



## Contextually relevant pedagogical agents: Visual appearance, stereotypes, and first impressions and their impact on learning

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### ABSTRACT

Humans draw on their stereotypic beliefs to make assumptions about others. Even though prior research has shown that individuals respond socially to media, there is little evidence with regards to learners stereotyping and categorizing pedagogical agents. This study investigated whether learners stereotype a pedagogical agent as being knowledgeable or not knowledgeable and how this acuity influenced learning. Participants were assigned to four experimental conditions differing by agent (scientist or artist) and tutorial type (nanotechnology or punk rock). Quantitative analyses indicated that agents were stereotyped depending on their image and the academic domain under which they functioned. Regardless of tutorial, participants assigned to the artist agent recalled more information than participants assigned to the scientist agent. Learning differences between the groups varied according to whether agent appearance fit the content area under investigation. Qualitative results indicated learner's stereotypic expectations as well as their unwillingness to draw conclusions based on visual appearance.

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### 1. Introduction

Virtual characters have been gaining influence in education; they have been examined as tools to enhance teaching and learning processes (Veletsianos & Miller, 2008; Gulz, 2004), given a physical image, portrayed as having a lifelike form (Gulz & Haake, 2006), and utilized within real-world instructional environments. More recently, virtual characters have become the standard rather than the exception: Educational institutions are scrambling to establish learning spaces in virtual worlds (Jennings & Collins, 2008) within which users have no option but to represent themselves as digital characters. These developments raise a number of questions regarding the use of virtual characters in electronic learning environments: How should virtual characters look? What impact, if any, does their external representation have? What is the role of visual aesthetics in the design of virtual characters? Does virtual character appearance influence learning, interaction, and learner perceptions?

The visual and aesthetic properties of virtual characters may influence variables of interest to researchers and practitioners within numerous domains. For example, children may be motivated to interact more frequently with characters portrayed as playful animals vs. professional adults. On the other hand, children may perceive virtual characters portrayed as professional adults as model figures and be motivated to engage in higher level interactions with them (Bandura, 1977). These hypotheses are closely linked to ideas of first impressions, activation and application of stereotypes, and domain-specific virtual characters. First impressions frequently influence and guide subsequent interactions in real life (Ritts, Patterson, & Tubbs, 1992), while stereotypes are mental schemata intended to reduce information overload and enable humans to make quick judgments based only on a small set of attributes (Devine, 1989). Previous work by Reeves and Nass (1996) seems to suggest that first impressions and stereotyping behavior transfer to human–agent interactions, thus having social and pedagogical implications.

In this paper, I explore these issues by asking whether (a) learners form impressions and apply stereotypes based on agents' visual appearance, and (b) agent visual appearance interacts with the content area in which agents function to influence learning. I proceed by reviewing prior literature, investigating the relationship between agent–learner interactions and the application of stereotypes, and presenting this study's research questions. Next, I explain the method used to study this topic, present my results, and conclude by discussing implications and limitations of this study.

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## 2. Literature review

Pedagogical agents are static or animated anthropomorphic interfaces employed in electronic learning environments to serve various instructional goals. Pedagogical agents are often given lifelike characteristics, such as emotion, reactivity, and speech (Rickel & Johnson, 2000), presented in human form, or portrayed within a fantasy realm as talking animals (Louwerse, Graesser, Lu, & Mitchell, 2005), cartoons (Mayer, Dow, & Mayer, 2003), or bugs (Lester et al., 1997).

In an investigation of the virtual character literature, Dehn and van Mulken (2000) call for a fine-grained perspective on pedagogical agent integration. Specifically, they state that,

The simple question as to whether an animated interface agent improves human–computer interaction does not appear to be the appropriate question to ask. Rather the question to ask is: *what kind of animated agent used, in what kind of domain influences what aspects of the user's attitudes or performance?*" (p. 19).

