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Similarity effects in online training: Effects with computerized trainer agents

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ABSTRACT

In this study, trainees worked with computerized trainer agents that were either similar to them or different regarding appearance or feedback-giving style. Similarity was assessed objectively, based on appearance and feedback style matching, and subjectively, based on participants' self-reported perceptions of similarity. Appearance similarity had few effects. Objective feedback similarity led to higher scores on a declarative knowledge test and higher liking for the trainer. Subjective feedback similarity was related to reactions, engagement, and liking for the trainer. Overall, results indicated that subjective similarity is more important in predicting training outcomes than objective similarity, and that surface-level similarity is less important than deep-level similarity. These results shed new light on the dynamics between e-learners and trainer agents, and inform the design of agent-based training.

1. Introduction

Technological advances are rapidly changing the way that organizations train their employees, and virtual training is now pervasive. Commonly referred to as the "e-learning revolution" (Galagan, 2000; Welsh, Wanberg, Brown, & Simmering, 2003) web-based or computer-based training is gaining in popularity as organizations attempt to capitalize on the many possibilities this medium offers. Sitzmann, Brown, Casper, Ely, and Zimmerman (2008) reported that 27% of companies offered technology-delivered training as of 2004, and growth has continued steadily since that time. Despite this rapid growth, there is still much to be learned about the factors that make online training most effective. A survey of e-learning providers indicated that lack of interaction was a primary concern for e-learners and made e-learning less attractive than classroom training and potentially less useful as well (Welsh et al., 2003). One e-learning provider noted that although network technology could make peer-to-peer interaction possible, these tools are very resource-intensive and typically not financially accessible to e-learners (DeRouin, Fritzsche, & Salas, 2004) .Thus, identifying ways to provide social interaction in online training will be an important focus of research as e-learning continues to become prevalent.

One innovation in this area is the use of animated computer characters as trainers. These characters comprise software programs (intelligent agents) that adapt to users over time, providing feedback and support that mimics that of a human trainer. Agents can learn in real time and adapt to users' preferences and external information. For instance, the web site Amazon.com employs agentic technology when it uses a customer's purchase history to make recommendations, based on what similar customers purchased. The agents allow for continuous feedback; a customer may specify whether a particular recommendation is helpful or not, and the agent will remember the customer's preferences and learn from this feedback. Animated pedagogical agents (APAs) are a specific class of agents that are represented as a human or animal body within the virtual environment, designed to facilitate learning (Baylor & Kim, 2005). APAs can be used in a variety of learning settings, and can be programmed to fill a number of diverse roles; for example, an APA may act as a tutor, instructor, coach, or peer (Lee et al., 2007). Research in the domain of human–computer interaction has demonstrated convincingly that trainees can view computerized agents as social actors (Mohammed & Angell, 2004). The *computers-as-social actors* paradigm (Reeves & Nass, 1996) has shown that even when computers display no cues to suggest identity, users are prone to assign them personalities and emotions, and form bonds with them as if they were humans (Nass & Moon, 2000; Nass, Moon, Fogg, & Reeves, 1995).

Given these findings, the use of intelligent trainer agents has been proposed as one mechanism that may help address problems of low engagement and isolation in web-based training (Baylor & Kim, 2005). Chou (2003) states that the "positive impact of research on educational agents lies in its ability to strengthen the social learning environment" (p. 260). In this context, agents may serve as buddies, coaches, or co-learners, working alongside the learner to provide comfort, reduce isolation, and act as a positive role model. Kim and Baylor (2005) argue that whereas traditional computer-based learning environments often fail to provide situated social interaction, this interaction can now be obtained

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through the use of agents. This is important both because of the aforementioned concerns about isolation in web-based training environments, and because peer support is known to improve transfer of trained skills (Baldwin & Ford, 1988; Facteau, Dobbins, Russell, Ladd, & Kudisch, 1995).

Researchers are beginning to learn how people interact with intelligent trainer agents; from this work it is clear that the presence of an agent can sometimes improve learner engagement and motivation, although these effects may depend on the features of the agent itself. At the same time, research from social psychology and education predicts that people will prefer to learn from trainers and educators who are similar to them in some way (Byrne & Nelson, 1965; Nass & Lee, 2001). What remains to be determined is whether this benefit of similarity extends to intelligent trainer agents. As such, the current study tests whether people prefer, and learn better with, trainer agents of the same gender/ethnicity as themselves. Additionally, because trainer agents can be customized in many ways beyond simple appearance characteristics, we examine trainee–agent similarity in terms of feedback-giving behavior. Specifically, we examine feedback-giving similarity along two dimensions: first, whether the trainer agent compares the trainee's performance to their peers, or only to their own past performance (normative vs. non-normative feedback); and second, whether the agent offers optional suggestions or gives firm directions about how to proceed through the training (directive vs. non-directive feedback).

