PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2009) **364**, 3559–3565
doi:10.1098/rstb.2009.0148

Review

Promoting motivation with virtual agents and avatars: role of visual presence and appearance

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Anthropomorphic virtual agents can serve as powerful technological mediators to impact motivational outcomes such as self-efficacy and attitude change. Such anthropomorphic agents can be designed as simulated *social models* in the Bandurian sense, providing social influence as virtual 'role models'. Of particular value is the capacity for designing such agents as optimized social models for a target audience and context. Importantly, the *visual presence* and *appearance* of such agents can have a major impact on motivation and affect regardless of the underlying technical sophistication. Empirical results of different instantiations of agent presence and appearance are reviewed for both autonomous virtual agents and avatars that represent a user.

Keywords: virtual agents; avatars; motivation; persuasion; visual presence; appearance

1. ANTHROPOMORPHIC VIRTUAL AGENTS IMPLEMENTED AS SOCIAL MODELS

Research indicates the effectiveness of human social models in influencing another to change behaviours, beliefs or attitudes, as well as social and cognitive functioning (e.g. Schunk 1981; Bandura 1986). Through processes such as observation, vicarious experience (experience gained by observing another) and social interaction, one can acquire the behaviours or expertise mediated through a human social model. The most effective social model is similar to the observer while representing someone whom the observer aspires to be like. One of the key attributes for a social model is *appearance*; how he/she looks influences the observer in making important assumptions regarding factors such as age, status, attractiveness and credibility.

The focus in this paper is on the motivational (e.g. self-efficacy beliefs, attitude, interest) and affective (e.g. feelings of connection, relief of frustration) changes that result from observing or socially interacting with anthropomorphic agents that are instantiated in the role of social models. Building upon Nass's paradigm of computers as social actors, there is significant evidence that humans can be socially influenced by such agents just as they would be by human social models (Nass & Steuer 1993; Reeves & Nass 1996; Nass & Moon 2000; Baylor 2007; Ebbers 2007; Kim & Baylor 2007*a*; Lee *et al.* 2007).

Further, there are several advantages to implementing anthropomorphic agents as social models. First, an agent implemented as a social model can be available when it is most convenient or timely for a user, online or through a computer-based application. Given the difficulties in arranging for a human mentor to coach another to lose weight, or for a teenage idol to persuade youth against joining gangs, the availability of an always-live agent as a social model is advantageous. Second, perhaps more valuable than availability, is the capability of customizing a computer-based social model to represent an *ideal social model* for a particular user or group of users. For example, an agent social model designed to positively influence inner-city youth to stay in school could be designed to appear as an older 'cool' peer, with respect to dress, age, race, gender and socio-economic status, with a persona that represents someone with whom they can identify as part of their in-group. This first step of designing how the agent will *appear* is critical (and is a focus of this paper). Other design features include providing an appropriate voice (Nass & Brave 2005), engaging non-verbal communication (e.g. deictic gestures and emotional expressions) (Baylor & Kim 2009) and establishing and maintaining rapport between the agent and the participant (Gratch *et al.* 2007). For additional functionality, the agent could also respond and interact adaptively through cognitive, emotional and motivational models of the user (e.g. de Rosis *et al.* 2003; Prendinger & Ishizuka 2005;

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One contribution of 17 to a Discussion Meeting Issue 'Computation of emotions in man and machines'.

de Melo & Paiva 2006; Swartout *et al.* 2006; Gratch *et al.* 2007; Arellano *et al.* 2008; McQuiggan *et al.* 2008), or interact with natural language, all of which can add to its believability.

The advantages of accessibility in real time and customization are significant, but not if considerable time is required to construct these personalized agent social models. Interestingly, while an agent with greater computational functionality may be perceived as more believable, research indicates that learners perceive, interact socially with and are influenced by anthropomorphic agents *even when* their functionality and adaptability are limited (e.g. Baylor *et al.* 2004, 2005*a*, 2006; Baylor 2005; Baylor & Plant 2005; Baylor & Kim 2005*a*, 2009; Ryu & Baylor 2005; Kim & Baylor 2006, 2007*b*; Guadagno *et al.* 2007; Kim *et al.* 2007; Rosenberg-Kima *et al.* 2007, 2008). Consequently, designing agents as social models is within the reach of many educators, health promoters and others who wish to promote new attitudes, change behaviours or positively influence others.

