A Simplistic Approach to Internationalization: Design Considerations for an Autonomous Intelligent Agent

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Abstract . A pilot of an autonomous intelligent agent telecommunications application offered the opportunity to investigate design is sues for a diverse international user group. Agent technology is new to most of these users. Usability engineering efforts focused on the look, feel, sound and dialog of a personal autonomous intelligent agent representation and the look and feel of its onscreen Web environment.

The goal was to make agent benefits available across cultural and linguistic boundaries. In this pilot study, time and resource constraints ruled out localized software versions. This agent had to operate in several cultural environments under one look and feel. Its dialog had to be machine-translatable into a variety of languages.

Usability engineering efforts were based on the belief that agents will radically change the way that humans interact with computers [Maes 94]. This hypothesis motivated the design of a non-traditional Web interface and the representation of an autonomous intelligent agent based on an inanimate object with human characteristics. Viewing agent attributes through the lens of traditional user experiences shed light on the characteristics the agent will need to convey. Instilling user trust in the agent became a primary usability engineering goal. Once established, trustworthiness can pave the way for a simple, easy to use Web interface.

1. INTRODUCTION

The design of an autonomous intelligent agent makes an impact on the user experience by establishing and projecting the agent's characteristics and capabilities. When designing an agent that will interact with an international audience, the broad range of the audiences' expectations broadens the range of issues that impact on design. However, meeting the usability requirements of an international audience, in some ways, reduces the range of design options. Rather than constraining design efforts, these issues open the way for exploring new paradigms for human-agent interaction.

This paper reports a pilot study in designing the look, feel, sound and dialog of an autonomous intelligent agent accessed through a Web browser. It also addresses design of the Web screens where the pilot version of the agent will appear. The pilot also had to pave the way for a future porting of the human-agent interface to a WAP (Wireless Application Protocol) phone.

The geographic locales for user groups are distributed over many parts of the world. They include Australia and Egypt. Several countries throughout Western and Central Europe bring a diversity of languages and cultures into the equation. North America is also a targeted

locale. Users comprise adults of all ages with varying computer literacy. Agent technology is new to the vast majority of this audience. The challenge was to design an agent that promotes successful and satisfactory user interaction for this diverse user group through its look, feel and sound, and whose dialog easily translates into many languages.

2. AGENT CHARACTERISTICS

An autonomous intelligent agent is most easily described through its characteristics. The classic characteristics are generally agreed upon [Brazier 98, Burgett 00, Maes 94, Maes 95]. Agents are commonly considered to be autonomous, reactive to their environment, proactive with respect to achieving goals, and social. In some cases, agents are also described as reasoning, beneficial and adaptive. In the pilot study, the agent is also personal, addressing telecommunication needs of only one user. When it comes to designing the look and feel of an agent designed to function in an international venue, it helps to look at agent characteristics from the perspective of user experience.

2.1. User Control v. Agent Autonomy

Before intelligent agents, the fundamental principle in usability engineering was to always make the user feel in control of the software, even in those cases where the user was not actually in control. Autonomous intelligent agents introduce a new paradigm. They can act independently. Although the agent under discussion will operate within the range of authority delegated by the user, the full range of an agent's behavior is neither predictable nor evident to its user.

The agent's autonomy and behavior focus on achieving the goals of its user. The agent pursues these goals on two levels. At the higher level, the agent does what its user tells it. At this level, where the agent pursues its user's expressed goals, the user is explicitly aware of the agent's behavior. At a lower level, the user is unaware of the agent's activities. This is the level of sub-goals where the agent interacts with a community of other intelligent agents, some of them carrying out the goals of other users. At this level, an agent can say "no" to another agent as long as the "no" is in order to pursue the goals specified by its own user. In achieving sub-goals, the agent acts autonomously. It autonomously selects appropriate sub-goals. When the agent carries out these sub-goals in the interest of achieving its user-specified high level goals, the user is unaware of the agent's specific activities. On this lower level, the autonomous agent is in control of its own behavior. With respect to the lower-level goals the agent pursues to support its higher level goals, the user is not in control.

The most critical challenge in the design of the agent's look and feel is to induce the user to trust the agent to such an extent that the user will comfortably give up some control. Such trust requires user confidence in the agent's competence and intentions.