In relation to this recommendation, it appears that researchers are failing to examine one important dimension of pedagogical agent usage: agent visual appearance, which is an issue that is at the forefront of learner–agent interactions. Students' learning, performance, engagement, and enjoyment when working with agents may be influenced by the way agents look. Gulz and Haake (2006) and Veletsianos (2007) support this claim by noting that the visual and aesthetic properties of pedagogical agents are an important design element that has been neglected in previous work. Arguably, the first item students notice when presented with a pedagogical agent is its obvious visible characteristics: gender, facial expressions, ethnicity, hairstyle, hair color, and clothing (Branham, 2001). These characteristics form the basis of first impressions and as such may activate stereotypes and expectations of agent usefulness, credibility, and intelligence. Taking this hypothesis a step further, an agent's visual appearance may interact with the content area under which the agent functions rendering the agent's visual appearance contextually relevant or irrelevant. For example, a pedagogical agent tutoring students on pre-school creative play practices may be expected to be visually different and conform to different standards than one teaching nuclear physics, gender studies, mechanical engineering, or history. Contextual relevance, the conformity of an agent's visual characteristics to the content area under which the agent purports to function Veletsianos (2007), therefore, may be an important element to be considered when designing and implementing pedagogical agents; especially due to the fact that it is an overlooked facet of agent design. Agent appearance conveys non-verbal messages to learners influencing learner perceptions and the way learners interact with agents (Haake & Gulz, 2009; Plant, Baylor, Doerr, & Rosenberg-Kima, 2009; Rosenberg-Kima, Baylor, Plant, & Doerr, 2008). Agent contextual relevance may activate stereotypes and agent knowledge/intelligence expectations in user minds, and this knowledge mapping may influence learning. Perceptions of competence (or incompetence) derived from agent image may influence learners' attention and perceptions of agents' relevance, degree of seriousness, and authenticity, and thereby learning. More specifically, contextual irrelevance is expected to disrupt learning, leading to lower retention rates. The reason for this can be traced to Cognitive Load Theory (Sweller, 1994): A contextually irrelevant pedagogical agent increases extraneous cognitive load because learners have to attend to more than one cognitive schema. Contextual irrelevance would therefore hinder learning because of the strains it would impose on working memory limits.

Even though Moreno, Mayer, Spires, and Lester (2001) and Gulz and Haake (2006, 2009) called on the research community to investigate the role of agents' visual presence in multimedia learning environments, the impact of contextually relevant pedagogical agents has not yet been examined and visual appearance seems to be disregarded in a number of studies: For example, sorcerers have been employed to teach economics (Craig, Cholson, & Driscoll, 2002) and cartoon-like characters have been depicted as physics experts (Mayer et al., 2003) without consideration of the impact of contextual visual representations.

### 2.1. Media as humans: the media equation

Extensive experimental evidence by Reeves and Nass (1996) showed that humans treat computers, and media in general, in a social manner. By replicating experiments designed to examine social interactions amongst humans and applying them to interactions between humans and media, Reeves and Nass presented the *media equation* positing that users ascribe social rules to their interactions with media. For example, humans rate computers more favorably when they are "polite" even though computers lack the ability to be polite. Equally important, it appears that regardless of age, expertise with media, and media design, users tend to apply social rules to their interactions with media (Alvarez-Torres, Mishra, & Zhao, 2001; Nass, Moon, & Carney, 1999).

### 2.2. The media equation: implications for pedagogical agents

If humans apply social rules to media, it follows that when interactions with media are mediated by virtual characters exhibiting lifelike characteristics, anthropomorphic characters would also be subject to social rules. The evidence presented by Reeves and Nass (1996) is extended to the pedagogical agent literature by phenomenological evidence from Veletsianos & Miller 2008 who support the notion that learners perceive their interactions with pedagogical agents as being fundamentally real and natural.

When humans interact with humans, they use a number of non-verbal cues to make assumptions about others (Epleya & Krugerb, 2005; Gulz & Haake, 2006). Non-verbal cues come from any visible characteristic or object such as hairstyle, hair color, presence/absence of glasses, jewelry, clothing, ethnicity, gender, or voice inflection. The totality of non-verbal cues allows individuals to form impressions about others (Bonito, Burgoon, & Bengtsson, 1999) and draw on their stereotypic beliefs as an information source to make assumptions about others (Devine, 1989; Hamilton & Sherman, 1996; Macrae, Milne, & Bodenhausen, 1994).

Stereotypes are defined as beliefs about the characteristics of groups of individuals (e.g., women are bad drivers, men do not ask for directions, Japanese are hardworking, Americans are individualistic etc.) and stereotyping is the application of those stereotypes when interacting with individuals from a particular social/ethnic group. Stereotypes are stored as schemata, often considered as types of cognitive neural networks, and their activation may be automatic and instantaneous (Devine, 1989). As stereotypes, pre-conceptions, and first impressions may lead individuals to form expectations about others (Epleya & Krugerb, 2005), the Media Equation posits that the same set of cognitive functions may lead individuals to form expectations about pedagogical agents. For example, Norman (1997) argued that individuals

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