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ABSTRACT

This research presents a preliminary investigation of the self-serving biases of interface agent users. For that, an experiment of current and potential users of Microsoft interface agents was conducted. The analysis demonstrates that interface agent users do not always attribute the successful outcomes of human-agent interaction to themselves and negative results to interface agents. In fact, people's attributions of credits and responsibilities depend on the category of support provided by an agent. This finding contradicts attribution theory. In addition, the study discovers the positive relationship between the degree of an agent's autonomy and the presence of self-serving biases. Overall, the research attempts to outline the factors that lead to the self-serving biases of interface agent users and suggests several theoretical and practical contributions for agent designers.

Keywords

Interface agents, attribution theory, self-serving bias, human-agent interaction.

INTRODUCTION

Psychology researchers argue that it is natural for people to refer to their personal factors if they succeed at doing something and to blame on other individuals or external circumstances if they fail to achieve their goals. For example, when students successfully pass a test, they often mention their personal abilities and good knowledge of the material. However, when students fail, they tend to attribute this outcome to an unfair test or to an inadequate level of instruction. People also transfer their attribution behavior to different modern technologies: they assign more responsibility to negative effects of the use of machines (Postman, 1992). Currently, due to the rapid proliferation of various software applications, people have developed a tendency to blame computers for their own mistakes and to hold computers morally responsible for errors (Friedman, 1997, Moon and Nass, 1998).

As of today, computers are not only powerful assistants but also decision influencers and even decision-makers. For example, automated pilots, expert systems, and decision support applications have the potential to provide a user with the best available solution. At the same time, as computers become more autonomous (or independent), people tend increasingly to attribute negative outcomes to machines and credit themselves with successful results (Kling, 1996).

Interface agents are an emerging technology that emphasizes the autonomy of software entities. Indeed, the goal of the incorporation of interface agents in end-user computer applications is to implement the indirect management approach instead of the less efficient direct manipulation method. The direct manipulation approach, introduced by Schneiderman (1983), requires that users explicitly indicate all tasks the system should perform. This method assumes that data, information resources, and communications flows are static, relatively small and well-structured. Although this approach ultimately fulfilled the needs of software users in the past, it becomes inefficient in the present dynamic environment because people cannot explicitly indicate all tasks the system should perform, manually process the constantly increasing volume of electronic correspondence, or spend sufficient time to learn newer features of updated versions of complex systems in order to operate an application effectively.

Interface agents allow people to utilize a more efficient indirect management method. It is for this reason they have become increasingly popular for the past several years. Interface agents observe user actions taken in the direct manipulation interface, understand their needs, learn their behavior, create users profiles, give advice to users, and receive feedback on their actions (Lieberman, 2001). In contrast to reactive and predictable conventional direct manipulation interfaces, proactive interface agents work continuously and autonomously in the background by monitoring the external environment and by

observing use actions. They act on users' behalf by automatically invoking commands provided by software applications, by cooperating with other agents that constitute agent architecture, and by interacting with software processes. Interface agents initiate communication with users when they consider it necessary and appropriate.

Despite these potential advantages of the indirect management approach over the direct manipulation method, literature provides controversial evidence on the superiority of either principle (Shneiderman, 1997). One of the reasons for this disparity of opinions may be the fact that interface agents are mostly associated with negative consequences of application usage, whereas people get the credit for successful work. Indeed, since interface agents are autonomous, users may tend to over-attribute negative outcomes of computer usage to agents. However, contemporary research offers no evidence to support this claim, and any documentation on studies of attributions of responsibility in human-agent interaction is lacking.

In order to bridge that void, this paper presents an empirical investigation of the self-serving biases of interface agent users to answer the following research question:

> Do interface agent users attribute positive outcomes to their personal factors and negative outcomes to interface agents in human-agent interaction?

ATTRIBUTION THEORY

The substantial body of prior research demonstrates that people tend to respond to computer technologies socially (Reeves and Nass, 1996). As such, the area of social psychology offers a strong theoretical framework that may be successfully utilized to study human-computer interaction. Particularly, attribution theory in social psychology can be applied to investigate computer user behavior (Moon and Nass, 1998).

