The Credibility of Embodied Conversational Agents (ECAs)

A look at the pros and cons of ECA credibility.

Keita Del Valle

Intelligent Computer-Based Instruction

Rochester Institute of Technology

Fall 2010

Imagine this banking scenario: you walk up to the ATM but instead of the normal touch screen with text and graphics, the screen is displaying the life-size head, shoulders and bust of an animated human character. The character smiles, blinks a few times and says "Hello! I'm Tessa. How may I help you with your banking today?" Your regular ATM machine interface has been replaced by an embodied conversational agent (ECA) and many years of in-depth research have gone into predicting, scripting and controlling how you will react and behave with Tessa during the next 10 minutes.

What is an ECA?

In the most simple and general sense, an embodied conversational agent (ECA) is a talking head. To be more precise, it is a computer application with **1)** a processor to manage language input into it; **2)** an engine to determine behavior; and **3)** a visual component to perform gestures and movement (Hubal et al., 2008). The visual piece need not be just a head – it can be full-bodied. It may be rendered on a display screen, as in the ATM scenario above, or it may be rendered in a full-immersion virtual environment as in some gaming or combat training scenarios. But how credible are these agents? Can their credibility be increased and, if so, how? And does their credibility have any significant impact on their effectiveness?

Credibility of ECAs

Why should we be concerned with the credibility of an agent? After all, wouldn't the user understand that it is just a machine they're interacting with – not a human – and adjust his expectations accordingly? Well, that's exactly what the designers of ECAs don't want to happen. The ideal situation is for the user *not* to adjust his expectations to that of a human-machine

interaction but to temporarily feel and behave as though a human-human interaction is taking place. The goal is to evolve an abstract system into a system that has a human identity and personality – all in order to enhance the user's experience (Geven, Schrammel, & Tscheligi, 2006).

Researchers look for ways to increase the likelihood of that temporary suspension of belief taking place. It requires the deep study of all the auditory and visual signals exchanged between humans during face-to-face communication (Cole et al., 2003) and then designing agents that model or mimic that behavior. For instance, instilling language alignment – a natural occurrence in human-human dialogue – into the behavior of an agent can make the agent seem more believable because the agent appears to be influenced by the user's behavior. The less polite the user is, the less polite the agent will be (De Jong, Theune, & Hofs, 2008). An agent whose "personality" remains unchanged regardless of how it is spoken to, can appear unrealistic and even rude.

Language alignment is just one of the ways of instilling "social resonance" – where communication is coordinated and individuals are easily exchanging meaning via signals – into an agent (Kopp, Bergmann, Buschmeier, & Sadeghipour, 2009). It's long been known that gaze behavior is an important nonverbal aspect of communication. Gaze reveals personality traits, relationship status, conversation impact and assists with turn-taking. Findings have shown that modeling human gaze activity in an agent can significantly increase the agent's believability (Van Es, Heylen, Van Dijk, & Nijholt, 2002).

Aside from modeling agents after humans in general, it appears that modeling an agent after the *specific user* also increases credibility. Recent research has found that when users interacted with agents that were facially similar to themselves, they "took the application more seriously, trusted the computer more and believed the computer was fairer" (Van Vugt, Bailenson, Hoorn, & Konijn, 2010). So, what about going a step further and letting the user control the agent's appearance, as is typically done with avatars in game environments? Recent research has found that not only is the agent's ability to motivate and persuade greatly increased when users choose the agent (which is very beneficial in a learning environment), allowing users to customize the agent, or even just giving the illusion of customization, can have a considerable positive effect on their perception of the agent. The current "one size fits all" deployment of agents may not be the most usable approach (Xiao, Stasko, & Catrambone, 2007).

The Downside of Credibility

How much effort should be put into humanizing computer interfaces? Should we just let computers interfaces be inanimate and abstract? After all, users already become emotionally and socially involved with computers, attributing feelings and emotions to them even when the interface has no humanistic component. Adding an embodied presence can lead users to believe the system will make rational, responsible and intelligent decisions in the same way that a human would; thereby lessening the user's sense of responsibility (Geven et al., 2006).

Allowing the user to select or customize the agent begins to cross over into the world of avatars – although, the agent's speech and movements are not representative of the user's as with avatars, the user has invested some time, thought and feeling into the creation of the agent. One

then has to wonder how long before the concept of attachment comes into play, increasing the chance that a user becomes upset by something the agent does or says or becomes emotionally troubled by the loss of the agent. Research has shown that in virtual worlds, participants suffer great emotional distress when their avatars are harmed in a malicious way. The question has been raised as to whether this type of attachment is any less legitimate than human attachment to possessions and ideals – something currently considered acceptable (Wolfendale, 2007).

