USER ADOPTION OF INTERFACE AGENTS FOR EMAIL

USER ADOPTION OF INTERFACE AGENTS FOR ELECTRONIC MAIL

By

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ABSTRACT

This dissertation addresses the issue of user adoption of interface agents for electronic mail (email). Interface agents are reactive, continuous, collaborative, and autonomous software entities that act on a user's behalf by communicating directly with a person offering assistance and advice in performing computer-related activities. The study presents and empirically validates a model that describes user adoption behavior, offers insights on important features of this technology from the end-user perspective, reports on critical incidents of agent usage, and offers recommendations for developers and marketers.

As means of investigating this phenomenon, a survey of actual users of an interface agent-based email system was conducted. Emphasis was placed on identifying user needs and key factors that influence their adoption decisions. Data analysis involved quantitative and qualitative techniques (Partial Least Squares, descriptive statistics, classical content analysis). An extended version of the Technology Acceptance Model was introduced and tested, and the user context surrounding email agent adoption was explored. Survey findings suggest that existing management information systems and social sciences theories, models, and methodologies may be fruitfully applied to investigate user adoption of novel interface agent technologies.

By combining and synthesizing results of a deductive and inductive analysis of the survey data, a new, grand model of interface agents adoption and use is suggested that is the central contribution of this research. According to this model, in voluntarily usage conditions, two general types of factors influence user adoption behavior – user perceptions and agent operability. User perceptions are either positive or negative mental reflections of several properties of an agent, such as perceived enjoyment, usefulness, ease of use, intrusiveness, and attractiveness. Agent operability embraces factors pertaining to operational characteristics of an agent, such as compatibility, system interference, reliability, and personalization.

Findings also suggest that to foster the diffusion of highly useful agent systems, developers and marketers need to become aware of the importance of individual user characteristics, enhance their understanding of factors influencing people's adoption decisions, and demonstrate the functionality of interface agents through non-agent technologies.

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Chapter 1: Introduction

1.1 Problem Statement

This dissertation addresses the issue of user adoption of interface agents for electronic mail (email). Contemporary email applications have certain inherent drawbacks in the way people interact with them. Today's email systems provide inadequate support for constantly changing user needs, fail to convey ambiguous content and human emotions, overload people with growing flows of unstructured information, and present inefficiencies in interface designs that adopt a direct manipulation approach. As a result, many individuals feel frustrated utilizing email. They miss important messages, fail to understand new features of their email systems, and cannot clearly express or understand equivocal information.

The use of interface agents is a potential solution to these shortcomings. However, despite the promising benefits of incorporating interface agents in electronic mail systems, prior research has not addressed the issue of user acceptance of interface agents in such environments. The topic of user adoption has been traditionally considered a central issue in MIS (Management Information Systems) research because each innovation should be accepted by end users that provides an unarguable justification for the investment of time, efforts, and funds.

The past three decades have witnessed the emergence, expansion and world-wide adoption of email (Ducheneaut and Bellotti 2001; Goodwin 1993; Kraut et al., 1999; Sproull and Kiesler 1991). In fact, email is a very heavily used computer-mediated telecommunications media today. The development of new email technologies, communications models, and end-user applications has made electronic mail attractive to millions of people around the globe.

At the same time, the agent research community has devoted substantial efforts in creating interface agents that assist computer users in performing complex or repetitive tasks. Although fully agent-supported interactive applications do not yet exist, recent studies present a variety of hypothetical models, working prototypes, and pilot versions of such systems. In these agent-based environments, an interface agent plays the role of a virtual assistant offering real-time service and advice to users. Some users exhibit the willingness to accept interface agents more than others. The underlying reason for this disparity is unclear. For example, it is unknown why some Microsoft Word application users enjoy obtaining help from an animated paper clip whereas others are inclined to use conventional textual help menus.

Having the available agent technology is insufficient; it should also be accepted and utilized appropriately by its target users. The significant literature base in human-computer interaction and information systems research suggests that users' perceptions of an information system as well as people's individual cognitive differences significantly influence a person's decision whether to utilize a particular software technology (Agarwal

and Prasad 1997; Agarwal and Prasad 1999; Davis 1989; Mason and Mitroff 1973; Taylor and Todd 1995b; Venkatesh and Davis 2000). The research presented in this dissertation intends to serve as a theoretical model for measuring and predicting users' adoption of interface agents in electronic mail environments. This model views an individual as a unit of adoption and explains his or her personal adoption decisions. It is hoped by analyzing user behavior via quantitative and qualitative analysis that recommendations can be made on how to address users' individual characteristics with respect to adoption decisions and how to do design really useful interface agents for email accepted by end-users.

1.1.1 What is Electronic Mail (Email)?

"When it comes to email, it is better to send than to receive."

(Reisman 1995, p. 111)

Electronic mail is a system that "uses computer text-processing and communication tools to provide a high speed information exchange service" (Sproull and Kiesler 1986, p. 1493). Email is an asynchronous, fast, and text-based medium which helps people overcome temporal and geographical barriers to exchange information in a convenient manner. Email is both a **point-to-point** and **broadcast** medium. As a point-to-point medium, it enables the sender to send individual messages to known recipients. As a broadcast medium, email allows the sender to mail the same message to several recipients at once which facilitates quick and inexpensive spreading of information among members of an organization or social group. For example, the 'To', 'CC', and 'BCC' fields of most email clients permit a user to enter large numbers of recipient addresses. Popular mailing list servers, such as LISTSERV[1] and Majordomo[2] automatically broadcast messages received from each person to all email users who have registered for the service. In addition, email is credited with being a **free** communication system. Indeed, most companies, organizations, and educational institutions offer free email service. There are many free email access providers. In 2003, Yahoo! Directory[3] presented a list of 144 such companies. As reflected by the extensive collection of books, articles, and research papers on the subject, electronic mail has been intensively studied for the past twenty years.

Electronic mail has turned into one of the most successful computer applications ever designed. Email has been ranked an important technological invention since it offers efficiency gains over previous communication processes and alters social communication rules (Lucas 1998; Sproull and Kiesler 1986). It is often described as a **killer** and even a **serial-killer** application of both existing software telecommunications systems and the

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[1] LISTSERV is a commercial automatic mailing list server created by Eric Thomas for BITNET in 1986 and currently operated by L-Soft International, Inc. LISTSERV is a distinct product which is often mistakenly referred to any list server. It is available at http://www.lsoft.com.

[2] Majordomo is the freeware Internet mailing list management program developed by Great Circle Associates, Inc. It is available at http://www.greatcircle.com/majordomo.

[3] The Yahoo! Directory is available at http://www.yahoo.com.

Internet (Ducheneaut and Bellotti 2001; Khare 1998). Email was originally developed as a simple communication application. Now it is used for additional functions. For example, email assists users in information management, task coordination, document archiving, and collaboration with other people. Some email applications serve as personal information management tools by providing an integrated solution for managing digital communication and organizing day-to-day activities. For instance, Microsoft Outlook not only provides email and instant messaging environments, but also offers various information, time and task management facilities.[4] Such contemporary applications are faster, more reliable, and easier to learn. They also incorporate new features and employ graphical user interfaces, pull-down menus, filters, and rich-text display (Rohall and Gruen 2002). However, as the volume of communication and the variety of tasks grow, today's email systems fail to provide an adequate level of user support because individuals still interact with their email clients by means of a direct-manipulation approach.

The direct manipulation approach, first described 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. The system interface design is relatively simple. First, the interface emphasizes the visualization of objects. Second, actions on interface objects correspond to actions on real objects. Third, a user controls all actions and the application may not initiate a task on its own – the user must invoke each task explicitly. Although this approach ultimately fulfilled the needs of email users in the past, it becomes inefficient in the present dynamic telecommunications environment because people cannot manually process the constantly increasing volume of electronic correspondence, and they cannot spend sufficient time to learn newer features of updated versions of email systems in order to operate an email application effectively.

As a result, users argue that email is dramatically overloaded and provides inadequate support for many routine tasks, especially for message searching and filing (Ireland 1997; Sherwood 2002; Whittaker and Sidner 1997). People feel overwhelmed with the volume of textual information received. Currently, both information saturation and information pollution represent a major challenge for users of most information systems (Cai and Zhang 1996; Johnson and Dunlop 1998; Krupa 2001). *Information saturation* refers to the abundance of content growing so fast that people cannot adequately compare the value of available information sources on a particular subject or topic. Information saturation leads to competition among various information sources for user attention. With respect to email, information saturation happens when individuals receive so many messages that they cannot possibly read and comprehend them. Currently, the challenge of human-computer interaction research is to use advances in technology to preserve user attention and to avoid information saturation (Siewiorek 2002). The elimination of information saturation decreases cognitive load on computer

[4] Detailed information about MS Outlook is available at the Microsoft Website at http://office.microsoft.com.

users (Chalmers 2003) which should increase their productivity and satisfaction with the medium. *Information pollution* relates to redundant, duplicated, erroneous, or poorly maintained information that can obscure other information and impede the decision-making process (December 1994; Hillman 1982). It mostly occurs when information providers do not meet their users' needs or interests. Email users feel frustrated when they have to go through hundreds of irrelevant messages and clean their mailboxes. Unwanted commercial email is an example of information pollution.

The issue of unsolicited commercial communication, often labeled 'junk email' or 'spam,' has been widely discussed since the birth of electronic communication (Denning 1982), but no solution has been found. Currently, the flood of unsolicited messages is significantly growing and may soon account for half of all U.S. email traffic (Krim 2003). In some cases, flows of irrelevant, unwanted, and ill-structured electronic communication eventually evolve into an organizational nightmare (Gwynne and Dickerson 1997). Many users do not use filters because they consider the manual construction of filtering rules a daunting experience or do not have faith in automatic filtering technologies. Individuals are afraid of losing important messages a filter mistakenly identifies as spam. Automatic filters will never be perfect. Spammers constantly upgrade their skills and develop new ways to bypass filtering mechanisms. As a result, even those email users who utilize filters receive junk mail. If someone receives a high number of false negatives,[5] most filter designers suggest increasing the level of risk tolerance of the filter. However, in this case, there is a great degree of false positives.[6] Currently many people experience both problems simultaneously; they receive unsolicited and lose important messages (Weinstein 2003). Many email experts do not recommend that users allow filters to automatically delete suspicious junk mail before they manually review it (Browning 1998). This undermines the purpose of the technology and reduces the level of trust in automatic message filing systems. According to Segal and Kephart (1999; 2000), a message filtering agent which facilitates rather than implements message filing both reduces information saturation and builds trust in the system. In general, the email direct-manipulation interface, which poorly supports a wide range of user activities, appears to be detrimental to the way humans easily interact with email applications (Ducheneaut and Bellotti 2001).

Email is often utilized to convey information which is considered inappropriate for this type of communication. Many researchers (Lucas 1998; Schmitz and Fulk 1991; Trevino, Daft and Lengel 1990; Webster and Trevino 1995) regard email as a moderately low richness media which is unsuitable for conveying highly equivocal information. As indicated by the actual email usage studies, individuals still utilize email to transmit both equivocal and unequivocal information (Rice and Shook 1990). A possible explanation of this behavior is the relative convenience of using this tool. For example, a manager may decide to inform a subordinate about a complicated issue via electronic mail solely

[5] False negatives are junk messages that were not identified as spam by filters.

[6] False positives are legitimate messages incorrectly classified as spam by filers and deleted.

because an email application is constantly open and facilitates immediate message delivery. In this case, a subordinate often has to ask for clarifications because the initial message did not convey enough details or lacked social cues. The manager typically accounts this time-consuming follow-up process to the poor performance or inappropriateness of email as a communication tool which, in turn, increases his or her dissatisfaction with email in general.

Despite these problems associated with the use of electronic messaging, the present situation with email cannot be considered critical. Most people continue utilizing email as a major means of communication, and this trend is predicted to persist in the future. There are, however, ways to improve email systems. For example, human-computer interaction research suggests that a conventional text-based direct manipulation interface is a major source of users' dissatisfaction with their email tools (Ducheneaut and Bellotti 2001) and that interface agents may provide a possible solution to address the challenges discussed above.

1.1.2 What are Interface Agents?

Interface agents are a newer class of software that may potentially offer help in addressing the problems associated with email applications as described above. Interface agents exhibit strong visual and/or audio presence and interact with human users directly.

Recent years have demonstrated a growing interest in intelligent agents as aids for providing user assistance and automating complex or routine tasks that have been previously performed by human users (Hayes-Roth 1995; Jennings 2001; Jennings and Wooldridge 1998; Maes 1994; Maes, Guttman and Moukas 1999; Negroponte 1997; Nwana 1996). Current research in software agent technologies has boosted the development of prototypes and working models of intelligent agents which are already incorporated in end-user commercial applications. Despite extensive work in this area, the agent research community has not agreed upon a universal definition of intelligent agents.

According to Bradshaw (1997), two distinct approaches to depict the concept have been attempted: 1) as a description; and, 2) as an ascription. As a **description**, intelligent agents are described with respect to a certain subset of characteristics which agents should possess such as autonomy, continuity (Shoham 1997), reactivity, agency, intelligence, mobility (Gilbert et al., 1995), proactiveness, and personalization (Etzioni and Weld 1995). As an **ascription**, intelligent agents are portrayed in terms of what users ascribe them to be. If users believe that they are delegating computer-related tasks to particular software entities, these entities are ascribed as intelligent agents.

The current trend in software technology reveals a development towards incorporating interface agents which mediate communication between a human user and a computer (Ball et al., 1997; Laurel 1997; Maes 1994; Prendinger, Descamps and Ishizuka 2002). Interface agents are a subset of intelligent agent technologies which came into use in the mid-nineties. Although interface agents are at an early stage of development, they are already appearing in real-life computer applications.

With respect to an interface agent definition, this dissertation adopts a 'description' approach. The use of an 'ascription' definition is not appropriate because it carries a high degree of subjectivity. By adopting an 'ascription' approach, virtually anything may be ascribed as an agent (Shoham 1989). For instance, a light switch may be considered an agent "with the capability of transmitting current at will, who invariably transmits current when it believes that we want it transmitted and not otherwise; flicking the switch is simply our way of communicating our desires" (Shoham 1997, p. 273).

An **interface agent** is defined as a reactive (adapts its behavior under the changes in the external environment), continuous (long-lived), collaborative (collaborates with other agents or electronic processes), and autonomous (independent) visual computational system which acts on a user's behalf by communicating directly with a person offering assistance and advice in performing computer-related tasks. For an agent to be considered an "interface" agent, it should directly communicate with the person through the input and output of the user interface (Lieberman and Selker 2003). An interface agent is in charge of interacting with the user. It accepts user requests, directs them to computer devices or other agents, monitors task execution, and reports back to the person. The agent may add graphics or animation to the interface, use speech input and output, or communicate via other sensory devices. Interface agents may be employed in the form of virtual real-time assistants, pedagogical tutors in interactive learning environments, presenters and entertainers. They may be incorporated in virtually any kind of software system including email applications (Maes 1994).

Now that the definition of interface agents has been discussed, the following section of the dissertation offers rationales for examining interface agents for electronic mail.

1.1.3 Why study Interface Agents for Electronic Mail?

"Automation is here to liberate us."

(Hoffer 1972, p. 64)

One of the most salient reasons for studying interface agents is their ability to transform the way people use text-based computer telecommunications mediums such as electronic mail. As reflected by the extensive number of research projects in this area, there has been a strong interest in incorporating interface agents in email applications over the last decade or so (Bergman, Griss and Staelin 2002; Brzezinski and Dain 2001; Lashkari, Metral and Maes 1994; Maes and Kozierok 1993; Payne and Edwards 1997). At the root of this interest is the vision that agents will become a long-term solution for providing user assistance in tackling the currently challenging task of email management.

The specific interest in interface agents as electronic communication support tools lies in their ability to offer a new model of human-system interaction. In fact, interface agents possess many capabilities that may be successfully employed in email applications. For instance, interface agents may: **reduce information overload** associated with electronic communication (Segal and Kephart 1999); **speed up information exchange** by serving as an intelligent information acceleration tool

(Karnouskos and Vasilakos 2002); **connect together different parts of distributed messaging systems** in a heterogeneous network (Sekiba et al., 1998); **facilitate knowledge flows** in organizations by offering expertise location technologies (Bontis, Fearon and Hishon 2003; Kautz, Selman and Milewski 1996; Kautz, Selman and Shah 1997; Wills et al., 2002); and, **serve as intelligent and personalizable interfaces** between users and other seamlessly integrated service agents that work in the background performing communication-related tasks (Kautz, Selman and Coen 1994). It is these potential benefits for both end users and organizations that raise awareness and interest in interface agents for email.

Despite this potential, there seems to be a gap between the expected user adoption of interface agents and their actual acceptance in both electronic messaging systems and other applications. Many projects have been **technology-focused** rather than **problem-focused**. These studies tend to look at the technical characteristics and capabilities of an interface agent and value technical realizations of an agent-based system over that of user testing. The literature fails to provide clear evidence of the benefits of utilizing interface agents, and the results of past empirical studies on the usefulness and user adoption of interface agent technologies appear to be mixed and inconsistent (Dehn and van Mulken 2000). Several factors may potentially explain this issue.

First, most previous projects lack a thorough methodological background. For example, they utilize non-validated measurement instruments and rarely report on the operationalization of constructs or scale development. As indicated by the best practices of MIS research (Straub 1989), only the use of a reliable and valid research instrument allows researchers to present statistically sound results. Secondly, many investigations include statistically insufficient sample sizes. For instance, Hertzum et al. (2002) in their study on trust of information seekers in agents, employed a group of eight participants. Lester et al. (1999) surveyed ten students in an attempt to demonstrate the usefulness of agent-based learning environments. It is argued that those sample sizes are not satisfactory. Thirdly, most prior investigations were conducted in laboratory settings. On the one hand, the applicability of laboratory experiments has been successfully addressed in several MIS areas, for example, in usability studies (Head 1998; Rubin 1994). For instance, the laboratory experiment may produce statistically valid and generalizable results with respect to a new computer interface because the perceptions of its usefulness and ease of use as well as behavioral usage intentions may be established during a brief tutorial or an experiment with this technology (Davis 1989; Davis, Bagozzi and Warshaw 1989). On the other hand, laboratory investigations, which utilize convenience rather than probabilistic data samples, may not produce results generalizable to the entire population of interface agent users. As hypothesized by Dehn and van Mulken (2000), in contrast to other information technologies, adequate behavioral intentions towards interface agents may take some time to establish. For example, the usage intentions towards an interface agent of a person who explored it during a short experiment may differ from those of an individual who utilized this agent for several weeks or months. More research is needed to bridge the gap between unconvincing and conflicting conclusions of past experiments.

With respect to email interface agents, the majority of projects are realized in the form of technical reports rather than journal articles. Those technical reports investigate technological aspects of a system leaving out user experience, perception, satisfaction, and adoption of the application (Bergman et al., 2002; Helfman and Isbell 1995; Prendinger and Ishizuka 2001a; Rohall and Gruen 2002). More importantly, there has been no work towards building a model for measuring and predicting user adoption of interface agents for email, which might be a primary cause of inconsistent findings of previous investigations. In addition, previous research initiatives rarely address the practical aspects of the usage, development, and promotion of interface agent technologies. As of today, there are few, if any, guidelines or recommendations for manufacturers and marketers of this technology.

1.2 Research Objective

This dissertation aims to contribute to both theory and practice. With respect to theory, the primary objectives are to gain insights on the factors which affect a user's decision to start or continue utilizing interface agents in electronic mail environments, to hypothesize a model which explains such user adoption behavior, and to subject this model to extensive empirical testing. Regarding practice, the purpose of this research is to produce guidelines and recommendations on the utility of email interface agents which would be of interest to developers and marketers alike. To reach these objectives, the study suggests a deductive and an inductive research approach that polls real-life end users of this technology, via a Web-based questionnaire, on the cognitive and contextual factors surrounding the adoption of email interface agents.

1.3 Scholarly and Practical Significance

This dissertation introduces a theoretical model for measuring and predicting user adoption of interface agents for email built upon the convergence of the Technology Acceptance Model (TAM) (Davis 1986; Davis 1989; Davis et al., 1989; Igbaria, Schiffman and Wieckowski 1994), innovation theories (Agarwal and Prasad 1998; Serenko and Detlor 2004), uses and gratifications studies (Dimmick, Kline and Stafford 2000), computer playfulness investigations (Webster and Martocchio 1992), and interface agent research (Dehn and van Mulken 2000; Lieberman and Selker 2003; Maes 1994; Maes 1995) that aim to explain user adoption decisions. This study conducts a comprehensive literature review of those areas and reconciles different points of views from various disciplines such as intelligent agents, human-computer interaction, and social sciences. It is hoped that by analyzing email interface agents from a user perspective, a greater understanding of the factors that influence individual decisions whether to accept or reject agent technologies can be obtained.

The expected contribution is that by conducting an in-depth empirical investigation based on a theoretical model, the study will yield a realistic explanation and depiction of user adoption of interface agents for email. In order to address the needs of

practitioners, the investigation will present recommendations and guidelines for the development and marketing of email interface agents. As opposed to previous technology-centered studies on interface agents, this dissertation offers an alternative, user-focused rationale which hopefully may be successfully used in future agent development initiatives to advance the creation of useful and practical interface agent systems for electronic mail.

1.4 Outline of Dissertation

The dissertation consists of six chapters. Chapter 1 (this chapter) introduces the problem under investigation, presents the research areas and highlights the importance of the study for both theory and practice.

Chapter 2 offers a comprehensive literature review of interface agents and forms the foundation for the introduction of a theoretical model. As such, it examines prior work on the characteristics of interface agents. Most importantly, this chapter discusses email notification programs which represent the first commercial realization of email interface agents.

Chapter 3 presents a thorough analysis of the Technology Acceptance Model (TAM) and addresses key antecedents of the model that may pertain to user adoption of interface agents. It describes the importance of user predispositions towards interface agents, touches on recent developments in innovation theories, and extends TAM by incorporating perceived enjoyment with the system as a new model construct.[7] The chapter concludes with the formation of seven research questions and nine hypotheses.

Chapter 4 discusses the methodology utilized in this dissertation to test the hypotheses and to answer the study's research questions. First, it describes respondent selection, response rate, and recruitment procedures. Second, this chapter presents data collection techniques for deductive, inductive, and user context analyses. As such, it offers the actual survey instrument, or questionnaire, targeted to real-life users of interface agent email notification applications. Third, Chapter 4 outlines quantitative and qualitative data analysis techniques. Last, it presents results of a pilot study.

Chapter 5 offers data analysis and results. First, it outlines the full study in detail and summarizes statistics pertaining to user context, such as gender, age, occupation, education, country of residence, email usage, income level, and actual agent usage of survey participants. Second, this chapter covers model testing; it presents common method bias assessment, the measurement model, the structural model, the effect size, and control variables. Third, it reports on data analysis pertaining to user perceptions of several characteristics of email interface agents and offers an analysis of open-ended questionnaire items pertaining to various factors for usage termination, reasons why

[7] A construct (also called factor or latent variable) is a theoretical abstraction that helps to explain and organize one's knowledge about an unobservable and unmeasurable phenomenon. A construct is measured indirectly through observable variables that either reflect or form this construct.

individuals like or dislike this technology, features of an 'ideal' agent, and recommendations for agent developers and marketers. Lastly, Chapter 5 presents a proof of theoretical saturation and data validity checks.

Chapter 6 (last chapter) offers a comprehensive discussion and conclusions. First, it provides answers to research questions and related hypotheses and outlines a new, grand model of email interface agent adoption and use. Second, it covers methodological, theoretical, and practical contributions of this dissertation. Last, Chapter 6 presents several limitations of this study, suggests avenues for future research, and offers concluding remarks.

Chapter 2: Agents

The purpose of this chapter is to examine the literature pertaining to the field of agent-based research. This comprises an overview of agent studies and recent realizations of agent technologies in email systems. It is believed that a review of such work will help identify factors that may potentially influence user adoption behavior regarding interface agents in electronic mail systems. The goal is to provide the reader with a firm description of interface agents which emphasizes the role of interface agents in email applications and highlights certain features of interface agents that may offer insights on user adoption decisions.

To achieve this goal, this chapter is organized as follows. Section 2.1 concentrates on presenting a description of interface agents. This section uses theories and findings from previous agent investigations, reviews characteristics of interface agents, and reconciles these diverse viewpoints to reflect the nature of interface agents incorporated in electronic communications applications.

Section 2.2 examines agents for electronic mail applications. To organize the disparate literature on the topic, this section identifies the major categories of agents utilized in the electronic communication domain: service agents, intelligent filters, MailBots and interface agents, and develops a preliminary typology schema which depicts these types of agents based on their degree of user-agent interactivity. By employing this proposed categorization model, this section analyzes email agents and highlights their potential to alleviate some of the problems associated with email usage identified earlier. Most importantly, this examination describes email notification interface agents, which are utilized in an empirical investigation of the suggested study's model.

2.1 Interface Agents and Their Characteristics

Interface agents are defined as software entities which are reactive, continuous, collaborative, and autonomous and that possess additional characteristics and capabilities such as strong visual and/or audio presence and direct interaction with users.

Strong visual and/or audio presence is the first feature characterizing interface agents because their major purpose is to add graphics, animation, and speech input-output to the interface (Lieberman and Selker 2003). "Interface agents draw their strength from the naturalness of the living-organism metaphor in terms of both cognitive accessibility and communication style" (Laurel 1997, p. 68). Typically, interface agents are implemented in the form of human-like or cartoon-like animated characters, electronic figures, graphical user interfaces, textual boxes, or any other visual components.

Direct interaction with users is the second characteristic of interface agents since interface agents communicate with people by bypassing intermediaries. They observe users 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; Lieberman and Selker 2003). 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 observing users actions. They act on the behalf of users 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. For example, an email interface agent works constantly in the background by monitoring all incoming messages, sorting them out, and interrupting users only when a high priority message arrives. In addition, the interface agent may announce who the sender is, provide a brief textual abstract of the email message's context, or even generate an automatic reply.

Interface agents are employed in the form of personal application assistants, secretaries, butlers (Lashkari et al., 1994; Maes 1994; Maes and Kozierok 1993; Xiao, Stasko and Catrambone 2004), Web guides (Keeble and Macredie 2000; Sharon, Lieberman and Selker 2002), shopping or electronic commerce companions (Lieberman and Wagner 2003; McBreen and Jack 2001), virtual tutors in interactive learning environments (Gulz 2004; Johnson, Rickel and Lester 2000; Lester et al., 1997; Person et al., 2000), storytellers (Cavazza, Charles and Mead 2002), presenters,[8] virtual actors[9] (Hornby and Pollack 2001; Miranda et al., 2001), entertainers (Gebhard et al., 2003), and even home appliances aids (Müller et al., 2001). For example, an email interface agent helps users accomplish various tasks, such as sorting messages, filtering information, finding addresses, scheduling meetings, and announcing reminders.

Although interface agents have not been widespread in contemporary end-user applications, artificial intelligence and human-computer interaction researchers are tackling problems of creating interface assistants that may be successfully employed in various software applications. For instance, the recently developed Multimodal Presentation Markup Language[10] enables easy creation of Internet presentations done by interface agents (Tsutsui and Ishizuka 2000). This technology allows people to implement webpages enhanced by interactive interface agents.

As with intelligent agents, no uniform definition of interface agents agreed upon by the agent research community exists. This research area is so young and diverse that

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[8] For example, the powerActor 2000 package facilitates seamlessness integration of MS Agent animated characters into MS PowerPoint slide shows. It allows creating independent presentations done solely by agent characters, e.g., agents read the text, interact with each other, change slides, etc. The product is available on the Bertil Wiklund website at http://poweractor.online.fr/index.html.

[9] An online demonstration of animated agents as virtual actors is presented at the Microsoft Agent Theater website at http://www.dwacon.com/AgentTheatre/AgentTheatre.htm.

[10] For more information on the Multimodal Presentation Markup Language refer to the MPML project home page at http://www.miv.t.u-tokyo.ac.jp/MPML/en/. An alternative technology is the Microsoft Agent Scripting Software (MASS) agent toolkit developed by Abhisoft Technologies. The product is available at http://www.abhisoft.net/mass/.

most interface agent publications have been materialized in a form of conference papers (e.g., Descamps and Ishizuka 2001; Descamps, Prendinger and Ishizuka 2001; Dohi and Ishizuka 1999; Fukayama et al., 2002; Lisetti 2002; Prendinger and Ishizuka 2001b; Seiji and Tomohiro 2001) and workshop publications (e.g., Gong 2002; Person et al., 2000; Persson 1999; Svensson, Persson and Höök 1999). The literature presents different descriptions, characteristics, and attributes of interface agents. The features of personalization, anthropomorphism, and entertainment/enjoyment appear in many interface agent studies (Dehn and van Mulken 2000; Lieberman and Selker 2003), and, therefore, they are discussed in more detail below.