Since user control is the traditional foundation of human-computer interface, it is not unreasonable that users will need to give up control gradually. With users who are novice to agent technology, the designer has the opportunity to build trust incrementally by continuing to offer some impressions of user control where appropriate. For example, in the telecommunications scenario, the agent respectfully asks its user for permission to pursue high level goals.

2.2. User Expectations v. Agent Reaction and Adaptation

An agent can learn from its environment and adapt its behavior in reaction to what it learns. Traditional software has exhibited some "learning." For example, Microsoft Word can learn that Marie Smith often types the word *Smith* after the word *Marie* and so, offers to display *Smith* whenever *Marie* is input. An autonomous intelligent agent goes much further, gathering information about its user and the other agents it collaborates with. The agent then responds by modifying its behavior in accordance to what it learns. This is beyond the range of expectations for novice users of agent technology.

The usability principle of consistently demonstrating that user expectations are being met works well with static systems, but is not practical with respect to an ever-learning adaptive agent. The challenge is to put the user at ease with at least two facts. First, the agent is aware of certain aspects of the user's behavior. For example, in the pilot, the agent is aware of the user's behavior with respect to the system and with respect to mobile phone usage. Secondly, the agent will act outside of the user's constant cognizance. Again, trust is paramount. Moffat [Moffat, 1997] defines an agent's "personality" within the context of its reactions. In this vein, the designer's task is to convey a trustworthy personality against the inevitability that the user will not control the agent's interactions with actors such as other agents or other humans. These are the interactions that the agent engages in to achieve its lower level goals.

2.3 User Commands v. Agent Proactivity and Beneficial Intent

The common paradigm for human-computer interaction is that the user issues commands and the program obeys. However, the autonomous intelligent agent can operate proactively, both within the scope of goals the user has expressed and in pursuit of goals unknown to the user which support his stipulated goals. So sometimes, without first consulting the user, the agent proactively performs actions to achieve goals that will benefit the user. The agent does this independently as the opportunity arises. It can proceed proactively both in response to new information and without new information.

A non-intelligent program is designed to perform a limited range of tasks toward very well-defined goals. So, traditionally, users approach software as having no intent. In their proactivity, agents display goal-oriented beneficial intent, but outside the paradigm of "user expresses goal, program obeys by achieving goal." Because the agent's activities are not individually user-command driven, the agent representation has to ensure the user of its benevolent intent. It is the task of the usability engineer to depict an agent that works diligently in the user's best interest. It is especially important that the user never worry about the agent's beneficial intent in selecting low level goals. A strategy to this end is to inform the user of the agent's behind-the-scene interactions. For example, in the telecommunications scenario, the agent offers the user the opportunity to access a log of its activities. Sharing this information is also key to building an impression of trustworthiness for those users who are new to agent technology.

2.4 User Privacy v. Agent Society and Personalization

The agent is aware of a broader environment than the user is. It becomes more than just a responsive tool for the user. It is social. In addition to interacting with the user, the agent communicates and collaborates with other agents behind the scene. It is paradoxical that the agent's social behavior actually helps it to become personalized to the user. The agent has

the ability to interact with the appropriate agents that give it exactly the information it needs to provide a solution that is customized to the user's unique needs. However, in doing this, the agent may have to share information about the user. For example, in the telecom scenario, the agent builds a user profile, then shares information about the user's long distance usage to negotiate the best possible price plan for the user.

The agent's social nature introduces a need to ensure the user that his privacy is respected and won't be violated. In some target areas, this is of primary importance [French 00, Hofstede 97]. Again, this means that the agent representation must instill trust. It must be believable. If the user is to delegate authority to his personal agent, the agent must engender a belief in the user that it is competently acting in the user's behalf and that the user's best interest is its primary concern. Also, to be truly personalized in its interaction with its user, the personal agent's behavior must accommodate its user's cultural and linguistic expectations.

2.5 User Culture and Language v. Project Constraints

In this pilot study, time and resource constraints ruled out the possibility of localized software versions, but the goal was to make agent benefits available across cultural and linguistic boundaries. Despite the fact that user expectations will vary with locale, this agent has to operate in several linguistic-cultural environments under one look and feel. Its dialog has to be easily translatable into a variety of languages.

At a minimum, these considerations oblige designers to avoid offending any segment of the international user group and to take every step possible to minimize localization in versions to follow the pilot. The dialog bears the burden of being ready to accommodate future interaction through natural language technologies.

