

The impact of frustration-mitigating messages delivered by an interface agent

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Abstract. Mitigating frustration is important within computer-based learning contexts. In this experimental study where participants were purposefully frustrated, the interface agent message (apologetic, empathetic, or silent) was manipulated to investigate its impact on student attitude toward the task, attitude toward the agent, and attribution toward the cause of frustration. Fifty-seven undergraduate students responded to an invitation to participate in a web-based survey and to receive a movie ticket for their effort. An animated interface agent, “Survey Sam,” was present as students answered survey items and were confronted with a frustrating obstacle – an error message pop-up window that blocked them from answering the survey items. Survey Sam delivered either an affective message (apologetic or empathetic) or remained silent to the thirty students who actually completed the survey. Results revealed that the presence of an affective message (either apologetic or empathetic) led participants to report significantly greater frustration, suggesting that the affective message reinforced and validated their frustration. However, and more importantly, they attributed the cause of their frustration to the program instead of to themselves (as did the no message group). A comparison of message type (apologetic or empathetic) indicated that participants receiving the empathetic message rated Survey Sam as significantly more believable and sincere. Implications of these findings as a catalyst for further research in the development of frustration-mitigating support for computer-based contexts are discussed.

Introduction

Emotions within learning contexts are not stable. Students may experience many different emotional states during the learning process. According to appraisal theories of emotion, emotions arise from an individual’s meaning construction and appraisal of continuous interactions with the world [1, 2]. Especially in learning situations, the process of students’ meaning construction and appraisal may acquire different forms depending on the characteristics of the tasks given to those students. Frustration, where an obstacle prevents the satisfaction of a desire [3], is one of the negative emotions students deal with in most learning situations because a learning task usually requires student effort to solve challenging problems. Therefore, reducing the level of frustration becomes a critical issue in a computer-based learning situation [4].

One method for diffusing frustration involves offering an *apology*, especially if the one apologizing is taking responsibility for the obstacle causing the frustration, thus

admitting blameworthiness and regret for an undesirable event [5, 6]. A second method to diffuse frustration involves delivering *empathetic concern* for another's emotional experiences, especially if the one expressing concern is not perceived as the cause of the frustration. Empathy is an emotive-cognitive state where the emotional element involves concern with the personal distress of another person and the cognitive element involves understanding the perspective of the other person [7], resulting in a shared, or distributed, emotional experience.

With regard to previous agent implementations, Mori and colleagues evaluated an affective agent that was designed to alleviate frustration during a mathematics quiz game by delivering empathetic "happy for" or "sorry for" responses [8]; however, results were limited by a small sample size. While Johnson and colleagues have found that agent politeness is valuable in a tutoring environment [9], they have not focused on learner frustration. Baylor and colleagues investigated the role of interface agent message (presence/absence of motivation) and affective state (positive versus evasive) on student attitude for mathematically-anxious students [10]. While their results supported the value of cognitively-focused motivational messages [e.g., 11] on student confidence, results were inconclusive regarding the impact of affect as a mediator in the process.

1. Research Questions

This exploratory, experimental study was designed to investigate the impact of interface agent message (apologetic, empathetic, or none) on user frustration, attribution perception, and attitudes. Specifically, we investigated the following research questions:

1. Does the presence of an affective message impact participant attitude toward the task, attitude toward the agent, or attribution toward the cause of frustration?
2. Does the type of affective message (apologetic or empathetic) impact participant attitude toward the task, attitude toward the agent, or attribution toward the cause of frustration?

2. Method

2.1 Participants

Participants included thirty undergraduate students (average age = 19.7 years; 93% female) who had recently completed an introductory course on Educational Technology in a public university in the Southeastern United States. Fifty-five participants began the study, but only thirty actually completed it. Computer self-efficacy assessed as part of the pre-survey revealed no differences in efficacy between those who completed the survey and those who did not, or between treatment groups.

2.2 Research Environment and Interface Agent

The research environment was created to so that participants could complete a personality survey (based on the Big Five Factor theory of personality [e.g.,12] with the presence of "Survey Sam," a 3D animated interface agent. Upon entering the environment, Survey Sam introduced students to the survey, stating: "Hi, my name is Survey Sam. Here's the survey you take to get your movie tickets. Please do your best." While students were completing the survey, Survey Sam was always present and displayed basic animations, including eye-

blinking and head-turning, figuratively “watching” participants as they worked through the survey. His presence was maintained throughout the survey to establish his existence as a foundation for the message that he later delivered to 2/3 of participants.

Upon completion of the survey (for the thirty students, or 52%, who actually finished it), Survey Sam was either silent or provided one of two affective messages with a human voice: apologetic or empathetic. The script for the apologetic agent was based on the strategies in the Cross-Cultural Speech Act Realization Project [6] and the script for the empathetic agent paralleled the apologetic script based on Roger’s [7] emotive-cognitive description of empathy. Table 1 lists the scripts used in this study.

