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Anthropomorphic Design

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EDUC220K

June 27, 2007

I. Introduction

A highly controversial topic in human-computer interaction is the use of anthropomorphic agents. Anthropomorphism, by definition, is the “attribution of human motivation, characteristics, or behavior to inanimate objects, animals, or natural phenomena” (American Heritage Dictionary). The term “agent” in this case comes from the field of computer science and it refers to small programs (software agents) that are highly independent, and are used to perform a number of tasks with little or no human intervention. The purpose of anthropomorphic agents therefore is to 1) make communication between the computer and the user more “human-like” and 2) to increase the automation of tasks.

While many people find that anthropomorphic design is useful because they believe it promotes positive attitudes and engages the user, many people have found that anthropomorphic design is distracting and inappropriately reduces user control and responsibility. To address these different perspectives, numerous research studies have been undertaken to evaluate the effectiveness of anthropomorphic agents. Unfortunately for both sides, the results have not been black and white. In some studies, such as that of Lester et al. (1997), performance has increased after a period of interaction with an animated agent, as compared with the same program without an agent. However, in other cases, such as that of Dehn and van Mulken (2000), there has been no notable difference in performance between those participants interacting with anthropomorphic agents and those interacting with a text-based system. With these contradictory results, it has been difficult for educators and interface designers to be completely sold on the importance of anthropomorphic design.

II. Overview of Anthropomorphic Design

A. *Key interface design considerations*

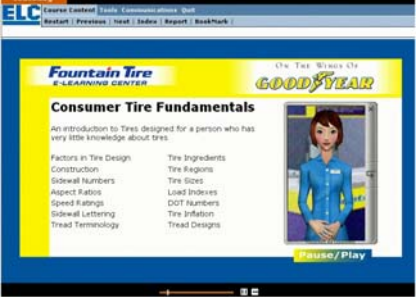
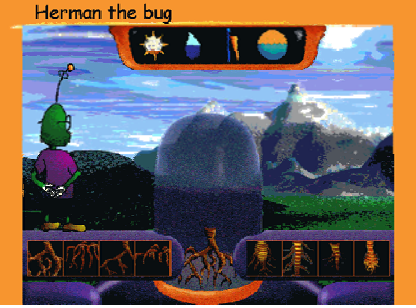
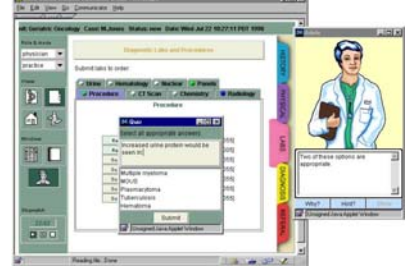
1. *The Role of the Agent*


Anthropomorphic agents can have many different roles that range from being a guide on the side, activated only at the user's request, to an ever present tutor helping the user to answer questions and resolve problems. Deciding what role the agent will have in the program is the most important step in the development process. An agent that performs an inappropriate role will only result in user frustration and anxiety. Some possible roles include:

- Desktop / personal assistants – In this role, the agent may help the user perform rudimentary tasks more easily.
- Presenters of information – In this role, agents read information from the screen or present it in an oral fashion.
- Learning Companions – In this role, the agent appears to learn along with the user so that the user does not feel lonely during the process.
- Mentors/Tutors – In this role, the agent guides the student through an educational environment and communicates instructions and feedback messages to them.
- Pedagogical agents – In this role, the agent takes on a pedagogical approach (ex. constructivist) to interact with the user and to make him or her engage in a number of cognitive processes that result in learning.

2. *The Look and Feel of the Agent*

Anthropomorphic agents also come in many different shapes, sizes, and colors. Below are a few examples of different types of anthropomorphic agents that have been developed.

	<p><i>Realistic 3D human representation</i></p>	<p>Fountain Tire has created "Paige": a virtual instructor that delivers online training to over 1,500 employees. This video capture illustrates Paige delivering an online course hosted by Operitel's Learnflex LMS. See the below link for complete video demonstration. http://www3.codebaby.com/demo/fountaintire/.</p>
	<p><i>3D non-human representation (with human-like characteristics)</i></p>	<p>North Carolina State University's Design-A-Plant is a knowledge-based learning environment project to investigate interactive problem-solving with animated pedagogical agents within the design-centered learning paradigm. This is a screenshot of Herman the Bug guiding the user through a Biology activity and giving them problem-solving advice.</p>
	<p><i>2D human representation</i></p>	<p>The Center for Advanced Research in Technology for Education (CARTE) developed this agent, Adele (Agent for Distance Learning Environments). She</p>

		interacts with students and tracks their learning as they work through course materials and simulation exercises.
	<p><i>2D cartoon-like non-human representation (with human-like characteristics)</i></p>	<p>This Clippit office assistant was a feature included in Microsoft Office 97 and subsequent versions until Office 2007, in which the assistants have been removed due to widespread user dissatisfaction. Users complained about both the role of the agent (it could not be easily turned off or adjusted to different experience levels) as well as the look of the agent (many users felt that it had a condescending tone or frequently looked annoyed).</p>

Some visual factors that should be closely considered when developing the look and feel of an agent are as follows:

- *Facial expressions:* Facial expressions provide 55% of the meaning of a message. Therefore, it is very important to pay attention to how users might react to the facial expression of an anthropomorphic agent. Expressions and movements such as smiling, eye brown raising, eye blinking, and head turning can either greatly enhance or greatly reduce the credibility of an agent, depending on their timing.

