

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

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**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, has indicated that agent role 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 users perceive emotionally evasive and unmotivated agents, and to try to uncover what perceptions and alternative strategies users may develop to deal with this kind of agent.

## 2. Experimental Method

Sixty-seven General Education Development students in a community college in the southeastern United States participated in this study. Students were 52% male with 17.9% Caucasians, 71.6% African-Americans, and 13.5% of other ethnicities, with average age 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 learned 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.

### 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, un-motivational agent, still improved their learning (i.e., “in spite of” this agent). This result was intriguing enough to motivate 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.



Fig. 1: the animated agent used in the study

### 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 intensity sampling to identify individuals willing to express opinions and describe their experiences.

Data were collected using direct observations and interviews. During the initial observation phase, participants navigated through a computer-based math learning module and interacted with a pedagogical agent that displayed evasive emotion without motivational support. Participants were asked at specific times to describe their perception of the agent’s emotional expressions. Researchers observed participants from a control booth through one-way windows and took field notes noting participants’ emotional expressions. During the follow-up interview, participants viewed digitally cued segments of their interactions with the agent, and were asked to describe their emotional expressions, feelings, and reactions at the specific time in the video recording.

#### 4.3 Coding the Data

Coding the data involved looking for meaningful patterns and themes that aligned with the purposes and the focus of the study. Interview data were digitized and transcribed 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; using different sources; and using perspectives from different analysts to review the data; which together lent further credibility to the findings.

### 5. Findings

From iterative and immersive data analyses emerged themes, each of which is discussed below.

*Learner Perception of the Agent.* This theme refers to learners' 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. 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.* This theme refers to learner: nervousness, anxiety, confusion, frustration, and confidence while interacting with the agent. Two categories not related to agent interactions but included in this theme were participants' emotional experience when exposed to timed questions, and learners' assessment of their prior content knowledge.

*Learner-Agent Social Interaction.* This theme refers 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, favorite teacher characteristics, and descriptive comparisons of the agent versus a face-to-face teacher, and the agent's voice versus the screen text.

## **7. Conclusions**

Participant responses imply that benefits of the agent depended on the learner and context characteristics. Participants seemed to perceive 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 the agent interact to affect the user.

## **8. Acknowledgements**

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