CHAPTER 2

Related Work in Personified Interfaces

This chapter describes related research in personified interfaces and agent-based interfaces. The related research stems from four areas: interface metaphors, social interface, believable agents, and software agents. The second half of this chapter describes psychological research on personification.

Metaphors with Character

Metaphors allow us to take advantage of our knowledge about objects and events in the real world to understand more abstract concepts. When used in an interface, they help us to understand the capability of the system, and provide us with expectations about what will happen when we take certain actions.

Apple Knowledge Navigator

"Phil", shown in Figure 1, a semi-intelligent agent who appeared in the Apple Knowledge Navigator video, could talk to the user. Phil came in two versions: a human facial image and a cartoon face, which may set up different user expectations. The common feature of Phil is the bow tie which is a salient and iconic costume element, making the character recognizable in both representations [Laurel 90].

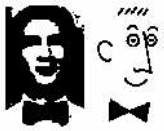

FIGURE 1. Two kinds of representation of "Phil" in the Apple Knowledge Navigator [Laurel 90]

Apple Guides

Apple Guides is a multi-media educational database that contains American historical information. A primary goal of Guides is to "reduce the cognitive load on users that is created by 'navigating' while trying to learn" [Oren 90]. Different characters with different facial features and costumes, called "Guides", are used to distinguish points of view that can be used to navigate through a historical database (Figure 2). Users assumed or wanted to attribute personality to each iconic Guides figure. This means that human figures induce characterization. Users rated the Guides characters as engaging and responded emotionally not to the computer but to the Guides characters. Oren describes the value of the Guides as follows:

personification helped users reduce the cognitive load to navigate themselves, made the interface more engaging, and suspended disbelief. [Oren 90]

FIGURE 2. The Guides characters [Oren 90]

The above research is based on the hypothesis that anthropomorphism in the interface is effective because we can easily predict how a character is likely to think and behave by its external trait [Don 92]. We know how to communicate with other people, and utilize that knowledge to anthropomorphize animals, objects, and computer software [Nass 94]. Laurel also states in defense of anthropomorphism that the key for applying character metaphors or anthropomorphism to an agent is to provide the appropriate set of traits for the given agent [Laurel 90]. The danger is that people may expect human-like intelligence, understanding, and actions from anthropomorphized characters [Laurel 90].

Research Related to "Social Interface"

The work of Nass *et al.*'s [Nass 94] has proven that people apply social rules to human-computer interaction, thus "computers are social actors". Their laboratory studies show that peo-

ple treat computers as human, even when the interface is not anthropomorphized. People prefer interacting with computers that demonstrate the same personality as they have, be it dominant or submissive [Nass 95]. Their work has been used as a basis for several other studies on personified interfaces. If the interaction with computers is social, using a character in the interface is perhaps a natural way to support the social aspect of the interaction.

Microsoft Persona Project

The Persona project [Bell 96] is one of the efforts by Microsoft to use lifelike characters in an interface. The Persona project is based on Nass *et al.*'s social interface paradigm. Persona uses natural spoken dialogue and expressive anthropomorphic figures (a parrot called "Peedy") for a computer assistant which interacts with the user. The goal is "to achieve a level of conversational competence and visual reactivity that allows a user to suspend disbelief and interact with the assistant in a natural fashion" [Bell 96]. Bell lists several requirements for an assistive interface: 1) it should support interactive give and take, 2) it should have some degree of decision making ability without bothering the user every time it needs confirmation, 3) it should know when to interrupt, 4) it should learn appropriate behavior depending on the user's mood, its task, etc. just as a human assistant does [Bell 96].

Microsoft "Bob"

Another product based on Nass *et al.*'s "social interface" is Microsoft "Bob". Bob is an animated personal guide used as a primary interface to the computer. Bob communicates with the user through speech balloons and provides help and possible options for the user to

choose from. The social metaphor helps the user to concentrate on a single source of information without being overwhelmed by too many options [Bell 96].

Research on Believable and Lifelike Agents

This section discusses pioneering research on believable agents, which focuses on building animated characters with agent technology. Believability is another important issue that makes software agents more usable and trustworthy.

MIT Media Lab's "ALIVE" System

The Media Lab's ALIVE system [Maes 95b] is a pioneering system that allows wireless, full-body interaction between a human and a graphical world inhabited by lifelike autonomous agents. One of the goals of the ALIVE system is to provide an "emotional" experience in a virtual world, by allowing users to interact with lifelike characters using s natural interface. Blumberg's autonomous creatures [Blumberg 94] in the ALIVE system are based on concepts from Ethology. This Ethological approach has proved to be effective in making believable and robust agents.