3. THE PILOT

A multi-national team located in Fairfax, Virginia, The Hague and London designed the agent and built the programs whereby the personal agent interacts with the user and with other agents. Usability engineering tasks included design of the screen look & feel, agent onscreen look, agent onscreen animation, agent onscreen movement, dialog interaction, and agent sound.

The personal autonomous intelligent agent operates within a telecommunications scenario. The pilot paradigm for interaction is a spoken prompt from the agent and user response through a screen widget. The agent's spoken prompts are also represented onscreen. When the application is ported to a WAP phone, the user will interact through speech recognition.

One usability engineering goal was to demonstrate intelligent agent interaction accessible through the Web. The pilot screen design also had to facilitate migration to the tiny screen of WAP phone. Another goal was to design the look and feel of a Web-based application with one agent representation suitable across the user base's diverse cultural boundaries. Although the pilot was designed in US English, linguistic elements had to be designed to facilitate translation into the languages of all target users. Finally, the design had to introduce and acclimate users to agent technology in a way that is engaging, not threatening.

Usability engineering efforts were based on the belief that agents will radically change the way that humans interact with computing technologies [Maes 94]. This hypothesis motivated

the design of a non-traditional Web interface. The primary goal behind the usability engineering efforts was to instill user trust. Once established, this would pave the way for a simple, easy to use interface.

4. FEWER SCREEN ELEMENTS

A primary goal was a simple look and feel for the Web display screen. This goal derived from two sets of expectations. First, users who trust their personal agents will delegate tasks to them. Secondly, by delegating activity to agents, humans will have less need for onscreen elements. The goal became a screen without a "Web-look" and whose design would port easily to a WAP phone screen.

The screen was divided into two logical areas, one for the agent representation and one for the dialog display. The predominant color scheme is light blue against a white background. This color scheme is easy on the eyes. In most of the user locales, light blue instills trust. It is not considered a threatening color in any of the targeted locales.

The agent representation occupies the left third of the computer screen. The remaining right two thirds house the dialog display (Figure 1.). Here, a blue vertical rectangle with rounded top corners resembles a mobile phone. This element fades out at the bottom of the screen. It contains two areas in slightly contrasting shades of blue. In the upper area, the agent's speech is reproduced in black text. Below, a user response box houses widgets appropriate to the agent prompt, such as a text input box or radio buttons. The sizes of these two areas change to accommodate the text expansion that is inevitable with translation out of English. In a future screen version, the lower area will display a textual representation of the user's speech input. The two dialog areas will easily merge into one to display the dialog on the WAP phone's screen where they will contain only a textual representation of the spoken dialog.

Company identification appears only at the top of this phone area. There are no banners or scrolling ads. The look is extremely simple, with few details to modify in localizing the graphic approach. No essential design elements will be sacrificed when speech interaction replaces the agent representation and the widgets.

The system's rich functionality is grouped into six menu items: profile, for creating, viewing and modifying a user profile; recharge, for instructing the agent to add funds to a prepaid mobile phone account; best plan, to provide the agent details for negotiating a better mobile phone plan; account data, to view and challenge account data; agent activity, to view a log of agent activity within time periods designated by the user; and logoff. Logon precedes the human-agent experience, so does not appear on the menu.

The menu resides within the agent representation. Users navigate onscreen by clicking on the menu and through dialog with the agent. Once the user selects a menu item, the agent leads him through tasks, so there are no submenus or other navigation aids. There is no need for scroll bars because forward and backward functionality reside in the user response box and because the dialog segments were kept short to eliminate scrolling.