Since interface agents interact with users directly and serve as their helpers, advisors, and assistants, it is assumed that individuals apply social rules, behaviors, and expectations to interface agents to at least the same extent as they relate similar social principles to computers in general. Thus, attribution theory can be utilized to study the behavior of interface agent users.

Attribution theory was developed over time from several key works of Fritz Heider, Edward Jones, Keith Davis, and Harold Kelly. It explains how people make causal explanations about events and describes the processes of explaining situations and the behavioral outcomes of those explanations.

The widespread practical application of attribution theory has resulted in the emergence of several different versions of this theory (Peterson et al., 2002). As of today, there is no uniform or widely accepted attribution theory; there are several different attributional perspectives. The premise of the motivational model of attribution theory is to identify and classify causes of outcomes of important events. Based on this perspective, the self-serving hypothesis in attribution theory was developed. It states that individuals tend to assign differently the causes of their successes and failures in various situations: they engage in self-enhancing attributions under conditions of success and, on the contrary, in self-protective attributions under conditions of failure (Miller and Ross, 1975). As such, causal attribution can be internal, associated with positive events ('I am responsible…') and external, associated with negative incidents ('Other people or situational factors are responsible…') (Blackwood et al., 2003).

There are both benefits and costs of self-serving biases. On the one hand, self-serving behavior offers various advantages to attributors (Lee and Tiedens, 2001). First, individuals feel good about themselves by taking personal credits for successes and protect their ego and self-esteem by disclaiming responsibilities for failures. Secondly, self-serving attributions may also serve public impressions.

On the other hand, there is evidence to suggest that people's engagement in self-serving behaviors is not always beneficial. For instance, victimization studies argue that victims of tragedies making external attributions for negative results take longer to recover (Tennen and Affleck, 1990). More importantly, self-serving biases for undesirable outcomes may have negative public impressions, especially when someone has high power and control over processes and results.

THE SELF-SERVING BIASES OF INTERFACE AGENT USERS

According to the American Heritage Dictionary (1992, p. 33), an agent is one that acts or has power or authority to act for or represent another. Recall an interface agent is a software entity that often acts on users' behalf. Currently, interface agents are employed in the form of personal application assistants, secretaries, butlers (Maes, 1994), Web guides (Keeble and Macredie, 2000), shopping companions (McBreen and Jack, 2001), virtual tutors in interactive learning environments (Johnson et al., 2000), and entertainers. The ultimate goal of agents is to add value and to enhance existing computer systems rather than

replace them. Interface agents perform complex and repetitive tasks in the background, make decisions, and act on behalf of computer users.

At the same time, as interface agents become more autonomous, they possess more power and control over the outcomes of human-computer interaction processes. When individuals delegate important tasks to interface agents, they expect agents to do tasks on their behalf and to provide users with final, and, hopefully, satisfactory results. By following the line of reasoning offered by attribution theory scholars, it can be assumed that users of interface agents act in a self-serving manner. They attribute every success in human-agent interaction to themselves, for example, to their computer skills, agent manipulation and personalization abilities or field expertise, and blame an agent for every failure in achieving their goals.

However, as of today, neither academia nor practice presents arguments to support or refute the application of self-serving biases to interface agent users. Among several reasons for this gap in the literature, perhaps the most salient is that, despite the extensive work underway in the incorporation of interface agents in real-life applications, most previous studies have focused on conceptual discussions, preliminary empirical investigations, or pilot systems rather than on end-user products. Among the few interface agent systems that have been delivered to the customer, Microsoft Agent is the most widely known application. Currently, Office Assistants have been incorporated in all MS Office applications.

Despite a wide usage of MS Animated Agents, both periodicals and the Internet offer anecdotal examples of the usefulness and appropriateness of this technology as a means of user assistance in MS Office (CNET, 2003, BBC, 2000). Some people reject this technology whereas others enjoy it. The underlying reason for this disparity is unclear. One of the possible explanations is that people tend to blame on an animated agent when they fail to complete a task the way they expected and credit themselves with positive outcomes.

As such, in order to explore user perceptions of interface agents and to answer the research question outlined in the first section of the paper, this study concentrates on the use of MS interface agents. Based on the discussion above, the following hypotheses are suggested:

H1: Microsoft Agent users attribute positive outcomes to their personal factors in human-agent interaction.

