

Adult Learner Perceptions of Affective Agents: Experimental Data and Phenomenological Observations

Daniel WARREN	E SHEN	Sanghoon PARK	Amy L. BAYLOR	Roberto PEREZ
<i>Instructional Systems Program RITL – Affective Computing</i>	<i>Instructional Systems Program RITL – Affective Computing</i>	<i>Instructional Systems Program RITL – Affective Computing</i>	<i>Director, RITL</i>	<i>Instructional Systems Program RITL – Affective Computing</i>
http://ritl.fsu.edu	http://ritl.fsu.edu	http://ritl.fsu.edu	http://ritl.fsu.edu	http://ritl.fsu.edu
Florida State University	Florida State University	Florida State University	Florida State University	Florida State University
rdw4048@fsu.edu	ess0086@fsu.edu	ssp5177@fsu.edu	baylor@coe.fsu.edu	rgp6722@mailier.fsu.edu

Abstract. This paper describes a two-part study of animated affective agents that varied by affective state (positive or evasive) and motivational support (present or absent). In the first study, all four conditions significantly improved learning; however, only three conditions significantly improved math self-efficacy, the exception being the animated agent with evasive emotion and no motivational support. To help in interpreting these unexpected results, the second study used a phenomenological approach to gain an understanding of learner perceptions, emotions, interaction patterns, and expectations regarding the roles of agent affective state and motivational support during the learning process. From the qualitative data emerged three overall themes important to learners during the learning process: learner perceptions of the agent, learner perceptions of self, and learner-agent social interaction. This paper describes the results of the phenomenological study and discusses the findings with recommendations for future research.

1. Introduction

Animated agents are graphical interfaces that are capable of using verbal and non-verbal modes of communication to interact with users in computer-based environment. These agents generally present themselves to users as believable characters, who implement a primitive or aggregate cognitive function by acting as mediators among people and programs, or by performing the role of an intelligent assistant [1]. In other words, they simulate a human relationship by doing something that another person could otherwise do for that user [2]. There has been extensive research that shows learners in agent-based environments have showed deeper learning and higher motivation [3]. A recent study [4] in which agents monitored and evaluated the timing and implementation of teaching interventions (e.g., help feedback), has indicated that agent role (expert, motivator, instructor) and agent voice and animation had a positive effect on learning, motivation, and self-efficacy. Yet, there are few studies which focus on the cognitive function of the agent in the learning environment [5], or which implement a systematic examination of learner motivation, perceived agent values, and self-efficacy. The focus of this study is to explore how emotionally evasive, unmotivated agents are perceived by users, and to try to uncover what perceptions and alternative strategies users may develop to deal with this kind of agent.

2. Experimental Method

A group of sixty-seven General Education Development (GED) students in a community college in the southeastern United States participated in this study. Students were 52% male, 44.8% female, with 17.9% Caucasians, 71.6% African-Americans, and 13.5% of other ethnicities. Average age was 22.3 years (SD=8.75).

There were four agent conditions: 1) Positive affective state + motivational support; 2) Evasive affective state + motivational support; 3) Positive affective state only; 4) Evasive affective state only. Students were randomly assigned to one of the agent conditions, and they worked through a three-step process (concepts, examples, practice) to solve percentage word problems. Before and after the task, students' math anxiety level and math self-efficacy were measured. The post-test also measured perceived agent value, instructional support, and learning.

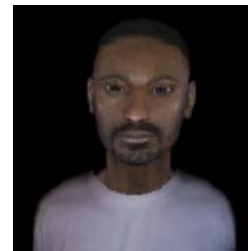


Fig. 1: the animated agent used in the study

3. Findings

Results indicated that students who worked with the positive + motivation support agent significantly enhanced their self-efficacy from prior ($M=2.43$, $SD = 1.22$) to following the intervention ($M = 3.79$, $SD = 1.37$, $p < .001$). Similar improvement was found for the agent with positive affective state only ($M=2.42$, $SD = .96$ vs. $M = 3.84$, $SD = 1.43$, $p < .001$) and for the agent with evasive + motivation support ($M = 3.06$, $SD = 1.53$ vs. $M = 4.13$, $SD = 1.03$, $p < .001$). Additionally, students perceived the agent with motivational support as significantly more human-like ($M = 3.83$, $SD = 1.02$) and engaging ($M = 4.03$, $SD = 1.09$) than the agent without motivational support ($M = 3.33$, $SD = 1.02$) ($M = 3.65$, $SD = .92$). As expected, the agent with evasive affective state and no motivation support did not lead to an improvement of student self-efficacy or to a perception of the agent as offering good instructional support. However, across all conditions, students performed significantly better on the learning measure than prior to using the program. In other words, students who interacted with an emotionally evasive, unmotivational agent, still improved their learning (i.e., "in spite of" this agent). This result was intriguing enough to be the motivation of the second part of the study, where students were observed and interviewed about their interactions with an agent that displayed evasive emotions and provided no motivational support. The focus of this part, then, was on understanding those interactions better, as well as getting students' feedback to improve the agent.