Table 1. Scripts for Apologetic and Empathetic Messages

Message	Scripts
Apologetic	<i>“I’m really sorry that this problem happened to you. I know that the problem could have been avoided on our part, and it was not your fault. I promise that I will report this problem to the system administrator so that it will never happen again. Please take a few minutes to describe your experiences from the previous screens. Thank you.”</i>
Empathetic	<i>“It must have been very frustrating trying to finish the survey with the problem you were experiencing. I sympathize with how you feel. I wish that I could have helped you to overcome this problem. Please take a few minutes to describe your experiences from the previous screens. Thank you.”</i>

2.3 Post-survey

The post-survey assessed the dependent variables of agent competency, agent believability, survey enjoyment, survey frustration level, and attribution of the cause of the frustration. Agent competency and agent believability measures were adopted from API (Agent Persona Instrument) developed by Ryu and Baylor [13].

Three to five items were used to measure each dependent variable and each employed 5-item Likert scales. Internal consistency reliabilities (Cronbach’s alpha) for Agent competency, Agent believability, Survey enjoyment, and Survey frustration level measure were .90, .74, .98, .88, and .75, respectively.

2.4 Procedure

A total of 289 emails were sent out to invite students to participate in a web-based personality survey and receive a free movie ticket upon completion. Respondents could complete the survey within the following four weeks.

The 55 participants who began the survey first provided demographic information and information regarding their computer self-efficacy. Following this, they completed items from the Big Five personality survey, as presented on five successive screens, with eight items per screen. Beginning on the second screen of the Big Five survey, a pop-up window appeared and covered up the survey items (see Figure 1). This pop-up window was

designed to stimulate annoyance and frustration in the participants. The participants had to move the pop-up window out of the way in order to answer the survey questions (the window would not close by pressing the red “X” button). Because the pop-up window moved back to the original spot after five to nine seconds, participants had to repeatedly move the pop-up window out of the way to respond to the survey. Indeed, this was such a frustrating experience that only 30 of the initial 55 participants completed the survey.

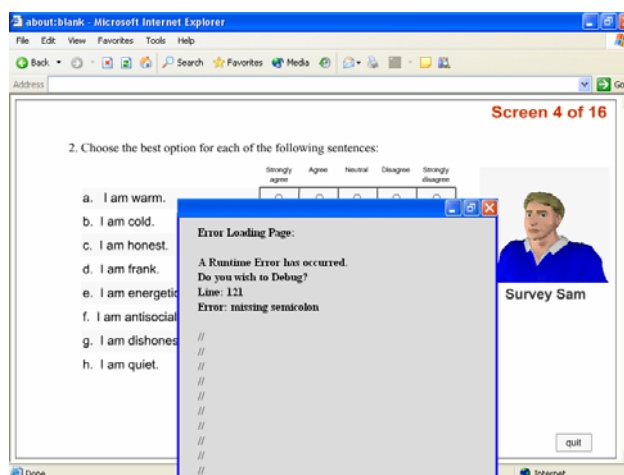


Figure 1. Screen shot with the pop-up window as an obstacle to answer survey questions

After completing the personality survey, the agent was either silent or provided an affective message (apologetic or empathetic). Next, students completed a post survey to assess agent competency, agent believability, survey enjoyment, survey frustration level, and attribution of the cause of the frustration.

2.5 Data analysis and design

A planned contrast with alpha level set at .05 was conducted to compare each dependent variable between those receiving no message (silent agent) and those receiving an affective message (either apologetic or empathetic). An independent sample t-test with alpha level at .05 was conducted to compare each dependent measure between the apologetic-message and empathetic-message groups. Students' perception of attribution of problem cause was analyzed with a one-way ANOVA, across the three agent conditions (silent, apologetic, empathetic).

3. Results

3.1. Impact of affective message

The major research question in this study was concerned with the effect of interface agent message (or absence). The descriptive statistics for each dependent variable are presented in Table 2.

Table 2. Means and standard deviations of dependent variables across groups.

<i>Message</i>	Agent competency		Agent Human-like		Agent believability		Survey enjoyment		Survey frustration	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Apologetic (n=11)	3.18	.68	3.00	.51	3.00	.94	3.25	.96	3.24	.82
Empathetic (n=9)	2.78	.93	2.78	.83	3.89	.60	3.06	1.09	3.15	.94
Silent (no message) (n=10)	3.22	.47	2.85	.39	3.23	.39	3.33	.53	2.23	.93

For survey frustration, the result showed there was a statistically significant difference between those receiving an affective message and those receiving no agent message, $t(27) = 2.772$, $p=.01$, $d=1.12$, a large effect, indicating that students who received an agent message reported significantly higher frustration from taking the on-line survey than students who did not receive a message.