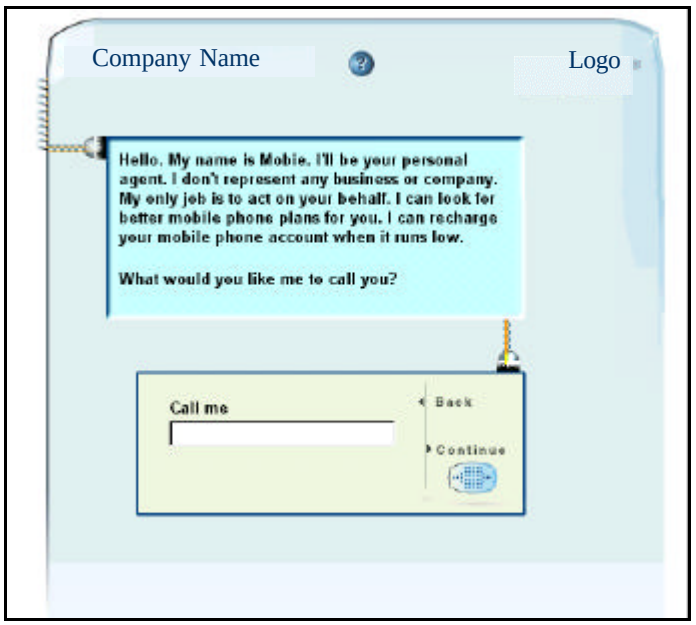

Figure 1. The pilot's dialog area houses an expandable display box for the agent's prompt and a box for the user's response.

Because semiotics varies with culture [French 00], eliminating icons reduces localization efforts. There is only one icon. It is a question mark, recognized in the target geographical areas as an icon for help. Help is always in view on the agent and on the Web screen.

5. AGENT LOOK

Personal agent technology is new to most of the pilot's users. The agent's look plays an integral role in establishing a user's comfort level with this new experience. So, the agent's look must facilitate interaction by conveying qualities such as trustworthiness, diligence, and beneficial intent.

The first decision in designing the agent was whether it should be an animal, a human, or an object. The animal option was quickly discarded because animals change significance with locale [Fernandes 95]. For example, in the US, a dog conjures images of fidelity and devotion, happy feelings. In Spain and Portugal, intended areas for the pilot, dogs are not man's best friend.

Likewise, a human appearance was not suitable because of cultural factors. It projects age and race to an audience with different opinions on aging and different expectations for racial characteristics. Body language can speak louder than words. The more human the agent representation, the higher the requirement for eyes, arms and feet. All of these are body parts that exhibit behaviors whose meaning varies and sometimes becomes taboo according to culture [Fernandes 95]. Plus, if a person looks too intelligent or powerful, the possibility of intimidating the user arises.

The remaining option was an object. At this point, design requirements conflicted with internationalization requirements. The agent's look has to build trust in the user and assure

him that the agent is constantly working hard on his behalf. While it has to appear confident, an agent can never intimidate the user. These are requirements for human characteristics. The solution was an inanimate object that exhibited human behaviors, but did not have eyeballs, hands or feet to minimize the potential for offending a segment of the international user group.

The telecommunications business scenario and the intended migration to a WAP phone provided the solution. The agent took the form of a mobile phone. The simple look of the phone serves as a *tabula rasa* on which to sketch out the required human qualities. For example, to accomplish this, the agent is almost entirely portrayed in trust-inducing shades of blue. Most of its lines are rounded to present agent technology in an engaging, non-threatening way and thus facilitate conveying beneficial intent.

The agent representation has few human characteristics, but displays human behavior. It is not necessary to give detailed human physical characteristics to an intelligent agent to convey character or to engage users [Loyall 97, Nass 94]. So, in order to minimize localization work, there is little detail to the agent's look. Its most human element is a characterization of a mobile phone screen modified to resemble sunglasses.

An inanimate object can easily house functionality such as a menu or help. Clicking on the menu contained in the agent representation is more natural than clicking on a menu housed within an animal or a human. More than half of the surface of the mobile phone is devoted to the menu. This tactic provides room for text expansion after the menu is translated. The menu is always visible to connote the agent diligently on standby to work for its user.

6. AGENT ANIMATION

Expression of emotion has been a standard approach to making an intelligent agent believable. [Bates 94, Reilly 95]. However, the international nature of the user base restricts the potential for expressing emotions. It is necessary to project enough emotion to engage the user and make the agent appear believable, but, in the interest of mitigating the potential for offending portions of the diverse user base, emotion was kept to a minimum. The agent expresses interest by changing the straight line over the sunglasses area to a curved line. There is a slight impression of happiness conveyed by the curved lines when the agent bends to listen, but it does not smile. It never looks bored, angry, surprised or confused.

Some human qualities are represented through non-human characteristics. For example, diligence is represented through lights above the sunglasses in an area analogous to a forehead. These lights flash to signal that the agent is busily working. To the same end, the phone antenna extends, signaling that the agent is actively engaged in its work.