- *Gestures*: Gestures are the next most visible expression following facial expressions. Gestures generally augment verbal skills when speakers find them inadequate to express everything that they want to say. Gestures that appear rehearsed generally are considered unflattering. A good rule of thumb to follow is to make gestures as natural as possible and to always match them to what is being said. Mismatched multi-channel messages are confusing and can come across as deceitful to the user.
- *Gaze patterns*: Eyes are generally the area that people look at the most when conversing. In one study, participants focused their attention on the eyes 43.4% of the time, with the mouth being the next most frequent at 12.6%. Therefore, it is very important to make eye movements appropriate considering the context of the conversation or situation.
- *Posture*: An individual's posture conveys presence and is an efficient communicator of emotion. Postures typically are either open or closed. When a posture is open (ex. arms open) it indicates a willing attitude. When a posture is closed (ex. arms crossed in front of the chest) it communicates disinterest and a resistive attitude.
- *Intonation / Paralanguage*: The way that words are pronounced can be used to infer emotion and personality traits. In anthropomorphic design, there is such a thing as an attractive voice, which is defined as "sounding more articulate, non-monotonic, lower in pitch, higher in pitch range and appropriately loud" (Cowell & Stanney, 2005, p. 282-284).

B. Advantages and Disadvantages of Anthropomorphic Design

Many people believe that anthropomorphic design has the potential to greatly increase user satisfaction. However, many people also believe that the disadvantages of anthropomorphic design greatly outweigh the benefits. Below is a summary of some of the major goals of anthropomorphic design as well as some of the commonly referenced advantages and disadvantages of each.

Goal	Advantages	Disadvantages
<p><i>To make a computer more human-like.</i></p>	<p>Making the computer appear human-like helps to establish a relationship with the user and build their trust. Giving the computer human-like characteristics makes it more approachable and makes it more attractive to people with little computer experience.</p>	<p>Shneiderman (2005) argues that giving the computer human-like characteristics disempowers users by clouding issues such as who is responsible for a system's actions. It reduces user control and destroys a user's sense of accomplishment. He even goes so far as to say that anthropomorphism deceives users because it lets the user think that the computer has all the capacities of a human. As a result, users are tempted to assign the computer with human foibles and blame it when something goes wrong (p 80-82).</p>
<p><i>To grab the user's attention and/or to make learning more engaging.</i></p>	<p>Anthropomorphic design commands people's attention. Walker, Sproull, and Subaranni (1994) found that people who interacted with a talking face spent more time on an online questionnaire, made fewer mistakes, and wrote more comments than those who answered a text questionnaire.</p>	<p>Anthropomorphic designs can be distracting and a waste of time. Many people believe they are annoying, silly characters who hinder rather than enhance productivity, especially when they cannot be turned on or off. Giving the user no control over them increases anxiety and frustration. Takeuchi and Naito (1995) found that the presence of a face provided important extra conversational cues, but that this also required more effort from the human interacting with the system and</p>

		sometimes served as a distraction.
<i>To encourage natural dialogue.</i>	Many animated agents allow you to speak your questions to them rather than requiring that you type them. This is generally more efficient and when done correctly, can increase user trust.	Speech recognition software does not always pick up everything or may incorrectly translate what you say. The accuracy of the technology still falls short of a human assistant or text based assistant. Also, designers must accommodate for the deaf, those users who prefer to type, as well as the different qualities of microphones that may be available to users.
<i>To help automate tasks.</i>	Users do not have to learn complex command structure and functionality. The agent takes care of most of this for them.	Users have different levels of background knowledge. If automation is only targeted for example to a novice user, experienced users will become easily frustrated.

C. Framework for Evaluating Anthropomorphic Agents

In “Anthropomorphic Agents as a User Interface Paradigm: Experimental Findings and a Framework for Research,” Catrambone, Stasko, and Xiao (2002) provide an excellent framework for evaluating anthropomorphic agents. Their framework emphasizes three main components for evaluation.

1. *The Features of the Agent*

- *Fidelity* – How realistic looking does the agent need to be?

- *Presence* – Should the agent be constantly present or only present when the user asks it to be?
- *Role* – What kind of role should the agent play?
- *Initiative* – Should the agent proactively make suggestions and offer guidance or should it respond only when directly addressed?
- *Other Variables* - What gender should the agent be? How competent should the agent come across? What should their personality be like? Etc.