1.1. Theoretical background

According to the *similarity-attraction hypothesis* (Byrne & Nelson, 1965) people are more attracted to others who match their personality and other characteristics. Further, people are more likely to trust those who are similar to themselves (Brewer, 1979). In a training context, this may result in greater adherence to a tutor's advice and recommendations. Because we know that human–computer interaction tends to mirror human–human interaction (Moon & Nass, 1996; Nass & Moon, 2000) it is reasonable to expect that learners will be more attracted to, and willing to trust, agents that are similar to themselves.

Past research has demonstrated a positive effect of similarity on computer users' technology acceptance during human–computer interactions (Nass & Lee, 2001; Nass et al., 1995). Nass et al. (1995) matched people with dominant or submissive personalities with either dominant or submissive computers. Users preferred to work with computers that matched their own personalities, rated matched computers as more intelligent, and were more likely to listen to the matched computers' than the unmatched computers' suggestions. No main effect of computer "personality" was found; that is, there was not a single computer personality that was preferred overall.

There is also evidence that learners are more likely to rely on advice from an agent whose ethnicity is similar to their own. Pratt, Hauser, Ugray, and Patterson (2007) matched adult learners with either a Caucasian or African–American computer agent, and found that learners changed their opinion to be consistent with agent advice to a greater degree when matched with a same-ethnicity agent. The authors used a social identity framework to explain these findings, suggesting that learners feel more positively about a same-ethnicity agent and thus are more likely to rely on its advice. These findings are also consistent with Lee and Nass (1998), who found that same-ethnicity agents were rated as more attractive and more trustworthy than different-ethnicity agents. Learners were also more likely to adjust their decisions to match the agent's when the agent shared their ethnicity. This effect is not limited to human–computer interactions. It has also been demonstrated in human–human interactions. For example, Mexican–American college students express a strong preference for an ethnically similar over an ethnically dissimilar counselor (Abreu & Gabarain, 2000).

As indicated above, the current study examines similarity both in terms of appearance and feedback-giving behavior. This distinction is reflective of what researchers have referred to as surface- vs. deep-level diversity (Mohammed & Angell, 2004; Tsui, Egan, & Xin, 1995). Where surface-level characteristics include age, ethnicity, or gender, deep characteristics include attitudes, personality, or values. In a team context, we know that differences with respect to surface characteristics such as ethnicity predict lower performance ratings (Kraiger & Ford, 1985), diminished communication quality (Larkey, 1996), and reduced commitment to the team (Tsui et al., 1995). Further, differences with respect to deep-level characteristics such as attitudes predict higher team cohesiveness (Harrison, Price, Gavin, & Florey, 2002), although the effect of these differences depends on the job-relatedness of the attitude in question. Researchers have explained these effects in terms of *social identity* and *social categorization* theories (Tajfel, 1978; Turner, 1982), which predict that people define themselves in terms of group memberships. These group memberships then become a basis by which they judge others. By increasing the value of others who belong to their category, they increase their own perceived self-value. Conversely, those who belong to different social categories are viewed less positively, in an attempt to preserve a positive self-image (Tajfel & Turner, 1986). In a training context, social categorization processes may result in trainees being less willing to trust and take advice from trainer agents who belong to different categories; trainees may also view these trainers as less likeable and useful.

Thus drawing from the similarity-attraction, human–computer interaction, and social categorization literature, we predict that similarity will have positive effects on a number of training outcomes.

1.2. Hypotheses

Hypothesis 1. E-learners will like training more (H1a), find training more useful (H1b), be more engaged in training (H1c), learn more (H1d), find the trainer more likeable (H1e) and find the trainer more useful (H1f) when interacting with computerized trainer agents of the same gender and/or ethnicity.

Hypothesis 2. Trainees will like training more (H2a), find training more useful (H2b), be more engaged in training (H2c), learn more (H2d), find the trainer more likeable (H2e) and find the trainer more useful (H2f) when interacting with trainer agents who share their personal feedback style with regard to directiveness and/or normativeness.

It is important to make a distinction between similarity as assessed by objective characteristics, and perceptions of similarity. Turban and Jones (1988) showed that perceptions of, not actual, attitudinal similarity between supervisors and employees were positively related to employee satisfaction, performance ratings, and pay ratings. Harrison et al. (2002) emphasize the idea that perceptions are a key factor in determining the effects of similarity; they note that typical measures of similarity, such as calculations of Euclidian distance or standard deviations in teams, have resulted in small effect sizes and mixed findings. That is, the psychological processes undergone by the trainee which assign the trainer agent to either the same category or a different category than the trainee are crucial in triggering effects of similarity on eventual training outcomes.

Hypothesis 3. Perceptions of similarity with respect to appearance and feedback-giving style will have greater effects on training outcomes than objectively assessed similarity.