HCI Seminar Final Report: User Frustration

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ABSTRACT

Frustration generates negative effects toward computer users, as when computer act in unexpected way and stops them from completing their goals. Several approaches were suggested to address this problem, but none of them succeeded. A new method was developed to solve this problem by introducing an interface agent to alleviate the negative feelings of the users. Those agents do not solve the problem which caused frustration, but rather attempt to return affective feedback demonstrating empathy and sympathy.

This article presents a research summary of selected academic papers related to user frustration, with a focus on utilizing interface agents to reduce negative feelings of users. These papers present different experiments to examine the effectiveness of interface agents reducing user frustration, and ways to improve these agents.

All the research and experiments revealed that the use of agent with affective feedbacks will help to reduce the frustration of user; however the overall effect of an agent may vary depending on the implementation.

Due to problems introduced by the method of conducting those experiments, such as using questionnaires to collect the emotional state of participants, result obtained may be influenced by undesired noises hence are inaccurate. Future experiments should draw more attention on obtaining accurate data and control the selection of participants regarding to the issues attempted to investigate.

INTRODUCTION

Frustration is the most frequent complaint registered by users who have a negative computing experience (Katie Bessière, Newhagen, Robinson, & Shneiderman, 2006), and is one of the main reasons people avoid to use computers. Lazar et al. (Lazar, Jones, Hackley, & Shneiderman, 2006) defined frustration as when the computer acts in an unexpected way that annoys users and keeps them from realizing their task goals.

The frustrations may be caused by the crash of application, network delays, unclear error messages or confusing interface (Ceaparu, Lazar, Bessiere, Robinson, & Shneiderman, 2004). They lead to results such as personal dissatisfaction and loss of self-efficacy. Furthermore, the workplaces may be disrupted, the learning process may be slowed and the participation in communities may be reduced (Lazar et al., 2006). Hence, reducing the level of computer frustration becomes a critical issue(Baylor & Rosenberg-Kima, 2006).

Three major research areas were explored on the topic of Computer Frustration. Research in the first area focused on discovering the reasons which caused frustration, together with factors which may influence the level of frustration and the effects frustration may bring (Katie Bessière et al., 2006; Lazar et al., 2006).

Research in the second area drew attention on attempting to implement mechanisms of sensing and interpreting the verbal or biological expressions of users to decide if they are frustrated (Hazlett, 2003; Scheirer, Klein, Fernandez, & Picard, 2001). Research utilized these techniques demonstrated the ability of them to collect reliable data (Kapoor, Burleson, & Picard, 2007; Mori, Prendinger, & Ishizuka, 2003).

Research in the third area attempted to find solutions to the frustration problem. Traditionally there are two solutions. One is trying to determine and fix the problem causing the frustration, and the other is trying to prevent the problem from happening. While they are important approaches, none of the implementations succeeded (Picard, 1999). A new solution was introduced by Klein et al. (Klein, Moon, & Picard, 2002) , which is to design a computer-user interface to support user to recover from negative emotional states. Based on their findings, a new area of research was born – the research on the effects of interactive agent to reduce the user frustration.

This paper combines the findings in previous works on the topic of user frustration, mainly focused on the area of the effect of interactive agent. Methodologies are described and approaches, problems and findings are discussed.

TEXT-BASED AGENTS

The two traditional approaches to user frustration failed because they are impractical. First, the possibility of providing the system with all knowledge it needs to determine and fix problems is questionable (Maes, 1994), especially when the actions of users are unpredictable. Second, the prevention of the problem can never be achieved since all software has bugs. Furthermore, in

those solutions the emotions of user are always ignored (Picard, 2000), which are the actual problem that should be addressed of (K. Bessière, Ceaparu, Lazar, Robinson, & Shneiderman, 2004). Thus apart from addressing the cause of frustration, the idea of affective computing (Picard, 1999) was introduced. It expends human-computer interaction by including emotional communication, together with means of handling affective information. Following the idea, Klein et al. (2002) focused on making the system to respond meaningfully to negative user emotions, such as frustration. The system may not solve the cause of frustration completely, but it can alleviate frustration and the negative effects it may have brought (Jaksic, Branco, Stephenson, & Encarnação, 2006). Since "getting more frustrated can make the problem solving situation more difficult" (Katie Bessière et al., 2006), changing the mood of user may also improve the ability of problem solving.

