The Interaction Behavior of Agents' Emotional Support and Competency on Learner Outcomes and Perceptions

Heather K. Holden

United States Army Research Laboratory
Learning in Intelligent Tutoring Environments (LITE) Laboratory
Simulation Training and Technology Center, Orlando, FL 32826
heather.k.holden@us.army.mil

Abstract. Pedagogical agents, visual 'tutor' representations embedded within computer-based learning environments, exhibit lifelike appearance, persona, and social characteristics in an attempt to establish an ideal learner-agent relationship. This article reports on a study to assess the impact and interaction behavior of a pedagogical agent's emotional support and competency on learner's self-efficacy, performance, and agent perceptions (i.e., perceived intelligence and trust of the agent).

Keywords: Pedagogical Agents, Virtual Tutors, Intelligent Tutoring Systems.

1 Introduction and Methodology

The intention of an intelligent tutoring system (ITS) is to provide learners with customized, computer-based instruction through the utilization of artificial intelligence resources. Pedagogical agents are often added to the ITS interface to establish a personal relationship and emotional connection with the learner. Thus, the aim of the learner-agent relationship is to emulate the same benefits as the human relationship in one-to-one tutoring as found in Bloom's two-sigma problem [1]. A central component of human one-to-one tutoring as well as general teaching/learning is social interaction. Social interaction builds trust, influences learners' motivation to learn [2], and attributes to learners' cognitive and affective development [3].

A 2x2 mixed-design experiment was created to investigate the impact of the independent variables (i.e., emotional support and competency) on learners' Sudoku Self-Efficacy (SSE), perceptions of the agent's intelligence and trustworthiness, and performance/subjective knowledge acquisition. This study used an adult sample of convenience consisting of 35 volunteers (21 males / 14 females). For the experimental testbed, a learning environment was developed to teach participants how to play the game Sudoku with a pedagogical agent/virtual tutor, Audie, an animated Microsoft Agent that resembles a computer. Participants were randomly assigned to interact with one of four experimental versions of Audie [e.g., Emotionally-Supportive and Competent (ESC), Emotionally-Supportive Only (ESO), Competent Only (CO), and Neither Emotionally-Supportive or Competent (NESC)]. The two hypotheses that were found to be favorably supported are: ($\mathbf{H_1}$) Learners who work with an ESO virtual tutor will have higher self-efficacy in a learned task than those

S.A. Cerri et al. (Eds.): ITS 2012, LNCS 7315, pp. 624–625, 2012.

who work with a CO tutor and ($\mathbf{H_2}$) Learners who work with an emotionally supportive (i.e., ESO or ESC) tutor will perceive the virtual tutor as more intelligent than it really is.

2 Results and Conclusions

One-way between-groups and repeated measures ANOVA found that there were no significant differences between the agent conditions in regard to learners' Sudoku Self-Efficacy (SSE). However, there was a significant relationship between learners' post-measures of SSE and their perceived trust (PT) in the agent/tutor ($r = .368$, $p = .029$). As expected, participants of the emotional supportive only (ESO) condition reported the highest post-experiment self-efficacy ratings for all conditions, thus supporting $\mathbf{H_1}$. Furthermore, the ESO condition was the only group to collectively increase learners' SSE throughout the experiment.

In addition, the agent type had a very large effect on learners' perceived intelligence (PI) of the agent. Subjects who worked with the CO agent reported the highest PI ratings among the experimental groups. A comparison between the ESO and NESC groups were used to test and support $\mathbf{H_2}$. Although not statistically significant, subjects of the ESO condition reported higher PI of the agent (approximately 4.0 points higher on average) than the subjects of the NESC condition group. However, the agents in both groups had the same level of intelligence. Interestingly, the ESC agent condition, which combined high emotional support and high competency, had a negative impact on the agent's PI. This is seen with reductions in perception scores throughout the progression of the experiment.

The results of this study provide insight on learner's responses to the interaction behavior between two essential agent characteristics. Ultimately, this study could lead to better methods of manipulating these independent variables for targeted learners and domains. Identifying the optimal degree of an agent's characteristics can (a) maximize learners' trust and acceptance of both the learning environment and pedagogical agent and (b) increase learners' readiness to learn, self-efficacy towards the domain, and the effectiveness of their learning experiences. Future work could utilize this study's findings to investigate how agent characteristics impact learners' trust/acceptance of the intelligent tutoring system (ITS) the agent is embedded within, thereby increasing our understanding of learners' ITS acceptance, expectations and future usage intentions. Future studies can also assess the impact of agent characteristics on learners' real-time and predictive cognitive and affective states.

References

1. Bloom, B.: The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring. Educational Researcher 13(6), 4–16 (1984)
2. Baylor, A.: Beyond Butlers: Intelligent Agents as Mentors. Journal of Educational Computing Research 22(4), 373–382 (2000)
3. Kim, Y., Baylor, A.: A Social-Cognitive Framework for Pedagogical Agents as Learning Companions. Educational Technology Research and Development 54(6), 569–596 (2006)