2.1.1 Personalization

The role of personalization in software applications has been continuously explored for the past decade because the traditional "one-size-fits-all" approach fails to provide the necessary business advantage in highly competitive contemporary environments (Brusilovsky 2001). Currently, many computer systems, including interface agents, employ personalization techniques in order to enhance the user experience and provide better customer service.

When an interface agent provides personalized user assistance or acts on behalf of a person, the agent should be able to obtain all necessary information about the individual, such as his or her habits, interests, needs, requirements, idiosyncrasies, and preferences, to interpret them, to create a user profile, and to adapt under each user. In order to achieve this, the workings of personalized interface agents may need to incorporate machine learning techniques (Maes 1994). In this case, an interface agent is given minimum background knowledge about the most common user characteristics and basic tasks it may be expected to accomplish. When a user is engaged in computer-related activities, the interface agent works continuously and autonomously in the background by looking over-the-shoulder of the user. It tries to interpret his or her actions to identify behavioral patterns. The interface agent also considers both direct and indirect feedback from the individual. Direct feedback occurs when a person acknowledges an agent's actions or recommendations. Indirect feedback takes place when an individual neglects an agent's suggestions or initiates different actions. The user may explicitly train or 'advise' the interface agent and demonstrate what action to undertake in each particular situation (Lieberman 2001). Once the interface agent has profiled the user, it starts acting cautiously on the owner's behalf and making recommendations.

The past ten years have witnessed the development of various types of interface agents whose workings are based on gathering the maximum amount of information about a user while requiring the minimum interaction with this person (Shearin and Lieberman 2001). The Internet offers tremendous opportunities for employing personalized interface agents to assist Web users to navigate this vast information space. Examples of such agents include Adaptive Web Site Agents (Pazzani and Billsus 2002) and IntelliShopper (Menczer, Street and Monge 2002a; Menczer et al., 2002b). Adaptive Web Site Agents are virtual guides that assist users with navigating unknown and complex sites by providing personalized online help based on a user's location on the site

and previous navigational patterns. IntelliShopper is a personal shopping assistant designed to empower online consumers. The interface agent observes users actions while they are shopping, learns their preferences with respect to various features associated with online offerings, looks for additional products that might match users needs, and presents this information in a concise and efficient form.

The present technologies allow personalizing not only an interface agent's actions but also its appearance, voice and presentation style to reflect the individual preferences of each user. For example, the AiA[11] Personas project presents a series of personalized animated information assistants which deliver website contents and provide orientation assistance in a dynamically expanding navigation space (André and Rist 2002; André, Rist and Muller 1999).

Despite the attractiveness of the personalization concept, this characteristic is not required for a software entity to be considered an interface agent. First, it is difficult to form a reliable pattern of user behavior over a short period of time or when user behavior and preferences drastically change. Therefore, many interface agents continue to rely on a pre-programmed set of rules rather than on user profiles. Secondly, as public concern over privacy issues increases, more people are expected to reject agent technologies whose workings are based on the premise of collecting information on an individual's behavior (Serenko 2003; Serenko, Ruhi and Cocosila 2004). Lastly, there are many successful implementations of software systems that do not employ personalization but, nevertheless, are classified as interface agents (Ball et al., 1997; Cheyer and Julia 1999).

2.1.2 Anthropomorphism

"To create an artificial being has been a dream of men since the birth of science."

Professor Hobby (William Hurt),

Artificial Intelligence (Spielberg 2002)

Anthropomorphism[12] is the ascription of human-like attributes and features to non-human objects. This characteristic of intelligent machines has a long-standing tradition in robot engineering, human-computer interaction, artificial intelligence, and interface agents research (Burgoon et al., 2000; de Laere, Lundgren and Howe 1998; Duffy 2003; King and Ohya 1995; King and Ohya 1996; Nass, Fogg and Moon 1996; Nass et al., 1994; Nass et al., 1993). Some people tend to anthropomorphize hardware and software, to interact with computer systems as if they were real living beings, and to describe them in terms of human or personal characteristics such as needs, beliefs, desires, and intentions. For example, someone may say that an anthropomorphized machine 'reads,' 'writes,' 'thinks,' 'talks,' 'learns,' 'feels,' 'catches and transmits

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[11] AiA – Adaptive InfoBahn Access.

[12] The word *anthropomorphism* comes from the Greek words *anthropos* ('human being / man') and *morphe* ('form / shape / structure').

viruses,' etc. Such modeling of computer behavior allows these individuals to understand software systems more easily since it is natural for people to think of anything that exhibits very complex behavior as a person rather than a thing. If it is applied properly, "anthropomorphism may provide opportunities to enhance human-computer interaction, to improve training and educational activities, and to extend the computer's capabilities through the application of intelligent agents and avatars" (Marakas, Johnson and Palmer 2000, p. 738-739).

The aspects of anthropomorphization, personification, and emotionality have been one of the most controversial discussion topics in the field of interface agents research. Since interface agents interact with human users directly and serve as their helpers, advisors, and assistants, it seems natural and intuitively appealing to incorporate life-like behavior, human, animal, or cartoon-like faces, natural voice, and emotions into these agents since they should presumably enhance the user experience and impact positively on user satisfaction with an agent. The anthropomorphized interface agents are often called **believable agents** (Bates 1994; Lester et al., 1999) or **embodied conversational interface agents** (Cassell 2000) because of their ability to demonstrate human expressions, emotions, personality, mood and social intelligence, to interact with people in natural language, and to simulate the illusion of life. Some studies even envision intelligent human-like agents that cohabit virtual worlds with people and support face-to-face dialogues, serving as guides, mentors, and teammates (Rickel and Johnson 2000; Rickel et al., 2002).

The idea of anthropomorphization of interface agents has been realized in various technical projects and empirically tested in human-agent interaction studies. Examples of such technical realizations are Microsoft Agent, InfoWiz Interactive Information System (Cheyer and Julia 1999), AgentSalon (Sumi and Mase 2001), AnswerAgent,[13] and AvatarBT agents (Ballin et al., 2002). These projects manifest the ability of contemporary software technologies to incorporate anthropomorphic features in interface agents. Empirical studies, however, offer vague, confusing, and ambiguous arguments with respect to the advantages of anthropomorphization in interface agents. For instance, Takeuchi and Nagao (1993) observe that people converse with an agent featuring facial displays more successfully than with one without faces. Walker, Sproull, and Subramani (1994) investigate subjects' responses to an animated talking face by comparing people's experiences with a highly anthropomorphized face, a stern face, and a regular text-box. The results reveal a positive relationship between the level of a person's engagement in a conversation and the degree of an agent's human-likeness. Koda and Maes (1996) obtain experimental results on the usefulness of personified agent interfaces in a poker computer game. Their findings demonstrate that anthropomorphized faces help users engage in entertainment activities.

In sharp contrast, Takeuchi and Naito (1995) conclude that facial displays and human-like behaviors of interface agents distract people from concentrating on a task in a

[13] An online demo is available at the Conversive, Inc website at http://www.conversive.com.

card matching game. Kiesler, Sproull, and Waters (1996) conducted a study on the cooperation between people and interface agents which vary in degree of human likeness. Their test reports that individuals exhibit the most anti-social and anti-cooperative behavior when they interact with the most human-like interface agents. Parise et al. (1999) improved the appearance and degree of believability of the interface agents utilized in the Kiesler et al. study and conducted a similar experiment which found that the likeability and appealingness of interface agents does not lead people to cooperate with them. This evidence implies that anthropomorphism is not a required feature for interface agents.

Overall, many software assistants that are considered interface agents, for example, Letizia (Lieberman 1995) and the Apt Decision Agent (Shearin and Lieberman 2001) have been successfully implemented without anthropomorphizing graphical user interfaces. In addition, the **persona effect**, which manifests the advantage of a computer system augmented by an animated interface agent over that of without one (Lester et al., 1997), has not been convincingly proved (Dehn and van Mulken 2000; van Mulken, André and Müller 1998). It is hoped that future research efforts will clarify the discrepancy over the usefulness issues of anthropomorphization in interface agents.

2.1.3 Entertainment and Enjoyment Values

Entertainment and enjoyment values are the third feature of interface agents that materializes in many previous investigations. It is based on an intuitive and appealing assumption that animated interface agents invoke positive mental emotions in their users (Dehn and van Mulken 2000; Maes 1995). Previously, the entertainment potential of animated agents has been mostly used in the computer gaming industry for achieving realistic life-like behavior and adapting game settings for individual players (Lund 2001). Currently, many forms of entertainment present animated interface agents that act in various virtual environments such as simulation rides, movies, animation, and theater. Entertainment features are also incorporated in many interface agents, especially ones that are realized in the form of interactive characters.

When interface agents interact with users, they sometimes play a role of performers carrying out actions that people may find enjoyable under appropriate circumstances (Rist, André and Müller 1997). The positive influence of such actions on the human-computer interaction process has been verified by preceding empirical investigations. For example, Lester et al. (1999) conclude that the strong visual presence of interface agents in knowledge-based educational environments increases students' enjoyment and enhances their learning experience. Takeuchi and Naito (1995) demonstrate that people identify and accept entertainment values of an animated face-like interface agent in a virtual interactive card matching game. These findings are consistent with the results obtained by Koda and Maes (1996) who also tested a face-like agent in analogous experimental settings. Their empirical study reveals that personified interface agents are well-suited for an entertainment domain because of their ability to help users engage in tasks. Suzuki, Ishii, and Okada (1998) implemented an agent system called 'Talking Eyes' in which people chatted with interactive interface agents. Their

experiment suggests that individuals enjoy chatting with agents for purely entertainment purposes even if they cannot obtain desired responses.

Despite the importance of user enjoyment with an interface agent, entertainment is not a mandatory characteristic of interface agents. First, the pursuit of fun is the secondary purpose of this technology. Second, entertainment features should only be realized in appropriate situations and targeted to the right group of people.

2.1.4 Summary

The above discussed characteristics of interface agents that include personalization, anthropomorphism, and entertainment/enjoyment. Despite continuous efforts of numerous research projects to prove the fruitfulness and effectiveness of these attributes with respect to interface agents, it is argued that none of these agent features, or their combination, is binding for a software entity to be considered an interface agent. This argument is based on contradictory findings, opposing discussions, small data samples, biased experiments designs, and prejudiced conclusions of many previous investigations. In addition, none of the prior studies has addressed individual differences of the subjects involved in the experiments. For example, the experimental study conducted by Lester et al. (1997) reveals the strong presence of the persona effect with respect to educational applications. However, the empirical testing involved 100 middle school students at an average age of 12. Although it is a considerable number of subjects, the assumption that a homogeneous young audience may be highly predisposed towards accepting interface agents or overstating their benefits compromises the authors' conclusions. This argument is consistent with past information systems and computer adoption research which highlight the importance of personal user characteristics in individual technology acceptance decisions (Agarwal and Prasad 1999; Thatcher and Perrewe 2002; Zmud 1979).

2.2 Agents for Email Applications

There are several key challenges that many contemporary email users experience: inadequate support for constantly changing user needs and requirements; inability to convey equivocal information including emotions; heavy information overload; and inefficient direct manipulation. It is these issues that shadow many advantages of existing electronic messaging tools and that may potentially impede future acceptance and usage of email as a leading communication medium. According to human-computer interaction research (for example, see Gruen et al., 1999), software agents may alleviate these problems by addressing actual user needs, offering value-added services, implementing new approaches, automating complex or routine tasks, improving system interfaces, and enhancing an individual's experiences with email applications.

Gruen et al. (1999) suggest the following five categories of email related assistance which may be provided by agents:

1. Pre-Processing – an agent processes a message to present it in the most efficient way to the user;
2. Filtering / Prioritizing – an agent filters out incoming mail and ranks it in order of importance;
3. Adding Relevant Information – an agent supplements a message with additional relevant information; for instance, the sender's affiliation;
4. Delegating Complex Tasks – an agent performs a series of complex or repetitive steps in response to a single high-level request by directly manipulating the system; and,
5. Inferencing – an agent makes suggestions and recommendations which are based on a user's profile; for example, points out information a user might consider significant.

In addition to these types of support, agents may help users integrate their email systems into various computer applications, facilitate the use of email with new devices, trace the status of all messaging and work related activities, generate automatic responses, and add interactivity and emotions to convey equivocal information.

There are several challenges that email agents researchers currently face. First, most research initiatives in these areas are disparate and independent from one another which often results in the duplication of prior work. Secondly, many projects are purely technology-oriented. They value a technological realization of a system over user evaluations and rarely commercialize the application. It is these problems that impede the development of this research area and delay the emergence of really useful email agent systems.

The following four sub-sections of this dissertation attempt to bridge that void by offering a comprehensive and methodological analysis of the field. Thus, Section 2.2.1 (next section) offers a preliminary typology schema of email agents. The application of this categorization method allows identifying four types of agents employed in email systems: service agents, intelligent filters, MailBots, and interface agents discussed in Sections 2.2.2, 2.2.3, and 2.2.4 respectively.

2.2.1 A Typology of Email Agents

The importance of emphasizing the conceptual distinction between active software entities such as interface agents (which interact with human users directly) and passive intelligent applications, such as filters and automatic mail readers, (which are invisible to users) has been previously addressed in electronic communications studies (Kautz et al., 1994). However, no research provides a solid categorization schema to classify different types of agents in email applications. This section of the dissertation attempts to introduce such a preliminary typology schema that both fosters future agent research and provides a clear definition of an interface agent for email.

A comprehensive analysis of the intelligent agent literature yields the following categories of agents in the electronic mail domain: service agents, email filters, MailBots,[14] and interface agents. The major distinction among these types of agents is the **degree of user-agent interactivity**. The level of user-agent interactivity reflects a user's awareness of an agent's existence in an email system and the extent of interaction, communication, and collaboration between the user and the agent. This viewpoint is fully consistent with previously accepted dimensions of human-computer interactivity: responsiveness and the facilitation of interpersonal communication (Heeter 1989; Tannenbaum 1998). Figure 2.1 illustrates a preliminary typology schema of agents for electronic mail environments.

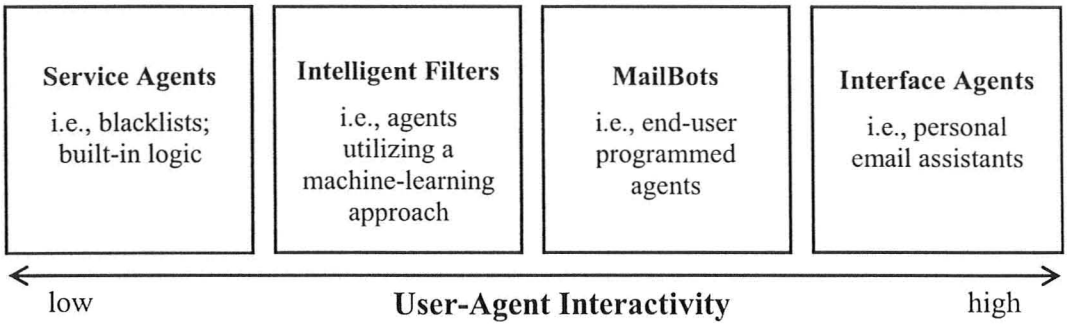

Figure 2.1: Email Agents Preliminary Typology Schema

According to this schema, service agents utilizing internal blacklists and built-in logic symbolize the lowest level of user-agent interaction. Email users are usually unaware of the existence of these agents. Intelligent filters that employ machine-learning techniques embody a medium-low degree of user-agent interaction. These agents work in the background by silently analyzing the behavior of email users, creating user profiles, and offering assistance or acting on the behalf of individuals when appropriate. People are usually aware of these agents and occasionally interact with them. MailBots that require end-user programming encompass the medium-high stage of user-agent interaction. Email users frequently interact with these agents, instruct them, and monitor their performance. Interface agents, which are often labeled as personal email assistants, signify the highest extent of user-agent interaction. In contrast to the previous groups of agents, email users constantly interact with interface agents which are embedded in an email application and play the role of a virtual secretary or assistant.

Service agents and various intelligent filtering agents represent the most frequently utilized categories of intelligent agents in email systems (Loia, Senatore and Sessa 2001b; Tai and Yamamoto 2000). The major advantage of these agents is their

[14] A MailBot (also called a mailing bot or an autoresponder) is an intelligent application that autonomously and continuously reads incoming electronic messages, understands content, and replies to senders.

ability to perform repetitive and complex tasks in the background without interrupting users. Interface agents are an emerging technology that has been employed in end-user applications over the past few years. The key benefit of interface agents lies in their ability to communicate with users in plain text or natural language and to serve as an intelligent and entertaining interface between individuals, system components, computer processes, and other agents.

As discussed earlier, an analysis of the degree of human-agent interactivity identifies major categories of agents for email applications: service agents, intelligent filters, MailBots, and interface agents. The three subsequent sub-sections facilitate an in-depth discussion of these agent types and offer insights on how agents may alleviate problems that many email users experience today.

2.2.2 Service Agents and Intelligent Filters

The idea of utilizing intelligent software modules to sort out arriving email traffic had been initially proposed and realized by Malone et al. (1987) in their pioneering experiment entitled "The Information Lens Intelligent Information-Sharing System" which drew the attention of thousands of IS researchers. The general purpose of email filtering is to automate the filing of incoming messages. The underlying workings of an email filtering agent are relatively simple. The agent monitors all incoming mail traffic, reads all messages, tries to understand their contents, and takes appropriate actions such as deleting a message, moving it to a specific folder, informing a user immediately or later, etc. There are two approaches to implementing email filtering agents: 1) using blacklists and built-in logic (Helfman and Isbell 1995; Pollock 1988; Rennie 2000); and, 2) using machine learning approaches (Balabanovid and Shoham 1995; Boone 1998; Maes and Kozierok 1993; Manco et al., 2002). **The former approach**, which relates to the usage of service agents, has proved to be inadequate for processing large volumes of dynamic and unstructured communication. Although the degree of user-agent interaction is very low, this approach requires the constant intervention of agent designers, technicians, and programmers, especially when the nature of communication alters, user preferences change, or people need to modify their mailboxes. For instance, technical support personnel should constantly monitor the condition of built-in logic and update it when necessary. **The latter approach**, which includes the use of intelligent filtering agents, presents a solution to these challenges. In this case, an agent observes all user interactions with an application, learns that user's preferences and interests, and forms a model of high-level user intentions by employing machine learning techniques (Brzezinski and Dain 2001). When the agent encounters a situation similar to one it has previously seen, it either suggests or performs an appropriate action. The agent research community has recognized the value and benefits of employing this approach, which is evident by the substantial body of research and commercial projects (Lang 1995; Payne and Edwards 1997; Payne, Edwards and Green 1997; Tsai, Tseng and Cheng 2000).

Despite the numerous advantages of automatic message filing, some people do not feel comfortable when they completely delegate important tasks to an intelligent software application. This may have negative impacts on agent system usage and adoption. Many

individuals are frustrated by the long time spans required in order for an intelligent filter to gain sufficient knowledge about its user. SwiftFile[15] (formerly known as MailCat) is an intelligent application that presents a new paradigm of email assistants (Segal and Kephart 1999; Segal and Kephart 2000). This adaptive email classifier fully addresses the challenges discussed earlier. First, it learns a user's profile by analyzing the pattern of previously filed messages. Second, the system adapts to changing conditions by using incremental learning techniques. The agent monitors user actions, analyzes all messages that have been added to or deleted from the mailbox, and dynamically updates the predictions model. Last and most importantly, SwiftFile **facilitates** rather than automates message filing. The system presents three MoveToFolder shortcut buttons above each message. These buttons allow the users to quickly move an incoming message into one of the three folders that the application predicts to be most relevant. If none of the recommended folders is relevant, the individuals may file the message manually. The experiments revealed that SwiftFile's predictions are accurate over 80% of the time. This approach not only substantially reduces the time and cognitive burgeon required to file messages, but also increases user trust towards agent systems.

The advantage of incorporating intelligent filtering agents in email applications is indisputable because they alleviate user overload with both solicited and unsolicited communication flows, thereby decreasing the degree of information saturation and pollution. Advanced agents not only execute message processing rules, but also learn user profiles, habits, and preferences and adjust the flow of emails. Currently, most email clients and systems incorporate some kind of junk mail filter, a spam assistant, or general sets of email filing rules (Bergman et al., 2002). For instance, Microsoft Outlook, Netscape, Hotmail, and Yahoo! include bulk mail filters, user-defined message processing procedures, and blacklists.

2.2.3 MailBots

A **MailBot** is an email-processing application that runs continuously on a user's computer, waits for incoming messages, analyzes their contents by applying basic reasoning capabilities, and performs actions that have been specified by individuals. Usually, these actions include generating a personalized automatic response to an incoming message, collecting customer email addresses for future follow-ups, and forwarding an inquiry to an appropriate person in an organization. For example, by reading a message, a MailBot discovers that a customer is requesting additional information about a new company product. Next, it replies by creating a personalized message, attaches an appropriate electronic catalogue, and forwards this request to the customer service department for possible future follow-up. Some MailBots, for example, PromaSoft AutoResponder,[16] also include incoming message filtering mechanisms.

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[15] An online demo of SwiftFile is available at the IBM Thomas J. Watson Research Center website at http://www.research.ibm.com/swiftfile.

[16] Available online at http://www.autoreplying.com/features.htm.

On the one hand, the use of MailBots dramatically reduces the number of manually processed messages (Finch et al., 1995), eases the load of customer service representatives, speeds-up response time, enhances customer experience with the company, increases satisfaction, and builds loyalty. On the other hand, end-user programming plays a critical role in implementing message processing and personalizing rules which requires technical knowledge and skills (Terveen and Murray 1996). Every time users need to adjust their MailBots, they have to manually indicate all tasks, type sample responses, and set preferences. In addition, email marketing software, including MailBots, often produce a flood of unwanted electronic communication causing spam which is one of the most devastating outcomes for email users (Loia, Senatore and Sessa 2001a).

2.2.4 Interface Agents

The goal of email interface agents is to add value and to enhance existing messaging systems rather than replace them. Interface agents may perform a variety of functions aimed to address existing problems associated with email use, to reduce user workload with the system, to increase efficiency, and to make the email experience more pleasant and enjoyable.

First, interface agents minimize users' competence in employing email tools by offering interactive tutorials, demonstrations, and real-time advice which reduces time and eliminates frustration when someone starts learning a new or an updated messaging application. This is very important given the growing number of novice users and the accelerating pace of new systems development.

Second, interface agents retain a history of all users' activities and remind them about incomplete or recently performed tasks. Such services are especially important if users resume utilizing an application after a significant break (Gruen et al., 1999; Lesh, Rich and Sidner 1999). Interface agents also monitor progress of specific tasks, detect opportunities and threats to those activities, inform users, and even offer possible solutions (Griss et al., 2002).

Third, interface agents facilitate the use of email with mobile devices. For example, interface agents may convert a message from one format to another depending on the device with which the user is accessing email (Karnouskos and Vasilakos 2002) and transform a long message into a brief abstract which mobile phone, pager or palmtop computer users can quickly skim though to determine whether the email is urgent or important. For example, Abu-Hakima, McFarland, and Meech (2001) developed the AmikaFreedom™ multi-agent architecture for email highlighting.[17] This system reads inbound messages, summarizes each one, and highlights parts of a message that an agent considers important according to users' preferences. AmikaFreedom helps email users reduce the time-consuming process of opening and reading every message to determine

[17] For more information on the system, visit the AmikaFreedom website at http://www.amikafreedom.com/afc1/amikafreedom.com/WhatIs.htm.

its relevance and importance. In addition, AmikaFreedom agents may forward highlights to mobile devices which have limited message presentation abilities. Other agent systems may assign relevance scores to incoming and outcoming messages based on pre-established criteria (Brzezinski and Dain 2001). This way, users may reduce the amount of time required to review email that increases their productivity.

Fourth, interface agents help people efficiently administer multiple email accounts. Usually, most email users have several mailboxes (Thai, Wan and Seneviratne 2002). Although it is possible to retrieve messages from multiple accounts by logging into one system, managing this application is complex and time consuming. Interface agents allow users to consolidate multiple email accounts into one personalized intelligent interface managed indirectly by a user. This smart and adjustable interface, in turn, operates different email accounts in a direct manipulation mode thereby hiding tasks complexity.

Fifth, interface agents help locate expertise in a company. Overall, the potential contribution of agent-based systems to organizational knowledge management practices has been frequently emphasized (for example, see Gaines 1997; Houari and Far 2004; Liebowitz 2001; Roda, Angehrn and Nabeth 2001; Roda et al., 2003; Staniszkis and Staniszkis 2003). Kautz, Selman, and Milewski (1996) originated the concept of utilizing email communication for expertise mapping in organizations. By exploiting the suggested technique, a software agent applies information retrieval procedures to analyze records of email communication patterns for each employee. This allows gathering information about the expertise of all organization members that can augment existing knowledge management practices. This idea has already been employed in commercial applications, for example, in Tacit KnowledgeMail® (Tacit 2003) and validated by a number of conceptual and empirical research projects (Bontis et al., 2003; Kanfer, Sweet and Schlosser 1997; Wills et al., 2002).

Last, but not least, interface agents perform various tasks; for example, they incorporate or manage message filtering facilities, announce calendar reminders and scheduled meetings, notify users about recently arrived messages, or simply entertain them. An email system augmented by a personal assistant may include one or more interface agents. For instance, a calendar agent may be employed to present calendar announcements and a notification agent may be designed to read incoming messages (Bergman et al., 2002).

Despite the extensive work underway in the incorporation of interface agents in email applications, most previous studies and projects have been realized in forms of conceptual discussions, preliminary empirical investigations, and pilot systems (Bergman et al., 2002; Dabbish et al., 2005; Florea and Moldovanu 1996; Griss et al., 2002; Gruen et al., 1999; Lashkari et al., 1994; Maes 1994; Voss 2004) rather than in end-user products. **Email notification programs** are one of the first commercial applications that utilize interface agent technologies in the electronic mail environment and, therefore, merit attention.

The general purpose of electronic mail notification programs is to inform users about novel or modified information, for example, the arrival of a new message (Libes 1997). Email notification services have a long-standing tradition on the software market. Email notification facilities have been incorporated in the early versions of BSD[18] UNIX OS by utilizing classic biff-like programs.[19] Biff is a small program that enables OS to print notices directly on the terminal of an email recipient (Nemeth et al., 2000). Figure 2.2 presents an example of this message notification box.

> New mail for serenkav@mcmaster.ca has arrived:
>
> ---
>
> From: detlorb@mcmaster.ca
>
> Subject: K726 Lecture Notes
>
> Date: Mn, 10 March 03 12:30:22 CDT
>
> Hi Alexander,
>
> would it be possible for you to present your Agents and Toolkits / Agents and Privacy class on April 3rd rather than March 27th....

Figure 2.2: Email Notification Mailbox – biff

[18] BDS – Short for Berkeley Software Design, Inc., a commercial supplier or BDS UNIX OS.

[19] The original biff program was written by Bill Joy. Biff was named after the Heidi Stettner's dog who barked at the postman. Heidi suggested that since a dog barks at the postman, so can software, when a new message arrives (i.e., bark at incoming email).

The later versions of biff programs have further extended the idea of user notification. For example, the xbiff implementation of biff displays a mailbox icon with a flag that goes up when a new message arrives. If a user clicks the box, xbiff lowers the flag and remembers the current 'empty' state until another new email appears (Fulton and Swick 2002). Figure 2.3 illustrates an example of an xbiff notification mailbox.

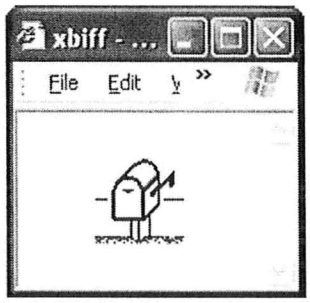

Figure 2.3: Email Notification Mailbox – xbiff

A brief analysis of the current software market reveals a variety of email notification programs. For example, The Linux Portal[20] presents over 50 different mail notification programs and utilities for Linux operating systems. Most of these programs represent a service type agent which works continuously and autonomously on a user's machine monitoring incoming email traffic. MailBell (EmTec 2003) and ePromtper (Tiburon 2003) are examples of such intelligent applications whose purpose is to notify users about newly arriving messages in the most convenient way for them. Some programs may display a notification box, present a part of the message, or play sound. In addition, they may also monitor the status of multiple email accounts, for instance, Hotmail, Yahoo, or AOL. Recently, Microsoft has supplied Outlook with email notification features. The user may create a rule which facilitates the presentation of brief notifications when a new message arrives. However, the major disadvantage of such programs is that they periodically check the status of a mail server which increases network traffic and delays message delivery. NotifyMail (NotifyMail 2003) is a new type of email notification service agent. As opposed to the previous systems, NotifyMail does not check the arrival of new messages at specific intervals – instead, the agent resides on the mail server and passively waits for incoming email which it immediately forwards to users. This approach not only speeds up message delivery but also reduces network congestion and saves CPU resources.

