

# The Impact of Three Pedagogical Agent Roles

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## ABSTRACT

This exploratory experimental study validated the effectiveness of pedagogical agent roles for promoting motivational and learning outcomes within the MIMIC agent-based learning environment. In a between-subjects design, 73 learners worked with an agent representing one of the following three agent roles while learning about instructional planning: Motivator, Expert, or Mentor (designed to incorporate both motivation and expertise). The roles were evaluated according to three contrast comparisons, comparing the value of the agents with and without *motivation*, the value of the agents with and without *expertise*, and the overall value of the *Mentor agent* (which combined motivation and expertise). Results indicated that the motivational agents (Motivator & Mentor) were significantly more engaging, human-like and facilitative of learning than the Expert agent, yet were also less credible. The agents with expertise (Expert & Mentor) were significantly more credible, and led to better performance on the transfer measure than the Motivator agent, yet were also less supportive and less human-like. Overall, the Mentor was perceived as significantly more engaging and facilitative of learning than the other two agents, and also led to significantly better transfer performance.

## Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: User Interfaces-- *Evaluation/methodology*

## General Terms

Measurement, Design, Experimentation, Human Factors

## Keywords

Pedagogical agents, agent roles, agent-based learning environments.

## 1. INTRODUCTION

Several years ago researchers speculated that anthropomorphic computer-based agents could be beneficial for human-computer interaction [1]. There is significant empirical evidence that by rendering system more human-like, users' interactions with the computer are much smoother [2]. Furthermore, Moreno and colleagues [3] suggest that likable animated pedagogical agents

may help students develop an emotional connection with the agent, to facilitate their enjoyment of the learning situation. Along this line, the learner's development of a social relationship with a pedagogical agent is a key mechanism to foster interaction and promote learning within a computer-based learning system [4-6].

In terms of learning, how should this social relationship best be operationalized in order to promote desirable outcomes in the areas of motivation/engagement and learning? Should the agent be motivational and supportive during the learning process, expert-like and knowledgeable, or a combination of the two (i.e., as a Mentor)?

## 2. PROCEDURES

### 2.1 Design and Validation of Agents

Three three-dimensional animated pedagogical agents were created in Poser to represent three different instructional roles within the MIMIC (Multiple Intelligent Mentors Instructing Collaboratively) [7] agent-based learning environment: 1) agent as Expert; 2) agent as Motivator; and, 3) agent as Mentor. The agent roles were implemented through use of image, voice, animation, script, and affect as described in [8]. The motivational and Mentor agent had the most expressive animations (in terms of facial expressions and gesture) while the Expert had the most subdued expressions. In terms of script/message, the Expert agent provided *information* whereas the motivational agent provided *encouragement and support*, and the Mentor agent provided *both* information and encouragement/support. The learners' perception of the agent roles as fulfilling the intended purpose were validated in controlled studies with two separate samples of students, as described in [8]. Images of each agent are shown in Figure 1.



Figure 1. Motivator Agent, Expert Agent, and Mentor Agent

### 2.2 Procedure

The participants in this study included 73 undergraduates in an introduction to educational technology course. They were

randomly assigned to one of 3 agents conditions (Motivator, Expert, Mentor) by MIMIC. Each agent was referred to as “Chris” within the program. After developing a complete instructional plan within the environment, they answered questions in the following areas: a) transfer of learning; b) perception of agent as engaging (from API instrument, see [9]); c) perception of agent as facilitating learning (from API instrument [9]); d) perception of agent as credible (from API instrument, see [9]); e) perception of agent as human-like (from API instrument, see [9]); and, f) perception of agent as supportive. The entire procedure took approximately 90 minutes. All measures were implemented in previous research and most consisted of multiple Likert scale items, with the exception of the transfer of learning measure, which was open-ended and scored according to detailed rubrics after obtaining inter-rater reliability as described in [10]. For more details regarding measures, see related studies [9, 11, 12].

### 2.3 Data Analysis

Data were analyzed through 3 contrast comparisons via one-way ANOVA. The first contrast (*motivation*) compared the motivational conditions [Motivator (.5) and Mentor (.5)] versus the Expert (-1). The second contrast (*expertise*) compared the expertise conditions [Expert (.5) and Mentor (.5)] versus the Motivator (-1). The third contrast (*value of Mentor*) compared the Mentor (1) versus the Expert (-.5) and the Motivator (-.5).

### 3. RESULTS

For the *motivation* contrast (see Figure 2), significant differences ( $p < .05$ ) indicated that the agents with motivation were more engaging, human-like and facilitative of learning than the Expert agent, yet were also less credible.


 <p>Motivator    Mentor</p>	<p>More engaging More human-like More facilitative of learning Less credible</p>
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Figure 2. Motivation Contrast Results

For the *expertise* contrast (see Figure 3), significant differences ( $p < .05$ ) indicated that agents with expertise were more credible, and led to better performance on the transfer measure than the Motivator agent, yet were also less supportive and less human-like.


 <p>Expert    Mentor</p>	<p>Better transfer of learning More credible Less supportive Less human-like</p>
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Figure 3. Expertise Contrast Results

For the *value of Mentor* contrast (see Figure 4), significant differences ( $p < .05$ ) indicated that the Mentor agent was perceived as more engaging and facilitative of learning than the other two agents, and also led to significantly better transfer performance.


 <p>Mentor</p>	<p>Better transfer of learning More engaging More facilitative of learning</p>
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Figure 4. Mentor Contrast Results

### 4. DISCUSSION

The results supported that the agents fulfilled their intended roles in providing expertise and/or motivation. Overall, the fact that the agents with expertise (Expert and Mentor) led to better transfer performance than the Motivator validates that encouragement alone is not sufficient and that credible information is necessary for transfer of learning. Further, the fact that the Mentor led to better transfer than the Motivator/Expert is also of interest, validating the importance of the agent to have both expertise *and* motivation in support of learning.

### 5. ACKNOWLEDGMENTS

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