H2: Microsoft Agent users attribute negative outcomes to interface agents in human-agent interaction.

Prior experience has been found an important determinant of behavior in various situations (Ajzen and Fishbein, 1980, Fishbein and Ajzen, 1975). There are significant differences in the perception of a computer system between experienced and inexperienced users (Taylor and Todd, 1995). Human-computer interaction research demonstrates that people identify effective patterns of interacting with software applications, remember them, and apply those patterns across a variety of situations (Dix et al., 1989). Thus, individuals, who have experienced a particular positive or negative outcome from interface agent usage, may perceive agents to be more or less responsible, depending on individuals' previous familiarity with such results:

H3: The self-serving bias of Microsoft Agent users towards particular positive and negative situations tends to change based on their prior experiences with similar incidents.

Currently, the actions and types of assistance provided by MS Agent technology for Office applications are relatively limited. In general, two categories of assistance are offered: 1) help menu support; and, 2) the presentation of tips and real-time advice. These kinds of assistance differ in their nature and in the way interface agents interact with users. In the former case, people initiate all actions by calling agents in a help menu. In the latter situation, agents pop up when the system believes it is necessary to offer user support. It is hypothesized that individuals will give credit or assign responsibility differently in either case:

H4: The self-serving bias of Microsoft Agent users differs depending on two categories of user assistance: 1) help menu support; and, 2) the presentation of tips and real-time advice.

In addition to previous experience with this technology, individuals perceive each positive or negative situation to be more or less important. For example, some users may consider the fact that an interface agent has just presented a tip extremely important whereas others may be more tolerant to this event. Therefore, their self-serving biases are expected to differ to some extent:

H5: The self-serving bias of Microsoft Agent users differs, depending on the perception of the importance of a situation.

METHODOLOGY

In order to answer the study's research question and hypotheses, an experiment with current and potential users of MS interface agents was conducted.

In order to understand and to measure the self-serving biases of the subjects, individuals were asked to read four brief vignettes on the usage of interface agents in MS Office. The use of vignettes in attribution theory experiments has a long-standing tradition in psychology research (Weiner, 1980).

Recall MS interface agents offer two distinct categories of user assistance: support with a help menu, and the presentation of tips and real-time advice. Therefore, two vignettes corresponding to each type of assistance were created. For each kind of assistance, one positive and one negative situation were presented. As such, subjects were presented with four vignettes.

The initial versions of vignettes were written by the authors. Several people reviewed and commented on these vignettes in order to assess their face validity. Based on this feedback, text of the vignettes was modified.

In order to create a research instrument accompanying these vignettes, the Attributional Style Questionnaire (ASQ) was adapted (Peterson et al., 1982). The use of this instrument yields scores for individual differences in the tendencies to attribute the causes of bad and good events to internal (person-specific) or external (other people or circumstances) factors. The ASQ consists of instructions, eighteen brief statements, and a measurement scale. Since the present investigation utilizes vignettes, only instructions given to respondents and measurement scales were adapted. In the result, the research instrument employed in this study included four vignettes, each of which was accompanied by five questions measuring the attributional differences of a person regarding a particular situation. Appendix I presents this instrument. The order of positive and negative situations was randomized among the subjects to avoid confounding of results.

The instrument was administered to a group of 30 individuals who comprised students of a North American university. A semi-structured instrument administration method was selected; when respondents had questions, the researchers verbally provided all necessary clarifications.

RESULTS

Respondents to the survey were male (68%) and female (32%) at the average age of 33 years. At the first stage of data analysis, the internal consistency of the scale measuring the attribution style of a person (questions 2 and 3) for each situation was calculated. The Cronbach's Alpha exceeded 0.8 for each situation. As such, the attributional score for each situation was determined by the calculation of the average of questions 2 and 3.

In order to test H1 and H2, scores on positive and negative situations were compared by using the paired two-sample for means method. The following differences in the attributional scores were obtained:

$$\text{Situation 1} - \text{Situation 3} = -0.40 \ (t = 1.104)$$

$$\text{Situation 2} - \text{Situation 4} = 0.27 \ (t = 0.723),$$

where –0.40 and 0.27 are the average differences in means. Thus, H1 and H2 were rejected. Differences in signs reveal that people's attributions of credits and responsibilities depend on the category of assistance that supports H4. When individuals fail to locate information in a MS help menu by using agents, they blame on themselves, whereas when agents initiate interactions but fail to deliver what was expected, computer users blame on agents.