Bates' "Oz project"

Bates' Oz project [Bates 94] aims to build a believable character by conveying the emotions of the character. Bates believes that believability does not come from "honest or reliable character", but from providing the "illusion of life", and "permitting the audience's suspension of disbelief." In doing this, "emotion is one of the primary means to achieve believabil-

ity." Their work is based on the OCC's emotion model (discussed in Chapter3) and studies of traditional animation techniques [Bates 94].

Elliott's "The Affective Reasoning Project"

Clark Elliott's Affective Reasoner [Elliot 94a] is a real-time simulation platform for emotional agents. These agents have the ability to react emotionally to each other and to the user. The platform has an "emotional engine", speech recognition package, music selection and playback mechanism, and facial representation generator. Elliott states that in some cases cartoon-like faces are more effective to express emotional responses than sophisticated 3D faces [Elliot 95]. To test the believability of emotional characters, three groups of subjects were shown a set of videos of the Affective Reasoner, in which the agents interpret an ambiguous sentence with a line-drawn face with facial expressions, synthesized speech, and music. The results show that 1) subjects are able to detect the intended emotion with over 70% accuracy, and 2) music is better than facial expressions in helping subjects identify the right emotion [Elliott 94a]. As the film industry has known for decades, music can engage users, because it "gives additional cues to the user about the emotional states of the characters," and it is "a powerful arousal, and mood-induction tool" [Elliott 95]. Elliott [Elliott 94b] has suggested that a poker game is a good testbed for enhancing believability of agents through emotional expressions. Some model of emotion or personality is essential to make a realistic computer model of a game such as poker.

Personifying Software Agents

MIT Media Lab's "Newt"

Newt [Sheth 94] is a personalized news filtering system developed at the MIT Media Laboratory. A user can create a set of agents, represented by cartoon-like characters, that assist the user with the filtering of an on-line news source. These characters have different costumes depending on the topic they are interested in, and they change their postures when the user is looking at their specific news topics (Figure 3). Although the main focus of this work was on refining the prediction algorithm, what is interesting to the field of personified interface are findings that users who had knowledge about the system's internal mechanism had no difficulty in correlating the agent's behavior to its internal state and could trust their agent. While those who had no knowledge did not understand the agent's behavior, nor did they trust the agent. Another issue that could be improved was to give immediate feedback to users after they responded to the agents. This result shows that visualizing the agent's internal state and explaining its behavior is essential for making a trustworthy and acceptable agent [Sheth 94].

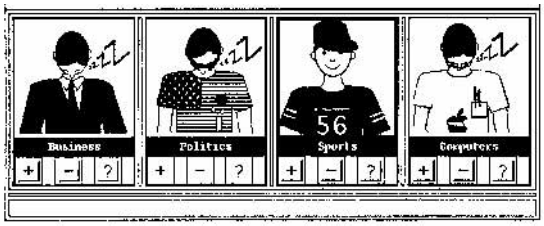

FIGURE 3. The representation used in Newt [Sheth 94]

MIT Media Lab's "Maxims" and the Calendar Agent

Maxims [Lashkari 94] is an agent that assists the user with handling e-mail, and the calendar agent [Kozierok 93] is an agent that schedules meetings on behalf of the user, developed by the MIT Media Laboratory. In both studies, a caricature face with facial expressions is used to convey to the user the degree of certainty when the agent makes a prediction (Figure 4). The agent gives immediate feedback by its caricature face when the user takes an action. This visualization contributes to the user's trust of the agent [Kozierok 93, Maes 94].

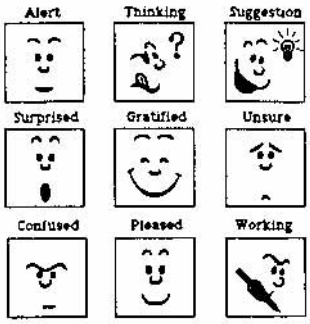

FIGURE 4. The facial representation used in Maxims and the calendar agent [Kozierok 93]

In summary, the above two studies hypothesize that users interact with agents more easily when they are able to predict the agents' characteristics and behaviors from their external traits. A face with facial expressions helps the user understand the agent's behavior and internal states, when used properly. The results are obtained by observation or interviews. None of the studies discussed so far are based on a systematic experiment and quantitative analysis. If the user does not understand the meaning of the visual cues, then personification would confuse the user more. Thus, there is a need to study the following issues:

- Whether faces are the best way to represent the agent's state.
- If yes, what types of faces are appropriate to represent the agent's internal state.
- Whether facial expressions are useful for explaining the agent's behavior.

Research on Users' Impression of Personified Interfaces

The research described so far reports positive effects of personified interfaces. However delightful a personified interface seems, it is important to verify these intuitions. Recently, researchers have begun quantitative analyses of users' experiences with personified interfaces. Interestingly, some of this research indicates that adding faces to an interface does not necessarily provide better human-computer interactions.