Intelligent email notifiers have a wide area of application. For instance, Frank et al. (2000) developed an email alerting system that periodically checks a user's mailbox on an email server and informs him or her over the phone when a new message arrives. The experience demonstrates that individuals who do not have a permanent Internet

[20] The Linux Portal is available at http://www.linuxlinks.com.

connection and who receive only a few emails per day benefit from utilizing this application.

The previously portrayed email notification agents represent the service category of agents. These agents run continuously and autonomously on users' terminals or mail servers. In most cases, people are not aware of these agents' existence and users almost never interact directly with these service notification agents.

In contrast to service agents, interface agents play a very active role by interacting regularly with individuals. The purpose of such agents is three-fold. First, similar to service agents, interface agents notify users about incoming messages. Second, they provide an intelligent interface between human users and other parts of a complicated system thereby hiding task complexity. Third, in addition to regular notification services, interface agents incorporate a large variety of communicative, entertaining, and information management functions. The following two examples: Email Announcer 4.0 from Blind Bat Software[21] and TalkToMe™ from Cantrell Software[22] explain the workings of notifications interface agents for email in more detail.

[21] The software is available at the Blind Bat website at http://www.blindbat.com.

[22] The software is available at the Cantrell website at http://www.talk-to-me.net.

The Email Announcer adds two new features to Microsoft Outlook. First, the system incorporates an interactive cartoon-like character which announces incoming email messages by utilizing Microsoft Agent technologies. Figure 2.4 displays a snapshot of an interactive character Merlin notifying users about new email. The agent acknowledges the sender (Brian Detlor) and reads the subject line (Participation for K726 lectures). Depending on a user's preferences, it may also read the entire message. The agent also informs individuals if senders have requested a 'read receipt.' In addition to presenting messages received by Outlook, the Email Announcer is capable of retrieving email from Hotmail email accounts. The major benefit of utilizing such an agent is that users do not have to be distracted from their current activities and switch from the application they are currently working with to their email system to see message details.

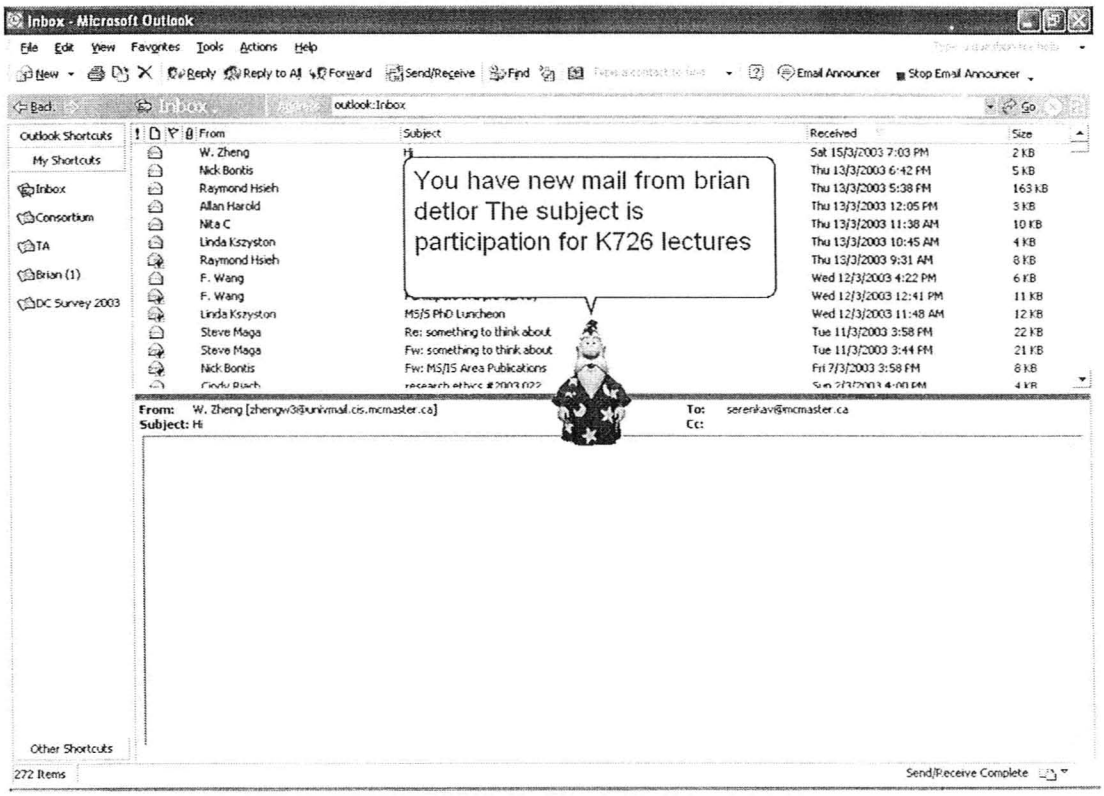

Figure 2.4: Email Announcer. Email notification message

Secondly, the Email Announcer is able to announce reminders which pop up in the MS Outlook Calendar. This service is very convenient for users who are currently engaged in other activities, for example, web surfing, and cannot read messages. Figure 2.5 shows an example of a calendar reminder.

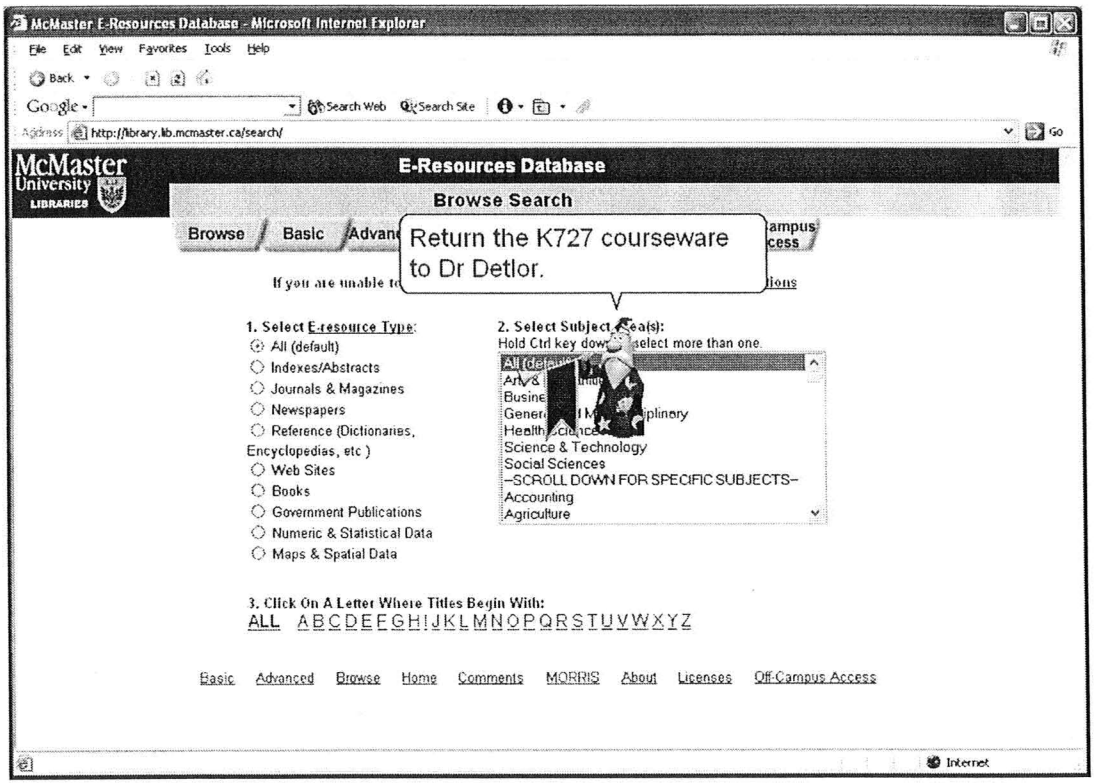

Figure 2.5: Email Announcer. Calendar notification message

A simple graphical interface allows users to set a number of parameters of the program, for example, to select a character, its voice and basic animation attributes, to personalize the MS Outlook toolbar, and to specify announcement details. The use of the application is very simple, and the employment of this system does not require coding. This is very important since most email users do not have any programming skills. The screenshot of Email Announcer Settings is presented in Figure 2.6.

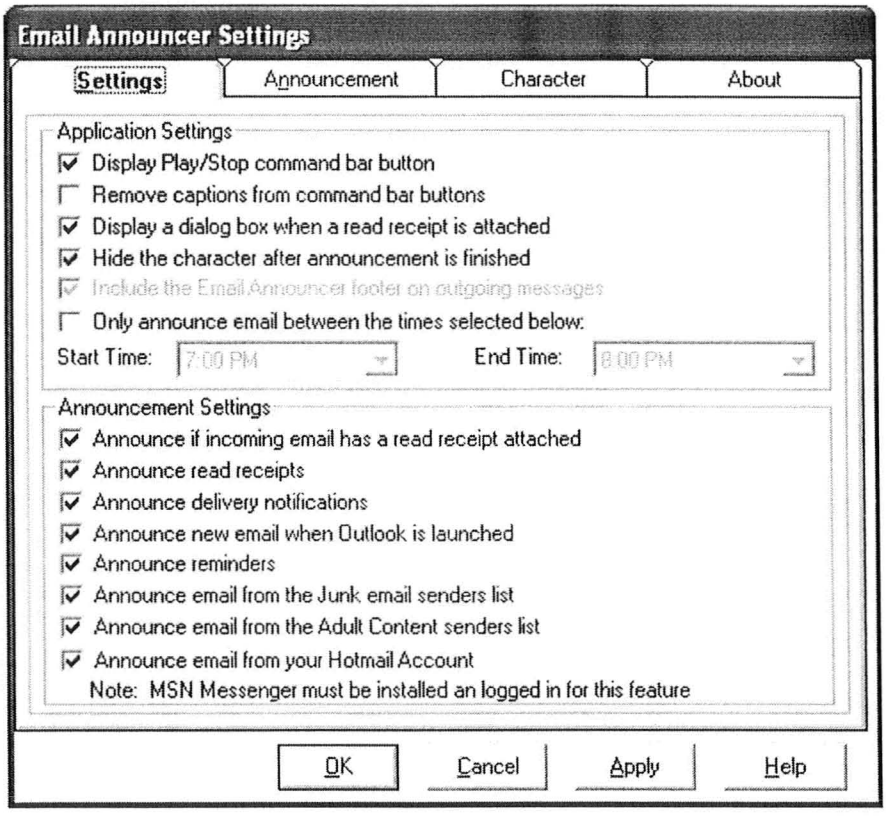

Figure 2.6: Email Announcer Settings Interface

TalkToMe is another example of an interface agent-based email notification application. In addition to the basic email notification functions, an interactive character may greet a user, read webpages, and announce date and time. If two individuals have this system installed on their computers, they may send animated messages to each other that may potentially improve the richness of electronic mail as a telecommunications channel. Figure 2.7 offers the screenshot of TalkToMe Graphical User Interface.

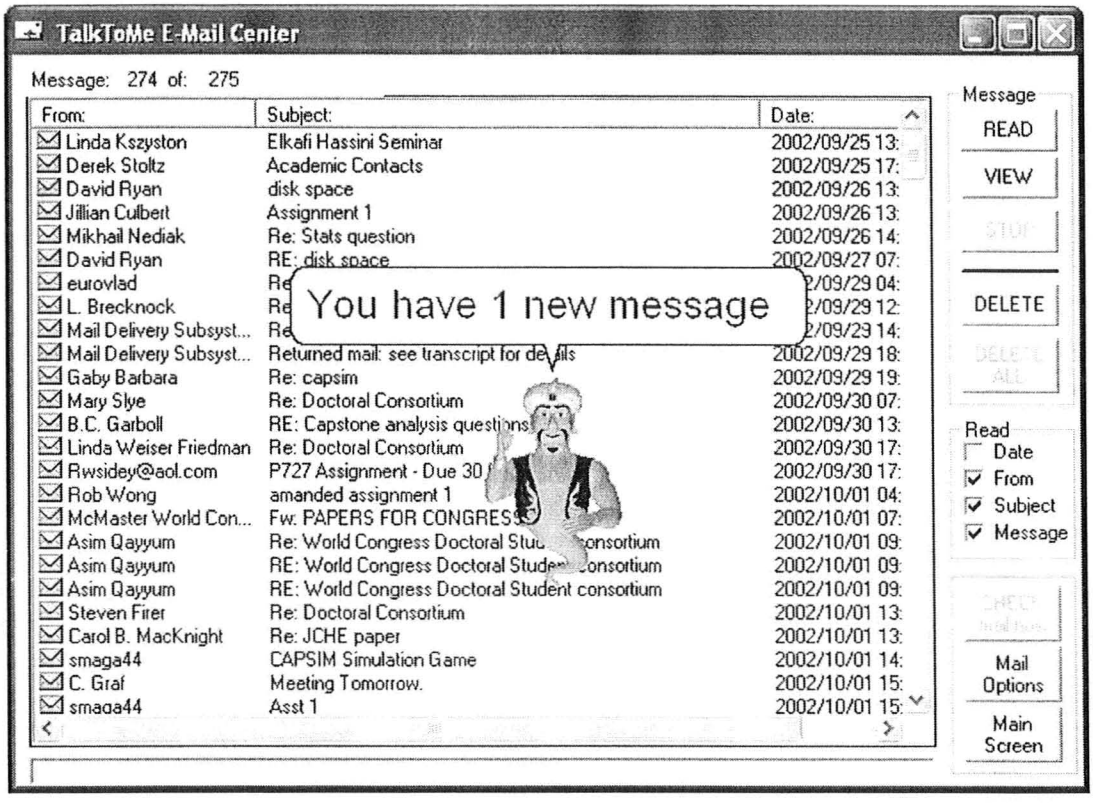

Figure 2.7: TalkToMe Graphical User Interface

In conclusion, interface agents for email have attracted the attention of both researchers and practitioners because of their ability to substantially alleviate many problems associated with the use of email. As demonstrated throughout the literature review presented in the previous sections of this dissertation study, most past and contemporary research efforts facilitate conceptual discussions and empirical investigations on the usefulness of interface agents in electronic mail environments or concentrate on technical realizations of agent-based email systems. The issue of user acceptance of email interface agents has not been addressed as of today.

Chapter 3: Theoretical Model

This chapter offers a theoretical model of user adoption of email interface agents and outlines research questions and hypotheses. This model is expressed as a set of components, and it depicts ways they interact with one another. Taking an end-user perspective, this dissertation's model emphasizes individual user characteristics and people's perceptions of various aspects of interface agents for email. To build this model, the dissertation combines prior findings pertaining to information systems, computer science, human-computer interaction, and sociology research to justify the extension of the original Technology Acceptance Model and to reflect the nature of interface agents for email. This chapter attempts to reconcile popular viewpoints which aim to explain user technology adoption decisions such as the Technology Acceptance Model (TAM) (Davis 1986; Davis 1989; Davis et al., 1989; Igbaria et al., 1994), innovation theories (Agarwal and Prasad 1998; Rogers 1995), uses and gratifications studies (Dimmick et al., 2000), computer playfulness investigations (Webster and Martocchio 1992), and interface agents research (Dehn and van Mulken 2000; Lieberman and Selker 2003; Maes 1994; Maes 1995) and to apply these perspectives to interface agents in electronic mail systems. Further, the suggested model is utilized as a lens of analysis to form the study's research questions and hypotheses outlined at the end of this chapter.

3.1 Previous Research on Email Adoption

Since its emergence in 1971,[23] email adoption has been extensively studied in information systems, computer science, and sociology research. There are at least ten distinct theories that attempt to explain the acceptance and use of electronic mail as communication media: 1) diffusion of innovations (Murphy and Tan 2003; Rogers 1995); 2) social influence (Fulk 1993; Fulk, Schmitz and Steinfield 1990); 3) social presence (Rice 1993); 4) critical mass (Markus 1990); 5) structuration (Orlikowski 1992; Orlikowski et al., 1995; Yates and Orlikowski 1992); 6) critical social (Ngwenyama 1997); 7) media symbolism (Trevino et al., 1990); 8) media richness (Daft and Lengel 1986; Daft, Lengel and Trevino 1987); 9) channel expansion (Carlson and Zmud 1994; Carlson and Zmud 1999); and, 10) uses and gratifications theory (Dimmick et al., 2000). None of these ten approaches can be applied directly to measure user adoption of interface agents in email environments. First, they explore the nature of electronic communication itself. Second, these theories investigate aspects that enable and motivate the use of a particular communication channel but not an email application. Third, they derive and examine general user perceptions of email usage rather than factors that may be associated with utilizing an interface agent. For example, media richness theory attempts to explain media choice as a rational process resulting from a match between objective medium characteristics and the content of a message. Social influence theory and channel expansion model are two recent extensions of media richness concept. They

[23] The first email message was sent by an engineer named Ray Tomlinson in late 1971.

analyze people's adoption behaviors by looking at user experiences in utilizing a particular communication channel and at perceived social influences respectively. Structuration theory examines the role of electronic communication technologies in changing organizational forms. As such, other areas should be investigated to achieve the purpose of this dissertation.

3.2 The Technology Acceptance Model

The **Technology Acceptance Model** (TAM) is one of the most frequently utilized end-user technology adoption frameworks in the MIS literature. It identifies and measures key factors that influence individuals' decisions whether to accept or reject particular information or computer technologies. With respect to the purpose of this dissertation, the major advantage and distinction of TAM is two-fold. First, as demonstrated by a substantial body of prior research, TAM may be successfully applied to investigations concerning user adoption behavior in virtually any computer field. Secondly, it provides the basis for building technology acceptance frameworks in very narrow areas. TAM can be extended by incorporating novel domain-specific constructs and antecedents to accommodate a variety of factors that affect people's acceptance decisions with respect to newer technologies such as interface agents.

TAM takes its roots at the convergence of two disciplines: information systems and psychology. Information systems researchers have often examined social psychology theories of behavior as the theoretical foundation for investigating the determinants of end-user acceptance of new technologies. The Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975) is the most frequently utilized model that has a long-standing tradition in IS research. TRA is a general theory that has been "designed to explain virtually any human behavior" (Ajzen and Fishbein 1980, p. 4), and it can be employed in a broad variety of situations to understand and predict usage behavior. For the past two decades, it has provided the background for the development of various extensions of technology acceptance frameworks, concepts, and theories (Ajzen 1991; Compeau and Higgins 1995; Loch and Conger 1996; Mathieson 1991; Venkatesh et al., 2003).

In order to explain computer usage behavior, Davis (1986; 1989; 1993) accumulated findings from previous IS research and introduced the Technology Acceptance Model (TAM) based on the original TRA. Davis' model is considerably less general than TRA, and it provides an explanation of the determinants of computer acceptance. Specifically, TAM identifies a casual relationship between two key beliefs: 1) perceived usefulness and perceived ease of use of the system, and 2) users' attitudes towards use, their behavioral intentions to use, as well as their actual usage behavior (Davis et al., 1989). Figure 3.1 illustrates the workings of TAM.

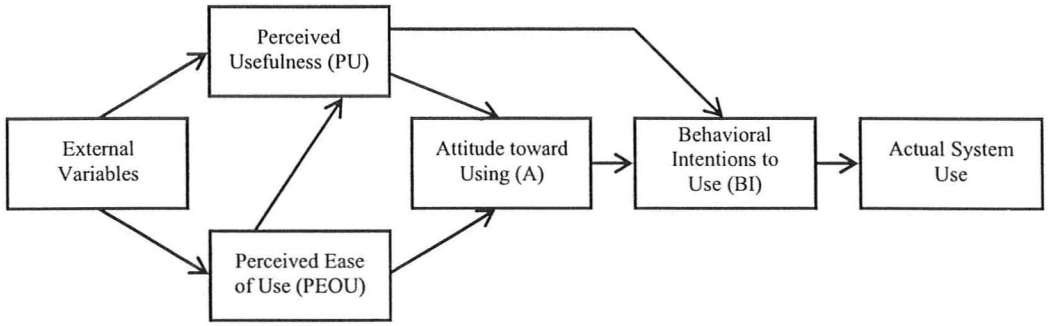

Figure 3.1: TAM by Davis et al. (1989, p. 985)

According to the model, a person's **behavioral intentions** (BI) towards utilizing a particular system is a major factor for why he or she actually uses it. BI, in turn, is jointly determined by an individual's **attitude** (A) and **perceived usefulness** (PU) of the system. Formula (3.1) presents the estimation of BI:

$$BI = A + PU. \quad (3.1)$$

This equation describes the following PU - BI relationship: users tend to form positive intentions towards highly perceived usefulness of the system. With respect to the A - BI relationship, the model implies that positive attitude evokes more favorable behavioral intentions which, in turn, influence actual system use.

Equation (3.2) indicates that two interrelated constructs: perceived usefulness (PU) and perceived ease of use (PEOU) affect attitudes towards utilizing a system:

$$A = PU + PEOU. \quad (3.2)$$

Davis defines **perceived ease of use** as "the degree to which a person believes that using a particular system would be free of physical and mental effort" and **perceived usefulness** of the system as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989, p. 320). External variables, which later studies labeled as **antecedents** of PEOU and PU, serve as a bridge between TAM constructs and individual differences, situational constraints, and other interventions influencing a user's behavior. External variables are the major factor impinging PEOU. Both, PEOU and external variables have a direct affect on PU. This

allows viewing PEOU and PU as distinct but related constructs of the model. Formulas (3.3) and (3.4) present the relationship among PU, PEOU and external variables:

$$PU = \text{External Variables} + PEOU, \quad (3.3)$$

$$PEOU = \text{External Variables}. \quad (3.4)$$

The viability of TAM has been successfully tested in various technology acceptance studies in different areas (Adams, Nelson and Todd 1992; Bhattacherjee 2001; Hendrickson, Massey and Cronan 1993; Szajna 1994; Szajna 1996; Taylor and Todd 1995a; Taylor and Todd 1995b) including the World Wide Web (Moon and Kim 2001) and electronic commerce (Devaraj, Fan and Kohli 2002; Gefen and Straub 2000; Koufaris 2002). Recently, TAM has been adapted to investigate instructor satisfaction with agent toolkits in academia (Serenko and Detlor 2003). As of January 2005, the Thomson Corporation's ISI Web of Science Social Sciences Citation Index (SSCI) lists 1,066 journal citations to the two journal articles that introduced TAM (Davis 1989; Davis et al., 1989) which illustrates the wide recognition and acceptance of this model.

Despite the success and extensive adoption of the original TAM, MIS researchers have continued investigating the factors that influence the key constructs of this model: perceived ease of use and perceived usefulness of the system. A better comprehension of the antecedents and determinants would allow both researchers and practitioners to understand the underlying reasons driving user acceptance of particular information technologies. The latest meta-analysis of key projects that test the viability of TAM conducted by Legris, Ingham, and Collerette (2003) suggests that significant factors are not included in TAM.

To enhance the model, Venkatesh and Davis (1996) suggest that an individual's computer self-efficacy and system's objective usability are key antecedents of perceived ease of use. Data from three experiments support the hypothesis that an individual's perception of a system's ease of use is anchored in his or her general computer self-efficacy, and objective usability has an impact on perceived ease of use after direct experience with the system. Further, technology acceptance research in various domains also highlights the importance of understanding key TAM antecedents (Chau and Hu 2002; Devaraj et al., 2002).

To manifest the importance of antecedents of TAM, Venkatesh and Davis (2000) developed and tested a theoretical extension of the Technology Acceptance Model which has been referred to as the **Technology Acceptance Model 2** (TAM2). This model explains perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes that were overlooked in the original TAM. Among the key antecedents of perceived usefulness are subjective norm, image, job relevance, output quality, and result demonstrability. A number of studies applied, extended, and tested the viability of this model in different settings (Hong et al., 2001; Riemenschneider and Hardgrave 2001; Schaik, Bettany-Saltikov and Warren 2002; Thong, Hong and Tam 2002). Despite its attractiveness, TAM2 cannot be applied to investigate user adoption decisions with respect to email interface agents because its antecedents reflect user-

specific attributes in organizational environments. However, these studies support the fruitfulness of extending the original TAM to test user acceptance of technological innovations such as interface agents for email.

An extensive review of the human-computer interaction, information systems, and interface agents literatures reveals three new factors that may pertain to user adoption behavior regarding interface agents (Agarwal and Prasad 1998; Davis, Bagozzi and Warshaw 1992; Webster and Martocchio 1992). **Perceived user enjoyment** is the first facet that may be included in TAM as a new construct of the model. The assumption that user enjoyment is a significant determinant is based on the importance of user enjoyment with email (as identified in the next section of this dissertation) and with interface agents (as discovered under the label of interface agent characteristics and analyzed in Section 2.1.3 of this dissertation). **Computer playfulness** and **personal innovativeness in information technology** are the second and third factors that may be incorporated in TAM as antecedents of the model. The hypothesis that these antecedents influence TAM determinants is based on the assumption that individual-specific characteristics play an important role in perceiving the usefulness, ease of use, and enjoyment with new innovative technologies such as email interface agents. The three subsequent sections of the dissertation discuss these novel factors in more detail.

3.3 Perceived Enjoyment

Since their inception, computers have been mostly regarded as tools designed to help people perform work-related tasks, automate complex processes, store information, and facilitate fast, reliable and inexpensive communication. As reflected by Davis' original Technology Acceptance Model, users are expected to perceive computer-based systems in terms of their usefulness and ease of use. In recent years, however, as computers enter entertainment fields such as games, virtual reality, arts, animation, and cinema (Murray 1997), which are not considered work-related activities, many people have become more aware of the hidden enjoyment values of human-computer interaction processes. This shift of user perceptions of computer systems from pure 'work' to 'work and pleasure' highlights the importance of addressing user enjoyment with software applications such as email and, especially, interface agents which are often designed to increase user enjoyment with HCI experiences. Therefore, user enjoyment with interface agents should be investigated since it may potentially carry significant weight with respect to user adoption decisions.

Contemporary motivation research presents two major concepts that explain task enjoyment with respect to computer technologies: **the theory of optimal flow experience** (Csikszentmihalyi 1975; Csikszentmihalyi 1990; Hoffman and Novak 1996) and **general motivation models** (Venkatesh, Speier and Morris 2002). Figure 3.2 visualizes the relationships between these concepts and the constructs employed in this dissertation study. It illustrates the two major branches comprising task enjoyment motivation research and highlights the major theoretical contribution found in these literature sets that have bearing on this study's proposed theoretical model.

Although flow and motivation theories overlap considerably, they do not represent interchangeable models and, therefore, are analyzed separately (Puca and Schmalt 1999). Flow influenced the development of the construct of **computer playfulness** that is analyzed in the next section. That section provides a thorough discussion of the theory of optimal flow experience to justify the incorporation of a new construct of computer playfulness into the proposed model. Thus, the workings of the left branch found in Figure 3.2 are explained there.