The agent has, from the user's visual perspective, two states: open and closed (Figure 2.). The open state offers access to the menu. The user, not the agent, controls these states by clicking on a triangle on the agent. For persons novice to agent technology, control over the menu fulfills a portion of the expectation of control. This tactic thus helps users learn to gradually accept the concept of autonomous intelligent agents.

Figure 2. From the user's visual perspective, the agent has two states, open and closed.

In its open state, the agent becomes larger. In its closed state, the agent becomes smaller so that it is not obtrusive, respecting the user's privacy.

7. RANGE OF MOVEMENT

Through its movement, an agent can either engage or alienate a user. Too much movement attracts the eye and distracts the user; too little can signal a lack of diligence. Users don't have expectations for movement in inanimate objects [Reilly 95]. This gives designers leeway in defining the agent's range of movement. Resource constraints dictated a minimum amount of art work, and therefore a limited range of movement. So the agent was restricted to the left third of the screen. It never goes in front of the dialog area. It can move toward the user or away from the user.

To show interest in its response to user input, the agent turns slightly toward the dialog area of the screen (Figure 3.). The agent never turns its back on the user, neither does it face the user for long periods of time. These behaviors are offensive in some of the target locales.

When the agent observes the user's work, it takes on curved lines (Figure 3.). This softens its look and provides a more cartoonish, less intimidating appearance. A softer look when bending informs user of benevolent intent. However, when the agent stops moving, its look

Figure 3. To show that it is listening, the agent turns toward the dialog area and bends, taking on curved lines.

looses many of the cartoonish aspects. This more serious demeanor projects its advanced capabilities and speaks to portions of the user base that will not accept its serious purpose if it looks too much like a cartoon character.

8. INTERACTION THROUGH DIALOG

The paradigm adopted for user agent dialog was agent prompt and user response. Through this paradigm, the agent leads the user through the dialog. The agent always offers an informative statement or new prompt as soon as the user interacts with a widget. This fast response has the purpose of emphasizing the agent's responsiveness and thus increasing its believability [Loyall 97].

Linguistic style can be an integral conveyor of an agent's character [Walker 97]. Although written in American English, the pilot dialog will serve as the model for future localized versions. While there is a large school of thought that an agent should project personality [Bates 94, Reilly 95, Walker 97], in this study, great care was taken that the dialog not project any personality characteristics that would be offensive to the target audiences. The agent has to induce trust and appear competent. The strategy is polite dialog that asks permission, but does not grovel. For example, the agent asks, "Would you like me to automatically recharge your prepaid mobile phone account for you?"

Speaking in the first person can impart needed personality to an agent [Walker 97]. However, this agent needs to function in an international workspace. Some of the cultures to be addressed are individualistic societies where using "I" is indicated. Others are collectivist societies where the agent needs to demonstrate connectivity to the user [French 00, Hofstede 97]. The need to project personality prevailed over the need to establish connectivity and the agent's prompts use the word "I," but, wherever possible, the agent also refers to the user

within the sentence. For example, the agent makes statements such as "**I**'ll be **your** personal agent" and "**I** can look for better mobile phone plans for **you**." While this tactic does not acknowledge a wide community, it at least emphasizes the relationship between agent and user.

The agent's dialog bears the burden of introducing new technology in an engaging, non-threatening way. It also has to build user trust by conveying the agent's competence and diligence. Therefore, the agent often says "I **can**" and "I **will**." The agent explains its capabilities in the "I can" statements. The dialog also has to build user trust. Therefore, the agent makes statements such as "I don't represent any business or company." It displays its benevolent intent by adding "My only job is to act on your behalf."

Although the agent has one look, in its dialog, it needs to prepare to become multi-lingual. Its dialog has to be easily translatable, preferably with much of the work done through machine translation (MT) with a minimum of post-editing. At a minimum, for the purposes of the pilot, dialog has to make sense when run through one of the MT programs available on the Web. To the greatest extent possible, the agent has to speak in short declarative sentences. Its questions have to be unambiguous. Compound sentences sometimes became necessary. In these cases, syntactic clues and connecting words clarify relationships among elements of the sentences. Verb forms are usually simple. To facilitate MT, the dialog avoids jargon. [O'Connell 00]

Tactics to facilitate machine translation also prepare the dialog for speech recognition (SR). SR gives the agent the burden of using a limited domain vocabulary and of teaching this vocabulary to the user through its prompts. The paradigm of the agent speaking first facilitates this task.