An independent sample t-test setting alpha level at .05 was conducted to compare each dependent variable between participants receiving an apologetic message and those receiving an empathetic message. Results revealed that for agent believability there was a statistically significant difference between the apologetic-message group and empathetic-message group, $t(18) = -2.445$, $p<.05$, $d=1.16$, a large effect, indicating that students in the empathetic-message group believed the animated agent more (e.g., believed that Survey Sam “meant what he said,” and “was sincere in what he said”) than students in the apologetic-message group.

3.2. Attribution of cause of problem

Students also rated their attribution of the cause of the problem. Descriptive statistics for the attribution of problem cause are presented in Table 3.

Table 3. Descriptive statistics for attribution of problem cause

<i>Message</i>	Themselves		Survey Sam		Computer software		Internet	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Apologetic (n=11)	1.82	.75	3.00	1.27	3.82	1.08	3.09	1.14
Empathetic (n=9)	1.56	.73	2.00	1.00	4.22	.83	2.67	1.32
Silent (no message) (n=10)	2.50	.53	2.90	.74	3.60	.70	3.30	.68

(Range of 1-5, where 1=SD and 5=SA)

A one-way ANOVA setting the alpha level at .05 was conducted to examine whether students attributed the cause of the problem to themselves, to Survey Sam, to the computer software, or to the Internet. The ANOVA yielded a significant overall difference, $F(2,29) = 5.03$, $p < .05$, $\eta^2 = .27$. Follow-up Fisher’s least significant difference (LSD) tests were performed to determine whether significant differences occurred between the mean scores for each pair of treatments. These tests revealed that those in the silent agent (no message) group tended to attribute the problem to themselves more than the other two message groups ($p < .05$). There was no statistically significant difference between the apologetic-message agent group and the empathetic-message agent group.

The ANOVA was also conducted to determine whether there were differences between groups in attributing the cause of the problem to Survey Sam. As expected, those receiving an apologetic message tended to attribute the problem to Survey Sam ($p < .05$). This validates the treatment, as it indicates that participants believed Survey Sam when he apologized and took responsibility for the problem.

4. Discussion

Results indicate that the presence of an affective message contributed to participants reporting significantly greater frustration. This indicates that they resonated with and believed the agent, as his message essentially “re-activated” their frustration, validating it and amplifying it. More importantly, students who received the agent’s affective message also tended to attribute the cause of the frustration to the program (rather than themselves).

Given that the problem was indeed out of their control, implementations like this that can reassure users that they are not at fault are of importance; indeed, this was only a five-sentence intervention, yet it yielded a large effect (over a standard deviation). Future research should consider the nature of this self-reported “frustration” and its relative weight in relation to users’ attributions of the cause.

Results also indicated that students who received the empathetic message rated the agent as more believable than students in the apologetic-message group. Since the empathetic message conveyed an understanding of the participant’s perspective rather than focusing on responsibility, it may have had the effect of making the participant feel that he/she and the agent were figuratively “in the same boat.” This might have provided the participant with the perception of the interface agent as an understanding bystander instead of a responsible/apologetic or non-responsive helper. Also, the delay of the apology from the initial occurrence of the problem may have lessened the credibility of the apologetic message in terms of perceived sincerity. In addition, an apologetic message that conveys responsibility for the problem may also place the agent in an inferior position, i.e., the agent may be perceived as someone who has failed in avoiding technical problems. Either way, it is interesting that such a brief message from a non-human, computer-based, interface agent has such a profound impact, in line with findings by Reeves and Nass [14].

In retrospect, given that 25 of the 55 respondents who began the survey did not finish it (a 45.5% attrition rate), the survey was likely *too* frustrating. Another limitation is that the experiment had a low number of participants per condition (9, 10, and 11 respectively). However, in spite of the relatively low statistical power, the results were statistically significant with large effect sizes ($d > 1.0$). Another important consideration is that participants completed the study at their own computer and chosen time/place. While control in implementation was thus lost, ecological validity was enhanced, as this type of computer-based frustration could only be authentically simulated in a real context. Despite these limitations, the import of the findings is that the presence and nature of an affective message can impact how a user perceives frustration. These findings provide the catalyst for further research in the development of frustration-mitigating support for computer-based contexts.

Future research should include a control group to isolate the message(s) from the interface agent as the delivery mechanism. Future studies could also consider the timing of the message, including messages delivered during each problem occurrence rather than after-the-fact. Future studies could also track user interactions to determine when

participants quit during a frustrating task and could compare participant personality characteristics with their frustration levels, attribution perceptions, and attitudes. *Also, note that we are in process of collecting more user data over the next weeks.*

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