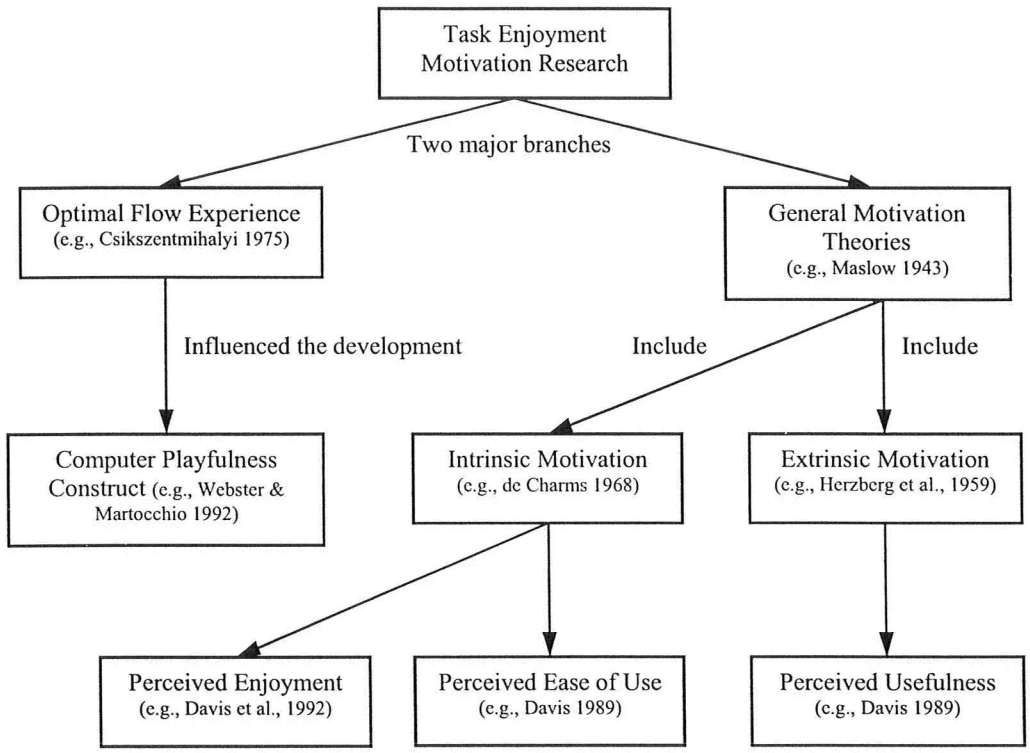

Figure 3.2: Task Enjoyment in Motivation Research: the Perceived Enjoyment Construct

The right branch in Figure 3.2 deals with general motivation theories. These are further described as comprising two broad categories of motivation (Maslow 1943): extrinsic and intrinsic (Calder and Staw 1975; Deci 1975; Ryan and Deci 2000). **Extrinsic motivation** pertains to an activity which is done in order to obtain a desirable outcome. For instance, a secretary may start using new features in a word processing program because he or she believes that utilizing these additional functions will increase his or her job productivity. With respect to Davis' Technology Acceptance Model, perceived usefulness is an appropriate illustration of extrinsic motivation for using information technologies. Monetary incentives, praises from supervisors, and career expectations are the most frequently used examples of extrinsic rewards in the

organizational behavior literature (Herzberg, Mausner and Snyderman 1959; Kanungo and Mendonca 1997).

In contrast, **intrinsic motivation** refers to a voluntarily activity done for no apparent reinforcement other than the process of performing the activity *per se* (de Charms 1968). In this case, satisfaction is inherent in the task and the positive experiences associated with the activity itself. The innate psychological needs for self-competence, determination, realization, autonomy, recognition, relatedness, and entertainment are the major intrinsic driving forces of engaging individuals in various intrinsic activities.

The theory of intrinsic motivation has been successfully utilized to explain task enjoyment with computer-related activities. Hassenzahl et al. (2000) demonstrate that users perceive task-related functions and design implementations of a software system independently of hedonic qualities of this application. Hedonic qualities comprise non task-specific quality dimensions of the system which users consider enjoyable and entertaining. Originality, novelty, innovativeness, visual effects, and playful features represent essential hedonic aspects that are frequently employed to increase the perceived qualitative appeal of a software system. Hedonic motives underlie one of the critical factors of Internet usage (Bourdeau, Chebat and Couturier 2002) and inspire users to accept new information systems (Kendall 1997). According to consumer research, hedonic values of a product or service strongly influence purchasers decisions in both brick-and-mortar locations (Babin, Darden and Griffin 1994) and online shopping environments (Childers et al., 2001; Henderson, Rickwood and Roberts 1998). The extant literature depicts both intrinsic factors and hedonic qualities as a perceived enjoyment construct (Davis et al., 1992).

Perceived enjoyment refers to "the extent to which the activity of using the computer is perceived to be enjoyable in it's own right, apart from any performance consequences that may be anticipated" (Davis et al., 1992, p. 1113). Perceived enjoyment is an example of pure intrinsic motivation since it symbolizes the use of a software system just for the sake of using it. This concept, coined by Davis, Bagozzi, and Warshaw (1992), takes its roots in the computer game field where perceived user (or player) enjoyment is a key factor by which to judge the quality and appeal of a particular software game (Malone 1982). In their classic study, Davis and his colleagues hypothesized and empirically proved that perceived enjoyment explains significant variance in usage intentions beyond those accounted for by perceived usefulness and perceived ease of use of a machine. Their research project discovered the positive interaction between perceived usefulness and perceived enjoyment. Based on this observation, Davis and his colleagues conclude that enjoyment has a higher positive effect on user intentions when the software application is perceived more useful and visa versa. They argue that for systems that are high in perceived usefulness, perceived enjoyment has a greater impact on acceptance decisions. At the same time, for systems that are low in perceived usefulness, perceived enjoyment has a reduced impact on acceptance decisions.

Other researchers report similar findings in various information technologies acceptance studies. Many subsequent investigations include the construct of perceived enjoyment into TAM and recognize that people adopt computer technologies because of their usefulness, ease of use, as well as their entertaining potential. For example, Igbaria, Schiffman, and Wieckowski (1994) extend the original Davis' et al. study by focusing on impacts of perceived usefulness and perceived enjoyment on levels of user satisfaction and their consequent technology acceptance decisions. Their empirical research involving 471 computer users suggests that perceived enjoyment has a stronger impact on user satisfaction than perceived usefulness. Choi et al. (2003) present analogous conclusions with respect to the predictive power of perceived enjoyment in their recent validation of the framework of user attitudes towards interactive TV.

Igbaria (1996) integrates the theoretical perspectives and empirical findings of previous research on the adoption, acceptance, and use of computers. His experiment presents a framework of computer usage that includes perceived complexity of a system as an antecedent and comprises three motivational factors: perceived usefulness, perceived enjoyment, and social pressure. Although analysis reveals a relatively small effect of perceived enjoyment on usage behavior, the negative influence of system complexity on enjoyment indicates the importance of addressing complexity issues in software products as a means to control user enjoyment.

Venkatesh (2000) goes beyond the traditional construct of perceived ease of use in TAM by identifying a number of antecedents that may potentially affect this construct. Perceived enjoyment has been justified and empirically validated as being one of the variables that shape users perceptions of system ease of use over time.

Several investigations on the role of perceived enjoyment in online environments have emerged from Davis' et al. and Igbaria's et al. initial works. Van der Heijden (2003) investigated an extension of TAM to explain the individual acceptance and usage of websites. The data obtained from 828 users indicated that perceived enjoyment positively influences both the intentions to use and the attitudes towards using a website. Teo, Lim, and Lai (1999) and Teo (2001) attest to this conclusion by analyzing motivation variables of 1,370 Internet users. Atkinson and Kydd (1997) present strong empirical evidence of the high explanatory power of perceived enjoyment in virtual entertainment environments.

Uses and gratifications theory finds the motive of end user perceived enjoyment or entertainment as being a strong determinant of the acceptance of various communications systems (Vorderer 2001). The uses and gratifications concept is a theoretical framework for studying psychological motives and behavioral tendencies associated with mediated communication. This model deserves attention since it offers insights on future directions of investigating areas that can be effectively utilized in creating an interface agent adoption model in email settings.

According to uses and gratifications theory, audiences actively seek out communication media in a goal-directed way which provides them with the means of gratifying a wide range of psychological needs (Katz, Blumler and Gurevitch 1974).

Several assumptions constitute the body of the theory. First, audience members are an important part of the media who actively seek out a medium to satisfy their individual needs. Second, individuals are aware of their needs and may easily identify and state them. Third, people are familiar with different media choices at their disposal and adopt the one that best satisfies their needs and requirements. Recent research efforts have resulted in restructuring the original concept to differentiate between the gratifications sought from a medium and the gratifications obtained because this approach demonstrates a higher explanatory power (LaRose, Mastro and Eastin 2001). Uses and gratifications researchers normally start with describing media use, then they solicit and rank usage reasons from current users, and, finally, investigators analyze those motives to generate gratifications factors that are later correlated with media adoption.

Uses and gratification theory was initially utilized in television (Greenberg 1974), telephone (Dimmick, Sikand and Patterson 1994), radio, VCRs, music, books, computer, magazines, and newspapers research, as well as in recent empirical investigations on the use of mobile phones (Leung and Wei 2000), pagers (Leung and Wei 1998), the Internet and World Wide Web (LaRose et al., 2001; Lin 1999), online media (Lin 2002), email (Dimmick et al., 2000), electronic bulletin boards (James, Wotring and Forrest 1995), and ICQ[24] chatting (Leung 2001).

Many independent uses and gratifications studies prove the importance of addressing user enjoyment with communications mediums. For example, Lin (1999) discovers that fun and excitement are significant predictors for both TV and online shopping adoption motives. Charney and Greenberg (2002) observe that diversion entertainment is the second strongest gratifications factor that explains the use of the Internet. Eighmey and McCord (1998) also conclude that entertainment aspects partially explain the reactions of online audiences to websites. Chou and Hsiao (2000) find that enjoyment values are one of the major motives of Web usage by people affected by the Internet Addiction Disorder (IAD). Dimmick, Kline, and Stafford (2000) utilize the fun or pleasure of communicating construct as part of sociability gratifications of email.

The concept of perceived enjoyment has been investigated in various other fields as well, for example: workplace computing (Perry and Ballou 1997; Webster and Martocchio 1993); moderated group chats (van Dolen and de Ruyter 2002); electronic mail (Bourdeau et al., 2002); and group support system (GSS) (Chin and Gopal 1995). Such studies make it reasonable to presume that perceived enjoyment can potentially influence usage behavior with respect to any innovative computer technology including interface agents. Thus, this dissertation includes perceived enjoyment with interface agents as the third construct of the Technology Acceptance Model.

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[24] ICQ or "I seek you" is an easy to use online instant messaging program. It is utilized as a real-time conferencing tool for chatting, electronic mail, file transferring, playing games, etc.

3.4 Computer Playfulness

Computer playfulness is a situation-specific individual characteristic that represents a type of intellectual or cognitive playfulness. It describes an individual's tendency to interact spontaneously, intensively, openly, creatively, and imaginatively with computers. It has been demonstrated by prior research that the degree of computer playfulness influences a person's perceptions of the entire human-computer interaction experience, especially the extent of user enjoyment. As such, this dissertation suggests that computer playfulness may serve as an antecedent of perceived enjoyment with an interface agent, and, therefore, may be utilized in the construction of a theoretical end-user adoption model for interface agents.

The concept of computer playfulness has emerged from the substantial body of prior research on play. **Play** is a "voluntarily activity pursued without ulterior purpose and, on the whole, with enjoyment or expectation of enjoyment" (English and English 1958, p. 394). Play is intensely spontaneous, irrational, and personal activity. It usually "embodies a high degree of motivation and achievement" (Caplan and Caplan 1973, p. xii).

The spontaneous nature of play is not obvious – play exists in the eye of the beholder (Harré and Lamb 1983). Play is purely intrinsically rewarding (Ellis 1973); "the reward is generated by the transaction itself" (Levy 1978, p. 6). Solely intrinsic factors influence someone's decision to be involved in a playful activity and produce a person's self-esteem, self-actualization, and self-realization. Playful behavior produces "activity characterized by pleasure, interest and reduction of tension" (Corsini 1987, p. 858).

Play behavior in humans and animals has been studied since the nineteenth century (Groos and Baldwin 1901; Groos, Baldwin and Baldwin 1898). The study of play has its roots in different disciplines such as psychology, clinical medicine, and biology. Initial investigations concentrated on the analysis of child play in an attempt to investigate the relationship between play and a child's individual characteristics (Bretherton 1984; Freud 1922; Lieberman 1965). The research projects of the past decade have also explored the concept of playfulness in adults (Glynn and Webster 1992). Empirical research on adults indicates that a general characteristic of playfulness relates positively to more exploratory behavior, individual creativity, and innovativeness (Vornbrock 1998). Recent studies on play behavior have explored the influence of playfulness on working, training and learning environments (Martocchio and Webster 1992; Perry and Ballou 1997; Webster and Ho 1997; Webster and Martocchio 1993).

According to Lieberman (1977) and Barnett (1991), general playfulness embraces five distinct behavioral variables: enjoyment, creativity, originality, imagination, and innovativeness. The multiple observations of child and adult playfulness in applied psychology research have identified the positive relationship between those variables and the degree of general playfulness (Mönks, Hartup and deWit 1972). For example, a more playful person exhibits a higher level of creativity, originality, imagination, and

innovativeness than a less playful individual. Figure 3.3 outlines the relationship among these constructs and variables.

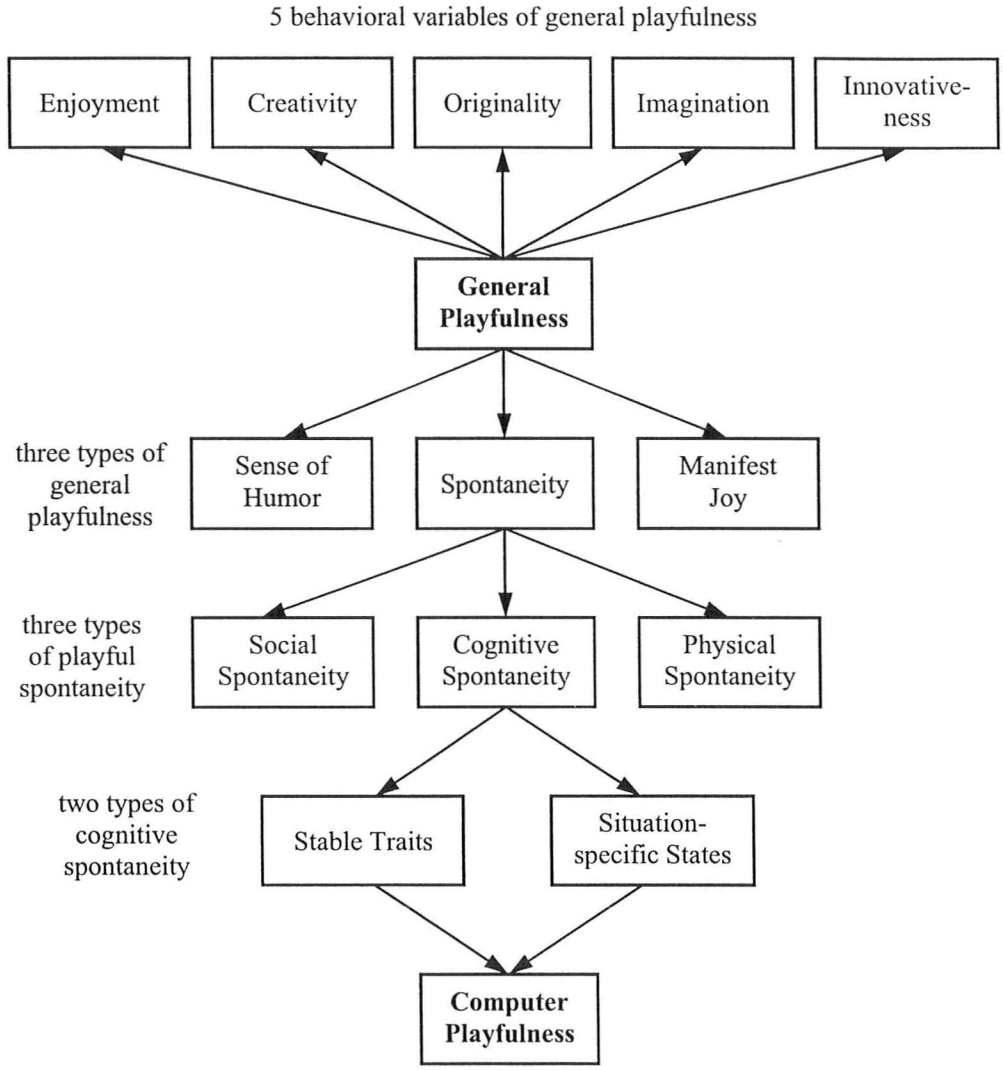

Figure 3.3: The Model of Relationships among General Playfulness and Other Constructs. Adapted from Lieberman (1977)

There are three types of general playfulness which represent intrinsic qualities arising in a familiar situation: sense of humor, spontaneity, and manifest joy. **Sense of humor** is a component of playfulness that results from surprisingness, incongruity and novelty of a product, event or situation. Sense of humor contributes to imaginative processes and boosts creativity. **Manifest joy** is a voluntarily activity which is always accompanied by apparent enjoyment. Joyful behavior is often associated with pleasure

and happiness of an individual. **Spontaneity** is the effortless and voluntarily recombination of familiar elements of the environment into innovative, unique, or novel pattern (Lieberman 1977). Psychology researchers define three dimensions of playful spontaneity: social, cognitive, and physical. **Social spontaneity** is the ability to be comfortable in a group setting and move freely in and out of such a social structure. It is strongly influenced by historical time and cultural settings. **Physical spontaneity** is the construct which is mostly expressed in physical activities such as dancing or jumping rope. **Cognitive spontaneity** refers to the imaginative play of a young child and the combinatorial play of a creative adult. According to Lieberman (1977, p. 58), someone who manifests cognitive spontaneity "will be testing hypotheses in the propositional 'if-then' manner, will go over his [or her] own thinking and the reservoir of factual knowledge through the process of reversibility of operations, and may come out with unique solutions as a result of 'playing with ideas'." There are two types of cognitive spontaneity: stable traits and situation-specific states (or flows).

Among these various dimensions of general playfulness, human-computer interaction studies consider cognitive spontaneity the most pertinent factor for computer playfulness (Martocchio and Webster 1992). **Computer playfulness** is a situation-specific individual characteristic that represents a type of intellectual or cognitive playfulness. It describes an individual's tendency to interact spontaneously, intensively, and imaginatively with computers. Thus, "a high level of cognitive spontaneity indicates a high degree of computer playfulness and a low level of cognitive spontaneity indicates a low degree of computer playfulness" (Webster and Martocchio 1992, p. 202). Playfulness is an appropriate construct in the study of human-computer interactions because of the symbolic and abstract nature of computer systems. Computers strongly influence and encourage user playfulness since they are relatively easy to use, provide quick instant responses, offer personalization features (Starbuck and Webster 1991), and incorporate playful items such as multimedia, graphics and animation (Yager et al., 1997).

Previous human-computer interaction research has demonstrated two basic approaches to playfulness investigations: play as a state and play as a trait (Woszczynski, Roth and Segars 2002). For example, Webster, Trevino, and Ryan (1993) and Chen, Wigand, and Nilan (1999) analyze playfulness as a state (or flow) whereas Martocchio and Webster (1992) consider playfulness a trait in human-computer interaction. The two following paragraphs highlight the conceptual differences between states and traits.

States are affective or cognitive episodes that depend on a particular situation and fluctuate over time. States "can be influenced by situational factors and the interaction between the person and the situation" (Webster and Martocchio 1992, p. 203). Flow is a time-limited experience. People in flow should not be completely aware of their own actions at a particular point in time. Once they look at themselves from outside, flow is interrupted (Csikszentmihalyi 1975). For example, a software game player may be so deeply involved in the game that he or she finds a self-reinforcing optimal experience and interacts with the computer in a certain way. However, a few minutes later, the game pattern of the same player may completely change.

As opposed to states, **traits** are moderately stable individual behavioral characteristics which are relatively invariant across different situations. This concept of trait stability has been successfully utilized in organizational behavior research as a proxy for identifying patterns of employees' behavior and formed the foundation for several theories of personality such as The Big Five (Digman 1990), Allport's theory (Allport 1924; Allport and Allport 1921), Eysenck's model (Eysenck 1990; Eysenck and Eysenck 1969), and Cattell's (1946) theory.

According to the **interactionist approach**, both traits and states influence people's behavioral patterns (Magnusson 1981; Shibutani 1961). This view offers a solution to the trait versus state debate by postulating that traits shape individual behavior in the long-term whereas states may delineate short-term behavior with respect to a specific situation. For example, a university student may feel very comfortable using a computer for various activities such as games, Internet browsing, communication, and learning and demonstrate the stable traits of confident computer usage. However, he or she may express a high level of situation-specific anxiety while using a computer under stressful or risky circumstances, for example, during a computerized test.

With respect to this dissertation, the interactionist approach is followed. It is hypothesized that both personal traits and situation-specific states influence the level of computer playfulness. As such, traits of computer playfulness represent a relatively enduring tendency to interact with computers playfully whereas states of computer playfulness signify a temporary condition of playful interaction with computers (Webster and Martocchio 1992). However, this research examines computer playfulness as an individual trait rather than a state. The argument behind this decision lies in the disruptive, intermittent, and sporadic nature of human-interface agent interaction in electronic mail environments. Indeed, email users interact with an email interface agent for a very short period of time; for example, when they ask an agent to perform a task or when an agent announces a new message. This irregular process, which usually lasts no longer than a few seconds, does not allow users to submerge fully into the process and to experience flows. It is presumed that states may influence the process of human-agent interaction in different settings where individuals interact with an interface agent continuously or over a long period of time, for example, in virtual games.

The proposed computer playfulness construct has been subjected to extensive empirical testing in various settings. Webster and Martocchio (1992) provide initial evidence for the construct validity, predictive efficacy, and reliability by conducting five independent experiments involving over 400 participants. Potosky (2002), Agarwal and Karahanna (2000), Bozionelos and Bozionelos (1999), Yager et al. (1997), Perry and Ballou (1997), and Webster and Ho (1997) successfully utilize, test, and validate computer playfulness in different experiments.

Others prove the effectiveness and fruitfulness of extending the computer playfulness construct and incorporating it into end-user acceptance models. For example, Atkinson and Kydd (1997) find computer playfulness a significant measure for predicting World Wide Web usage by university students. Anandarajan, Simmers, and Igbaria

(2000) further extend the concept of computer playfulness by introducing a new construct of *Internet playfulness*. Internet playfulness is an individual trait to interact spontaneity, inventively, and imaginatively with the Internet. This construct is viewed as being a key antecedent of an Internet usage model which is based on The Theory of Reasoned Action (Fishbein and Ajzen 1975). Moon and Kim (2001) enhance the understanding of individual World Wide Web acceptance behavior by proposing a new variable of *perceived Internet playfulness*.

Venkatesh (2000) pioneers the incorporation of computer playfulness into the Technology Acceptance Model (TAM) in his recent study on determinants of the perceived ease of use of a system. It has been confirmed that computer playfulness is an application-independent and intrinsic-motivation model antecedent. Lee, Kim, and Chung (2002) also employ computer playfulness as an antecedent of TAM to investigate usage and acceptance behaviors with respect to mobile Internet services. The experiment advances Webster and Martocchio's (1992) original construct by segregating computer playfulness into two independent variables: **focus** (which represents the level of user concentration on computer-related tasks) and **fun** (which reflects the level of user enjoyment with activities). Focus has been found to be a significant determinant of the perceived ease of use of a mobile Internet application. These studies support the validity of applying the construct of computer playfulness to test user acceptance of email interface agents.

3.5 Personal Innovativeness in Information Technology

Personal innovativeness in information technology (PIIT) is the domain-specific individual trait which reflects the willingness of a person to try out a new information technology. According to a recent study by Serenko and Detlor (2004), intelligent agents represent an innovation that implies that most existing innovation models, frameworks, concepts, and techniques may be successfully applied to agent technologies. For example, innovation adoption theories that have been productively applied to information technologies and computing fields may be utilized in agent adoption investigations. This dissertation attempts to employ this argument by applying PIIT to measure the degree of innovativeness of the people who utilize an email system augmented by an interface agent. In order to achieve this, the present dissertation study includes PIIT in the proposed dissertation model.

Individual characteristics play an important role in people's decisions to accept or reject innovations (Roehrich 2002; Rogers 1983; Rogers 1995; Tornatzky, Fleischer and Chakrabarti 1990). Some users may be highly predisposed towards adopting innovations whereas others may prefer to continue exploring familiar avenues. The substantial body of prior research in the area of personal innovativeness highlights the importance of this concept (Hirschman 1980; Hurt, Joseph and Cook 1977; Midgley and Dowling 1978; Midgley and Dowling 1993). Although such previous studies have greatly contributed to understanding the workings of a person's innovative behavior, they cannot be applied directly to investigations of user adoption decisions with respect to interface agents. First,

these studies concentrate on general or global innovativeness, which is a poor predictor of innovation adoption decisions in specific (Flynn and Goldsmith 1993; Goldsmith and Hofacker 1991; Leonard-Barton and Deschamps 1988) or new (Goldsmith, Freiden and Eastman 1995) areas, such as interface agents for electronic mail. Secondly, they measure adoption of innovation after the decision to adopt the technology has already been made which makes these tools an *ex post* descriptor rather than a predictor of behavior (Agarwal and Prasad 1998).

To raise awareness of the importance of personal characteristics of adopters in a specific domain, Agarwal and Prasad (1998) introduce the concept of personal innovativeness in the domain of information technology. The theory defines PIIT as the willingness of an individual to try out any new information technology and conceptualizes PIIT as "a trait, i.e., a relatively stable descriptor of individuals that is invariant across situational considerations" (Agarwal and Prasad 1998, p. 206). This study hypothesizes and empirically proves that PIIT serves as a key moderator for both antecedents and consequences of perceptions. In terms of antecedents, PIIT influences the use of alternative information channels for developing perceptions about technology. With respect to consequences, PIIT epitomizes risk taking behavior of adopters that affects their intentions to use a new IT since innovations are always fraught with high risk and uncertainty (Gilbert 1996). For example, individuals with higher PIIT are more willing to take innovative risks, and they will probably develop more positive intentions towards an innovation than people with lower PIIT. Figure 3.4 presents the model of PIIT.

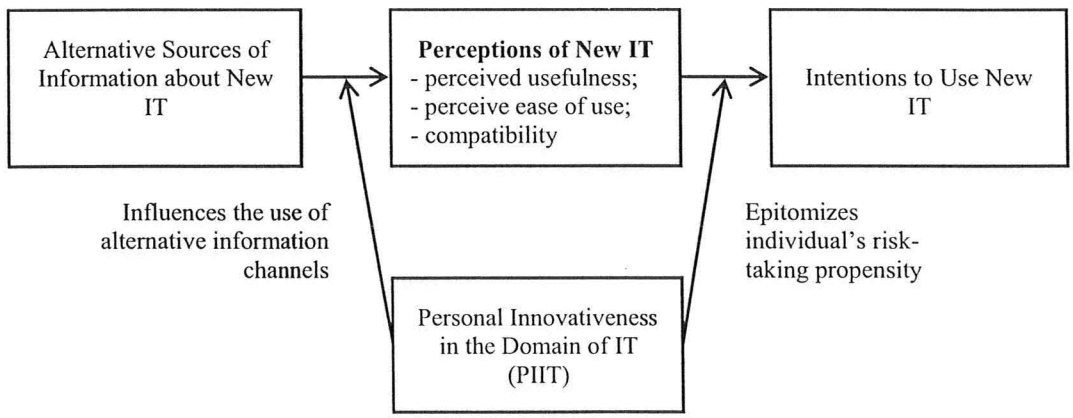

Figure 3.4: Agarwal and Prasad's (1998) Model of Personal Innovativeness in IT

In this model, PIIT is a key moderator of both antecedents and consequences of perceptions about interface agents. As an **antecedent of perceptions**, PIIT posits that individuals with higher PIIT will interpret the information about interface agents obtained from alternative sources more positively than those with lower PIIT given the same level of perceived usefulness, ease of use, and enjoyment with interface agents. As an **antecedent of user intentions**, the model presumes that people with higher PIIT will also

develop and demonstrate more positive intentions towards using the interface agent technology than those with lower PIIT.

Despite its newness, the concept of personal innovativeness in IT has already received considerable attention, recognition, and support in academia. For example, Karahanna et al. (2002) conclude that personal innovativeness is one of the factors that influences a person's perceived relative advantage of using Group Support Systems. Limayem, Khalifa, and Frini (2000) provide strong support for the positive effect of personal innovativeness on someone's attitudes and intentions to shop online. McKnight, Choudhury, and Kacmar (2002) test the concept of personal innovativeness in the Web Trust Model. Thatcher and Perrewe (2002) demonstrate that PIIT has a statistically significant direct positive relationship with computer self-efficacy and a direct negative relationship with computer anxiety. By adapting the measurement scale for PIIT proposed by Agarwal and Prasad (1998), the study identifies a positive relationship between the level of consumer confidence and the degree of personal innovativeness in online environments. Most importantly, PIIT has been positioned as an antecedent of TAM. Overall, this prior research manifests the appropriateness of incorporating PIIT in TAM to investigate user adoption of email interface agents.