The focus of this paper is on two of the most influential features of an agent social model—its *visual presence* within the computational system and its *appearance*. These features are critical for designing an effective agent as a social model regardless of its underlying level of computational functionality.

2. VISUAL PRESENCE OF THE AGENT

(a) *It must be seen, not only heard*

Before delving into implementing agents as social models, it is important to first consider the role of the agent's visual presence. The visual presence of an agent can enhance one's perception that 'someone' is socially present and collaborating in the same space (e.g. Heeter 1995; Nam *et al.* 2008). Research confirms that for motivational and affective outcomes in particular, the *visual presence* of an agent is critical; in other words, a voice alone (human or machine generated) with the same persuasive message is not sufficient. Baylor & Ryu (2003) found that providing an anthropomorphic agent (either static or animated) together with a human voice led to greater learner perceptions of agent credibility in the context of a learning environment. More recently, in a two-way between-subjects design of agent gender (male, female) and agent presence (visible, invisible), controlling for agent attractiveness and voice (prosody, tone), it was found that college students who interacted with *visible* agents reported significantly greater positive motivational outcomes. Specifically, effect sizes indicated a large effect on students' beliefs in utility of the topic, a large effect on student self-efficacy in success at the topic and a moderate effect on their interest in the topic (Rosenberg-Kima *et al.* 2007).

In other research, undergraduate students were purposefully frustrated through an obstacle—an error message pop-up window that interfered with their answering of web-based survey items (Baylor *et al.* 2005*b*; Baylor & Rosenberg-Kima 2006). During their attempts to close and/or move the window, an interface agent 'Survey Sam' was either visible (figure 1) or invisible. Following the frustrating

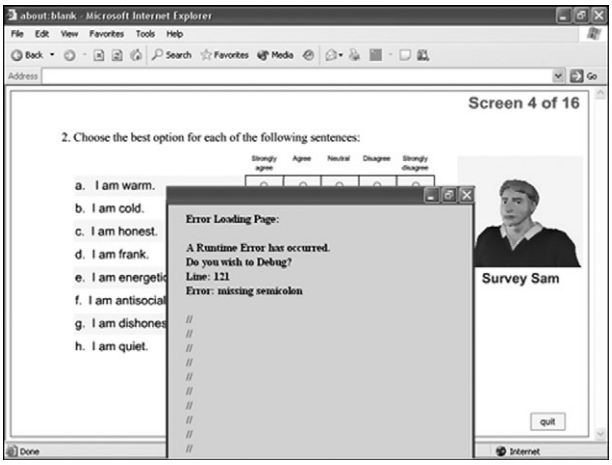

Figure 1. A frustrating obstacle (pop-up window) with Survey Sam visually present.

event, an apologetic or empathetic message was delivered (by the agent, or within a text box). Results indicated that the agent-delivered message was significantly more effective at mitigating participants' frustration than the message delivered in a text box, with a large effect size ($d > 1.0$). Specifically, when the agent delivered the message, participants tended to attribute the cause of their frustration to the computer system instead of to themselves.

Further, this simple five-sentence agent intervention not only reassured users that they were not at fault but also led to positive attitudes towards the experience (e.g. they were more likely to suggest the study to a friend). This suggests that delivery of a frustration-mitigating message via an anthropomorphic agent may be more effective than simple text-based feedback.

(b) *When more than one agent is visually present*

A unique affordance of multiple anthropomorphic agents is the split-persona effect, which indicates that splitting agent roles/functionality into two distinct agent personas is preferable to combining those roles/functionality into one agent persona (Baylor & Ebbers 2003). In the context of learning, three anthropomorphic agents were designed to represent the distinct roles of motivator (e.g. providing confidence-boosting messages), expert (e.g. providing informational support) and mentor (combining both the motivator and expert roles) (see Baylor & Kim 2005*b*).