4. Observational Method

The phenomenological follow-up study included six students enrolled in an Adult Education program at the same southeastern United States community college. Participants were selected using an intensity sampling method, to identify those individuals with personality traits that resulted in willingness to express opinions and to share and describe experiences.

Data were collected from students using direct observation and interview techniques. During the initial observation phase, participants navigated through a computer-based math learning module and interacted with a pedagogical agent. The agent displayed evasive emotion and did not provide motivational support. At specific phases of the learning process participants were asked to answer specific research questions regarding their perception of the emotional expressions of the pedagogical agent. Each participant interacting with the computer tutorial was observed from a control booth through one-way windows. Field notes were taken by the researchers noting poignant instances of a participant's emotional expressions while interacting with the agent, as evidenced through facial expressions, vocalizations, and gestures. These instances of emotive expression were digitally cued on the recording medium in order to facilitate access to them during the subsequent interview session with the participant. After the computer tutorial was completed, a follow-up interview occurred in which participants viewed the digitally cued segments of their interactions with the agent. During the interview sessions, participants were asked to describe their emotional expressions, feelings, and reactions at the specific digitally cued locations in the video recording.

4.3 Coding the Data

The process of coding involved looking for meaningful patterns and themes that were aligned with the purposes and the focus of the study. Interview data were digitized and then transcribed with a

simple word processing software. These files were then imported into NVivo™ software for subsequent data coding and analysis.

4.4 Validation and Triangulation Process

Triangulation of findings involved: comparing field notes from observations, interviews, and survey responses; using different data collection methods (observations, interview, and surveys); using different sources (participants); and using perspectives from different analysts to review the data; which together lent further credibility to the findings.

5. Findings

Subsequent to the coding of the data, the iterative and immersive search for patterns among data sources gave birth to categories, which further beget overarching themes: “learner perception of the agent,” “learner agent social interaction,” and “learner perception of self.” Each of these themes, their categories, and items are discussed below.

Learner Perception of the Agent. This theme naturally grew as an extension of the interview questions and computer survey items that prompted the participants to describe the agent’s emotional expressions, facial expressions, and tone of voice. Based on student responses to these items, this theme refers to the learner’s reaction toward the agent’s: emotion, facial expression, gaze, image, voice, and initial reaction. Responses such as “it was strange,” “what’s going on,” and “funny looking” characterize the initial reactions that students had toward the agent. All other categories within this theme contained two sub-categories: “learner’s assessment” (of the agent) and “learner’s recommendation” (to improve the agent), both in regard to the agent’s emotional expressions, facial expressions, and tone of voice.

Learner Perception of Self. Similar to the last theme, this theme naturally grew as an extension of the interview and survey questions focusing on the participant’s emotional experience while interacting with the agent. From these items emerged categories related to learner: nervousness, anxiety, confusion, frustration, and confidence while interacting with the agent. Two other categories not related to agent interactions that were included in this theme were the participant’s emotional experience when exposed to the timer in the timed questions section of the module, and the learner’s assessment of their prior knowledge in relation to the content of the module.

Learner-Agent Social Interaction. Unlike the previous two themes, this theme emerged solely from the follow-up interview questions, in which the participants observed video clip recordings of select moments of their interactions with the agent and were then asked prompted to describe, among other things, their experience in interacting with the agent. Categories included in this theme pertain to the agent’s: feedback, overall nature and manner, and support and encouragement. Other emergent categories include descriptions of possible agent social interaction interface options, characteristics of their favorite teacher (not necessarily math teacher), and descriptive comparisons of the agent versus a face-to-face teacher, and the agent’s voice versus the screen text.

7. Conclusions

Based on participant responses, it seems that the agent was beneficial to some participants and not so to others, and that these benefits or lack thereof were to a degree contextually based, and quite possibly dependent on learner characteristics. As alluded earlier, it seems that participants perceived that having the agent present and interacting with them could have afforded the possibility for providing support for their learning, but that the specific instructional and support strategies with this particular agent did not always do so.

Participant suggestions in terms of agent voice quality, facial expressions, eye contact, gestures, and emotional responses can be used to improve the interface. These improvements also apply to learner’s expectations for social interactions that do not distract from the learning task.

Participant responses also suggest that a more responsive agent in terms of the variety of learners' instructional needs would facilitate better learning experiences, and lead to less frustration and greater satisfaction. Participants expressed similar sentiments in terms of the agent's ability to provide more positive and reinforcing feedback and support, rather than simply saying "correct" or "incorrect," saying instead "good job" or "good try, but next time try better."

Although these results did not provide enough data to account for student gains in learning under unfavorable conditions (e.g., an agent with evasive emotional states), the study provided an insight into how students' emotions and perceptions developed in their interaction with an agent. At the same time, the experimental part of the study confirmed previous findings as to the benefits of motivational support and positive emotion displayed by an animated agent. Future research can be carried out on affect and how different aspects of it (e.g., motivation, agent emotion, frustration, anxiety) interact to affect the user.

8. Acknowledgements

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