With respect to H3, the attribution and situation importance scores of the respondents who experienced and those who did not experience situations similar to the ones presented in the vignettes were calculated. Three findings deserve attention. First, 50% of respondents reported they have experienced those situations while interacting with MS interface agents. Second, the average difference in the attribution styles of those two groups of respondents was –0.5. This implies that people who have already experienced a similar situation tend to give a credit to interface agents in case of a positive outcome and to blame on interface agents in case of a negative outcome. Third, the experienced users indicated that situation 4 (when an interface agent presented a wrong, unsuitable tip) was most important to them. This finding partially supports the claims of the contemporary media on the inappropriateness of suggestions often presented by agents in MS Office applications.

In order to test H5, four Partial Least Squares models were constructed. Figure 1 presents the model.

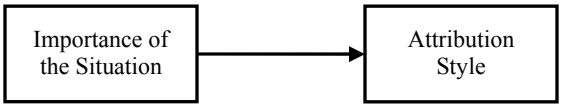

Figure 1: Association between the Situation Importance and an Attribution Style

The beta coefficients for situations 1 and 2 were strong ($\beta 1 = -0.333$, $\beta 2 = -0.324$) and those for situations 3 and 4 weak. The loadings of the corresponding items on a construct exceeded the required threshold of 0.7. The negative sign of the relationship implies that when people consider a task more important, they tend to give credit to an interface agent to a greater extent. As such, H5 was supported with respect to positive outcomes of human-agent interaction.

Recall question 1 of the questionnaire asked respondents to provide a cause of the situation. All answers were analyzed and coded by two independent coders. The reported agreement coefficient was 0.72 that falls into an acceptable range (Krippendorff, 1980). All discrepancies were discussed by the coders until a mutual agreement was reached. Figures 2, 3, 4, and 5 present causes why respondents believe they achieved or failed to achieve their goals while interacting with interface agents.

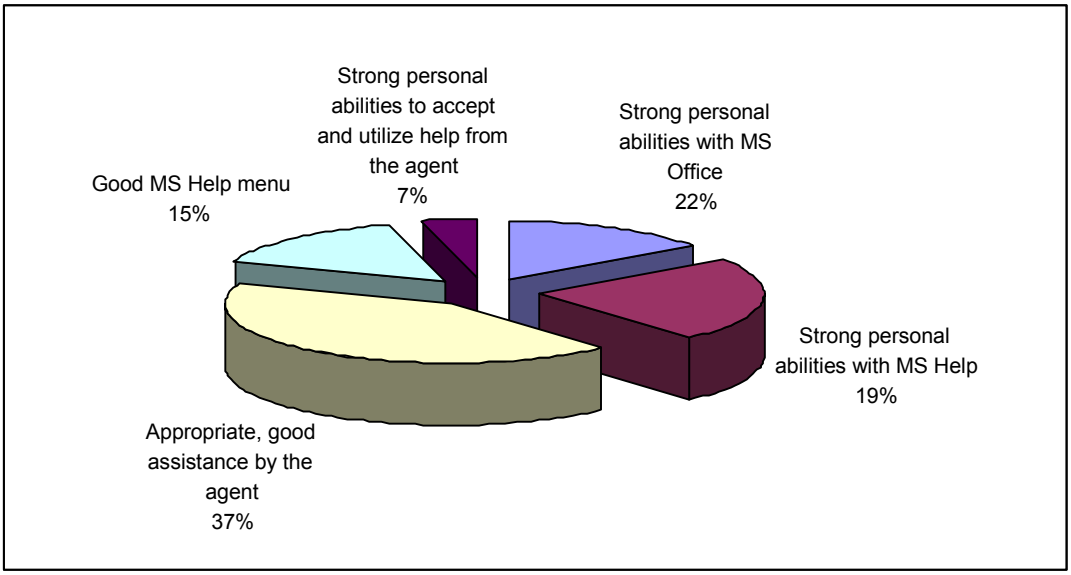

Figure 2: Cause of Situation 1 (Positive outcome)