Interface agents are programs implemented with artificial intelligence techniques to help user with computer tasks (Maes, 1994). Maes (1994) described four major tasks an interface agent can do: to perform tasks, to teach the user, to help collaborate different users and to monitor events and procedures. The use of agent to alleviate frustration can further aid the effectiveness of supporting the user, since the user will have better mood after the interaction (Klein et al., 2002).

A text-based agent was designed by Klein et al. (2002), which applied active listening technique that demonstrated empathy and sympathy. The technique is known to relieve strong, negative emotional states quickly and efficiently in human-human communication situations. In their experiment, frustration was induced by having the participants experiencing delays in a game (there was no delay in the control condition). Each participant interacted with the game for five minutes, followed by a popup questionnaire. Each participant was assigned to one of the questionnaires groups: ignore, vent or agent. In all conditions demographic questions were asked. In the ignore condition, participants were to rate the game with facts.

Both vent and agent conditions give opportunities to participants to rate the game with emotional responses. At the end they were asked to rate their frustration level. In the vent condition, the frustration rating was followed by an open-ended feedback question, which allows participant to freely report their feelings. In the agent condition, based on the selected level of frustration agent will respond with different feedback.

After the questionnaire each participant were asked to play the game once more without time limit, this time there was no delay in both groups. Results were analyzed depending on how long participants stayed for the post-questionnaire session, as if the frustration was alleviated, participants should have better feeling to the software and be more willing to interact with it. The game was designed to be boring, to eliminate the possibility that participant play it for fun.

Result showed that participants under agent condition are relieved from frustration and feel better on using the same computer system.

Some other interesting facts were demonstrated by their experiment results. First, giving people opportunity to vent is as effective as doing nothing at all, in terms of alleviating the bad feelings. Second, people would have more interest on products that have failed but was fixed and function correctly.

Although the result reported by Klein et al. (2002) was exciting, the method they used in obtaining the result was ambiguous(Hone, Aktar, & Saffu, 2003). The self-reported frustration level did not reveal significant results. Hone et al. (2003) suggested it may be because the data was not collected in time when the frustration occurs, but at the end of the game. They partially replicated the work of Klein et al. (2002), with two different changes. First, the frustration levels were measured during the experimental task itself. Second, it allows participants to select when to react with the agent. These modifications were done in hope of obtaining a better in-time result. All participants were asked to play a frustrating game, but there was no affective agent in the software for the control group. Two measures were taken, one during the game and one immediately afterwards.

Data showed that the level of frustration in the control group has increased at the second measurement, where with the presence of agent, there is significant reduction in frustration level. The result confirmed the findings of Klein et al. (2002), demonstrated that an affective agent is able to reduce the level of frustration.

EMBODIED AGENTS

Experiments described above displayed the effectiveness of text-based agents in reducing user frustration. However, most of the agents implemented more recently are embodied. They show expressive behaviors, often via facial or gestures (Burleson, Picard, Perlin, & Lippincott, 2004), to help them looking believable and likable. As the successful experience of the text-based agent came from the use of human-human communication strategy, having the agent appear humanoid may further improve the effectiveness(Hone et al., 2003). However they need to be designed carefully, since the initial attempts of using social agents have received a mixed response from users, such as stating them as unnecessary, distracting, or even irritating (Jaksic et al., 2006).

Hone et al. (2003) implemented an experiment comparing the effectiveness of a text-based agent versus an embodied agent. The contents of the affective feedback

provided by both the text based and the embodied agents are the same. However the embodied agent was made to be a blonde female character which talks via speech bubbles. Results showed that participants interacting with the embodied affective agent experienced greater reduction in self-rated frustration levels than those interacting with the text-based agent.

Type of message

Past research displayed two methods which can help to alleviate the level of frustration in human-human communication situations (Baylor, Warren, Park, Shen, & Perez, 2005). The first method involves offering an apology, as to admit the blameworthiness; it is most effective if the deliverer of the apology is responsible for the obstacle which generates the frustration. The second method involves delivering empathetic concern for the emotional experience of the another, similar to the active listening technique discussed in Klein et al. (2002); it is most effective if the one expressing concern is not perceived as the cause of frustration.

Baylor et al. (2005) explored whether the type of affective message (apologetic or empathetic) will impact the attitude of participant toward the task or the agent. Also the attribution toward the cause of frustration was examined, because it was assumed to affect the effectiveness of responses.

An online survey system was created with a virtual embodied agent which started the experiment by introducing the survey to participants, and then maintained its presence through the survey period, being silent with actions such as blinking or other predefined animation. The system was designed that it will repeatedly enter abnormal state to frustrate participants. At the end of the survey, the agent would either stay silent or provide apologetic or empathetic feedback to alleviate frustration.

