

# 'Embodied Interfaces': The Next Generation of HCI?

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## Abstract

Advocates of embodied agents often assume that such agents will enhance human-computer interaction (HCI) as they take advantage of our pre-existing social skills and provide an interface that is natural and engaging to use. But this is not guaranteed. A discussion is provided detailing some of the key technical and social issues that will need to be overcome for embodied interfaces to be of use in the next generation of HCI, along with an overview of related experiments that are to be conducted over the coming months. Final conclusions regarding embodied interfaces are then provided.

## 1. Introduction

The use of (human-like) embodied agents in human-computer interaction (HCI) is a research area which has received increasing interest over recent years. Advances in computer graphics have made it possible to efficiently create realistic three dimensional (3D) graphics that can be incorporated into interfaces. Embodied characters often exhibit a variety of human-like behaviours, including emotional expression, speech (synthetic and recorded), gestures and other facial expressions. There has been a wide debate regarding the use of embodied agents in interfaces with arguments both for (e.g. Lester et al., 1997) and against their use (e.g. Shneiderman and Maes, 1997). Supporters of embodied agents believe that they will take advantage of our pre-existing social skills (e.g. analysing tone of voice, facial expressions and body posture) thus making the interaction more natural and engaging. Additionally, it is believed that embodied interfaces will make the system more enjoyable to interact with and thus increase users' motivation to interact with the system, which it is believed will promote cognitive processes such as learning and problem solving.

Opponents of embodied agents argue that humanisation of an interface might have derogatory impact on HCI as it may produce false mental models of the agent's capabilities (Norman, 1997). For example, agents which exhibit human-like behaviour may be perceived as more intelligent than they actually are, which can lead to incorrect expectations about the system's abilities. Another argument is that embodied agents can have an impact on vital cognitive resources such as attention and can lead the user to be easily distracted from the task they are performing. Moreover, it has been suggested that there is no need to embody interface agents as users seem to treat computers as social entities even when they are not represented in a human form (Reeves and Nass, 1996).

Over recent years there have been a variety of studies which have empirically tested supporters' assumptions regarding embodied agents. However, these studies often seem to provide conflicting results regarding the helpfulness of such agents and this can make it difficult to assess the impact they may have in the next generation of HCI (Dehn and Van Mulken, 2000). Moreover, many of the agents that have been developed to date are of poor quality and cannot interact naturally and effectively with users. This inevitably causes people to question the potential role that embodied agents will play in future interfaces.

This position paper will start by discussing the main technical and social issues that will need to be overcome for embodied interfaces to become widespread. Related

experiments that are to be conducted over the coming months will then be outlined along with general conclusions about the future role of embodied agents in HCI.

## **2. Future of Embodied Agents in HCI**

High-quality embodied agents have the potential to effectively play a variety of roles in HCI including sales representatives, trainers, customer support advisors, employee mentors, teachers, site guides, marketers, motivational coaches, comedians and a wide range of others. However, despite the amount of research that has been conducted over the last decade, this potential is yet to be fulfilled as very few interfaces today make use of embodied agents.

### **2.1 Technical Issues**

Several technical issues need to be resolved in order for embodied agents to be of use in HCI. Initially, an agent's ability to make use of human social cues (e.g. eye gaze and emotional expressions) must improve significantly. Studies which have suggested that we treat computers as social actors (Reeves and Nass, 1996) add strength to the possibility that we may respond to embodied agents as though they are human, but if, for example, an emotional expression of empathy is poorly animated and a synthetic voice is used, it is unlikely to have the beneficial psychological impact that has been documented in human-human interaction. Only recently, developing a realistic 3D virtual human face was a huge undertaking in terms of both time and expense (Plantec, 2004). However, it is now becoming possible for people without extensive artistic and animation experience to create realistic virtual humans in a fraction of the time using affordable software that automates much of the process. This technology is likely to improve over the coming years increasing the potential for creating realistic-looking virtual humans.

While it is likely that realistic looking virtual humans will be available over the coming years, a major technical issue that will need to be overcome is an agent's ability to have a *natural* conversation with a human user. For this to be possible, embodied agents will need to combine the work of other large research areas such as affective computing, context-aware interfaces, natural language processing and other sub-fields of artificial intelligence. Only when these research areas have matured sufficiently will embodied agents be able to fulfil their potential. Kurzweil (2005) predicts that this will happen in the near future. With computer processing speeds doubling every year, Kurzweil believes that we will have virtual environments with realistic virtual humans (which will still be *unable* to pass the Turing Test) by 2010. By 2030, he predicts that it will be difficult to distinguish between virtual and real humans.