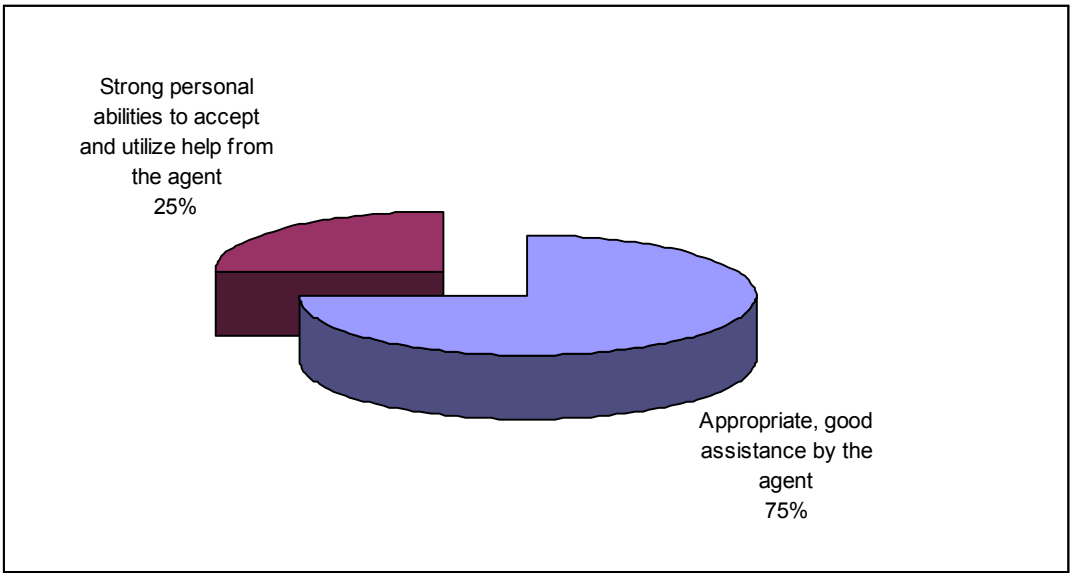

Figure 3: Cause of Situation 2 (Positive outcome)

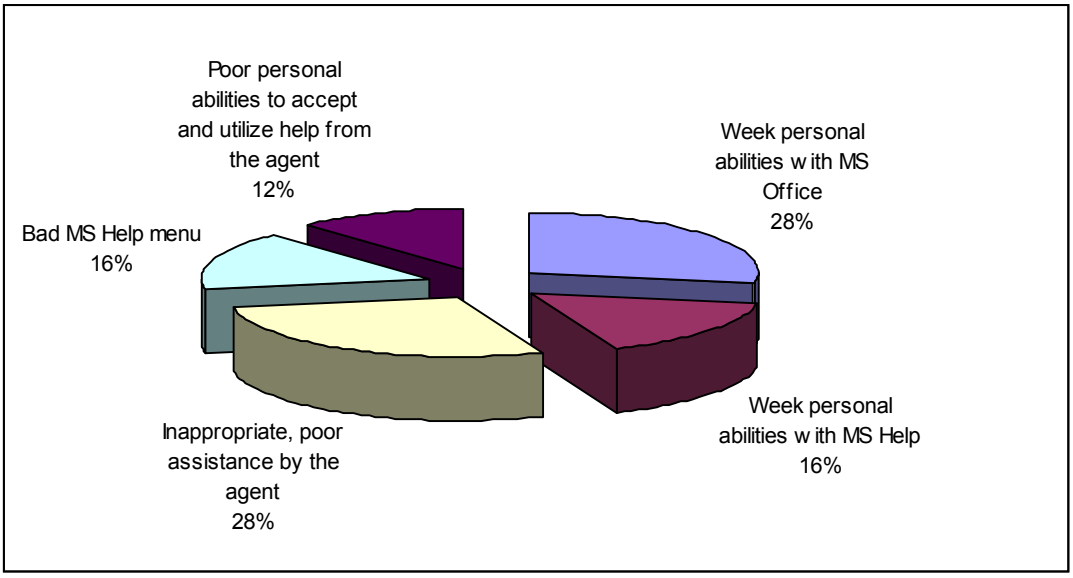

Figure 4: Cause of Situation 3 (Negative outcome)

