect of empathy by concentrating on different ways of expressing empathy and the modality of delivering such content. They designed 2 (modality: animated vs. no-visual) x 3 (intervention: non-empathy vs. empathy vs. empathy and expressivity) between-subjects study. In the animated conditions, human-like computer animated agent with a synthesized voice was employed, whereas in the no-visual conditions, the agent has no visual representation and a voice. Animated agents used several facial expressions such as happy, neutral, concerned and sad as well as a variety of hand, arm, finger, body and head movements. In the empathy interventions, the agent used polite and friendly expressions (e.g. "I see you didn't like this test. Hopefully, you will find the next task more interesting and enjoyable. Would you mind if we continue?"), actively asked questions to understand the subjects' current mood state (e.g. "I can see you didn't perform as well as expected. How do you feel right now?"), and employed such expressions to convey a sense of sympathy and empathy to the subjects (e.g. "I am sorry to hear that things did not go better, but that is completely normal"). Lastly, in empathy and expressivity conditions, the agent also facilitated the subjects to express their feelings freely. The results showed that the level of intervention (empathy and expressivity; empathy; and non-empathy) has no significant effect on alleviating the subjects' negative mood state. Similarly, the findings indicated no difference between different interventions at each level of modality. However, similar to Brave, Nass and Hutchinson' (2005) study, they also found that giving empathic feedback led to a more positive attitude toward the system, including greater likeability, trustworthiness, perceived caring, and enjoyment to interact with regardless of the modality of delivering such content, although the difference was somewhat more profound when the system was represented by a human-like agent. Another study by Liu and Picard (2005) employing a wearable computer designed for acquiring health-related information from users also generated similar results that it was more preferred by users when the computer used empathetic language in its interactions with users. Different from Nguyen and Masthoff's (2009) study, comforting users through expressed empathy via computer agents during interactions

have been shown to be important in alleviating user frustration and deemed to have important healthcare applications. In search for the most effective outcome for comforting users, Bicmore and Schulman (2006) examined two different conditions, which were allowing users to freely express their feelings, but having the agents provide imperfect empathic responses versus greatly restricting how users can express themselves, but having the agents provide very accurate empathic feedback. Once the identical mood induction procedure used for both conditions to induce mild anxiety, the intervention by the agent set in motion. While, in the former condition the agent used a high expressivity dialogue script, which prompts users to express themselves more freely and replies with "Really? That is the interesting to hear" with a neutral facial display, in the latter condition, the agent used a high emphatic accuracy script which provided users with appropriate emphatic feedback with a related facial display. They found that an agent with greater empathic accuracy was more efficacious at evoking positive affect and comforting users, even at the cost of restricting user input.

Multimodal Communication

Apart from text-based embodied agents, considering different input channels of affective information, studies investigating various aspects of multimodal communication, such as, appearance, movements of body and face, voice (speech and paralinguistics), touch and smell, etc. (Larsen & Frederickson, 1999) are also begun to appear in the literature. For instance, Fabri (2007) designed a virtual messenger, which was basically a chat tool with a 3D animated avatar, which produces the facial expressions in relation to the emoticons used within the text-based part of the interface. He showed that the use of expressive avatars were more effective and contributed to users' experiences positively. Similarly another study by (Graf, 2005) showed that using a digital character with multimodal abilities conversing with the user in augmented reality had positive impact on users. He further contended that using a virtual figure in such environments might help building a relation between the user in the real world and presentation content in the virtual space avoiding frustration and contributing empathy. As for the auditory input, Tajadura and Vastfjall (2006) put forward the ignored role of sound in affective responses with a brief literature review. They further showed the importance of voice in image dominant multimedia applications by demonstrating the effects of two types of ecological sounds on emotions, specifically self-representation sounds, such as heart beating and breathing, and embodied activity sounds, such as footsteps. Creed and Beale (2006) conducted experiments mixing face expressions with speech in an animation and investigated the effects of mismatches on subjects' perceptions of emotional expressions. They found that while subjects recognized emotions in static facial expressions easily, they had difficulty in audio only expressions. Furthermore, in animations with appropriately matched audio and video, positive affects (e.g. happy) recognized more than negative ones (e.g. concerned), whereas mismatching of facial expressions and speech had a significant influence on subjects' perceptions of the emotional expressions. In mismatching animations, both visual and auditory representations of positive affects rated higher, despite the fact that neither visual nor auditory channel was found to be dominant over the other.