3.6 Proposed Theoretical Model

The above review of the literature demonstrates the viability of incorporating the three following constructs into Davis' original Technology Acceptance Model as a means of offering insights into user adoption decisions regarding interface agents in electronic mail environments: computer playfulness, personal innovativeness in information technology, and perceived enjoyment. Computer playfulness and PIIT are external variables (i.e., external to the model) reflecting a user's individual characteristics. Perceived enjoyment is a cognitive factor involving a person's perceptions of a system (i.e., internal to the model). Consistent with previous TAM-based models, computer playfulness and PIIT are included as antecedents and perceived enjoyment is integrated as a TAM construct. Figure 3.5 outlines this model. This research initiative is unique and original in two aspects. First, it combines the construct of perceived user enjoyment and the antecedents of computer playfulness and PIIT under a single umbrella of TAM. Secondly, it applies this model to the investigation of user adoption of interface agents for email that is an unexplored research area.

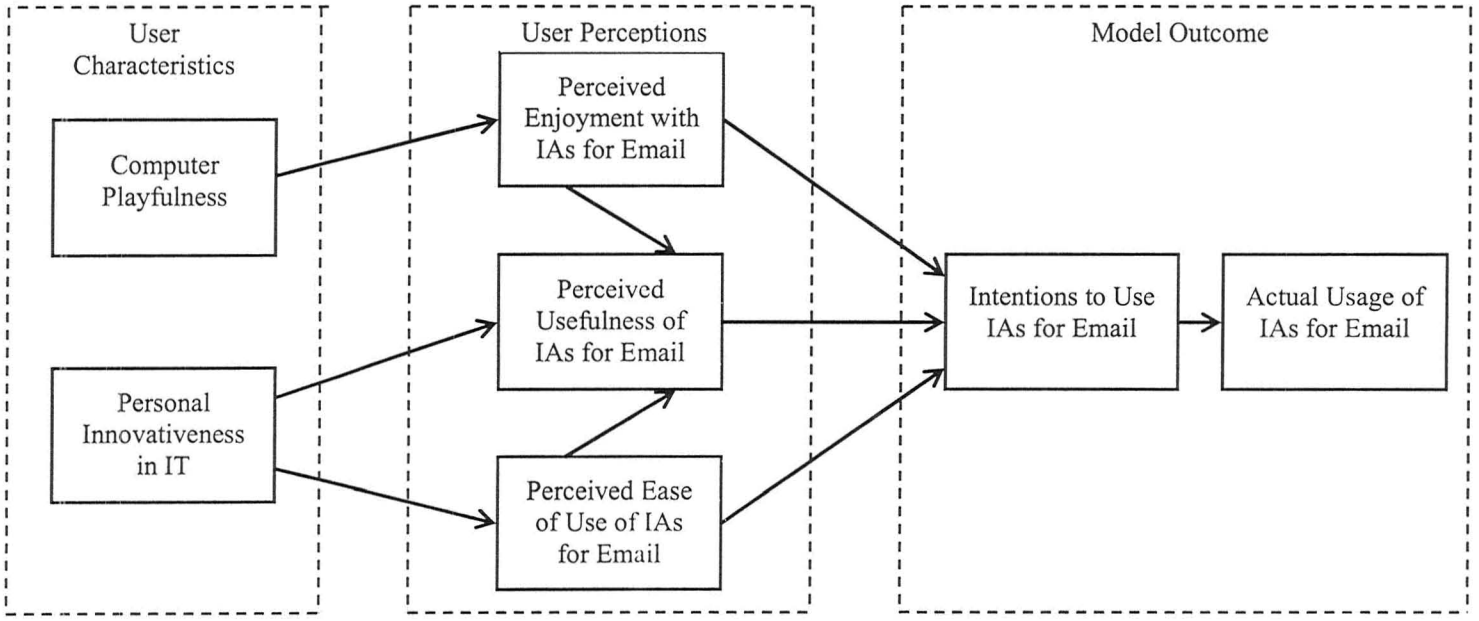

Figure 3.5: Theoretical Model of User Adoption of Interface Agents for Email

The purpose of the model is to describe individual behavioral intentions towards utilizing email interface agents. Consistent with many recent technology adoption studies (Agarwal and Karahanna 2000; Bhattacherjee 2001; Koufaris 2002; Venkatesh 1999; Venkatesh 2000), the proposed model omits the dependent variable that is present in the original TAM: attitudes towards using the system. The argument that supports this decision refers to the nature of someone's intentions to utilize a particular computer-based system. All previous investigations have identified strong positive relationships between attitude towards using the system and behavioral intentions towards use. Therefore, measuring only the variables of an individual's behavioral intentions towards using interface agents as well as the actual use should satisfy the purpose of the model.

According to the model, the actual usage behavior is influenced by behavioral usage intentions. Further, the model suggests that each construct: perceived usefulness, perceived ease of use, and perceived enjoyment influences a person's intentions whether to accept or reject a particular interface agent in email systems.

Consistent with Davis' initial realization of TAM, the proposed model includes two independent external variables which serve as a bridge between these three TAM determinants and user individual differences: computer playfulness and personal innovativeness in information technology. Considering the individual-specific nature of both computer playfulness and PIIT, these constructs reflect personal user characteristics and they are included in the model as positive antecedents of other variables. As such, computer playfulness is positioned as an antecedent of perceived enjoyment, and PIIT is presented as an antecedent of perceived usefulness and ease of use of interface agents for email. Computer playfulness and PIIT are separate constructs and, therefore, are expected to affect user perceptions individually. Thus, a person with a high degree of computer playfulness is expected to enjoy email interface agents to a higher extent than someone with a lower degree of computer playfulness. An individual with a high level of PIIT is also predicted to form more positive perceptions of usefulness and ease of use of interface agents than a counterpart with a low level of PIIT.

In terms of this dissertation, the Model for User Adoption of Interface Agents for Email is used to structure four general research questions:

RQ1: *How well do the individual characteristics of computer playfulness and personal innovativeness in the domain of information technology influence user perceptions of interface agents used in electronic mail systems?*

RQ2: *What are the possible associations among the constructs reflecting user perceptions (perceived enjoyment, perceived usefulness, and perceived ease of use)?*

RQ3: *How well do user perceptions of interface agents (perceived enjoyment, perceived usefulness, and perceived ease of use) impact a person's intentions regarding the usage of interface agents in electronic mail systems?*

RQ4: *How appropriate is the proposed theoretical model in explaining user adoption behavior with respect to interface agents in electronic mail systems?*

Recall in addition to the proposition and empirical testing of the model, this dissertation study aims to produce guidelines and recommendations on the usefulness of email interface agents that may be of interest to current and potential users, manufacturers, and marketers of this technology. Empirical findings in innovation research suggest that users often play a leading role in the invention and improvement new products and services (Biemans 1991; Lüthje 2004). As of today, many commercial projects have succeeded because designers and manufactures involved users in the early stages of innovation development. A strong understanding of user needs is a key factor separating new product winners from losers (Cooper and Brentani 1991).

Innovation studies always emphasize that it is crucial to collect information about consumers at each stage of a product's lifecycle. Rogers (1995) classify adopters on the basis of when they purchase a new product. For instance, he argues that *innovators* are venturesome, educated, and well-off individuals who risk acquiring innovations as soon as they emerge on the market. Midgley and Dowling (1978) and Goldsmith and Hofacker (1991) attempt to develop categories of adopters based on individuals' personality traits. Overall, the goal of most marketing surveys is to develop a sound understanding of the various characteristics of product users, such as demographics, habits and inclinations.

The understanding of user attributes and personal characteristics is also important in the field of agent-human interaction. For example, Isbister and Nass (2000) empirically demonstrate that individuals tend to prefer to utilize an interface agent whose personality is complimentary to that of users.

In addition to user attributes, the actual usage and user perceptions of interface agents are important issues that are of interest to both developers and marketers. Prior experience has been found to be an important determinant of behavior in various situations (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), including the use of computer technologies (Taylor and Todd 1995a) and interface agents (Serenko and Cocosila 2004). There are significant differences in perceptions of applications, depending on a user's level of expertise. For example, expert and heavy users of email interface agents may develop a stronger knowledge, special usage habits, and different perceptions of agents than individuals who use email agents less frequently that further affects their usage behavior (Hoch and Deighton 1989).

Based on this discussion, it is believed that the knowledge of user characteristics, agent usage patterns, and people's perceptions of interface agents will help all parties involved in the process of inventing, development, and marketing email interface agents to deliver the product that will meet customer expectation. The following research questions are suggested:

RQ5: *What are the characteristics of the user population who adopt email interface agents? For example, age, gender, occupation, email usage experience, etc.*

RQ6: *How do people typically utilize email interface agents?*

RQ7: *What are people's perceptions of email interface agents?*

These research questions form the background for constructing a number of specific hypotheses aimed to gather empirical evidence on user adoption decisions regarding email interface agents. These hypotheses are described below.

3.7 Hypotheses

The **first research question** pertains to investigating the influence of individual characteristics of computer playfulness and personal innovativeness in the domain of information technology on users' perceptions of email interface agent usage. Previous studies on computer playfulness demonstrate that the individual-specific trait of computer playfulness is positively associated with computer involvement, positive mood, satisfaction, learning, creativity, and exploratory computer behavior (Glynn and Webster 1992; Webster and Martocchio 1992). Martocchio and Webster (1992) demonstrate that computer trainees with higher levels of computer playfulness experience greater positive mood and are more satisfied with feedback on their performance. Previous play research suggests that during more playful interactions with different tasks, playful individuals not only engage in exploratory behavior but also spend more time and efforts on those activities and enjoy what they are doing to a higher extent (Csikszentmihalyi 1975; Csikszentmihalyi 1990). Anandarajan, Simmers, and Igbaria (2000) discover that people with a high level of Internet playfulness perceive Web-related activities more favorable and productive than those with a low level of Internet playfulness. Lewis (1999) reports that computer playfulness has a strong positive effect on enjoyment ($\beta = 0.4$, $p < 0.001$) but not on perceived ease of use.

By following the line of reasoning that Venkatesh (2000, p. 348) pursues to integrate computer playfulness into TAM, it is assumed that computer playfulness represents an abstraction of the openness to the process of human-agent interaction and such an abstraction criterion is expected to serve as an antecedent for perceived enjoyment with an interface agent. In this case, computer playfulness is a system or agent-independent variable that represents individual cognitive differences to interact playfully with an interface agent. Users who are generally more playful with computers are expected to utilize a new system with an interface agent just for the sake of using it rather than for achieving specific purposes. Since computer playfulness features include such characteristics as innovativeness, enjoyment, creativity, and originality, these people are predicted to tend to overestimate their degree of enjoyment during the use of an interface agent. Both personal traits and situation-specific states may influence the level of computer playfulness, however, in email environments, only traits may have a significant predictive power. As such, individual traits may determine general predisposition to interact playfully with an interface agent and may, therefore, serve as a TAM antecedent. Based on these observations, it is hypothesized that:

H1: *Computer playfulness will have a positive direct effect on perceived enjoyment with interface agents for email.*

Similar to computer playfulness, personal innovativeness in the domain of information technology may also potentially influence a person's perceptions of interface agent usage. Agarwal, Sambamurthy, and Stair (2000) empirically prove that personal innovativeness in IT strongly influences an individual's perceptions of an ability to perform computer related tasks. The study demonstrates that PIIT influences people's self-efficacy with a software application which, in turn, affects their perceptions of ease of use of this computer system. Agarwal and Karahanna (2000) confirm that the degree of personal innovativeness in information technology, mediated by the level of cognitive absorption of an individual, has a substantial positive effect on both perceived usefulness and perceived ease of use of the system.

Recall intelligent and interface agents are innovative technologies (Serenko and Detlor 2004). Based on this evidence, it is suggested that more innovative individuals will explore most features of email interface agents, perceive them to be more useful and become more adept at using them. Therefore, these people should find email interface agents more useful and easier to use:

H2: *Personal innovativeness in the domain of information technology will have a positive direct effect on perceived usefulness of interface agents for email.*

H3: *Personal innovativeness in the domain of information technology will have a positive direct effect on perceived ease of use of interface agents for email.*

The **second research question** aims to examine the internal interactions of the constructs that reflect user perceptions of the technology of interest. The hedonic qualities of software products often inspire people to engage into human-computer interaction processes more frequently. The hedonic features of email interface agents are conceptualized in the form of the perceived enjoyment construct. Previous MIS research argues that perceived enjoyment is an important factor influencing an individual's perceptions of the usefulness of computers (de Souza Dias 1998). The empirical investigations by Davis et al. (1992) discover the positive interaction between perceived usefulness and perceived enjoyment. Based on this observation, Davis and his colleagues conclude that enjoyment with has a higher positive effect on user intentions when the software application is perceived more useful and visa versa. They conclude that for systems that are high in perceived usefulness, perceived enjoyment has a greater impact on acceptance decisions. At the same time, for systems that are low in perceived usefulness, perceived enjoyment has a reduced impact on acceptance decisions.

In a recent empirical investigation of user adoption of interface agents in Microsoft Office applications, Serenko, Bontis, and Detlor (forthcoming) found that perceived enjoyment with an interface agent strongly influences the perceptions of the usefulness of this agent ($\beta = 0.707$, $p < 0.001$). With respect to the goal of this dissertation, it is believed that people who enjoy with email interface agents to a higher degree will also find this technology more useful. Thus, it is suggested that:

H4: *Perceived enjoyment will have a positive direct effect on perceived usefulness of interface agents for email.*

The initial Davis' TAM studies (Davis 1989; Davis et al., 1989) hypothesize and empirically demonstrate the positive direct effect of perceived ease of use on perceived usefulness of a system. Indeed, those individuals who perceive a particular computer application easy to operate should utilize it more extensively and perceive it more useful in the completion of certain tasks. Virtually all subsequent TAM-based investigations confirmed this standpoint (Gefen and Straub 2000; Gefen, Straub and Boudreau 2000). It is presumed that the same statement holds true in the case of interface agent research:

H5: *Perceived ease of use will have a positive direct effect on perceived usefulness of interface agents for email.*

The **third research question** relates to exploring the impact of the model's three constructs (perceived enjoyment, perceived usefulness, perceived ease of use) and on user behavioral intentions regarding the usage of interface agents in electronic mail systems.

Previous research demonstrates that people who perceive all computer-related tasks to be naturally enjoyable and who experience pleasure and joy from using a software system directly, regardless of expected performance outcomes, are likely to utilize it more frequently and extensively than other users (Davis et al., 1992). It is assumed that if a person actually enjoys using an interface agent which delivers incoming mail, announces reminders, or simply entertains a user, he or she will utilize it more extensively apart from all anticipated consequences, outcomes, and extrinsic rewards.

Various MIS studies in different areas argue that both perceived usefulness and perceived ease of use of a system influence a person's decision whether to utilize it in a specific context. In fact, it is the goal of each TAM study to demonstrate the influence of the constructs reflecting a user's perceptions of the technology under investigation on his or her behavioral intentions. In most cases, the influence of perceived usefulness is at least twice as strong as that of perceived ease of use.

In order to establish the relevance of these constructs as a predictor of usage intentions, the study hypothesizes that:

H6: *Perceived enjoyment will have a positive direct effect on behavioral intentions.*

H7: *Perceived usefulness will have a positive direct effect on behavioral intentions.*

H8: *Perceived ease of use will have a positive direct effect on behavioral intentions.*

The **fourth research question** pertains to two issues. The first relates to the analysis of the impact of behavioral intentions on actual usage of email interface agents. The rationale is that prior research strongly suggests that behavioral intentions are the key factor influencing actual usage of technology. For this, the following hypothesis is stated:

H9: *Behavioral intentions will have a positive direct effect on the actual use of email interface agents.*

The second issue refers to the measurement of predictive power of the entire model of user adoption of email interface agents. To address this matter, the study will estimate the model's total explained variance in behavioral usage intentions as well as in

actual usage behavior and compare the observed numbers with those of prior technology adoption investigations. Since only a visual comparison of R-square values[25] of the models will be conducted, and no hypothesis is suggested.

The **fifth, sixth, and seventh research questions** relate to the understanding of user background and their actual usage and perceptions of email interface agents. To answer these three research questions, information from users of this technology will be collected. Again no hypotheses are presented. To describe user characteristics, basic personal data of users will be collected and descriptive statistics on agent user population will be offered. As such the goal is to develop a demographic profile of those innovative individuals who utilize email interface agents. In terms of current employment and perceptions of agents, an inductive study will be conducted that does not require hypotheses.

To empirically test these hypotheses, this study develops a survey of actual users of email interface agents. In addition to the collection of data to validate the suggested model, the survey aims to obtain information to address practical contributions of the study. The following chapter presents a detailed description of the study's participants, methods, and survey design principles.

[25] The meaning of R-square values is discussed in the following chapter.

Chapter 4: Methodology

This study utilizes a mixed methods methodology that comprises both a deductive and an inductive approach. The purpose of the deductive approach is to empirically test a theoretical model of user adoption of interface agents in electronic mail environments. This part of the dissertation tackles research questions one through four (RQ1 – RA4) and a set of related hypotheses one through nine (H1 – H9). For this, Structural Equation Modeling (SEM) is employed that represents a quantitative data analysis technique.

The goal of the inductive approach is to investigate the contextual factors surrounding end-user agent adoption by employing both quantitative and qualitative research methods. This section attempts to answer research questions five, six and seven.[26] The appropriate quantitative and qualitative data analysis techniques are applied to investigate various aspect of user background (RQ5) and interface agent usage (RQ6), and to form an understanding of people's perceptions of email interface agents (RQ7).

After both deductive and inductive analyses are complete, results from both parts are triangulated to ensure the validity of the scientific findings.

4.1 Study Participants

4.1.1 Respondent Selection

An examination of project methodologies described in key MIS papers on technology adoption and user predispositions covered in Chapter 3 reveals an alarming trend involving college and university students in experiments and surveys. On the one hand, students represent a broad population of potential technology adopters and users. On the other, in those investigations, the use of students corresponds to a convenience rather than a probabilistic sampling method. This study employs a probabilistic sampling method. The probabilistic sampling method is one in which every member of the target population has a known, non-zero, and equal probability to be randomly selected for the experiment or survey (Kitchenham and Pfleeger 2002c). The aim of a probabilistic sample is to eliminate subjectivity and research bias and to obtain a sample that truly represents the target population. Only by following the probabilistic sampling method can one make generalizations about a user population. For these reasons, the probabilistic sampling method is chosen over the convenience sampling approach, which should increase the generalizability of this dissertation's results.

In addition, as Dehn and van Mulken (2000) note in their meta-analysis of the interface agents literature, all previous studies have measured individual experiences of a very short user-agent interaction timeframe. However, they hypothesize that behavioral intentions towards using interface agents may take some time to establish. Such an assumption would seriously undermine conclusions of previous experimental studies on

[26] Recall research questions 5, 6, and 7 do not have related hypotheses.

the usefulness and user adoption of interface agents conducted in laboratory settings. In order to circumvent any such biases in this research, the dissertation study aims to survey actual users of interface agents for email who have voluntarily chosen to use this technology and who have utilized it for at least three months. This period of time is chosen because it allows individuals to explore all features of the technology in detail and to form an opinion about its characteristics. For example, Venkatesh, Morris, Davis, and Davis (2003) in their validation of the Unified Theory of Acceptance and Use of Technology surveyed users three months after the implementation of a system.

According to basic survey design principles, the subjects of each study should be: 1) true representatives of the target user population; 2) knowledgeable enough to answer questions; 3) randomly selected; and, 4) motivated to provide accurate responses (Kitchenham and Pfleeger 2002b; Kitchenham and Pfleeger 2002c). The suggested methodology of the dissertation attempts to accurately address all these issues.

As stated above, the surveyed individuals should represent the general population to whom the technology under investigation is targeted. Thus, all individuals who utilize electronic mail as a form of communication would suffice. However, only those people who are familiar with interface agents for email may possess the necessary knowledge to provide insights on the reasons why they prefer to use or reject this technology. Therefore, the general study's target survey population is defined as all email users who have utilized interface agents in their email applications for a period of time long enough to form reliable behavioral usage intentions.

An intensive Web-search conducted by the author in January 2003 for possible implementations of interface agents in email applications resulted in the identification of 11 online-available email notification applications. As discussed in Section 2.2.4, the general purpose of electronic mail notification programs is to inform users about novel or modified information. An interface agent is employed in these applications to announce recently received email and ICQ messages, calendar reminders, and virus alerts. Several versions of interface agents offer extensive features such as teaching brief tutorials on email system usage, which is very valuable for novice users, and sending sound and animated messages. The list of these email notification agents is presented in Appendix 3. Out of those 11 products, three are freeware[27] and eight are commercial applications with prices ranging from $14.95 to $29.95 US. By following the assumption that most people who have voluntarily chosen to pay for the product either are currently using, or at least have made an attempt to use this agent-based application, it is argued that surveying present or former users of commercial email notification programs embedded with an interface agent would meet the requirements of the study. The major rationale behind this argument is that such individuals have interacted with an interface agent long enough to form stable beliefs, attitudes, and behavioral intentions which are not influenced by temporary factors such as first impression bias (Asch 1946) or experimental confounding.

[27] Freeware is a copyrighted software product given away for free by the producer. The developer retains the copyright, which implies that other parties are allowed to use, but not to alter or sell the product.

Since all companies allow free trials of their interface agent applications, it is assumed that most individuals who purchased the product had previously tested it and, therefore, did not have any technical difficulty using the software.

All eight commercial interface agent-based email applications were installed on the researcher's personal computer and successfully tested for one week. All applications were found to be similar to one another in terms of their features, reliability, operability, and ease of installation and use. In order to control for application and interface agent-specific effects, a decision was made to survey users of only one interface agent email notification system. As such, those individuals form a homogeneous group of subjects who have gained similar experiences with an identical agent-based technology. Out of the manufacturers offering a commercial agent software product for email (see Appendix 3), one company was randomly chosen by the author. The freeware products were excluded because it was assumed that the developers do not have accurate customer databases.

Thus, the executives of company ABC[28] were contacted through an email message which described the project and asked for an opportunity to survey those customers who have purchased the product. The executives from this company were supportive of the idea and agreed to assist in the study. A non-disclosure agreement with the company was signed that states that the company's name should be disguised. Initially, the list of customers who served as the study's participants was supposed to be randomly selected. For this, a probabilistic systematic sample method should have been utilized (Kitchenham and Pfleeger 2002c). However, given the limited number of ABC customers, the entire customer database was sent to the researcher who approached all individuals who purchased the interface agent-based application.[29]

To summarize, the dissertation attempts to survey the individuals who have purchased a commercial version of an interface agent email notification system developed by ABC Company and utilized it for at least three months. Given that most previous technology adoption studies have surveyed subjects after they interacted with the technology under investigation during a brief one or two-hour session, it is believed that three months is sufficient time for individuals to become knowledgeable about the software and to form reliable perceptions towards an interface agent.

4.1.2 Response Rate

With respect to this dissertation study, a decision was made to utilize a Web-based rather than paper-based survey. There are several advantages of the employment of an online survey. First, it reduces postage expenses. Second, it allows researchers to receive complete questionnaires immediately after a respondent submits a form. Third, the completion of an online form is more convenient for the participants since it is believed

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[28] Company ABC is a pseudonym.

[29] As per the non-disclosure agreement, ABC Company did not want to disclose the number of customers it had. For that reason, the actual response rate will not be reported in this dissertation. Any information about the actual response rate may reveal the number of customers the company has.

that most of them are Web-savvy. Last, the use of electronic questionnaires produces response rates comparable to those of regular surveys provided that researchers adequately design the data collection process. For example, Serenko and Detlor (2003) achieved a response rate of 66% in their online survey of invited instructors teaching artificial intelligence courses.

Response rate is the number of completed questionnaires divided by the number of participants who were asked to participate in a study. As of today, response rates remain a primary concern for many survey researchers (Larson and Chow 2003). The consideration of response rates is important for three main reasons. First, the validity of statistical conclusions may be seriously compromised if there is a high level of non-response because of a significant risk that the collected data are biased. Secondly, low response rates bring fewer numbers of cases than required for performing a rigorous statistical analysis. Thirdly, low response rates may indicate that the survey is not appropriate for this target population or that potential respondents do not find this research interesting and important (Frohlich 2002; Kitchenham and Pfleeger 2002a).

Response rates are an important indicator of survey research success. Usually, most paper-based surveys achieve an average response rate of 25 percent. In some cases, the response rate may be as low as three or as high as eighty percent. For example, the meta-analysis of operations management survey research by Frohlich (2002) reports the average response rate of 32 percent.

In order to increase response rates, several methods can be utilized. First, the use of monetary incentives yields consistent positive results in both consumer and organizational surveys. According to a study by Jobber, Saunders, and Mitchell (2002), the inclusion of any financial incentive, regardless of the amount, raises the response rate by approximately fifteen percent. The actual amount of the incentive has an additional positive effect on the response rate. It has been found that an increase in monetary reward by one dollar raises the response rate by two percent. With respect to this dissertation study, a decision was made to offer a monetary incentive of ten US dollars to all respondents who completely fill out an online questionnaire.

Secondly, the appropriateness of both questions and language used in the survey may dramatically contribute to obtaining a desirable response rate. It is suggested that respondents should possess enough knowledge and experience to clearly answer the questions, and that the language used in the construction of the questionnaire should correspond to the level of respondents' education. For example, Bontis, Crossan, and Hulland (2002), in their development of a survey instrument to measure the relationship between the stocks and flows of learning across organizations, targeted the language of the questionnaire at a high school level of comprehension. Regarding the present study, the language used in the construction of questions is relatively simple. The language of correspondence and instructions is targeted at a high school level of comprehension.

Thirdly, the length of a questionnaire has a substantial effect on response rate. According to Dillman (1999), a shorter questionnaire delivers a higher response rate than a longer one. Dillman recommends that the length of a questionnaire be below 11 pages.

Yammarino Skinner and Childers (1991) suggest that the decrease in the number of pages down to four raises the level of response by six percent. The length of the questionnaire utilized in this dissertation investigation is expected to be below 11 pages that may positively influence an individual's decision whether to participate in the survey.

Fourthly, several questionnaire-independent perceptions of respondents, such as study importance, confidentiality issues, and risks involved, may also affect the level of response. Prior research demonstrates that people tend to reply to surveys if they believe that their participation may potentially contribute to an important field. Individuals also want to be assured that all information they provide will be treated confidentially and that there are no risks involved in the participation. For this reason, the first Webpage of the questionnaire should explain the purpose and importance of the study, the process of the selection of respondents, the value of each respondent's contribution, and the treatment of solicited information. In addition, every attempt is made to minimize the number of questions pertaining to information that some people may consider private. As suggested by Kitchenham and Pfleeger (2002b) such questions are presented at the end of the questionnaire in order not to discourage potential respondents.

Lastly, administrative procedures, for example, the verification of respondents' addresses and multiple follow-ups, are well-established techniques of successful survey research which may increase a response rate by up to 18% (Yammarino et al., 1991). These techniques are utilized in the development of a data collection process by employing Dillman's Tailored Design Method. The principles of this method are presented in the next subsection of this dissertation.

To summarize, this study strides to achieve an adequate response rate. Table 4-1 below provides the calculation of a projected level of response.

Table 4-1: Projected Response Rate

Factor	Response Rate Increase
Regular mail or online survey	20%
$10 US monetary incentive ($10*2%)[30]	20%
Appropriateness of questions and adequate language[31]	1%
Perceptions of respondents[32]	1%
Tailored Design Method	18%
Total	**60%**

[30] The increase in the response rate as a result of the introduction of any financial incentive suggested by Jobber, Saunders, and Mitchell (2002) is ignored to keep the projection as conservative as possible. However, it is assumed that the increase in monetary reward by one dollar raises the response rate by two percent.

[31] Since no exact number for this factor was identified, a conservative estimation of 1% increase in the level of response has been made.

[32] Since no exact number for this factor was identified, a conservative estimation of 1% increase in the level of response has been made.

4.1.3 Respondent Recruitment

Recall this study surveys current and past users of an interface agent email notification application developed by ABC Company. The representative sample includes individuals who purchased the software at least three months ago. All electronic correspondence is sent by the researcher from an email account of ABC Company at research@ABCCompany.com.

In order to develop a methodologically sound data collection procedure, Dillman's Tailored Design Method was adapted (Dillman 1999). It represents an improved version of the previous Dillman's Total Design Method (Dillman 1978). The Tailored Design Method is a commonly used and widely recognized approach which outlines major principles of successful mail and Internet survey research. This method relies heavily on personalization and follow-up procedures, and it serves as the vehicle for conveying critical messages to potential respondents. By adapting the Total Design Method, the four-phase survey process was developed where every step takes place exactly one week after the previous email was sent.