In multiple studies with agents of different gender and race, this effect indicates that students learned significantly more and had significantly greater motivation when working with the two motivator and expert agents as compared to working with the one mentor agent (figure 2). This can be explained by the fact that it is easier for students to figuratively 'compartmentalize' the agent information when it was delivered by two distinct sources. With respect to motivational design, this effect suggests that having an affective or motivational coach implemented as a distinct agent may be preferable to having its functionality figuratively 'rolled up' into a more inclusive help or training agent.

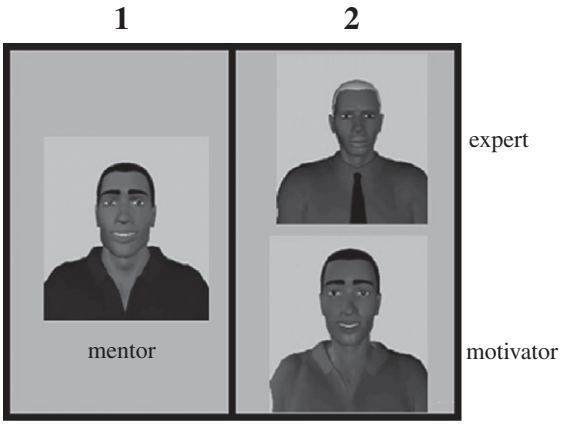

Figure 2. Split-persona effect—separating agent functionality into two parts (expert, motivator) is preferable to combining it within one agent (mentor).

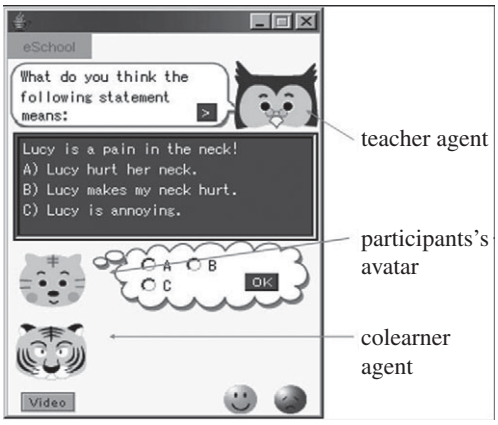

Figure 3. Teacher agent, participant's avatar and co-learner agent (Adapted from *J. Commun.* **57**, 191).

Alternatively, instead of interacting with multiple anthropomorphic agents, could affective support be enhanced when a student's avatar (i.e. his/her self-representation within the program) *co-learns* with a computer-driven agent? Lee *et al.* (2007) conducted an experimental study with 76 Japanese college students in three conditions: a caring co-learner agent (expressed empathic emotion and provided supportive and encouraging verbal feedback—figure 3), a non-caring co-learner agent (did not manifest caring orientations towards the participants, although all the other behavioural features were identical) and a control (no co-learner agent). As compared to students in the other two conditions, results indicated that students who worked with the caring co-learner agent had significantly greater feelings of social support (an index comprising five items: 'not alone', 'praised', 'attended', 'appreciated' and 'supported'), trust and enhanced recall.

In a different type of agent instantiation, Ebbers (2007) explored the roles of virtual agents serving as 'mastery models' (demonstrating positive attitudes towards the task and/or desired levels of performance so that a learner can learn vicariously) or as 'coping models' (modelling for the learners on how to cope with a situation as a novice) (e.g. Schunk *et al.* 1987). In an experimental study with 103 undergraduate students, she manipulated type of agent model (coping versus mastery) and interaction type (direct versus vicarious) and found a main effect where the agent as a coping model positively impacted learner motivation, self-efficacy and attitude. Similarly, Kim & Baylor (2006) experimentally found that agents that had similar competencies to learners were more influential in enhancing student self-efficacy beliefs than highly competent agents. These results are aligned with Bandura's (1997) concept of *attribute similarity*, that it is desirable to have similar personal characteristics of the learner and social model.