Walker *et al.*'s Study of Using a Human Face in a Questionnaire Survey

At Dec, Walker *et al.* [Walker 94] studied how having a face and facial expressions for a computer application affects users' performance and productivity. They compared subjects' responses to an interview survey under three conditions: questions spoken by a synthesized face with a neutral expression, spoken by a face with stern expression, or text-only. Subjects who responded to the spoken face made more effort in answering the question by spending more time, writing more comments, and making fewer mistakes. Those who responded to the stern face spent more time, wrote more comments, and made fewer mistakes than those who dealt with the neutral face. Walker *et al.* reports that having a face is engaging and takes more effort and attention from the user. A face with more expression in an interface leads to greater engagement, but does not always makes the experience for users better if it is added

incautiously. She raises questions about personifying an interface: 1) how does the face in a computer affect the behavior and attitudes of the user interacting with it? 2) how should the faces delivering information be different from those used for soliciting information, and what kind of face should appear? She also states that more work should be done to determine when a personified interface is appropriate [Walker 94].

Takeuchi *et al.*'s "Situated Agent"

At Sony, Takeuchi *et al.* [Takeuchi 95] compared users' impressions of an agent which helped them to win a card game. The agent was represented either as an arrow or a synthesized face. The result shows that users respond differently to systems having a face than to those without. The arrow was recognized as useful and reliable, while the face was rated as fun and entertaining. A face in an interface takes more effort from the user and leads to a lack of concentration on the task because of these reasons: a face in an interface catches more attention, and people try to interpret the meaning of the face. However, Takeuchi argues that it is not necessarily a negative effect in terms of involving the user [Takeuchi 95].

Brennan *et al.*'s Study on Effects of Message Style

Brennan *et al.* [Brennan 94] studied effects of message style with an airline reservation system. There are three message styles: Telegraphic (i.e., "Enter first request."), Fluent (i.e., "Please enter your first request."), and Anthropomorphic (i.e., "How may I help you?"). Users are equally successful in all three groups. Those who interacted with the Anthropomorphic agent treated the computer more like a human than did the others, such as using

indirect phrasing and conversational politeness. There was no difference in attributing intelligence to each agent [Brennan 94].

King *et al.*'s Study on Appraisal of Agents

King *et al.* [King 96] conducted an experiment on people's reactions to different objects (geometric shapes, etc.) and faces, such as Chernoff faces (Figure 5 [Chernoff 73]), caricatures, and realistic 3D human faces. Faces were rated to have more intelligence and agency than any objects. Within faces, subjects attributed minimal agency and intelligence to Chernoff faces, and maximum intelligence to a 3D human face with blinking eyes. King's results show that there are differences in the initial appraisal of visual representations based on whether they are objects or human forms, symbolic or realistic, or static or lively. King's research also points out that users' initial impression of an agent affects how they interact with the agent, and affects the user's model of the agent's ability. Thus a face of an agent has to be carefully chosen to represent the agent's ability properly [King 96].

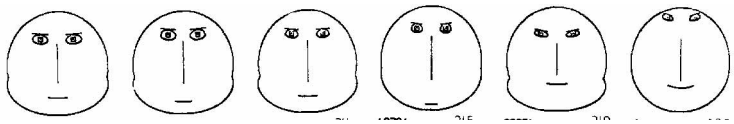

FIGURE 5. Examples of Chernoff faces [Chernoff 73]

Isbister's Study on Perceived Intelligence

Isbister's literature study [Isbister 95] shows that people's judgement of other people's and of TV characters' intelligence is not based on their true intelligence but rather their per-

ceived intelligence. She proposes to apply this tendency to computer interfaces to make agents look intelligent. There are several dimensions which affect people's judgement of another's intelligence: "appearance--judging a book by its cover; language cues; actions/behavior; and group membership" [Isbister 95]. These dimensions should be taken into careful consideration when designing software agents by using the right visual clues (attractiveness, dress, and other physical features), adding verbal cues, and applying social competence.

Need for User Interface Studies in Actual Applications

The studies mentioned so far contrast with the study in this thesis in several important ways.

The research in the first category (Guides, Persona, Bob, Newt, Maxims) is "implementation-oriented". The focus is on implementation but not on interface and user reactions. In the latter category of research--"psychological/literature studies"--little in terms of implementations was made (except Takeuchi), and the implementations are far from realistic. There is a need to study the effect of personified interfaces in an actual application, not in a controlled laboratory or unrealistic environment.

This thesis is unique in two ways: an application to test agent-based interfaces, namely a poker game, was actually built, and experiments were performed on the World Wide Web so as to have as many and versatile subjects as possible, and the results were analyzed quantitatively and qualitatively. The design of the application is described in the next chapter, and the design of experiments and analysis are described in the subsequent chapters.