

Pedagogical Agent Design: The Impact of Agent Realism, Gender, Ethnicity, and Instructional Role

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Abstract. In the first of two experimental studies, 312 students were randomly assigned to one of 8 conditions, where agents differed by ethnicity (Black, White), gender (male, female), and image (realistic, cartoon), yet had identical messages and computer-generated voice. In the second study, 229 students were randomly assigned to one of 12 conditions where agents represented different instructional roles (expert, motivator, and mentor), also differing by ethnicity (Black, White), and gender (male, female). Overall, it was found that students had greater transfer of learning when the agents had more realistic images and when agents in the “expert” role were represented non-traditionally (as Black versus White). Results also generally confirmed prior research where agents perceived as less intelligent lead to significantly improved self-efficacy. The presence of motivational messages, as employed through the motivator and mentor agent roles, led to enhanced learner self-regulation and self-efficacy. Results are discussed with respect to social cognitive theory.

1 Introduction

Pedagogical agent design has recently been placing greater emphasis on the importance of the agent as an actor rather than as a tool (Persson, Laaksolahti, & Lonnqvist, 2002), thus focusing on the agent’s implicit social relationship with the learner. The social cognitive perspective in teaching and learning emphasizes the importance that social interaction (e.g., Lave & Wenger, 2001; Vygotsky, Cole, John-Steiner, Scribner, & Souberman, 1978) plays in contributing to motivational outcomes such as learner self-efficacy (Bandura, 2000) and self-regulation (Zimmerman, 2000). According to Bandura (1997), attribute similarities between a social model and a learner, such as gender, ethnicity, and competency, often have predictive significance for the learner’s efficacy beliefs and achievements. Similarly, pedagogical agents of the same gender or ethnicity or similar competency as learners’ might be viewed as more affable and could instill strong efficacy beliefs and behavioral intentions to

learners. Learners may draw positive judgments about their capabilities when they observe agents who demonstrate successful performance.

Even so, while college students were not more likely to choose to work with an agent of the same gender (Baylor, Shen, & Huang, 2003), in a between-subjects study they were more satisfied with their performance and reported that the agent better facilitated self-regulation if it was male (Baylor & Kim, 2003). Similarly, Moreno and colleagues (2002) revealed that learners applied gender stereotypes to animated agents, and this stereotypic expectation affected their learning. With respect to the ethnicity of pedagogical agents, empirical results do not provide consistent results. In both a computer-mediated communication and an agent environment, participants who had similar-ethnicity partners than those with different-ethnicity partners presented more persuasive and better arguments; elicited more conformity to the partners' opinions; and perceived their partners as more attractive and trustworthy (Lee & Nass, 1998). In a more recent study, Baylor and Kim (2003b) examined the impact of pedagogical agents' ethnicity on learners' perception of the agents. Undergraduate participants who worked with pedagogical agents of the same ethnicity rated the agents as more credible, engaging, and affable than those who worked with agents of different ethnicity. However, Moreno and colleagues (2002) indicated that the ethnicity of pedagogical agents did not influence students' stereotypic expectations or learning.

Given their function for supporting learning, pedagogical agents must also represent different instructional roles, such as expert, instructor, mentor, or learning companion. These roles also may interact with the agent's gender and ethnicity given that human social relationships influence their perceptions and understanding in general (Dunn, 2000). In a similar fashion, the instructional roles of the pedagogical agents may influence the perceptions or expectations of and the social bonds with learners. Along this line, Baylor and Kim (2003c, *in press*) showed that distinct roles for pedagogical agents—as expert, motivator, and mentor—significantly influenced the learners' perceptions of the agent persona, self-efficacy, and learning.

Lastly, Norman (1994; 1997) expressed concerns about human-like interfaces. If an interface is anthropomorphized too realistically, people tend to form unrealistic expectations. That is, a too realistic human-like appearance and interaction can be deceptive and misleading by implying promises of functionality that can be never reached. On the other hand, socially intelligent agents are of “no virtual difference” from humans (Vassileva, 1998) and can provoke “illusion of life” (Hays-Roth & Doyle, 1998), thus impressing the learners interacting with a “living” virtual being (Rizzo, 2000). So, we may inquire how realistic agent images should be to establish social relations to learners. Norman argues that people will be more accepting of an intelligent interface when their expectation matches with its real functionality. What extent of agent realism will match learners' expectations with agent functionality is an open question, however.

Consequently, the relationships among pedagogical agent gender, ethnicity, instructional role, and realism seem to play a role to enhance learner motivation (e.g., self-efficacy), self-regulation, and learning. The purpose of this research was to examine these relationships through two controlled experiments. Experiment I exam-