The survey collects feedback on attributes including the competency of agent, the degree to which the agent is similar to human, the believability of the agent, the survey enjoyment and the survey frustration. Participants were also asked to rate the attribution of the cause of the problem, to targets including themselves, agent, software and internet.

As results indicated, participants who received any of the two affective responses tended to attribute the cause of frustration to the program rather than themselves. This together with the fact that they trusted the affective agent made them resonate and reactivated their frustration. Thus they reported significantly higher frustration, compare with participants who did not receive a message. Because the problem could not be resolved by participants, by having them attribute the cause of frustration to the software, they are reassured that although the experience was frustrated and not perfect, it was not their fault, so they can still walk away with a positive feeling.

Compare the different affective response, participants receiving the empathetic message found the agent to be more believable and sincere. They concluded the reason may be due to the agent apologize for the problem at the end of the experiment, rather then reply immediately; the time gap between the encounter of obstacle and the receiving of apology may have reduced the sincerity of such feedback. The same problem has occurred in Klein et al. (2002) and was specifically addressed by Hone et al. (2003), as described in previous sections. Overall the empathetic message was more effective.

Linguistic message

In human–human interaction, nonverbal behaviors such as gesture and posture support the meaning of the linguistic message, and convey important information about personality and emotional state (Mori et al., 2003).

A set of experiments were developed by Mori et al. (2003) to examined the effects linguistic style message may have on user frustration. A system was designed as a mathematical quiz game, with an agent which can perform facial and body gestures. To enable more complex gesture, instead of the common upper body figure, the agent is displayed in whole body. It communicated through a combination of speech bubbles and speech functionality, which can be synchronized with gestures. The dress, gestures and speeches of the agent all follow the Japanese (where the experiment was conducted) culture.

Out of thirty quiz questions, six delays were inserted to cause frustration. Skin conductivity and heart rate were measured as indicators of user frustration. This method overcame the limitation of "self-reported data tend to be unreliable" as stated by Klein et al. (2002).

The agent stays on screen through the game period, and performs both verbal and non-verbal feedbacks depending on whether the subject selected the correct answer or not. It also expresses empathy immediately after the occurrence of the delay. The agent in the control set, on the other hand, was designed to be non-affective, only replies right and wrong, and does nothing if delay occurs.

The behavior of affective agents differed in two areas, which are the linguistic style and the facial and body gestures. In the linguistic style, although both agents answers right and wrong, the affective agent answers with words which are more formal in Japanese language, while the non-affective agent answers in plain right and wrong. Only affective agent was implemented with facial and gestures. It express smile when participant answered correctly, and appear to be sad otherwise. When delay happens, the affective agent performs gestures which Japanese people perceive as a sign of apology, and also

apologize verbally which convey the politeness and sorriness.

The result supported the fact that participants who experienced affective agent tended to find the game being easier, less frustrated and more enjoyable. However, compare with users assigned to the non-affective agent, it was decided that none of the differences reached the level of statistical significance.

Speech

Speech was an essential part in human-human interaction. Three of the research found implemented this functionality into their agents (Baylor & Rosenberg-Kima, 2006; Jaksic et al., 2006; Mori et al., 2003). However, none of them attempted to examine the effect it would have on reducing the user frustration, as an aid to the visual embodied agent.

Baylor & Rosenberg-Kima (2006) compared the implementation of an embodied agent which has speech ability, to the same agent with voice only by have the visual presence disabled. The same set of experiment as discussed in previous section was conducted(Baylor et al., 2005). Results showed the agent which has a visually presence was more believable. I is also significantly more likely to alleviate the frustration or problems participants encountered, when it is delivering empathetic feedback. There was no significant difference between the agents with respect to apologetic feedback.

One important finding is that certain participants were annoyed by the slow manner of the artificial speech, since it can be faster for them to just read the text (Jaksic et al., 2006).

Gender

Gender is an important observable attribute of human kind. Of the papers discussed where embodied agent was presented, two implemented them as female (Hone et al., 2003; Jaksic et al., 2006) and two implemented them as male (Baylor et al., 2005; Mori et al., 2003), while others did not attempt to implement them in any gender (Burleson et al., 2004; Maes, 1994).

Hone (2006) hypothesized that user interacting with a female embodied affective agent will experience greater reductions in self-rated frustration levels than those interacting with a male affective agent. A user-study was carried out to examine the correctness of this hypothesis.