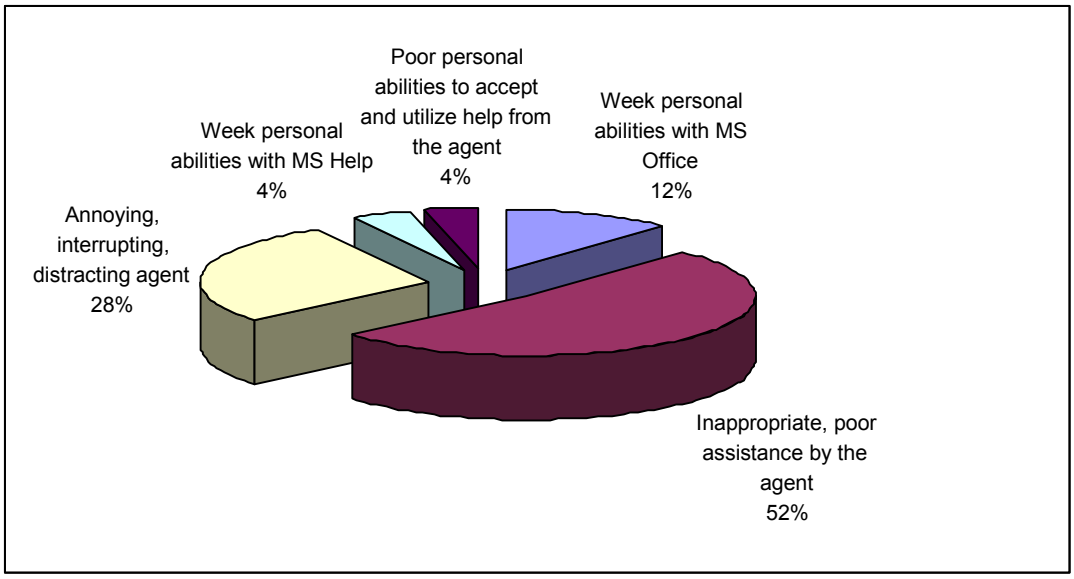

Figure 5: Cause of Situation 4 (Negative outcome)

DISCUSSION AND CONCLUSIONS

The purpose of the study is to investigate the self-serving biases of interface agent users. The research question asked whether individuals attribute positive outcomes to their personal factors and negative outcomes to interface agents in human agent interaction. Several key findings were discovered.

First, a general self-serving bias as discussed in attribution theory was not observed. Instead, it was discovered that the self-serving biases of interface agent users are situation-specific. The analysis of the qualitative data (Figures 2, 3, 4, and 5) reveals an interesting pattern. When an interface agent was utilized as an intermediary between a person and a help menu, around 40% of respondents attributed their success or failure to their personal abilities with MS Office applications or MS help system and approximately 30% respondents to the interface agent. This implies that the self-serving bias does not exist if an agent is not given a high degree of autonomy. At the same time, when the agent initiated communication with a user by offering tips, over 50% of respondents attributed the outcome to the agent's assistance (appropriate, good assistance provided by the agent – 75%; and, inappropriate, poor assistance provided by the agent – 52%).

Second, in case of a negative outcome, almost one-third of respondents mention 'the annoying, distracting agent.' This finding is consistent with anecdotal evidence frequently provided by periodicals and the Internet on the 'constantly annoying paper clip in MS Office.' Indeed, many MS Office users find popping up agents irritating, especially, when they add little value for the current computer tasks.

Third, since 50% of all respondents have experienced the situations presented in the study's vignettes, it is concluded that interface agents are frequently utilized in MS Office and that people have come across both positive and negative incidents of agent usage. More experienced users tend to give credit to agents for positive outcomes and attribute more responsibility for negative results.

Last, as the importance of tasks increases, computer users give more credit for successful results to interface agents.

In addition to contributions into theory, several practical contributions are suggested. Agent designers should be aware that the more autonomous interface agents become, the more responsible people will hold agent if they fail to deliver what was expected. Any dissatisfaction that results form customer disappointment will lead to negative words of mouth and bad publicity of this technology. As such, before increasing the degree of an agent's autonomy, manufacturers need to assure the quality of the agent's performance.