Overall, these studies suggest that having a visually present agent is desirable for enhancing motivation and positive affect (e.g. frustration mitigation, feelings of support). Based on the split-persona effect, it may be preferable for a motivational agent (e.g. as a coach or persuader) to be employed as a separate and distinct agent instead of adding motivational functionality to existing agents within a system. In a learning environment, if the agent is caring and/or reflects a 'coping model' role, motivational and affective results can be enhanced.

3. IMPACT OF AGENT APPEARANCE

Once the visual and social presence of an anthropomorphic interface agent is established, one of the most important factors in its design as a social model is *appearance*. As supported by research with humans, a social model's appearance is key to influencing another's motivation, attitude and future behaviours through directly impacting message acceptance and self-efficacy (confidence) beliefs (Bandura 1997).

(a) *Agent gender and racelethnicity*

Building on social psychology research that indicates that humans are more persuaded by a person from a member of their in-group, work with anthropomorphic agents has also shown that observers tend to be more influenced by an agent of the same gender (e.g. Baylor & Kim 2004; Baylor 2005; Guadagno *et al.* 2007; Kim *et al.* 2007) and same ethnicity/race (Baylor & Kim 2004; Gulz *et al.* 2007; Pratt *et al.* 2007; Plant *et al.* in press). However, these generalizations are context dependent. For example, if Caucasian students are randomly assigned a Black agent as an 'expert', it may surprise them with respect to their expectations, leading them to have greater self-efficacy (confidence) and interest towards the topic (Baylor & Kim 2004). In contrast, it may be particularly valuable for Black students to work with agents of the same race as they tend to have strong affiliations with same-race agents, both when they are given a choice and also when it is randomly assigned (Baylor & Kim 2003; Baylor *et al.* 2003). However, with respect to learning, this affiliation may be detrimental as Black students may actually perform better with different-race agents (Moreno & Flowerday 2006). When interacting with an agent who attempted to convince them of the merits of engineering as a career, middle-school students (male and female) were

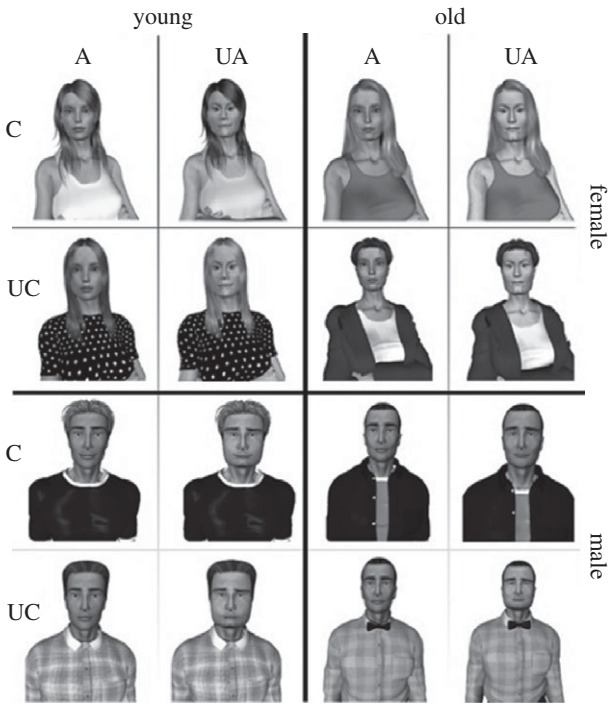

Figure 4. Anthropomorphic interface agents differing by attractiveness, gender, age and 'coolness'. A, attractive; C, cool; UA, unattractive; UC, uncool.

significantly more persuaded and reported greater positive attitudes towards engineering from a female (as opposed to male) agent (Plant *et al.* 2009). This suggests that for younger students, female agents may be more powerful role/social models overall, perhaps because of both parental influences and the fact that most schoolteachers are female.