There's also the concept of the "uncanny valley" – a concept first brought to light by Masahiro Mori in 1970 where he showed that something is more agreeable the more human it looks until it hits a point where it is so human-looking that its non-human traits make it look eerie (MacDorman, Green, Ho, & Koch, 2008). This concept has been shown to exist with ECAs, where users find that agents who are too realistic are scary (Geven et al, 2006).

Finally, there are some populations, such as inner-city adolescents, where the affect of ECAs has been studied very little (Hubal et al., 2008). Agents that too credibly mimic the dialogue, postures and gestures of a someone deemed oppressive by the user may have less than positive results.

Conclusion

Advancements continue to be made in the development of credible ECAs and toward the goal of having users view computers as human guides rather than crowded toolboxes (Xiao et al., 2007). Applications have been developed to automatically generate an agent's non-verbal behavior (eye gaze, gestures, etc.) based on the dialogue text (Breitfuss, Prendinger, & Ishizuka,

2007). Work is being done to equip agents with vision through the use of computer cameras so the agents can use information about the user's environment to better assist the user (Geven et al, 2006). Returning to the ATM scenario described in the beginning of this paper – it would be great if Tessa could "see" if someone has suddenly approached you from behind and either alert you or perform some other protective action. But it's also important for designers to understand whether Tessa subtly gives you the creeps and whether you should be allowed to customize or even replace Tessa. Will you be more embarrassed if Tessa tells you your account is overdrawn than if an ordinary face-less, ATM told you the same thing? How will you feel if you return to the ATM to find Tessa gone and John is smiling back at you instead? Will you have a positive view of Tessa if her language, gestures, and body posture indicate that her background is similar to yours? Will you blame Tessa for your poor banking choices? Despite technological advances to make agents even more credible, we must continue to investigate the consequences of increased agent credibility. I think the success of ECAs still largely depends on successfully determining what applications and what target populations benefit most from an ECA, and, in each situation, successfully determining how best to deploy the agent (customizable or not) and how realistic to make it.

References

Breitfuss, W., Prendinger, H., & Ishizuka, M. (2007). Automated generation of non-verbal

behavior for virtual embodied characters. *Proceedings of the 9th international conference on*

Multimodal interfaces, 319-322.

Cole, R., Van Vuuren, S., Pellom, B., Hacioglu, K., Ma, J., Movellan, J., Schwartz, S., Wade-

Stein, D., Ward, W, & Yan, J. (2003). Perceptive animated interfaces: First steps toward a

new paradigm for human–computer interaction. *Proceedings of the IEEE,* 1391-1405.

De Jong, M., Theune, M., & Hofs, D. (2008). Politeness and alignment in dialogues with a

virtual guide. *Proceedings of the 7th international joint conference on autonomous agents*

and multiagent systems – Volume 1, 207-214.

Geven, A., Schrammel, J., & Tscheligi, M. (2006). Interacting with embodied agents that can

see: how vision-enabled agents can assist in spatial tasks. *Proceedings of the 4th Nordic*

conference on Human-computer interaction: changing roles, 135-144.

Hubal, R., Fishbein, D., Sheppard, M., Paschall, M., Eldreth, D., & Hyde, C. (2008). How do varied populations interact with embodied conversational agents? Findings from inner-city adolescents and prisoners. *Computers in Human Behavior, 24* (3), 1104-1138.

Kopp, S., Bergmann, K., Buschmeier, H., & Sadeghipour, A. (2009). Requirements and building blocks for sociable embodied agents. *Proceedings of the 32nd annual German conference on Advances in artificial intelligence,* 508-515.

MacDorman, K., Green, R., Ho, C., & Koch, C. (2009). Too real for comfort? Uncanny responses to computer generated faces. *Computers in Human Behavior, 25*(3). 695-710.

Van Es, I., Heylen, D., Van Dijk, B., & Nijholt, A. (2002). Making agents gaze naturally - does it work?. *Proceedings of the Working Conference on Advanced Visual Interfaces*, 357-358.

Van Vugt, H., Bailenson, J., Hoorn, J., & Konijn, E. (2010). Effects of facial similarity on user responses to embodied agents. *ACM Transactions on Computer-Human Interaction (TOCHI), 17*(2) *article no 7*.

Wolfendale, J. (2007). My avatar, my self: Virtual harm and attachment. *Ethics and Information Technology, 9*(2), 111-119.

Xiao, J., Stasko, J., & Catrambone, R. (2007). The role of choice and customization on users'

interaction with embodied conversational agents: effects on perception and performance.

Proceedings of the SIGCHI conference on Human factors in computing systems, 1293-1302.