Although this study has yielded some interesting results, the small sample of respondents is the key limitation of the project. The authors suggest that future researchers do a large-scale confirmatory study which will include at least 100 subjects.

The field of agent-based computing is in the early stage of development. MS Agent is one of the first technologies realized in the form of an end-user commercial product. It is suggested that developers should emphasize the creation of really useful interface agents embedded in software applications. The authors caution that the commercialization of interface agent technologies that add little value may result in total customer rejection of the product.

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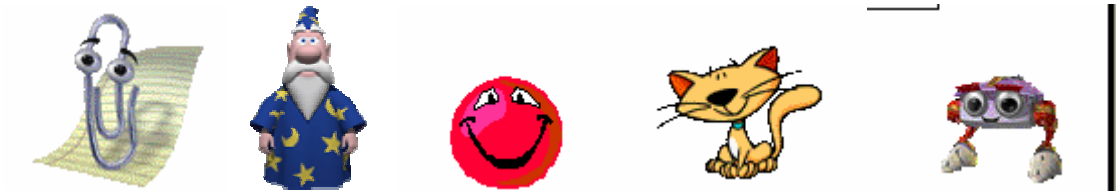
APPENDIX I

Instructions

Definition: An MS Animated Agent is an interactive character that pops up when you use a help menu in a Microsoft application such as Word, Excel, PowerPoint, or Outlook. Sometimes, the agent pops up to present messages and tips intended for more efficient usage of these applications. Below are examples of MS Animated Agents:



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Instructions: Please try to vividly imagine yourself in the situations that follow. If such a situation happened to you, what would you feel would have caused it? While events may have many causes, we want you to pick only one – the *major* cause (i.e., reason) if this event happened to *you*. Please write the cause in the blank provided after each event. Next, you are asked to answer three questions about the *cause* and two questions about the *situation*.

General story: You are an employee of a large company. Your work includes the preparation of reports of the department. You spend most of your time working with MS Office applications.

Positive situations:

Situation 1. Once you wanted to find out how to prevent a table from breaking across pages in MS Word. You selected 'Help' on the menu, and an animated agent popped up. You typed a few keywords, and the agent provided the exact information you looked for. This helped you place the tables the way you wanted to. Your managers praised you for a nicely looking report.

Situation 2. When you were concentrating on a difficult task with MS Excel, an animated agent popped up. It presented a tip on a more efficient use of keyboard shortcuts. You followed the tip and completed the task more efficiently than before.

Questions: (asked for each situation individually)

1. Write down the *one* major cause _____

2. Is the cause of your successful task completion due to something about you or to something about the animated agent? (circle one number)

totally due to the agent totally due to me

1 2 3 4 5 6 7

3. Who is credited for the successful task completion? (circle one number)

totally the agent totally me

1 2 3 4 5 6 7

4. How important would this situation be if it happened to you? (circle one number)

not at all important extremely important

1 2 3 4 5 6 7

5. Have you ever experienced a similar situation? Yes No

Negative situations:

Situation 3. Once you wanted to find out how to prevent a table from breaking across pages in MS Word. You selected 'Help' on the menu and an animated agent popped up. You tried to type different keywords, but the agent did not offer any useful information. You spent ten minutes trying different keywords, but did not find what you looked for. You clicked 'Hide', and the agent disappeared. You finished the document with tables spanning across multiple pages. Your manager was disappointed by the look of the report.

Situation 4. When you were concentrating on a difficult task with MS Excel, an animated agent popped up. It presented a tip on a more efficient use of keyboard shortcuts. You read the tip, but found it complicated and declined it. After that, you realized you lost track of your previous activity and you had to go back to re-do some work.

Questions: (asked for each situation individually)

1. Write down the *one* major cause _____

2. Is the cause of your unsuccessful task completion due to something about you or to something about the animated agent? (circle one number)

totally due to the agent						totally due to me
1	2	3	4	5	6	7

3. Who is responsible for the unsuccessful task completion? (circle one number)

totally the agent						totally me
1	2	3	4	5	6	7

4. How important would this situation be if it happened to you? (circle one number)

not at all important						extremely important
1	2	3	4	5	6	7

5. Have you ever experienced a similar situation? Yes No