Figure 4.1 visualizes all stages of this process.

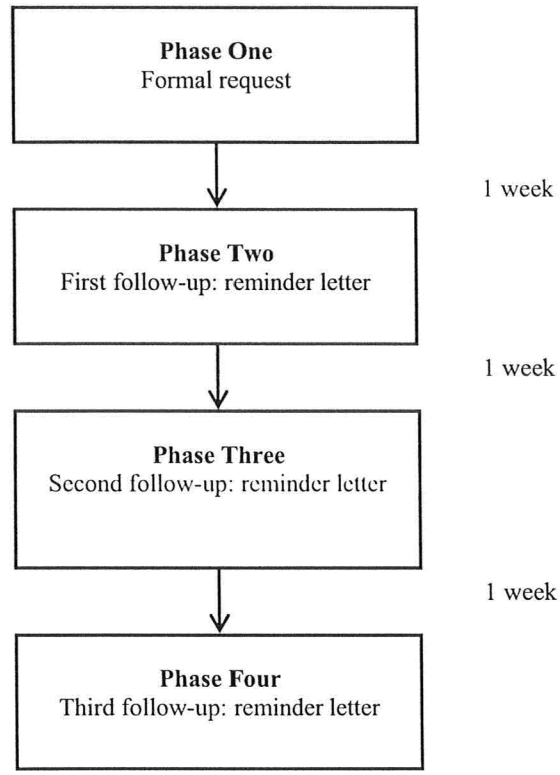

Figure 4.1: The Four-Phase Survey Implementation Approach

During the **first phase**, all individuals on the list are sent a personalized email message. The purpose of this request is two-fold. The first is to provide details or conditions of the study for those who immediately wish to involve themselves. The second aim is to build anticipation for those who doubt their potential participation in the investigation. The message provides the URL of the Web-based questionnaire and mentions the compensation of respondents. A sample request message utilized in this dissertation investigation is presented in Appendix 4.

At the **second phase**, all individuals on the list who did not complete the survey are sent another personalized email. In order to increase the perceptions of personalization, a person's name is mentioned twice: in the introductory line and in the text body. The date of product purchase is also included (see Appendix 5).

During the **third phase** of the survey, a second follow-up email is sent to all recipients who did not complete the survey. The purpose of this message is to remind the potential participants about the study. Again, each letter is personalized. Appendix 6 offers an example of this email message.

At the **fourth phase**, a third follow-up electronic message is sent to all individuals who did not submit a completed questionnaire. Appendix 7 presents the third follow-up letter.

Overall, it is believed that the employment of this data collection approach would yield an adequate response rate and solicit responses that would provide valid answers to the study's research questions.

4.2 Data Collection

4.2.1 Deductive Approach

The goal of this section is to develop a method by which to test the previously identified hypotheses which may serve as the basis for accepting, modifying, or rejecting the model.

In order to test the study's hypotheses, this research employs a statistically-grounded survey method. A survey is one of the most widely used research methods in various disciplines, including MIS. Contrary to popular belief, a survey is "not just an instrument for gathering information. It is a comprehensive system for collecting information to describe, compare or explain knowledge, attitudes and behavior" (Pfleeger and Kitchenham 2001, p. 16). The survey process comprises the following activities: 1) the identification of a target population; 2) the design and, if necessary, the pretest of an instrument to establish its validity and reliability; 3) the decision on appropriate data analysis techniques; 4) the calculation of sample size requirements and the selection of a valid sample; 5) the prediction of an acceptable response rate; and, 6) the development of data collection procedures (Pfleeger and Kitchenham 2001).

Recall the suggested model employs five dependent and two independent variables. The dependent variables are perceived usefulness, perceived ease of use, perceived enjoyment, behavioral intentions, and actual usage. The independent variables are personal innovativeness in information technology and computer playfulness. Both categories of these variables and their measurement scales are presented below.

4.2.1.1 Independent Variables

Personal innovativeness in the domain of information technologies (PIIT) is epitomized as "the willingness of an individual to try out any new information technology" (Agarwal and Prasad 1998, p. 206). This self-report instrument has been operationalized by Agarwal and Prasad (1998) in the form of a four-item questionnaire illustrated in Table 4-2 below. Both the instrument developers and succeeding researchers find this tool highly reliable and valid (Agarwal and Karahanna 2000; Agarwal et al., 2000; Thatcher and Perrewe 2002).

This dissertation study's model positions PIIT as an antecedent of TAM and intends to measure the construct independently of users' perceptions about interface agents. Therefore, the original PIIT scale may be applied in this study with no modifications.

Table 4-2: Perceived Innovativeness in the Domain of Information Technology (PIIT)

Scale Items. 7-item Likert scale (strongly disagree/strongly agree).	
Personal Innovativeness in the Domain of Information Technology (PIIT). Instructions: The questions below ask you to describe your behaviors in the context of **information technologies**. Information technologies are computer systems concerned with all aspects of managing and processing information. Information technologies include personal computers, software applications, telecommunications networks (e.g., the Internet and Email), etc. Please indicate the number that best matches your opinion.	
Item Identifier	**Question**
PIIT1	If I heard about a new information technology, I would look for ways to experiment with it.
PIIT2	Among my peers, I am usually the first to try out new information technologies.
PIIT3	In general, I am hesitant to try out new information technologies. (R)
PIIT4	I like to experiment with new information technologies.
	(R) - Reverse Scaled Item

Computer playfulness reflects an individual's tendency to interact spontaneously, intensively, and imaginatively with computers. A 22-item Computer Playfulness Scale (CPS) was introduced by Webster and Martocchio (1992) based on adaptation of Lieberman's (1977) Adult Cognitive Spontaneity Construct. This 22-item scale was subjected to thorough statistical examination including factor analysis, internal consistency, concurrent, discriminant and predictive validity, predictive efficacy, and test-retest reliability. This methodologically sound evaluation of the scale provided a reliable initial assessment of this instrument and generated a short seven-item version of the CPS. Table 4-3 below presents this seven-item scale.

Table 4-3: The Computer Playfulness Scale

Scale Items. 7-item Likert scale (strongly disagree/strongly agree). Instructions: The following questions ask you how you would characterize yourself when you use personal computers.[33] For each adjective listed below, please indicate the number that best matches a description of yourself when you interact with computers.	
Computer Playfulness Scale (CPS).	
Item Identifier	**Question**
CPS1	Spontaneous.
CPS2	Unimaginative. (R)
CPS3	Flexible.
CPS4	Creative.
CPS5	Playful.
CPS6	Unoriginal. (R)
CPS7	Uninventive. (R)
	(R) - Reverse Scaled Item

[33] The term "personal computer" is utilized in the instructions instead of the original Webster's "microcomputer" to reflect the changes in the contemporary computer terminology.

Many subsequent studies have successfully subjected both full and short forms of the CPS to validity and reliability testing (Atkinson and Kydd 1997; Hackbarth, Grover and Yi 2003; Potosky 2002; Yager et al., 1997). To measure the level of computer playfulness of individuals using interface agents for email, the short version of the CPS is applied. This instrument asks individuals to indicate their degree of agreement on seven adjectives.

4.2.1.2 Dependent Variables

Recall the following three definitions of variables described in the study's model. **Perceived usefulness** (PU) is defined as a user's subjective probability that using interface agents in the email system will increase his or her performance. **Perceived ease of use** (PEOU) is conceptualized as an individual's perceptions that utilizing interface agents is free of mental, physical or any other efforts. **Behavioral intentions** (BI) is labeled as a person's intent to continue using interface agents in the email environment.

The initial Likert scales for measuring perceived usefulness, perceived ease of use, and behavioral intentions were first introduced by Davis (1989). Initially, both perceived usefulness and perceived ease of use were realized in the form of two independent 14-item sets of questions. Since then, various pre-tests and assessments of scales have reduced the number of items at first to ten and then later to only six items per construct. In 1989, Davis, Bagozzi, and Warshaw further streamlined these scales to two four-item questions. Table 4-4 presents these scales.

Table 4-4: Perceived Usefulness and Perceived Ease of Use Scale Items by Davis et al. (1989)

Scale Items Instructions: Please answer all questions based on your experience with the WriteOne application.	
Perceived Usefulness. 7-item likely/unlikely Likert scale.	
Item Number	**Question**
1	Using WriteOne would improve my performance in the MBA program.
2	Using WriteOne in the MBA program would increase my productivity.
3	Using WriteOne would enhance my effectiveness in the MBA program.
4	I would find WriteOne useful in the MBA program.
Perceived Ease of Use. 7-item likely/unlikely Likert scale.	
Item Number	**Question**
1	Learning to operate WriteOne would be easy for me.
2	I would find it easy to get WriteOne to do what I want it to do.
3	It would be easy for me to become skilful at using WriteOne.
4	I would find WriteOne easy to use.

These questions were designed to explain perceived usefulness, perceived ease of use, and behavioral intentions in regards to using a computer word processing system, called WriteOne. The questionnaire was targeted to MBA students utilizing the system.

A behavioral intentions measurement scale was first implemented as the following single statement: "I presently intend to actively use WriteOne regularly in the MBA

program." Afterwards, it was transformed into two questions positioned on a 7-item Likert scale: "Assuming I had access to the system, I intend to use it", and "Given that I had access to the system, I predict that I would use it" (Venkatesh and Davis 2000).

Since their inception, these above-mentioned scales for PU, PEOU, and BI have been utilized across numerous technology adoption studies and subjected to successful reliability and validity testing (Mathieson 1991; Segars and Grover 1993; Taylor and Todd 1995b).

Consistent with many subsequent studies who adapted the original Davis' scale by replacing the name of the system (WriteOne) and usage circumstances (MBA program) with an application to be tested and usage conditions (Subramanian 1994; Venkatesh and Davis 1996; Venkatesh et al., 2002), and considering the adjustment on several perceived ease of use questions (Venkatesh 2000; Venkatesh and Davis 2000), this dissertation investigation utilizes a seven-point Likert measurement scale on perceived usefulness, perceived ease of use, and behavioral intentions with regards to the use of email interface agents. As suggested by Venkatesh et al. (2003), the tense of the verbs was adjusted. This part of the questionnaire is presented in Table 4-5 below.

Table 4-5: The Perceived Usefulness, Perceived Ease of Use, and Behavioral Intentions Scale for Interface Agents in the Email Environment

Scale Items. 7-item agree/disagree Likert scale. Instructions: Please answer all questions based on your experience with the email notification program developed by ABC Company. Please indicate the number that best matches your opinion.	
Perceived Usefulness.	
Item Identifier	**Question**
PU1	Using interface agents improves my performance in the email system.
PU2	Using interface agents in the email system increases my productivity in the email system.
PU3	Using interface agents enhances my effectiveness with the email system.
PU4	I find interface agents useful in the email system.
Perceived Ease of Use.	
Item Identifier	**Question**
PEOU1	My interaction with interface agents is clear and understandable.
PEOU2	Interacting with interface agents does not require a lot of my mental effort.
PEOU3	I find interface agents easy to use.
PEOU4	In find it easy to get interface agents to do what I want them to do.
Behavioral Intentions.	
Item Identifier	**Question**
BI1	Assuming I have access to interface agents, I intend to use them.
BI2	Given that I have access to interface agents, I predict that I would use them.

Perceived enjoyment (PE) refers to the extent to which using interface agents is enjoyable in its own right independent of any anticipated performance consequences. In 1992, Davis, Bagozzi, and Warshaw introduced and validated the perceived enjoyment scale in their motivational study of computer usage. The questions illustrated in Table 4-6

are designed to measure a subjects' degree of enjoyment with the two computer-based graphics systems: Chart-Master and Pendraw.

Table 4-6: The Perceived Enjoyment Scale by Davis, Bagozzi, and Warshaw (1992)

Scale Items. 7-item Likert scale. Instructions: Please answer all questions based on your experience with the WriteOne application.	
Perceived Enjoyment.	
Item Number	**Question**
1	I would find using Chart-Master (Pendraw) to be enjoyable (likely/unlikely).
2	Using Chart-Master (Pendraw) would be pleasant/unpleasant.
3	I would have fun using Chart-Master (Pendraw) (likely/unlikely).

Later, Igbaria, Schiffman, and Wieckowski (1994) expanded the perceived enjoyment scale by indicating up to six different pairs of words that rate an individual's feelings about using computer technologies ("Using a microcomputer in my job is: rewarding/unrewarding, pleasant/unpleasant, fun/frustrating, enjoyable/unenjoyable, positive/negative, and interesting/uninteresting"). Subsequent research finds both scales valid, reliable, and consistent. This demonstrates the construct's validity and gives support to the appropriateness and fruitfulness of applying and adjusting these tools to measure the degree of perceived enjoyment with different computer technologies (Koufaris 2002; Teo et al., 1999; van der Heijden 2003; Venkatesh 2000).

This dissertation adapts the original scale developed by Davis and his colleagues (1992) to determine the level of perceived user enjoyment with interface agents. First, it reduces the number of items in the questionnaire because MIS researchers call for short scales (Moore and Benbasat 1991). Second, both scales produce a comparable Cronbach's alpha coefficient which implies that these scales are equivalent to each other in terms of their internal consistency. Since the study's subjects are actual users of interface agents in email systems, Davis' questions are slightly adjusted by rephrasing conditional statements (for example, "would be pleasant" is changed to "is pleasant.") Table 4-7 offers the three perceived enjoyment questions that have been modified to reflect the purpose of the study.

Table 4-7: The Perceived Enjoyment Scale for Interface Agents in the Email Environment

Scale Items. 7-item agree/disagree Likert scale. Instructions: Please answer all questions based on your experience with the email notification program developed by ABC Company. Please indicate the number that best matches your opinion.	
Perceived Enjoyment.	
Item Identifier	**Question**
PE1	I find using interface agents to be enjoyable.
PE2	Using interface agents is pleasant.
PE3	I have fun using interface agents.

Actual usage is the extent to which an individual employs interface agents in his or her email application. Based on previous MIS studies (for example, see Igbaria, Iivari

and Maragahh 1995; Raymond 1985), the perceived frequency of agent usage is measured. It represents the actual degree of agent utilization given that the use of the system is voluntary. Respondents are asked to indicate how often they use email interface agents in the following environments: at work, at home, and in school. The score is obtained by the employment of a Likert-type scale ranging from 'never' to 'very frequently.' In order to obtain the final usage measure that is included in the dissertation model, the highest of these three measures (i.e., at work, at home, in school) is selected.[34] Overall, the use of a single item measure to assess self-reported technology use is consistent with previous investigations (Gefen and Keil 1998; Steffen 1998). Single-item measures also often employed in reference disciplines, for instance, in organizational behavior (Wanous, Reichers and Hudy 1997).

4.2.1.3 Other

In addition to these questions, the survey included instructions, definitions of an email system and an interface agent, and screenshots of an agent-based notification program. The purpose of the instructions is to clarify all concepts and provide guidance. The instructions given to potential respondents are neutral in order to eliminate the researcher's bias. The final questionnaire is presented in Appendix 2. Since all the scales used in the survey have already been subjected to comprehensive validity and reliability testing, there is no need to pretest or pilot-test this instrument. The survey received the clearance of the McMaster University Research Ethics Board.

4.2.2 Inductive Approach

The purpose of the inductive approach is to solicit responses from current users of an interface agent-based email notification application. The questions pertain to the following areas: 1) critical incidents with the technology; 2) most and least desirable characteristics of the technology; 3) evaluation of effects of interface agents which have been identified in literature; and, 4) insights for developers and marketers.

4.2.2.1 The Critical Incident Technique

In order to fully assess user experiences and to construct a typical scenario of a key episode of the usage of email interface agents, this dissertation employs the critical incident technique (CIT). The critical incident technique, which evolved naturally from work in the Aviation Psychology Program of the United States Air Forces, was best documented in the Colonel John C. Flanagan's[35] (1954) initial article published in

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[34] It is argued that it is not possible to create an 'actual use' construct by operationalizing it with three indicators pertaining to each usage environment (e.g., work, home, school). If it is done so, a set of reflective indictors will have very low reliability and validity given that some people may employ interface agents in only one particular environment, for example, at work, whereas others may utilize them only at home. The development of a construct with formative indicators is avoided as suggested by the MIS research design guidelines.

[35] John C. Flanagan is the founder of the American Institutes for Research, a not-for-profit organization dedicated to the study of human resources and their effective use.

Psychology Bulletin. The CIT is a flexible set of principles for gathering certain important facts concerning behavior in defined situations to facilitate the potential usefulness of obtained information in solving practical problems and developing broad psychological principles. An incident is "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (Flanagan 1954, p. 327). Each incident should have a high degree of significance for an individual's success or failure in a task (Andersson and Nilsson 1964). The technique is based on the assumption that people can report critical incidents on their own (Koenemann-Belliveau et al., 1994). As such, it involves the collection and analysis of brief, written, factual reports of actions in response to explicit situations or problems in a certain field. Incident reports may be written by individuals who actually took an action or by qualified observers. A critical incident is considered effective (or positive) if it helps to solve a problem, or ineffective (or negative) if it fails to solve a problem, creates new problems or facilitates the need for further actions.

The key goal of the employment of the critical incident technique is to build several typical scenarios of the usage of email interface agents under the influence of positive or negative critical events. These scenarios may be presented graphically as a set of factors, constructs or variables and relationships among them. The purpose of these scenarios is to form the understanding of user behavior in the case of both positive and negative critical incidents. It is expected to discover significant differences in user actions, feelings, and future behavior in the case of positive and negative incidents.

Similar to other qualitative data collection and analysis methods, the critical incident technique produces reliable, valid, and generalizable results. In order to address concerns about the rigor of the CIT methodology, Andersson and Nilsson (1964) performed a large-scale study of retail managers by utilizing this approach. The results demonstrate high reliability and validity of this research technique. Ronan and Latham (1974) also conclude on the adequate degrees of reliability and validity of the CIT.

The obtained data may be collected and analyzed both quantitatively and qualitatively by using a variety of methods. Flanagan (p. 334) states that mailed questionnaires produce the same results as those obtained by interview methods given that respondents are motivated to read the instructions and answer consciously. Andersson and Nilsson (1964, p. 400) found an acceptable level of correlation (0.85) between interview and unsupervised questionnaire data collection methods. Especially, self-administered surveys are acceptable for questions designed to be open-ended and self-reported (Wang, Hsieh and Huan 2000). Recently, Kracker (2002a; 2002b) utilized a survey instrument based on the critical incident technique to solicit students' written descriptions of their most memorable research and writing experience and performed content analysis of these messages to investigate students' perceptions of research anxiety.

The CIT minimum sample size requirements depend on the nature of the phenomenon of interest. According to Flanagan (1954), if an activity is relatively simple, it may be sufficient to collect only 50 or 100 incidents. At the same time, complex types

of behaviors may require several thousand incidents to obtain an adequate description of requirements. The meta-analysis of the CIT literature by Urquhart et al. (2003) reports that most recent studies examined 50 to 100 incidents, and only a few investigations included over 300 cases for analysis. The most useful procedure to determine whether the data collection analysis process should be stopped or continued is to count the number of new critical behaviors added to the classification system. When new cases add no or little value, it is assumed that an adequate converge of the phenomenon is achieved.

Originally, the critical incident technique was used to assess performance in professional practices (Urquhart et al., 2003). Later, it was applied in different fields, such as organizational behavior and human resources (Cowie et al., 2002; Mitchell, Alliger and Morfopoulos 1997), education (Johnson and Fauske 2000), marketing (Jones 1999; Keaveney 1995), hospitality (Callan 1998; Chell and Pittaway 1998), and tourism (Wang et al., 2000). More recent examples demonstrate the usage of the method in the information technology area. For example, by employing the CIT, Muylle, Moenaert and Despontin (2004) analyzed user satisfaction with websites, Castillo, Hartson and Hix (1998) conducted a usability study, and Tay and Ang (1994) investigated individual IT competence. The technique is particularly appropriate when the field is new and the goals of research include practical managerial problems and theory development (Keaveney 1995).

As such, the critical incident technique can be successfully utilized to achieve the purpose of this dissertation study. First, given that the technology of interest is relatively simple, it should be sufficient to collect only 50 valid responses. Secondly, data collection may be employed by means of self-administered questionnaires with results comparable to those obtained by interviews. Thirdly, classical content analysis may be applied to perform data coding.[36] Overall, it is believed that the use of the critical incident technique may provide an adequate and realistic description of behaviors of interface agent users, identify reasons why individuals intend to use this technology, find what individuals look for in an ideal email interface agent, and suggest strategies for agent designers and marketers.

By drawing upon previous investigations that utilized the CIT (Johnson and Fauske 2000; Wang et al., 2000), the study's participants are questioned on two distinct areas: 1) incidents that users deemed highly positive; and, 2) events that individuals considered extremely negative. Every respondent is asked to provide either one positive or one negative critical incident covering the following points: a) specific memorable events in the process of human-interface agent interaction that captured or demanded a respondent's attention; b) the outcomes of these situations; c) the meanings and perceptions of these incidents from a user's point of view or why an individual considered these specific events critical, important, and worthy attention; d) current and future actions taken during and after the incident; e) most desirable actions that an 'ideal'

[36] In this dissertation, classical content analysis is employed to analyze open-ended questionnaire items as discussed later.

interface agents would take in addition (for positive outcomes only), or most desirable actions that an 'ideal' interface agent would take instead (for negative outcomes only); and, f) the regularity the similar situations occur.

These six topics allow relating structure with process. In order to fully understand the dynamic and evolving nature of events, analysts should study both structures and processes and relate them to each other (Strauss and Corbin 1998). Structures create the circumstances in which problems, issues, or events pertaining to a phenomenon arise. Processes denote the action / interpretation of individuals in response to those happenings. By looking at structures, researchers learn why certain events occur, whereas by studying processes, they understand how people react. With respect to the CIT, topics *a*, *d*, and, *f* relate to structure and topics *b*, *c*, and *e* pertain to process. It is proposed that by looking at these issues a complete understanding of user behavior can be obtained. As such, eight open-ended questions for positive incidents and eight open-ended questions for negative events are constructed. Table 4-8 presents these open-ended questions.

Table 4-8: The Critical Incident Technique Questions

Instructions: Please answer the eight questions below with respect to the last most significant **POSITIVE** or **NEGATIVE** incident of usage of interface agents in an email application (e.g., a positive incident might be when an interface agent helped you to complete a task in your email application effectively, efficiently, or enjoyably. A negative incident might be when an interface agent hindered the completion of a task in your email application).	
Was this incident positive or negative? (positive / negative checkboxes)	
N	**Question**
1	Provide a complete and detailed description of this incident and indicate how long ago (e.g., days, weeks, months) it took place.
2	What was the outcome of this incident?
3	Why do you consider this incident critical?
4	What were you feelings and perceptions of this situation?
5	What actions did you take during the incident?
6	Did you change the way you use interface agents after that? If yes, please specify.
7	From your point of view, what are the most desirable actions that an 'ideal' interface agent would take in addition? (in the case of positive incidents) From your point of view, what are the most desirable actions that an 'ideal' interface agent would take instead? (in the case of negative incidents)
8	How often does a similar situation occur(ed) when you use(d) interface agents in your email applications (e.g., days, weeks, months, never again)?

4.2.2.2 Interface Agent Characteristics

Recall Section 2.1 of this dissertation discussed several characteristics of interface agents which are often mentioned in the reference literature. However, no study that presents a list of the most important features from a user's point of view was found. It is unknown why people like or dislike employing email interface agents, and how they envision an 'ideal' agent. In order to bridge that void and to present recommendations for interface agent manufacturers, part of the questionnaire solicits the reasons why individuals like and dislike using the technology under investigation. It is believed that by analyzing those reasons, a better understanding of agent characteristics may be formed. In addition, users are prompted to describe characteristics of an 'ideal' interface agent for email. Table 4-9 outlines these open-ended questions.

Table 4-9: Interface Agent Characteristics

N	Question
1	Provide at least three reasons why you like to use interface agents in your email application.
2	Provide at least three reasons why you do **NOT** like to use interface agents in your email application.
3	Describe at least three tasks that you would like an 'ideal email interface agent' to perform in your email application.

4.2.2.3 Effects of Interface Agents

By performing a meta-analysis of the human-computer interaction literature, Dehn and van Mulken (2000) present a comprehensive, yet exhaustive, list of effects of interface agents that may potentially influence the human-interface agent interaction process. Most of these effects are drawn from various independent investigations conducted in laboratory settings. As of today, no study reports how actual users value the effects of an interface agent-based technology. In order to bridge that void, this dissertation study attempts to solicit and analyze the opinions of interface agent users on several key effects of the technology. It is assumed that the awareness of interface agent designers and marketers of this information may potentially improve the quality of the technology and the way it is delivered to the customer.

As such, Dehn and van Mulken (2000) classified various effects of interface agents on a user, for example, the user's subjective experience of the system, the user's behavior while interacting with the system, and the outcome of the interaction. Each category includes several factors. The factors applicable to an interface agent-based email system are utilized in the construction of the study's questionnaire. Table 4-10 presents these questions. A seven-item important / unimportant Likert-type scale is utilized.

Table 4-10. Effects of Interface Agents

N	Question
1	Based on your experience with interface agents for email, how **important** is it for you: to believe that an interface agent's appearance should correspond to its level of intelligence
2	to believe that the information provided by an interface agent is accurate
3	to like the appearance of an interface agent
4	to feel comfortable with an interface agent
5	to perceive an interface agent useful
6	to perceive an interface agent enjoyable
7	to perceive all interactions with an interface agent as natural
8	to avoid being distracted by an interface agent while engaged in important tasks

4.2.2.4 Insights for Developers and Marketers

At the end of the questionnaire, respondents are prompted to indicate several recommendations for developers and marketers of interface agents for email based on their personal experience with the technology. These questionnaire items are optional; the answers are presented in the form of open-ended questions. It is hoped that the analysis of these answers may yield more recommendations for developers and marketers. Table 4-11 outlines these open-ended questions.

Table 4-11: Insights for Developers and Marketers

N	Question
1	Based on your experience with interface agents in your email applications, provide recommendations for interface agent designers.
2	Based on your experience with interface agents in your email applications, provide recommendations for interface agent marketers (i.e., online businesses that sell but not necessarily manufacture the technology).
3	Outline any other thoughts, concerns, or recommendations on this technology (if any).

4.2.2.5 Difficulty with Instructions and Questions

In addition to the questionnaire items pertaining to the purpose of the dissertation, it was attempted to solicit feedback from respondents to grasp their perceptions of the questions, procedures, and the data collection instrument. For this reason, several optional, open-ended questions are presented at the end of the questionnaire. This is a commonly used in self-administered surveys technique (Cooper and Schindler 1998, p. 323). Table 4-12 below provides a list of these questions.

Table 4-12: Questions on Respondents' Experiences with the Questionnaire

N	Question	Format
1	Have you experienced difficulty understanding the instructions for one or more questions of this survey?	Yes / No
1a	If Yes, please specify	open-ended
2	Have you experienced difficulty understanding one or more questions of this survey?	Yes / No
2a	If Yes, please specify	open-ended
3	Please provide any comments on the content, design, or administration of the questionnaire	open-ended

4.2.3 User Background

Since this study presents one of the first surveys of real-life users of interface agents for email, it is very important to develop the understanding of those presumably innovative individuals by soliciting information on their background. This information is imperative for manufacturers and marketers of email interface agents because it may give them an opportunity to develop and deliver the technology to a user population that potentially adopt these systems.

As such, several multiple-choice and open-ended questions about user background are asked. Table 4-13 below offers the questions. Appendix 2 offers the complete questionnaire.

Table 4-13: User Background Information

N	Question	Format
1	The average number of emails received per day	7-category scale[37]
2	The average number of emails sent per day	7-category scale
3	How much time do you spend working with your email per day?	scale from 0.5 to 8 hours per day
4	Age	20-65, increment by 5
5	Gender	male/female
6	Occupation	open-ended
7	Education	several categories

In order to produce guidelines on the design and marketing of email interface agents, it is imperative to understand several key issues pertaining to current and past usage of this technology. There are two distinct types of people who acquired an email interface agent: 1) individuals who currently use the technology; and, 2) those who do not but did in the past. The purpose of the first question "Are you currently using interface agents in your email application?" is to differentiate between these two categories and to present several follow-up questions targeted to the appropriate group of individuals. The follow-up questions solicit information on the circumstances, frequency, and utilized functions of the technology of interest. Table 4-14 offers the questions.

[37] See Appendix 2 (the questionnaire) for detail.