Conciseness played a major role in modeling the content of the dialog. In turn, keeping dialog to a minimum serves the goal of the agent presenting a neutral personality.

9. SOUND OF THE AGENT

Resource constraints and the high volume of storage required for speech recognition made it necessary to use a recording rather than SR for the pilot study. This provided flexibility in defining the characteristics of the agent's speech.

Since the recording was done in the US, the agent has the voice of a native speaker of American English. The speaker has a neutral accent and a voice that records well. Since the synthesis product to be used in a future version supplies only a female voice, a female speaker was chosen. Reviewing the recording identified sentences that had communicated well when rehearsed aloud, but did not communicate well as recorded speech. In these cases, the dialog was modified to improve communication.

To facilitate localization, each dialog segment was recorded as a separate file. Sometimes locale-specific differences within the same language require that only a portion of the dialog be localized. For example, the US dialog uses the term "recharge your account" while in other English-speaking countries, the expectation is to hear "top up your account." In such cases, only those segments containing such phrases will be re-recorded. Although this tactic does not address local accents, it does accommodate project resource constraints.

Expression of emotion has been a standard approach to making the representation of an intelligent agent believable [Bates 94, Reilly 95]. Expression of emotion in dialog is sometimes considered more important than conveying intelligence or competence [Loyall 97]. However, the international nature of the user base restricted the potential for expressing emotions. In the interest of mitigating the potential for offending a portion of the diverse user base, the speaker repressed emotion, speaking in an even tone. Nass and Lee [Nass 00] have demonstrated that any speech, even synthesized speech, will convey personality. Therefore this lack of emotion is not seen as inhibiting the user's perception of the agent's human characteristics as conveyed in its original representation.

To accommodate the international user group, the agent makes no sounds other than its speech. For example, even though the scenario is telecommunications, the mobile phone does not ring because rings sound different in different locales. The agent does not make any non-communicative sounds such as clearing its throat or humming, against the possibility that a supposedly abstract sound have an inappropriate or offensive meaning in any of the target locales.

10. CONCLUSIONS

Although this paper describes bringing design of an intelligent agent to life in an international arena, it is also about the novice user's experience in interacting with the agent. The goal of good agent design is to ensure a satisfactory and successful user experience. Lieberman [Lieberman 97] predicted that human-computer interfaces will grow in complexity to the point where they will surpass human ability to use them. He posed agents as the solution to the problem. This study has illustrated that agents present the potential for minimizing the amount of complexity a user has to encounter in an interface. It has illustrated that it is possible to deliver this technology to an international user base through design that focuses on simplicity.

The pilot will offer access to agent technology to a broad international audience. Users from a variety of cultural backgrounds will interact with the agent representation. Each cultural group will bring its own set of expectations for trustworthiness. The principal challenge of this study was to build confidence in the agent's trustworthiness by portraying it in a way that accommodates these expectations. At the same time, design had to prevent offending the users by betraying their cultural expectations. Traditional strategies such as using blue to instill trust are possible within this paradigm of simplicity. The approach was to simplify design to mitigate the potential of offending portions of the international user set. This turned out to be a mechanism to simplify both the look of a Web screen and an onscreen representation of an agent.

The principal finding of the study is that while internationalization restricts options, it does not have to impede design of successful and satisfactory human-agent interaction. Design of the agent representation and its Web environment follows generally accepted usability engineering principles that have been demonstrated to produce a successful and satisfactory user experience [Helander 97, Nielsen 99, Shneiderman 97]. A future research project will be usability evaluation of these kinds of intelligent agents. Within the context of the current study, it is possible to simplify the look of a Web site by delegating functionality to an intelligent agent. It is possible to convey human qualities in an agent representation in a way that minimizes the potential for offending segments of an international audience. It is possible

for an agent to address a human in language written to undergo machine translation. An intelligent agent can lead users unobtrusively through this dialog.

The agent representation projects personality and interacts in a simple environment through its look, its movements, its sound and its dialog. A bonus in the simplified approach was that the lack of user expectations for an animated mobile phone and the simplicity of the agent's look paid off in meeting resource constraints. The expectation is that this approach will also pay off in future localization savings.

The simplified approach does not constrain designers' ability to introduce a new technology to a broad international user base. Rather, there are opportunities and possibilities in simplicity.

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