(b) *Other appearance features: attractiveness, 'coolness', age*

Moving beyond the effects of agent gender and race/ethnicity, Baylor and colleagues (Baylor & Plant 2005; Rosenberg-Kima *et al.* 2008; Plant *et al.* 2009) manipulated other appearance features such as agent attractiveness, 'coolness' (operationalized by clothing and hairstyle) and age to investigate their influence on students' motivation towards engineering as a possible career. When given a choice of 16 validated agents varying with respect to attractiveness, 'coolness', age and gender (figure 4), undergraduate women were significantly more likely to choose the female, attractive, young, cool agent as 'most like themselves' and also as the agent they 'most wanted to be like'. However, they tended to select 'male, older, uncool' agents as most like engineers (confirming the stereotype of an engineer), and tended to choose to 'learn about engineering' from agents who were male and attractive, but uncool.

After receiving a 15 minute persuasive message from the chosen agent (figure 5), students' attitudes and motivation towards engineering were positively impacted as compared to a control group.

Next, given that the attractive agents were most influential as social models in this choice study, a large-scale experimental study was conducted with the eight attractive agents for undergraduate women (Rosenberg-Kima *et al.* 2008). Results revealed a main effect for gender where participants reported more positive stereotypes of engineering after interacting with a female agent, perhaps because it challenged their existing beliefs of a typical engineer. In contrast, participants interacting with a male agent reported that engineering was more useful and engaging. An interaction of 'coolness' and age indicated that agents who were young and 'cool' (i.e. peer-like; similar to participants) and agents who were old and 'uncool' (stereotypical engineers) were both most effective in enhancing student self-efficacy for engineering; thus, for self-efficacy, it appears that either the perception of similarity or expertise increased the effectiveness of the agent. Overall the most effective agent social model was the young, attractive, cool, female agent; this agent enhanced students' self-efficacy towards being successful as an engineer and positively influenced their negative stereotypes towards engineering.

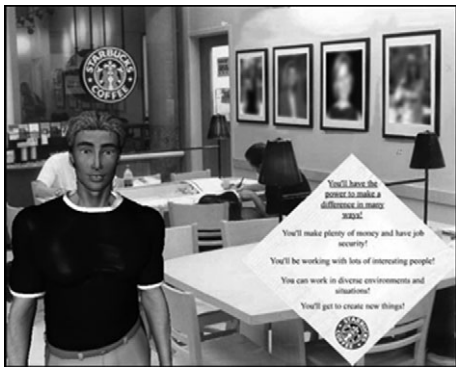

Figure 5. Sample screen shot.

In general, these studies suggest that individuals are more influenced by agents who are similar to themselves with respect to appearance-related characteristics (e.g. Bailenson *et al.* 2008). However, individuals' prior stereotypes and expectations can sometimes be used to a positive advantage depending on the desired outcome. For example, in the case of influencing women's motivation towards engineering, it was found that male agents were more influential than female agents in promoting the usefulness of engineering and potential engagement with it as a career. This is probably due to participants' existing stereotypes where they tended to believe a message from a male engineer is more credible than the same message from a female engineer. Consequently, the context of the persuasion (e.g. participants' prior knowledge, topic area) as well as the desired outcomes (e.g. interest, attitude change) must always be front and central when designing an agent's appearance.

In the next section, the focus on agent appearance will come from a different perspective—that of an *avatar* that physically represents a user in an online environment. While an avatar's appearance may or may not authentically reflect the user's actual appearance, it can still have a powerful impact in influencing his/her beliefs and behaviour in the real world.

4. AVATARS THAT REPRESENT (AND POTENTIALLY IMPACT) ONE'S POSSIBLE SELF

Virtual environments (such as web-based chat rooms) or gaming environments (such as the Wii) allow one to easily create a personalized avatar to represent his/her virtual 'self'. Here, the user can choose to create an appearance and physical representation that reflects reality or not. Of interest is the general question—is it better for one's avatar to match the reality of who she sees herself to be, or rather as who she aspires herself to be? In other words, as we change our self-representation, do our self-representations change our real behaviour and beliefs in turn (Yee & Bailenson 2007)? These questions have been systematically investigated by Jeremy Bailenson and colleagues, and the answer is strongly affirmative. His research has shown that the way in which people are represented in virtual environments can substantially change their verbal, non-verbal and task-related behaviour.