Table 4-14: Current Usage of Email Interface Agents

N	Question	Format
1	Please specify where and how often you use interface agents?	Likert type scale for each category below: very frequently, frequently, sometimes, occasionally, rarely, very rarely, never. Categories: at home, at work, in school, other (specify)
2	Given your overall experience with interface agents, please specify the functions of interface agents that you most frequently utilize	Likert-type scale same as above. Categories: announce messages in Outlook, announce reminders in Outlook, announce messages in Hotmail, Other (specify)
3	Given your overall experience with interface agents, what percentage of all messages that you receive is announced by interface agents?	A range from 0 to 100%, increment of 10
4	Given your overall experience with interface agents, what percentage of all calendar reminders is announced by interface agents?	A range from 0 to 100%, increment of 10
5	How long have (had) you been using interface agents? (months)	Open-ended

4.3 Data Analysis Techniques

4.3.1 Deductive Approach

4.3.1.1 Common Method Bias

Recall the data for this dissertation study are obtained through the use of self-reports. This data collection technique has hidden limitations, particularly the problem of common method bias (or common method variance) (Podsakoff et al., 2003). Given that the assessment of the negative effects of this confounding is rarely addressed in MIS literature (Woszczynski and Whitman 2004), this sub-section of the dissertation familiarizes the reader with this issue.

The measured variance of each construct comprises three distinct components: trait variance, error variance, and method variance (Spector 1994). Trait variance is attributable to variance of the measured construct; it is accounted for the trait component. Error variance is produced by random measurement errors. It non-systematically influences the measurements and affects an instrument's reliability. Method variance is variance generated by all other systematic factors that influence the measured variable. To a large extent, it is attributable to the data collection method.

Common method bias occurs when independent and dependent variables are provided by the same source (i.e., by the same individual) at one particular point in time. This is particularly dangerous when respondents are asked to fill out items that tap into independent and dependent variables within the same survey instrument. Overall, method variance affects the assessment of a particular trait or behavior, especially, when self-reports are used.

Despite the possibility of common method bias in self-report surveys, the value of self-report measures is unarguable in contemporary research (Schmitt 1994). When employed properly, self-reports usually present reliable and valid results (Howard 1994). Two methods may be utilized to conduct a test of common method bias: Harman's one-factor test and a partial correlation procedure (Podsakoff and Organ 1986). These techniques utilize statistical procedures to isolate the covariance that emerges due to artificial reasons.

Harman's (1967) single-factor test allows analyzing whether a substantial amount of common variance is present. In this approach, all variables, including dependent and independent, are entered into a model. The results of an unrotated solution are analyzed to determine the number of actual factors that emerge. Common method bias is present if a single or general factor appears that accounts for the majority of variables.

A partial correlation procedure is an extension of Harman's one-factor test. This technique tests "whether the relationships among variables of interest still exist after the common method factor has been statistically controlled" (Podsakoff and Organ 1986, p. 537). To test for common method bias, the data are re-arranged so that every respondent to the self-survey provides responses to either independent or dependent variables. In other words, independent and dependent data are paired that consequently reduces sample size by 50%. The correlation factor scores of full and partial models are compared to demonstrate the absence of a significant difference.

4.3.1.2 Partial Least Squares

Consistent with most previous TAM-based investigations, this dissertation study utilizes Structural Equation Modeling (SEM) as a major data analysis technique. SEM, also called causal modeling, latent variable structural equation (LVSE) modeling, and analysis of covariance structures, is a second generation data analysis approach used to test statistical conclusion validity (Gefen et al., 2000; Rigdon 1998). Despite its recent emergence, SEM has already taken a leading role in various business administration disciplines, for example, in marketing (Fornell et al., 1996), knowledge management (Bontis et al., 2002; Bontis and Fitz-enz 2002), and management information systems (Chin, Marcolin and Newsted 2003). Gefen and colleagues (2000) conducted a meta-analysis of the three major MIS journals such as MIS Quarterly, Information & Management, and Information Systems Research. They argue that SEM was used "in about 18% of empirical articles across the three journals, with PLS and LISREL being the two most common techniques" (p. 7). The growing body of prior MIS research reports several advantages of SEM over first generation regression models, for example, LOGIN, ANOVA, and MAVOVA. First, SEM permits modeling relationships among multiple independent and dependent constructs and allows testing research hypotheses simultaneously. For example, in order to test the linkages of the simplified version of the Technology Acceptance Model,[38] linear regression requires two separate analysis: 1) to

[38] This model excludes the measurement of user attitudes towards the technology under investigation.

assess the relationships between PU and BI, and PEOU and BI; and, 2) to assess the relationship between PEOU and PU. In sharp contrast, SEM performs the same analysis in a single run.

Secondly, first generation regression techniques analyze only the structural model. The structural model depicts a set of one or more dependence relationships that link the model constructs and demonstrates the assumed causation among dependent and independent constructs. Structural Equation Modeling, on the other hand, also assesses the measurement model. The measurement model specifies the indicators[39] for each construct and calculates loadings of observed items on their respected constructs. The combined assessment of both structural and measurement models facilitates a more rigorous analysis of the suggested research model (Chin 1998; Rigdon 1998).

According to recent research guidelines developed by Gefen, Straub, and Boudreau (2000), there are two primary methods of SEM analysis that meet high standards of MIS empirical investigations: **covariance analysis** (LISREL,[40] EQS, and AMOS) and **partial least squares** (PLS). Each technique utilizes a distinct SEM algorithm and produces different results. Table 4-15 below presents the comparative analysis between LISREL and PLS.

[39] Indicators (often called manifest variables or observed measures) either reflect or form a construct. With respect to this dissertation, an indicator corresponds to a single question. For example, PU1 is an indicator of the perceived usefulness construct (see Appendix 2). This construct is reflected by four indicators: PU1, PU2, PU3, and PU4.

[40] LISREL is the most frequently utilized covariance-based SEM technique in MIS.

Table 4-15: Comparative Analysis between LISREL and PLS.[41]

Issue	LISREL	PLS
Objective of overall analysis	To show that the null hypothesis of the entire model is plausible, while rejecting path-specific hypotheses of no effect	To reject a set of path-specific null hypotheses of no effect
Approach	Covariance-based	Variance-based
Objective of variance analysis	Overall model fit	Variance explanation
Required theory base	Requires sound theory. A solid theoretical model is required. Supports only confirmatory research	No sound theory is necessary. Tests predictive and exploratory statistical models. Used for theory building; for exploratory and confirmatory research[42]
Assumed distribution	Multivariate normal. Strong knowledge of data distribution is required	Handles deviations from multivariate normal. Requires only 'soft' assumptions about data distribution
Min sample size	100 – 150 cases[43]	10 times the number of items in the most complex construct[44]
Unidimensionality[45]	Does not assess	Assesses
Types of constructs	Supports reflective constructs only	Supports both reflective and formative constructs
Computing time	Slow	Fast
Number of indicators per construct	At least three indicator to identify a construct and four indicators for statistical analysis are required	No restrictions

In order to test the suggested model of user adoption of email interface agents, this study employs PLS. First, as described in Section 3.6 of this dissertation, the objective of data analysis is to test a set of path-specific hypotheses. Secondly, the suggested model is built upon the convergence of several distinct theories which have been previously applied to various information and computer systems. The model consists of seven well-established, valid, and reliable constructs. However, prior to this dissertation, there have been no attempts to investigate or even theorize the issue of user adoption of intelligent or interface agents. No work has been done to identify the factors which may potentially influence a person's decision whether to accept or reject agent-based technologies. The characteristics of agent user population are yet unknown. On the one hand, this

[41] This table was partially adapted from Gefen et al. (2000).

[42] Although PLS may be used for both exploratory and confirmatory research, it is more applicable to the studies where a theoretical model, or parts of it, was not previously validated.

[43] In most studies, at least 200 cases are required and over 300 cases are highly desirable.

[44] In general, PLS works better with small data samples than LISREL.

[45] A construct is unidimensional if the set of indicators has only one underlying trait or concept in common (i.e., the construct measures a single dimension). Unidimensionality implies high internal consistency (or reliability) but high internal consistency does not imply unidimensionality.

dissertation utilizes a strong body of prior MIS research based on sound theoretical knowledge. On the other, it attempts to investigate a totally unexplored area which may encounter unanticipated challenges, for example, violations of construct unidimensionality or deviations of data from a normal distribution. Thirdly, PLS minimal sample size requirements are lower than those of LISREL. Lastly, since PLS has been frequently utilized in TAM-based investigations (for example, see Igbaria et al., 1997; Venkatesh and Davis 2000; Venkatesh et al., 2003), the usage of this statistical tool allows comparing the predictive power of the proposed theoretical model with those of preceding projects.[46] It is for those reasons this study employs PLS for data analysis and hypotheses testing.

In order to describe the utility of the PLS approach, the following part of this section provides a non-technical introduction to this statistical technique suggested by Chin (1998) and presents an empirical example adapted from Gefen et al. (2000).

The first PLS data analysis approach was originated and completed by the Swedish scientist Herman Wold[47] in 1977 (Wold 1982). This technique was first referred to as 'soft modeling' because it provides an analytical alternative for situations where theory is relatively weak, the relationships between dependent and independent constructs are not well understood, data normality is questionable, and indicators may not conform to a previously specified measurement model. After its introduction, PLS has substantially been extended in various ways and applied in virtually any discipline including MIS.

All PLS models consist of three sets of relations: 1) the structural model; 2) the measurement model; and, 3) the weights relations. As discussed earlier, these sets of relations are estimated by PLS in a single run.

The structural model (also called the inner model or the inner relations) depicts relationships among a model's constructs based on substantive theory. According to this theory, the vector of an endogenous (dependent) variable is calculated as follows:

$$\eta = \beta^* \xi + \zeta^*, \tag{4.1}$$

where η is the vector of an endogenous variable, β^* is the total effect of the exogenous (independent) variable, ξ is the vector of an exogenous variable, and ζ^* is the vector of residual variables (unexplained variance). In other words, the structural model refers to a set of one or more dependence relationships linking the model's constructs. The purpose of the structural model is to represent the structural interrelationships of all variables. Structural interrelationships are linkages (also called paths) between research constructs (or variables) that express the underlying structure of

[46] In several well-known TAM-based investigations, linear regression was utilized. Both PLS and linear regression produce R-square values (to be discussed) that may be compared.

[47] Herman Wold was the head of Statistical Institute at the University of Uppsala, Uppsala, Sweden.

the phenomenon under investigation. Structural relationships usually reflect a study's hypotheses.

The measurement model (also called the outer model or outer relations) defines how each set of indicators relates to its respective construct. The indicators are partitioned into non-overlapping blocks. For blocks with reflective indicators, the construct – indicator relationship is described as follows:

$$x = \Lambda_x \xi + \varepsilon_x, \tag{4.2}$$

$$y = \Lambda_y \eta + \varepsilon_y, \tag{4.3}$$

where x and y are indicators for exogenous and endogenous variables, Λ_x and Λ_y are loadings matrixes (usually called factor loadings) representing simple regression coefficients connecting constructs and their indicators, and ε_x and ε_y are residual measures that can be interpreted as measurement errors or noise.

For blocks with formative indicators, the construct – indicator relationship is depicted as follows:

$$\xi = \Pi_\xi x + \delta_\xi, \tag{4.4}$$

$$\xi = \Pi_\xi x + \delta_\xi, \tag{4.5}$$

where Π_ξ and Π_η are multiple regression coefficients for the construct on its block of indicators, and δ_ξ and δ_ξ are corresponding residuals from regressions.

Weight relations provide case values based on which the model's constructs are estimated. As such, a construct's estimate is the linear aggregate of its observed indicators multiplied by their weights.

In order to offer a more concrete picture of the use of PLS, an empirical example is presented. Recall Section 3.2 of this dissertation presents the Technology Acceptance Model (TAM). In most TAM investigations, MIS researchers have utilized PLS to measure the influence of two key person's beliefs: 1) perceived usefulness (PU), and 2) perceived ease of use (PEOU) on behavioral usage intentions (BI). TAM also suggests that PEOU influences PU. As such, all else being equal, individuals find a system more useful if it is easier to use.

The purpose of the overall PLS analysis is to reject a set of null hypotheses of no effect by calculating several statistical indicators which are used by researchers to estimate the predictive power of the model and its different components. Figure 4.2 below presents casual path findings of TAM via PLS analysis.

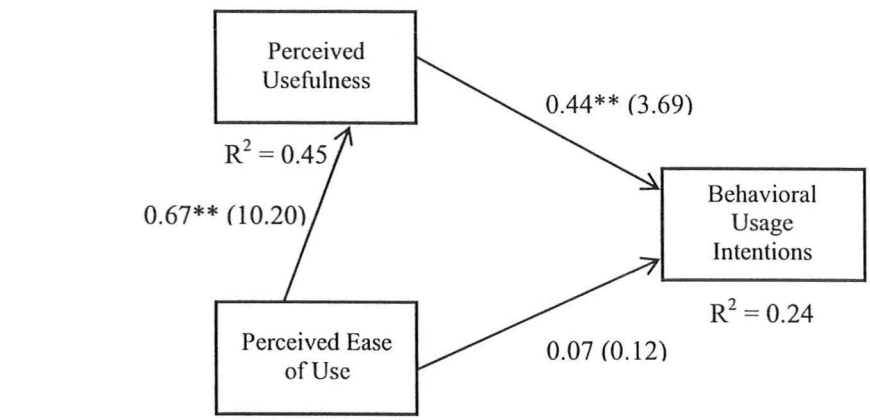

Figure 4.2: TAM Causal Path Findings via PLS Analysis by Gefen et al. (2000)

According to the PLS output, 0.67, 0.44, and 0.07 are the standardized coefficients, known as betas, which indicate the relative strength of statistical relationships. The respective t-values of each beta coefficient are presented in brackets (i.e., 10.20, 3.69, and 0.12). T-values represent the significance of a model's coefficients at a certain confidence level. In this example, 0.01% confidence level is used. T-values were obtained by performing jackknifing. As such, the diagram indicates that PEOU – PU and PU – BI relationships are significant.

In addition to betas and t-values, PLS reports R-squares and construct loadings. **R-square,** also called a coefficient of determination, is a measure of the proportion of the variance of a dependent variable that is explained by respective independent variable or variables. In other words, it is the path-specific variance explained by all independent constructs. In this example, since R-square of PU – BI and PEOU – BI relationships = 0.24, it can be said that 24% of the total variance in BI with respect to a new information system can be explained by the aforementioned path configuration of PU and PEOU.

Factor loadings are weightings reflecting the correlation between the original variables and derived factors. Squared loadings are the percent of variance in an observed item that is explained by its factor.

In addition to those statistical coefficients, there are several PLS techniques that can be used to evaluate the quality of the suggested model. **Jackknifing** is an "inferential technique that assesses the variability of a statistic by examining the variability of the sample data rather than using parametric by assumptions" (Chin 1998, p. 318). This

approach is utilized to provide estimates and to compensate for bias in statistical estimates by creating robust confidence intervals. **Bootstrapping** is a similar but more effective approach for estimating the precision of PLS estimates. Bootstrapping is considered more accurate since it utilizes a larger number of resamples than jackknifing. In general, the estimates calculated by both techniques should converge (Chin 1998).

Average Variance Explained (AVE) is a measure of the percent of variance captured by a construct from its indicators (Chin 1998; Gefen et al., 2000). It is calculated as the ratio of the sum of the variance captured by the construct and measurement error:

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum \mathrm{var}(\varepsilon_i)} \tag{4.6}$$

where λ_i is the component loading to an indicator and $\mathrm{var}(\varepsilon_i) = 1 - \lambda_i^2$.

It is recommended that AVE be at least 0.5 that means that 50 percent or more variance of the indicators should be accounted for. AVE is also used as a means of evaluating discriminant validity.

Unlike co-variance based methods, PLS does not produce goodness of fit indices. This makes the direct comparison of the results produced by PLS and LISREL (or AMOS) difficult. However, PLS results may be directly compared with those generated by linear regression based on R-square values. Note that Gefen and colleagues (2000) demonstrate that PLS, LISREL, and linear regression should produce similar results with respect to TAM.

To summarize, PLS is an appropriate data analysis approach utilized in TAM-related research that warrants its use in this study. The next section calculates the sample size required to meet the criteria of the PLS technique.

4.3.1.3 Sample Size

The minimum sample size requirement for PLS is determined by finding the larger of two possibilities: 1) a construct with the largest number of indicators (i.e., number of items in the most complex construct), or 2) a dependent construct with the highest number of independent constructs impacting it (i.e., the maximum number of arrows pointing to one dependent construct). The minimum sample size should be at least ten times the larger number of these possibilities (Chin 1998).

In this dissertation study, computer playfulness is the construct which has the largest number of indicators (7), and behavioral intentions is a dependent construct with the highest number of independent constructs impacting it (3). Therefore, this minimum sample is calculated by the following formula:

PLS min sample size = # of items in the CPS construct * 10. (4.7)

Therefore,

PLS study's min sample size = 7 * 10 = 70,

where 7 is the number of items in the Computer Playfulness Scale.

Thus, to meet the minimum PLS sample requirements, at least 70 valid responses from real-life users of interface agents for email should be obtained.

4.3.2 Inductive Approach

4.3.2.1 Paradigm and Research Method

With respect to this dissertation, the positivist paradigm is accepted. Positivist research assumes that the reality is objectively given, and it can be described by specific properties which are entirely independent of both researchers and utilized instruments (Myers 1998). This category of research takes the form of theoretical propositions or hypotheses describing dependent and independent variables are the relationships among them. This often allows increasing predictive understanding of the phenomenon in question. As such, positivist-based theories must conform to the rules of formal logic or experimental design. These rules dictate how researchers should relate the formal propositions of one theory to another. An example of the positivist method in MIS research is presented by Benbasat, Goldstein, and Mead (1987).

The acceptance of the positivist paradigm was a personal decision of the author based on his scientific views. The author believes that the reality of a situation is purely objective, and it exist independently of him, the study's respondents, and the research methods or instruments. Particularly, he assumes that factors, which affect perceptions, intentions and decisions of people regarding email interface agents, exhibit specific properties. These properties may be accurately observed and measured by an independent researcher that will provide an unbiased depiction of the phenomenon of interest.

Usually, it is a judgment of an individual researcher which paradigm to accept. This choice depends on his or her scientific views of the world, training, experience, psychological abilities, nature of the problem, and audience for the study (Creswell 2003).

There are various research methods that may be applied in empirical MIS investigations. Research methods are strategies of inquiry used in an attempt to solve certain problems which span from underlying philosophical assumptions to research design and data collection (Myers 1998). Among a diversity of these approaches, the most frequently utilized in the MIS field are action research (Baskerville 1999; Kemmis and McTaggart 1988), case studies (Yin 2003), ethnography (Myers 1999), grounded theory (Glaser 1978; Glaser 1992; Glaser and Strauss 1965; Glaser and Strauss 1967; Strauss 1987; Strauss and Corbin 1998), and classical content analysis (Bodkin and Perry 2004).

Most of these methods cannot be directly applied to investigate the issue of user adoption of email interface agents. For instance, action research is not appropriate because the present study intends to observe the perceptions and usage behavior of individuals rather than intervene into the process of human-agent interaction. Case-based

research is well-suited when the boundaries between the phenomenon and its real-life context are not completely clear. With respect to this investigation, it is noted that the context of an agent's usage is obvious. Ethnography is a helpful tool for organizational and group technology adoption investigations rather than for individual ones. Grounded theory is a useful methodology for the building of theories and the development of practical guidelines. Although it is believed that Grounded Theory may be successfully applied in this investigation, the author chose classical content analysis to as a primary technique for the analysis of open-ended questions. The next subsection offers an overview of this research approach.

4.3.2.2 Classical Content Analysis

Content analysis comprises techniques for reducing texts to a unit-by-variable matrix and analyzing that matrix quantitatively to test hypotheses or develop understanding of the phenomenon (Ryan and Bernard 2000). Researchers create a matrix by applying a set of codes to a set of qualitative data. Examples of data are notes acquired at fieldwork interviews, responses to open-ended questions, observations, written documents, electronic correspondence, journal, magazine or newspaper texts, and video films. The ultimate goal of classical content analysis is to explain and predict the phenomenon, for instance, the behavior of information system users. It can be utilized to conduct purely descriptive research, test hypotheses, and make inferences (Budd, Thorp and Donohew 1967).

It is difficult to provide an exact definition of classical content analysis because the technique can be used in many different ways. Since the emergence of the method, literature has presented various description of the approach. In the beginning, Berelson (1952, p. 18) stated that classical content analysis is a "research technique for the objective, systematic, and quantitative description of the manifest content of communication." This view was not taken as a final word by the research community (Budd and Thorp 1963). As such, several attempts have been made to improve the state of the field. Kerlinger (1973, p. 525) says that classical content analysis is a "method of studying and analyzing communications in a systematic, objective, and quantitative manner to measure variables." According to this standpoint, it is a method of observation similar to the examination of people's behavior of asking them to respond to scales except that researchers ask questions of communications. Krippendorff (1980, p. 21) defines classical content analysis as a "research technique for making replicative and valid inferences from data to their context." Weber (1990) and Ryan and Bernard (2000) view this approach is a set of procedures or techniques to make statistically grounded inferences from text.

Despite this divergence of opinions, most scholars agree that in most classical content analysis studies, the process consists of three stages (Riffe, Lacy and Fico 1998). First, the representative sample of content is drawn. If the target population is large, appropriate sampling techniques should be employed. Second, each unit of text is coded by a trained coder or coders. They utilize a codebook which presents category rules developed to measure or reflect differences in context. This produces a unit-by-variable

matrix that can be analyzed by the use of a variety of statistical techniques (Ryan and Bernard 2000). Third, the reliability, validity, objectivity, and the clarity of the description of research procedures need to be assured.

Reliability means consistent repeatability of results (Budd and Thorp 1963). In other words, it reflects the degree to which measurement procedures yield consistent results on repeated trials. The coding of text is usually assigned to several individuals. This allows measuring reliability as agreement among multiple coders on categorization content. Ideally, every coder by using the same codebook and technique on the same material should produce substantially identical results.

To ensure high reliability of coding, classical content analysis should start with defining the categories and subcategories relevant to the purpose of the study. After that, coders should be trained to apply the codebook to the content under investigation. Next, a pilot coding project should be done and reliability of coders assessed. Last, final reliability tests should be conducted at the end of the study.

Validity is a proof that the technique measures what it intends to measure. In general, the goal of validity is to demonstrate the usefulness of the measuring instrument or the other approach utilized in the study. Validity is more difficult to address than reliability. It is for that reason context analysis researchers have suggested many ways to assess validity (Kirk and Miller 1986). According to Bernard (1994) and Ryan and Bernard (2000) a concept's validity depends on the utility of the instrument itself and the collective judgment of the research community that both a construct and its measure are valid.

Objectivity is the neutrality of researchers. In order to be objective, scientists should leave out their personal opinions, beliefs, views, biases, and idiosyncrasies because they may potentially influence either findings (Riffe et al., 1998). Ideally, researchers should be indifferent to obtaining certain outcomes; they should develop a true understanding of the phenomenon and report it.

The clarity of the description of research procedures is necessary for the replication of the study. Researchers should accurately document all processes and keep the records for future use. Ideally, if a classical content analysis investigation is reliable, valid, objective, and supplied with required documentation, other scholars, by applying the same system of inquiry, research design principles, and operational definitions to the same set of data, should replicate previous findings. Only in this case can a researcher suggest new, modify, or challenge existing theories and views.

Previous classical content analysis studies present a variety of methods. They range from simple word counts, to counts of parts of speech, counts of classes of words, or counts of categories of subject matters (Gottschalk 1995). Some studies avoid counting words; instead, they record recurring sequences of happenings.

For example, Kolbe and Albanese (1996) studied characteristics of men appearing in advertisements by coding the body features, hairstyles, head positioning, dimensions of eye contact, and clothing of each male image appearing in target magazines. Tan and Teo

(1999) investigated the factors of Internet diffusion in Singapore by examining messages of local newspapers. Bodkin and Perry (2004) analyzed how effectively companies utilize their websites as marketing tools by coding 63 important website components. Detlor, Sproule and Gupta (2003) explored consumer preferences for Web-based information display across browsing and searching tasks by inspecting free-form textual responses of individuals involved in those activities.

Such projects demonstrate the appropriateness and fruitfulness of the application of classical content analysis as a research technique in virtually any area, including the investigation of user adoption decisions towards email interface agent users. It is believed that this research method may provide an adequate and realistic description of the perceptions of interface agent users, identify reasons why individuals intend to use this technology, find what individuals look for in an ideal email interface agent, and suggest strategies for agent designers and marketers.

With respect to this dissertation, an attempt was made to address the issues of reliability, validity, objectivity, and clarity of the description of research procedures. In order to ensure the reliability of the qualitative results of this dissertation, the coding of open-ended text is assigned to three independent coders. Draft *a priori* categories for a preliminary code book is developed based on several previous MIS and agent studies in the area of interface agents (Dehn and van Mulken 2000; Lester et al., 1997; Moundridou and Virvou 2002; van Mulken et al., 1998). Although some advocates of classical content analysis suggest that researchers refrain from defining categories and codes up front (Krippendorff 1980), Miles and Huberman (1994, p. 57) offer a valid method of creating a 'start list' of codes. They argue that these codes may come from a conceptual framework, research questions, hypotheses, problems areas, and key variables that investigators bring into the study. Several recent investigations in different areas also developed a preliminary coding structure (Bodkin and Perry 2004; Detlor et al., 2003; Jones 1999). The results of coding of three researchers must be compared several times during the data analysis process, agreement coefficients need to be calculated as suggested by Krippendorff (1980), and adjustments in the procedures should be made when necessary. In the case of discrepancies of coding, coders must meet and re-evaluate the results until mutual agreement on each code is reached.

Validity is a more complex issue than reliability. In order to demonstrate the validity of the findings, the triangulation of quantitative and qualitative data is conducted. Triangulation is the combination of different methodologies to study the same phenomenon (Jick 1979). It takes its roots in social sciences when Campbell and Fiske (1959) suggested the implementation of the multitrait-multimethod matrix. There are several advantages of triangulation (Rohner 1977). The comparison of data obtained by different methods allows testing for external validity of the findings. The employment of multiple methods may potentially uncover a new source of variance that cannot be identified by a single method that enriches our understanding of the phenomenon. Triangulation facilitates a synthesis of theories, and researchers become more confident of their results. With respect to this study, results obtained by the employment of close-ended and open-ended questions are compared. For example, it is assumed that the PE –

BI, PU – BI, and PEOU – BI linkages of the model are strongly supported. In this case, the top reasons why individuals like to use email interface agents should include PE, PU, and PEOU.

Objectivity is an ambiguous concept. It is the "simultaneous realization of as much reliability and validity as possible" (Kirk and Miller 1986, p. 20). With respect to this dissertation, objectivity is assured by the impartiality of the author. As a researcher, the author expressed various viewpoints of agent-based technologies ranging from optimistic (as discussed by Serenko and Detlor (2003)), to neutral (as presented by Serenko and Cocosila (2003)) and even critical (for example, see Serenko (2004b)). In addition, the involvement of three coders should also reduce the researcher's subjectivity.

The clarity of the description of research procedures is assured by the documentation of all processes. All records are kept in written form and stored for future use. It is hoped that the application of these techniques guaranties an acceptable level of reliability, validity, and objectivity.

4.3.2.3 Analysis of Interface Agent Effects

In addition to open-ended items, the importance of various interface agent effects is measured on a Likert-type scale (i.e., quantitative data are obtained). To analyze those responses, the ANOVA test is suggested. This allows determining the existence of differences among the item means of the entire dataset (Aczel 1996). If the *t*-value is statistically significant, the Tukey Honestly Significant Difference test is done that allows performing pairwise comparison of the item means.

In this case, different effects may be ranked in order of their importance based on end-user perceptions.

4.3.2.4 Other

Recall two open-ended items relate to suggestions for developers and marketers. To analyze these responses, two approaches may be utilized. The first is to perform classical content analysis of the responses by three coders as discussed in the previous subsection. This technique may be implemented if a high number of responses are obtained. The second is to provide a brief summary of each response without coding the text. This approach may be successfully employed if only a small number of responses are obtained, and every response presents a ready-to-use recommendation.

A decision on which approach to employ will be made upon the completion of the data collection phase.

4.3.3 User Background

Recall in addition to open-ended questions, the questionnaire employs a number of items pertaining to user background and ways they employ email interface agents.

In terms of questionnaire items referring to user background, such as gender, age, occupation, education, country of residence, mail usage and income level, descriptive statistics is presented. Data are summarized in form of graphs, figures, and diagrams. The

goal is to provide comprehensive summaries of the data that may be of interest to researchers and practitioners. Several of these variables may also potentially serve as control variables in the suggested model.