2. *The Characteristics of the User*

- *Personality* – What personality traits (extroversion, openness, conscientiousness, etc.) of potential users will increase or decrease their likelihood of liking the agent?
- *Background Knowledge* - How much background knowledge will the average user have? Is it possible for the agent to accommodate multiple experience levels?
- *Other Variables* – What is the average gender, age, computer experience, etc. of the average user?

3. *The Task the User is Performing*

- *Objectiveness* – Are users completing objective tasks or are the activities opinion-based?
- *Intent* – Will the user be working towards a specific learning goal or will they be carrying out a set of tasks in a familiar domain?
- *Other Variables* – Some other variables to consider are domain, degree of time pressure, duration, and consequences of the quality of task performance.

III. Anthropomorphic Design in Education

A. *What the research says*

In one case study by Moundridou and Virvou (2005), the researchers chose to evaluate the persona effect of a speech-driven anthropomorphic agent in a tutoring system. Participants consisted of 48 college students, half of whom received the agent and half of whom received a text-based version of it. The agent was responsible for guiding students in a learning environment and for communicating the system's feedback messages. The researchers evaluated the agent in terms of the effect that it could have on students' learning, behavior, and experience.

Results from the study showed that there were two main advantages that were induced by the presence of the agent. The first advantage concerned the students' subjective experience of the system. Students who worked with the anthropomorphic agent found it more enjoyable and easy to use than did those working with the agent-less version. The second advantage concerned the students' behavior while interacting with the system. Students working with the agent version of the system found the problems that they were asked to solve less difficult than students working without the agent, despite the fact that the performance of both groups of students was similar. This shows that students working with the agent were more motivated by the interface than students without the agent.

However, the agent failed in several categories. First of all, it did not manage to significantly improve the short-term learning outcomes of the students. Secondly, it did not manage to significantly affect students' attentiveness to the system.

B. *How to apply these results in the classroom*

These results might compel an educator to ask, “Is the increase in enjoyment and motivation caused by the anthropomorphic agents important enough to continue supporting the technology on its own, even though it may have no immediate effect on the student’s learning outcomes? The answer to this question should vary significantly depending on the learning goals of the class. If a teacher hopes to use an anthropomorphic agent alone to increase students’ knowledge of cellular biology, for example, then they may end up disappointed when their end-of-the-year results are not any better than they were before. However, if their goal is to engage and motivate students to learn more about cellular biology, to help them explore its inner workings, and to take a general interest in it, then they will most likely be satisfied (if the appropriate agent for the task was chosen).

C. What about Avatars?

Much hype and attention has been recently given to avatars which are becoming increasingly popular in educational games and three dimensional social environments. In contrast to anthropomorphic agents, avatars are generally human-like representations of the *user* themselves in a virtual environment or world. Users have become drawn to programs that have avatars because they 1) give users the ability to communicate their personalities through various direct and indirect means and/or 2) allow the user to “reinvent themselves” as someone or something completely new. One of the most popular avatar platforms used today is [Second Life](#). While many people use it just for gaming purposes, it is becoming increasingly popular for educational purposes as well. One company, [Sloodle](#), has developed an open-source tool that combines the virtual environment of Second Life with [Moodle](#), a learning system where teachers can structure lessons, thread discussions, and grade quizzes. Also, to combat some of the security concerns with Second Life, educators are only allowed to participate on their own “private island” where users “can choose whether they’d like the island to be limited to students in their class or program, or as in the case of the New York-based youth development organization

Global Kids, open to any teen using the system” (Appel, 2006). See examples below of two Second Life virtual classrooms.



<http://life-slc.org/wp-content/up/2006/10/John%20standing.GIF>

http://humanities.osu.edu/news/express/yr2006/images/december_article02.jpg

This type of environment could be particularly useful in distance education courses where students could collaborate with each other on projects that require physical interaction, be asked to do presentations to an entire class, and interact with each other in a physical class discussion using not only audio and text but also gestures and expressions. All of the above would help students to feel more connected to their classmates and teachers and to alleviate the “distance” that many students often feel while taking online classes.

IV. Conclusion

As the research shows, anthropomorphic agents have a future if the right kind of agent is used with right audience, is engaged in the right kind of tasks, and produces the right kind of results. Incorporating animated agents just because they “look cool” or “they are cute” will not make a program more effective. In fact, it will often lead to user frustration and sometimes even rejection of the program altogether.

In the field of education, anthropomorphic agents have the potential to be used successfully as long as the expectations for the agents are clear. If teachers hope to use anthropomorphic agents to increase student enjoyment and motivation, then it is likely they and their students will be highly satisfied. However, if the teachers hope for the anthropomorphic agents to magically increase their students' learning outcomes, then they most likely will be setting themselves up for disappointment.

Finally, while much research has been undertaken on the topic of anthropomorphic agents, there is still a great amount of ground to cover. More longitudinal research needs to be done to evaluate whether the motivational aspect of anthropomorphic agents can lead to long-term learning outcomes. Also, more experimental research needs to be undertaken to find out how anthropomorphic agents work with students of different ages since most of the research to date has only used students that are college-aged or older.

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