Lastly, Bianchi-Berthouse, Cairns, Cox, Jennett and Kim (2006) conducted a study, where they trained a system to accurately recognize emotions from bodily expressions even across different cultural backgrounds. They also showed that incorporation of full-body movements in the control of the game produced reports of higher sense of engagement by users.

CONCLUSION

As mentioned in previous sections, numerous researchers pointed out the relationships between emotions and cognitions using different theoretical perspectives. From appraisal theorists' point of view (e.g. Ellsworth & Scherer, 2003; and Scherer, 2003), emotions include patterns of perception and of interpretation. Emotions arise from attending and interpreting the environment and have an influence on thinking. From this perspective, it can be stated that emotion is construed as inherently private and information-based structures, which means that emotions occur at the individual level. On the other hand, others support the idea that emotion is an observable property of social action. For instance, Boehner et al. (2007) suggest that "emotion is an intersubjective phenomenon, arising in encounters between individuals or between people and society, an aspect of the socially organized life world we both inhabit and reproduce." (p.6). The design implication of this statement would be the importance of considerations of sociocultural factors such as social and cultural context, learning, and individual differences contributing emotions, in line with the debate of origins of emotions. Regarding the consensus that there are different forms of emotions, such as basic emotions stemming from evolution and biology and more complex emotions involving various cognitive components that differ across individuals and cultures (Izard 2007; Panksepp 2007; Pelachaud, 2009), it might be possible to define general HCI design principles for basic emotions, while designers should be on watch for more context- and culture-driven designs when emotions requiring higher cognitive processing are in question. Moreover, with the rise of distributed cognition and situated cognition accounts, which place a great emphasis on the role of social interaction in cognitive processes, the relationship between cognition and emotion is being investigated in connection with social action. Being a relatively new territory in HCI, it is expected that this trend will also influence the studies, which are bringing affect into the computerized environments. The design implication of this change calls into attention the issue of designing interactions for massively multiple users rather than individuals.

Design Suggestions

Based on the reviewed literature, we may come up with some basic design suggestions:

- Follow user-centered design methods, especially the participatory design approach, is the best development approach for creating these types of environments.
- Apply emotions to computer messages, for example write simple apologetic statements for errors.
- Consider sociocultural factors such as social and cultural context, learning, and individual differences contributing emotions, in line with the debate of origins of emotions.
- Follow general HCI design principles for basic emotions.
- Create systems that can recognize and interpret user emotions.

TRENDS AND FUTURE

Even though, several studies presented before mention the importance of considering social norms in HCI, they examined the effects of using social rules governing interpersonal communication on the interaction between users and computer interfaces. Using social rules in the computerized environments could not be equated to constructing electronic environments in which emotions are socially constructed in interaction with other users via computer interfaces. However, with the development of Web 2.0 and Web 3.0 technologies, social networking and collaborative learning environments are becoming popular more and

more each day, which signals the importance of multimodal designs utilizing multiple modes of communication channels for affective information and emotions. However, while creating multimodal designs, designers should be alert about choosing compatible modes rather than mismatching them (see Creed & Beale, 2006). This development also triggers the anticipated changes in the role of computer interfaces from assisting users to complete their tasks effectively and efficiently to providing users with an environment that brings them together for different purposes, which may also lead to socially constructed emotion. Since new technologies provide an environment for social interaction among individuals, but not only between the computer and individuals, a new term has appeared to represent the interaction between individuals via technology: Human-Human-Computer Interaction (HHCI) (Twidale, 2005). The design implication of this change is the issue of designing interactions for massively multiple users rather than individuals, namely the issue of HHCI design.

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KEY TERMS AND DEFINITIONS

Human Computer Interaction (HCI): The discipline that investigates human physical, cognitive and affective activities that are enacted during the interaction with computers.

Human-Human-Computer Interaction (HHCI): A newly emerging field that examines the social interaction among individuals via technology, along with the interaction between the computer and individuals.

Emphatic Agent: An interactive agent with built-in active listening, empathy, and sympathy statements for feedback.