The results confirmed the hypothesis. However the approach used has limitation on that “the specific choice of agent embodiment used” (Hone, 2006) may affect the results. The differences between the embodiments of agent selected are more than just gender. They cover differences such as height, dress and color scheme; all of those can affect the result.

Another interesting finding in the experiment (Hone, 2006) suggested that affective agent may be more effective at relieving the frustration of female participants, than the frustration of male participants. This is in contrast to findings by Klein et al. (2002) who examined demographic detail of participants but found no indication on gender effects. As none of these two experiments was designed specifically for finding such relationship, Hone (2006) concluded that further work is required, and it is important to control the gender of participant in experiments in this area.

DISCUSSION

Collectively, all studies examined here suggested that user frustration can be alleviated by implementation of affective agents. Rather than solving problems that caused the frustration, they aim to deal with frustration itself. The results are promising, since the traditional solutions to computer frustration did not succeed in eradicating the problem (Klein et al., 2002). Implying such discovery to software designs, we can see that even a text-based affective agent is capable of relieving negative affects, and further on making subjects feel better about using the same system that frustrated them in the first place (Klein et al., 2002). It is a cheap solution to failures.

Most of the research in this area focused on finding if a particular aspect of the agent will have an impact on the effectiveness of the agent. Those attributes mainly arisen from the affective attributes in human-human interaction, due to the findings that users respond to computers the same way they do to other humans (Klein et al., 2002). Not only does the contents of the affective message attributes to the effectiveness, but the design such as the manner which sentences are presented, the gestures and the appearance of the agent all can make difference to them. And there can only be more.

While the design of agent is important, there is never a design to everyone’s like. Apart from market research on the cultural background (Mori et al., 2003) and careful design of the agent (Hone, 2006), it is also important to provide an option for user to turn the agent off, since there are always people who are distracted by the presence of an agent (Jaksic et al., 2006).

Although as mentioned in previous section, there are many research focused on detecting computer user’s frustrations with means other than questionnaires, only Mori et al. (2003) applied some of those techniques. Most of the experiments were still conducted with only surveys as measure of frustration. While Hone (2003) criticized Klein et al. (2002) for ignoring the data presented in their survey result, Mori et al. (2003) discovered participants underestimate the extent to which they were frustrated, and attribute the cause of the problem to participants, stating that they answer in the way they believe the experimenter expects them to answer.

The gender of the participants may be another issue which affects the reliability of the experiment results, as indicated by Hone (2006). Among the research, only Mori et al (2003) attempted to control the genders of the participants.

Future experiments should draw more attention on eliminating such affective elements. More objective method should be occupied, such as physiological user data assessment, to detect reliable data (Mori et al., 2003). The participant selection should also be well categorized, with regard to the target problem, to prevent as much bias as possible (Hone, 2006).

CONCLUSION AND FUTUREWORK

A set of studies was presented, on the hypothesis that a well designed computer agent capable of expressing affective feedback can effectively alleviate user frustration. While they all confirms to the hypothesis, more attention was placed on how attributes of agents can impact on the effectiveness of the agent.

As concluded from the results of those research, we find that an embodied female agent which feedback to computer user with empathetic messages will be most effective. However due to the uncertainty existed in the methodologies carried out in those research, this conclusion may be unreliable.

Future works are expected, on attributes which may affect the effectiveness of the agent, such as the voice output and real-time interaction. More complex dimensions of interaction should also be taken into account. Although agents presented in these research tend to feedback with sad faces to frustrations, in human-human interaction the most effective solution may not always be like that.

Current modeling technology can provide a better environment for building agents which look more human-like, together with the artificial intelligence, should further realize the goal of simulating a virtual agent which can really listening to users complains and produce appropriate feedbacks.

Another approach may be the utilization the self-learning artificial intelligent systems. Since all the research topics presented are based on human react the same way to computers as they do to other human, it may not be true for everyone. Providing an intelligent agent which adjusts its feedback depending on reaction of participants may create a more general and precise result on how a computer based agent should behalf to reduce user frustration.

Among all the research presented, only Jaksic et al. (2006) created an environment which is associated to daily life. Others conducted their experiments with either gaming system or survey systems, which are less practical, hence decreased the value of their findings. More research should be done on practical areas such as school systems or commercial websites to discover where the affective agent will be most suited and which are not.

All works in the future should apply means other than questionnaires, such as physiological user data assessment or facial detection, to detect reliable data. Participant selection should be well categorized, regarding to the targeting problem, to prevent as much bias as possible.

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