### **2.2 Social Issues**

Should these predictions turn out to be correct, it will be possible to create embodied agents that are indistinguishable from humans within a few decades. The implications of this would be huge and would raise a number of social issues. How will people respond to agents that act like humans? Will we embrace or reject the technology? How will we feel about taking advice from virtual humans? Can synthetic emotional expressions have the same psychological impact as human emotion? Even if virtual humans are technologically viable in the future, it is not guaranteed that we will feel comfortable interacting with them.

If these predictions are not correct, then we will not be able to produce completely human-like agents. But this simply sets up another set of problems: what forms of representation usefully benefit interaction – equally, what domains benefit from embodiment, and why?

Changes in the nature of the interaction are also caused by changes in the users and their perceptions and expectations, as well as in the technologies employed. For

example, internet shopping has grown strongly over the past few years, well after the dot com boom era, as more and more users become familiar with the technologies and systems. As more advanced games infiltrate more and more homes for entertainment purposes, so users become more familiar interacting with embodied entities on the screen, and hence this more familiar interaction metaphor could drive a widespread acceptance of, and demand for, embodied interaction in general.

### **3. Experiments**

In order to understand how people might respond to future embodied agents, it is necessary to simulate how that interaction might take place. Over the coming months, we plan to conduct a number of experiments that will investigate our responses to embodied agents and are currently in the process of building a nutritional coach that will attempt to help motivate people to eat more healthily. The agent will make use of psychological behaviour change models and will use a number of the strategies and techniques that human therapists use when helping clients change problematic behaviour.

#### **3.1 Research Questions**

A number of recent studies have suggested that users tend to like and trust emotional agents more than unemotional agents (Brave et al., 2005; Bickmore and Picard, 2004). In human-human interaction, people are more easily influenced by people they like and trust and are more likely to act on their advice. Does the same apply in HCI? If emotional agents are perceived as more likeable and trustworthy than unemotional agents can they potentially motivate people more effectively? An agent's representation may also effect the strength of a user's response to synthetic emotion and consequently might have an impact on an agent's ability to influence user attitudes and behaviour. The main research questions that we are going to address include: -

1. How do users respond to synthetic displays of emotion? Can emotional agents motivate people to change problematic behaviour more effectively than unemotional agents?
2. What impact does the type of representation (e.g. textual content, synthetic speech, multimedia video) used by an agent to express emotion have upon a user's perceptions and behaviour?

#### **3.2 Experiment Overview**

The initial experiment to be conducted will investigate how people respond to synthetic displays of emotion. Subjects will be divided into two conditions: emotion and no emotion (control). An interaction will then take place with a (embodied) nutritional coach which will ask questions related to the subject's current diet and motivation to change their eating behaviour. To reduce the possibility of the agent being perceived as lacking intelligence through poor dialogue, subjects will respond to the agent's questions by selecting from pre-scripted responses. After the interaction with the agent is complete, subjects will be able to view educational material about maintaining a healthy lifestyle for as long as they desire. Once they have finished looking at the material provided they will be asked to complete an online questionnaire which will be used to assess their perceptions of the interaction and the agent. Subjects will also be debriefed to elicit qualitative information about their perceptions of the interaction.

#### **3.3 Further Experiments**

We intend to conduct a similar experiment again over an extended period of time (i.e. around four weeks), which will test the impact of an agent's representation on a user's reactions to synthetic displays of emotion. Subjects will be asked to interact

with the coach on multiple occasions to measure how our perceptions of emotional and embodied agents change with time and to examine the long-term effects that interacting with a computational agent has on peoples' eating behaviour. Further experiments will be conducted with other problematic behaviours (e.g. smoking) to test the consistency of any effects found.

#### 4. Conclusion

It remains difficult to predict the role that embodied interfaces will play in the next generation of HCI. When considering what this role might be, it can be easy to look at the standard of agents developed to date and conclude that they will not play a significant role in our future interaction with computers. The graphics and animation are often poor, a synthetic and monotone voice or static text is usually used for communication purposes, and the agents themselves have limited use of language. However, it is now becoming easier to create human-looking agents with affordable software and with computer processing speeds accelerating at an exponential rate, it is likely that agents developed over the coming years will be far superior to the ones currently available.

While it seems almost inevitable that embodied agents will become more advanced in their capabilities, it does not guarantee that they will be adopted by users. People may find it strange interacting with a virtual human and could reject the technology outright. Research which has focused on how we respond to embodied agents has failed (to date) to clarify whether embodied agents will enhance or hamper HCI, with results from related studies often conflicting with each other. More experiments of the type outlined above which simulate how we might interact with embodied agents in the future are essential in helping us understand the potential benefits of using such agents in HCI.

The future of embodied agents in HCI depends on whether the main technical and social issues outlined can be resolved. If they can, embodied interfaces have the potential to enhance HCI in a wide variety of domains including entertainment, teaching, sales, the helping professions, and product support. However, if these issues cannot be resolved, embodied interfaces (in many cases) will become a frustrating interaction experience and are likely to be of limited appeal.

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