In one line of research, the potential effect of an avatar representing one's 'possible' self was investigated. For example, if users watch an avatar that looks like themselves exercising and losing weight in a virtual environment, they will subsequently exercise more and eat more healthy in the real world as compared to a control group (Fox & Bailenson 2009). In a different study, participants were exposed to an avatar representing themselves running on a treadmill, another avatar running or an avatar representing themselves loitering. Within the 24 h after the experiment, participants who were exposed to the avatar running that represented themselves exercised significantly more than those in other conditions. Similarly, if college-aged students observe their avatar ageing in a virtual mirror, they form a psychological connection to their 'future selves' and decide to invest more money in a retirement account as compared to a control group (Ersner-Hershfield *et al.* 2008). These studies extend prior work on 'self-perception theory' (Bem 1967), showing that changes in aspects of one's virtually represented self can lead to changes in one's real physical self.

In a different line of research, they investigated how people tend to conform to how their avatar appears, regardless of how it is perceived by others—a process referred to as the Proteus effect (Yee & Bailenson 2007). In one study, they manipulated the attractiveness of the avatars and observed participants' behaviours. Participants with more attractive avatars demonstrated increased self-disclosure, friendliness and extroversion and were more willing to approach opposite-gendered strangers after less than 1 min of acting through their 'altered' avatar. In contrast, participants with an unattractive avatar kept a significantly farther distance away from strangers (5 feet versus 3.5 feet) and shared significantly less personal details. In a second study, participants with taller avatars behaved more confidently in a negotiation task than participants with shorter avatars; specifically, they were more willing to make unfair splits in negotiation tasks. In contrast, participants with shorter avatars were more willing to accept unfair offers than those who had taller avatars. As indicated by the authors, 'These two studies show the dramatic and almost instantaneous effect that avatars have on behaviour in digital environments' (p. 285). More recently, the authors have extended this work beyond the more controlled laboratory setting to an actual online community (Yee *et al.* 2009). In this more ecologically valid context, they found that both the height and attractiveness of an avatar in an online game were significant predictors of the player's performance. Further, behavioural changes originating within the virtual environment tended to transfer to subsequent face-to-face interactions. Participants were placed in an immersive virtual environment and were given either shorter or taller avatars. They then interacted with a human confederate for about 15 min. In addition to causing a behavioural difference within the virtual environment, the authors found that participants given taller avatars negotiated more aggressively in the subsequent face-to-face interaction with the confederate than participants given shorter avatars.

In both cases—an autonomous interface agent or an avatar that represents one's self—the significance of the agent's appearance is clear. However, there is limited research to suggest what role appearance plays, over time, in a longer-term human–agent relationship. For example, is it beneficial for one's avatar to gain weight when the human does? Future research needs to examine more carefully the role of appearance when the human–agent/avatar social relationship persists over time (see Bickmore & Picard 2004).

5. CONCLUSION

Placing an anthropomorphic agent as the front-end for a motivational system requires careful attention to design. In general, while having such an agent visually present to deliver persuasive or soothing messages can be beneficial, there are several considerations regarding how to physically instantiate it and how to design its appearance. With respect to the agent's visual presence, multiple agents may be preferable (e.g. in a learning system, where motivational support is best kept separate from instructional information) or the implementation of a 'companion' peer agent (e.g. instantiated as a co-learner or as a coping model) may be beneficial. The appearance of the agent(s) as a social model is a key factor for its success in promoting motivation and should be carefully considered. While providing a social model from the same ingroup as the user is generally advantageous, there are certain contexts where the opposite may be better (e.g. Black students may learn more when the agent is White). Along this line, providing users with a choice of agents is generally unwise as users tend to choose agents who are not the most beneficial for them (Baylor *et al.* 2003; Baylor & Plant 2005; Moreno & Flowerday 2006). Overall, though, there are great possibilities to customize an agent so that it can serve as an effective social model.

When we design avatars to represent ourselves within virtual worlds and gaming environments, their appearance has considerable impact on our virtual and real-world behaviour. This blending of our real

and virtual selves is powerful and exciting, and future research should address the motivational and affective impacts.

This manuscript was supported as independent research while the author was serving at the National Science Foundation in Arlington, VA, USA. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

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