With respect to data relating to current or past usage of agents, again, descriptive statistics is offered. In addition, correlations among usage circumstances and most or least frequently utilized features are investigated. The purpose is to understand how individuals actually use the technology of interest.

4.4 Pilot Study Results

A pilot study was completed from March 23rd to April 13th, 2004. A Web form was utilized to collect data. The purpose was to estimate the preliminary response rate, to test whether subjects understood all instructions and questions correctly, to ensure the viability of reaching the target user population, and to make sure that the Web form worked well. Given the small sample size of the pilot study, no data analysis was conducted.

Recall that Dillman's (1999) Tailored Design Method was adapted to implement the survey. The four-stage process was utilized for data collection: an initial invitation to participate in the survey and three follow-up reminders. All four stages were accurately followed in both the pilot and full study. All correspondence was sent over email.

During the pilot study, ten user names were randomly chosen by the researcher from the customer database of ABC Company. The names were presented in alphabetical order, and every N^{th} person on the list was selected. Table 4-16 offers the milestones and results of the pilot test.

Table 4-16: Pilot Study Results

Date	Phase	# of requests	# of bounced back emails	# of responses
March 23, 04	Initial invitation	10	1	2
March 30, 04	Reminder 1	7	0	1
April 6, 04	Reminder 2	6	0	0
April 13, 04	Reminder 3	6	0	0

These three respondents did not have any difficulty completing the questionnaire, and they provided the data that would meet the purpose of this study. The obtained responses were included in data analysis.

Chapter 5: Data Analysis and Results

5.1 Survey Administration

Full data collection occurred during the period from April 14th to June 1st, 2004. The data collection process was split into two rounds. This allowed making the procedure more manageable and decreasing the researcher's workload. The same approach as in the pilot study was employed. The entire customer list of ABC Company was utilized.[48]

In total, 75 usable responses were collected. Fifty-nine questionnaires were fully completed, and 16 surveys were partially completed (i.e., one or more required response fields were left unanswered). There was no similar pattern in the incomplete questionnaires. Table 5-1 presents the number of responses received in the full study, and Figure 5.1 offers the breakdown of responses by phase and round.[49]

Table 5-1: Full Study Results

Date	Phase	# of responses
Round 1		
April 14, 04	Initial invitation	15
April 31, 04	Reminder 1	6
April 28, 04	Reminder 2	7
May 5, 04	Reminder 3	3
Subtotal:		**31**
Round 2		
May 11, 04	Initial invitation	14
May 18, 04	Reminder 1	11
May 25, 04	Reminder 2	10
June 1, 04	Reminder 3	6
Subtotal:		**41**
Total:		**72**

[48] For that reason, the actual response rate is not reported in this dissertation as per the non-disclosure agreement with ABC Company. Any information about the actual response rate may reveal the number of customers the company has.

[49] The results of the pilot study are excluded from Table 5-1 and Figure 5.1. The actual data obtained in the pilot study are included in the further analysis.

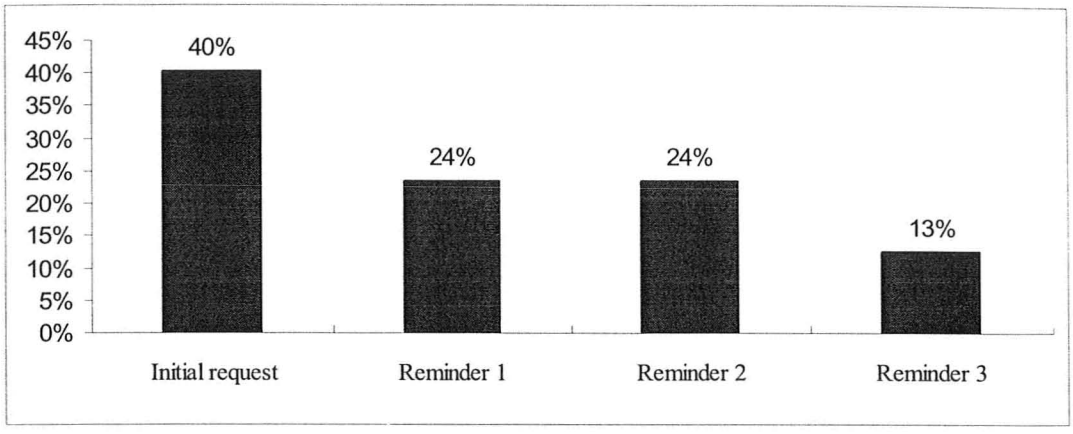

Figure 5.1: Breakdown of Responses[50]

The figure above demonstrates that 40% of all responses came after the initial invitation message. Reminders 1 and 2 were very effective; together, both reminders generated almost one-half of all responses. The last reminders produced a lower response rate. It was believed that additional reminders would bring few, if any, additional responses.

To test for statistical differences in responses received after the initial request, reminder one, reminder two and reminder three, the means of 25 items of the suggested model of user adoption of email agents were compared. Two groups of data were collected to analyze the proposed model: 1) behavioral and perceptual data (PU, PEOU, PE, BI, USE), and 2) trait-specific data (PIIT and CP). Multiple Analysis of Variance (MANOVA) was conducted on each set of variables individually. MANOVA is a statistical data analysis technique for the assessment of group differences across multiple variables simultaneously. In contrast to ANOVA, MANOVA should be utilized if there is more than one group of variables.

The Multivariate General Linear Model function of SPSS was utilized to conduct the test. With respect to user perceptions, behavioral intentions, and usage of email interface agents, no difference among the data pertaining to four collection phases was found (Wilk's Lambda[51] = 0.409, significance level = 0.113). Regarding user traits, again, no difference was observed (Wilk's Lambda = 0.655, significance level = 0.710). This suggests that the average personal traits as well as agent perceptions, intentions, and usage were similar among those who submitted a questionnaire at different phases. Therefore, the data collection stage at which each survey was received did not affect the results. This confirms there was no temporal bias in data collection.

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[50] Note: the total percentage may slightly differ from 100% because of rounding.

[51] Wilk's Lambda is a multivariate test statistics indicating whether group means are different. The value ranges from 0 to 1, with 0 indicating that the means are different and 1 that they are the same.

By following the suggestions of Moore (2000), data obtained from the participants who submitted a completed survey and those who returned a partially completed one were analyzed. In order to test for the homogeneity of the data pertaining to both groups of respondents, scores on several close-ended items from fully and partially completed questionnaire were compared on two groups of data (i.e., similar to the approach utilized earlier in this section).

Based on the results of MANOVA, no statistically significant difference in complete and incomplete surveys was found in the degrees of user perceptions, behavioral intentions, and usage (Wilk's Lambda = 0.77, significance level = 0.349) and in user-specific traits (Wilk's Lambda = 0.914, significance level = 0.868). Therefore, there is no difference in score means of fully and partially completed questionnaires. This confirms there was no response bias in data collection.

In order to ensure the validity of collected data, two optional open-ended questions asking whether respondents had any difficulty with instructions or questions were presented. Seven subjects expressed their concerns with the questionnaire. Three individuals mentioned they were slightly confused about the Critical Incident Technique, for example:

(P103): *"The 'feelings' question was confusing..."*

At the same time, this person provided an accurate response to this question by indicating that he[52] was '*frustrated.*' The other two respondents also accurately completed this section.

Two respondents complained about the large number of open-ended questions, one person mentioned the similarity of several close-ended items, and one individual was concerned about the length of the questionnaire.

Overall, it was presumed that all items were clear, relevant and well structured, and that all respondents who wished to complete the questionnaire might do so.

5.2 User Background

Recall the study involved 75 individuals who purchased the interface agent-based email system developed by ABC Company, and who utilized this application for at least three months. This section describes the respondents and their use of agents in detail. Consistent with MIS paper presentation guidelines, data that relate to user context are presented in the beginning of the 'Results' section.

5.2.1 Gender

Overall, the purpose of descriptive statistics is to summarize data by using numerical properties or graphs.

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[52] Since gender information was collected, the correct references to the respondent's gender were made throughout the 'Results' Section of this dissertation.

Eighty percent of the surveyed users were male and twenty percent female. The binominal nonparametric test was conducted to compare the populations. A nonparametric method is suitable in this situation since it deals with enumerative data (i.e., frequency count), does not require specific parameters, such as mean or standard deviation, and takes no specific assumption about data distribution (Aczel 1996, p. 624). The binominal test with the parameter $p = 0.5$ was applied, where p is the test proportion of male and female in general (i.e., 50% male and 50% female). The Z approximation of the test confirmed the statistical significance of population differences ($p < 0.000$).[53] This demonstrates that the population of interface agent users was male-dominant.

5.2.2 Age

Respondents to the questionnaire indicated their age on an eleven-point scale ranging from under 20 to over 65 years old with increments of five. Subjects were informed that the specification of their age was required (similar to most other questions). In fact, Web Surveyor was programmed to allow individuals to leave this question unanswered (i.e., it was possible to electronically submit the questionnaire without providing a response to this item). On the one hand, it was crucial to obtain demographical information about the respondents to form the understanding of the entire user population. On the other, it was believed that some people might feel uncomfortable sharing this information. In this case, these individuals might provide inaccurate data or withdraw from the survey. As such, two respondents submitted a survey without indicating their age.

[53] The actual value of Z-approximation statistics for the binominal nonparametric test is not reported by SPSS 11.5.0.

Figure 5.2 below presents age demographics. Overall, it demonstrates that over 65% of all users were between 31 and 50 years old, and that the 46 – 50 age category was the most frequent user group.

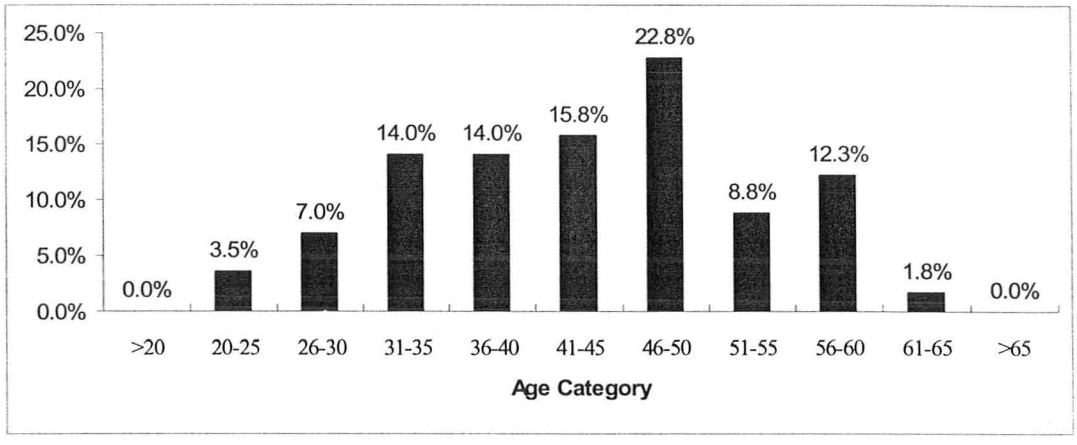

Figure 5.2: The Age Categories of Email Interface Agent Users

5.2.3 Occupation

During the survey, information pertaining to respondents' current occupation was solicited. After analyzing the data, two distinct occupational categories emerged: information systems / information technology-related (IS / IT), and engineering.[54] Figure 5.3 visualizes the findings.

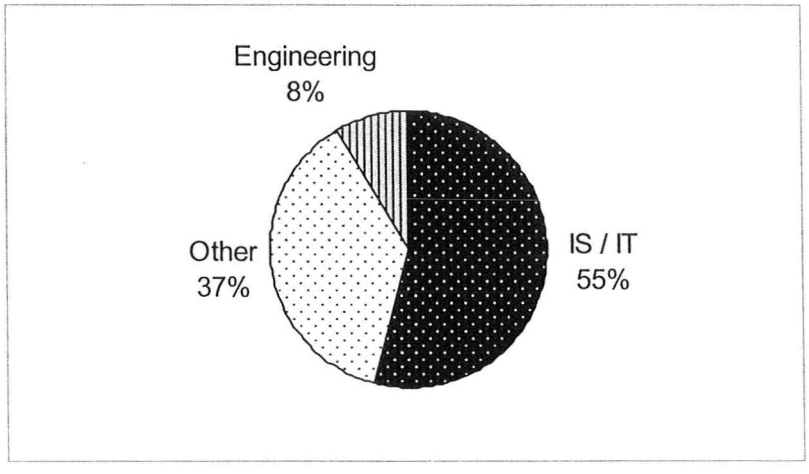

Figure 5.3: User Occupation

[54] This occupational category excludes IS / IT-related engineers, for example, software or hardware engineers.

The 'Other' category includes various occupations that are not related to IS / IT or engineering. No additional category emerged since most occupations were reported by only one person. For example, the following occupations were provided: project manager, medical doctor, student, contract manager, freelance editor, translator, business consultant, salesperson,[55] attorney, finance broker, social worker, and bricks-and-mortars business owner.

In addition to current occupation, job status of respondents was also analyzed. It was discovered that 34% of users belonged to middle and senior management. Examples of this category included a chief executive officer, vice president, department manager, or senior technology expert.

5.2.4 Education

The majority of email interface agent users were well-educated. According to the survey, 81% of them had a college / university degree, 17% completed secondary / high school, and 2% elementary school. Overall, US residents were the most educated; 92% of them had a college / university degree. Figure 5.4 presents the educational demographics.

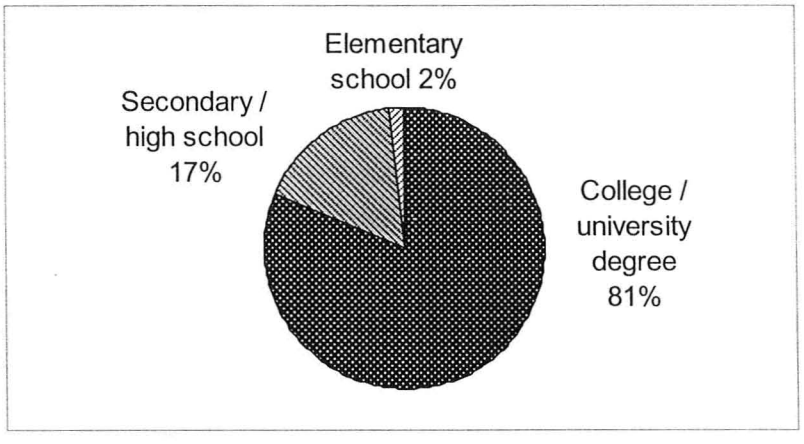

Figure 5.4: User Education

5.2.5 Country of Residence

Email agent users provided their current country of residence. As such, 63% of respondents resided in the USA, 12% in the European Union countries (except the UK), followed by the UK, Australia, Canada, and New Zealand (see Figure 5.5). The UK was presented separately from other European Union states in order to emphasize the significance of the proportion of users in this country. As such, 85% of all users resided in an English-speaking country. This is a very high proportion given that only 35.8% of all

[55] The person who reported this occupation is involved in the distribution of consumer products for a bricks-and-mortars business.

Internet users speak English as their primary language (Global Research 2004). A reasonable explanation for this disparity would be that the email interface agent developed by ABC Company is available in English language only.

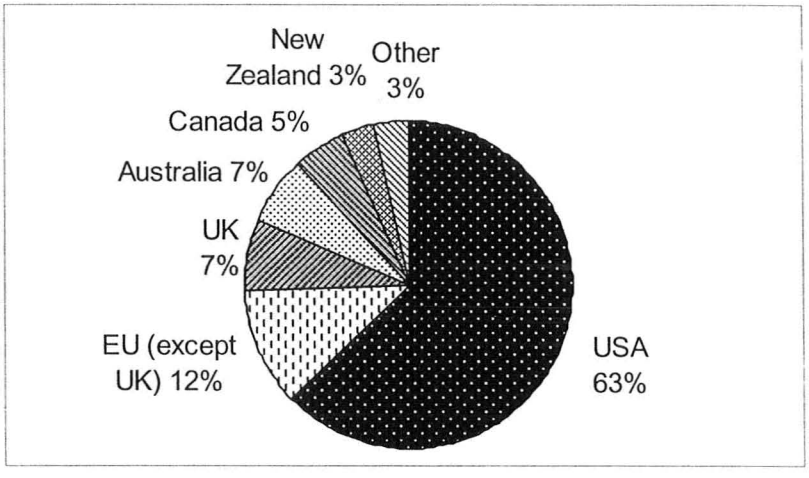

Figure 5.5: User Country of Residence

5.2.6 Email Usage

The respondents to the survey were asked three questions pertaining to their current usage of electronic mail: the number of email messages received, the number of email messages sent, and the number of hours spent working with an email application daily. Figure 5.6, Figure 5.7, and Figure 5.8 present the results.

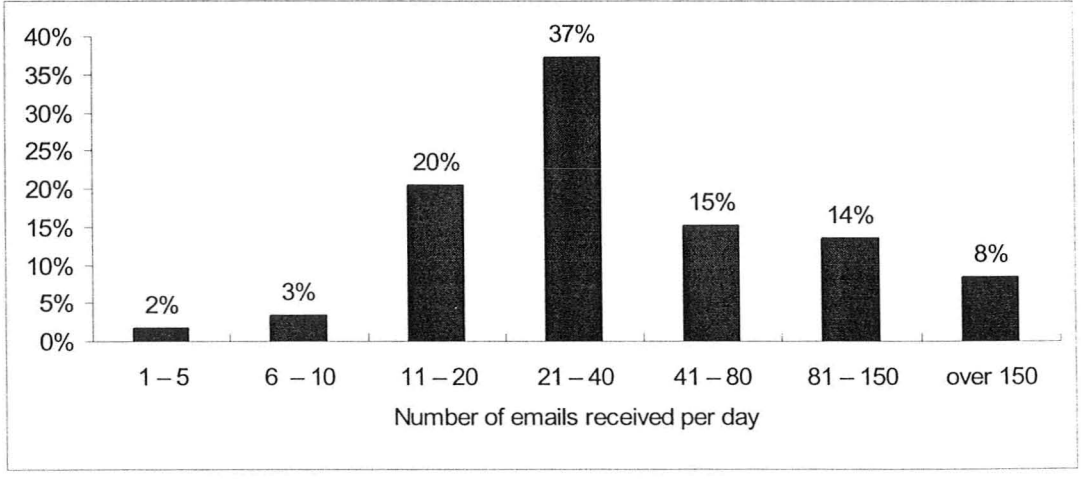

Figure 5.6: Number of Email Messages Received Daily by Agent Users

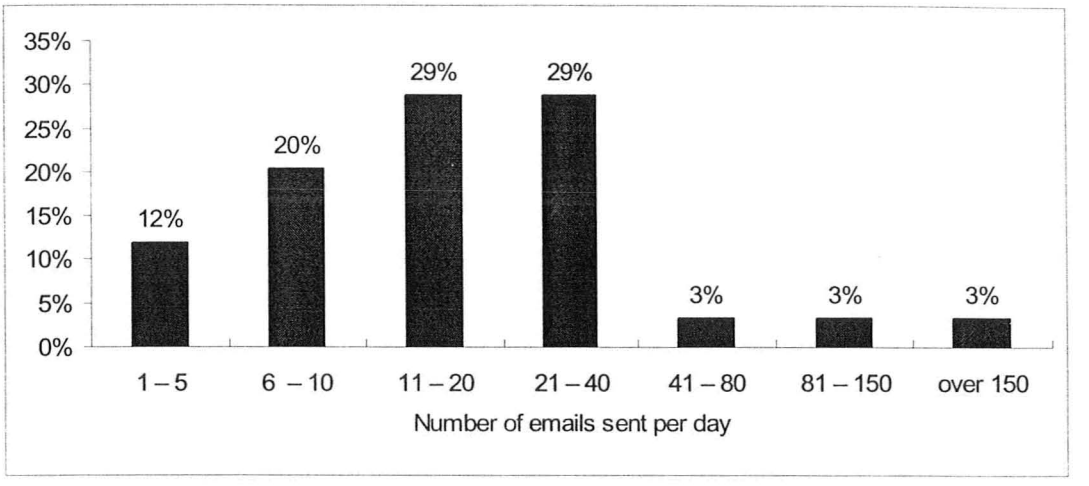

Figure 5.7: Number of Email Messages Sent Daily by Agent Users

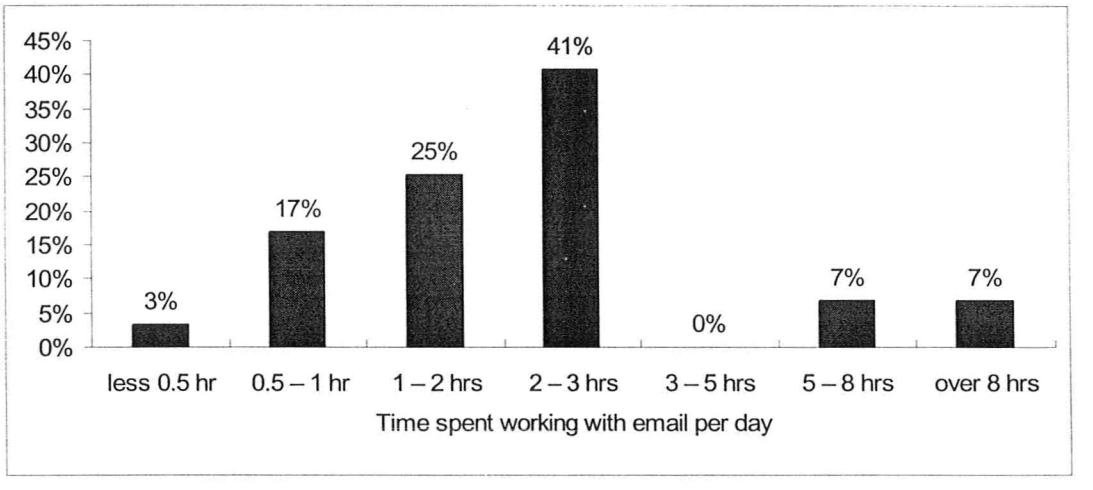

Figure 5.8: Time Spent with an Email System Daily by Agent Users

Overall, the above figures imply that the individuals who utilized interface agents were very heavy email users. The comparison of these numbers with the results of a recent empirical study on email usage by university students conducted by Serenko and Turel (2004b) further confirms this observation. They surveyed 186 undergraduate and graduate students of two Canadian universities on their email usage by asking the same questions. Their investigation concludes that the average university student receives and sends from one to five emails daily, and spends only 30 minutes working with an email application.

In addition, three percent of all individuals who were invited to participate in this dissertation study used third-party spam blockers, for example, MailBlocks[56] or Earthlink.[57] These third-party spam blockers are software systems that scan all incoming email before it reaches a user's mailbox. In contrast to regular email filters, they do not sort inbound messages. Every time when a new person sends email to a spam blocker user, the system generates a 'challenge' message that is forwarded back to the original sender. This individual is expected to take several actions, for example, click on the link or enter a keyword. The purpose is to ensure that the sender is a person, not a machine. The fee ranges from $10 to $30 US per month. Thus, it was assumed that mostly heavy email users would sign-up for this service.

5.2.7 Income Level

Recall no questions pertaining to the financial status of agent users, for example, income level, were asked. However, based on other data as well as the author's interaction with respondents, a solid understanding of their financial position was formed. First, as described in Section 5.2.3 'Occupation', one-third of the users belonged to middle or senior management. Second, these individuals were highly-educated because 81% of them had a college / university degree (see Section 5.2.4 'Education'). Overall, the level of income for this category of people is high. A recent survey conducted by the US Department of Commerce (Clancy 2002), reveals the positive relationship between the level of education, financial well-being, and use of computers. Third, 19% of the subjects kindly declined the compensations of $10 US for the completion of the questionnaire by either contacting the researcher or leaving a comment in the questionnaire. For example, some of them noted:

> (P48): *"I don't need the money. I would like to hear more about your work."*
>
> (P83): *"Good Luck with your dissertation! Please donate the $10.00 to a charity, church, school or 'worthy cause' of your choosing."*[58]
>
> (P137): *"With my sincere consideration, as much as I appreciate the thought, I would like the $10.00 be used to further development of the software and or concepts needed to do it. I find software like this hard to find. Thanks and keep up the great work."*
>
> (P153): *"Hi Alexander, Not a problem ... I apologise for taking so long to fill out the questionnaire but I've been kinda busy with real life issues ...*

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[56] Available online at http://about.mailblocks.com.

[57] Available online at http://www.earthlink.net/spamblocker.

[58] Since the rules governing the NSERC grant, which supported funding for this dissertation, do not allow donating money to a charity, a cheque was sent directly to this respondent who, in turn, made a donation to the charity of his choice.

I'm glad I could be of help in some small way ... I didn't do it for the money ... truly ... so ... there is no need to pay me !!!"

Based on this evidence, it was believed that most email agent users belonged to the high-income category of Internet users.

5.2.8 Actual Usage of Email Interface Agents

Respondents provided information on their current or past usage of the technology. The current users indicated that they used it for 16 months on average, ranging from three to 36 months. The past users utilized it for 8 months on average, also ranging from three to 36 months. Figure 5.9 and Figure 5.10 outline the extent of the usage of interface agents at work and home.

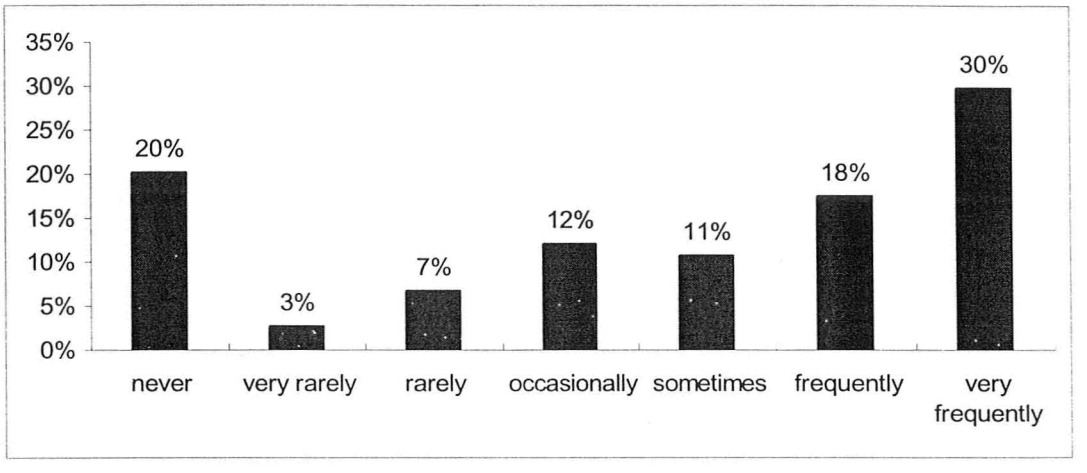

Figure 5.9: Actual Usage of Email Interface Agents at Work

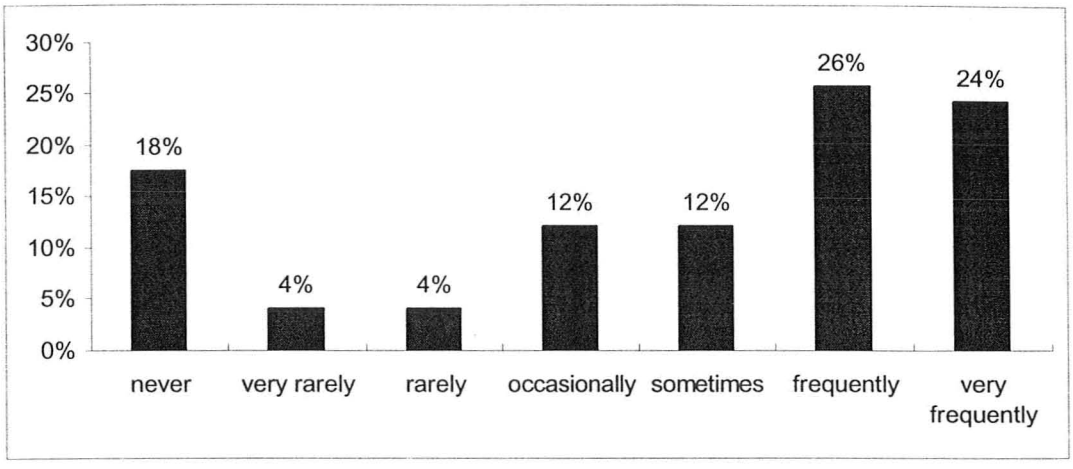

Figure 5.10: Actual Usage of Email Interface Agents at Home

Overall, these figures indicate that most respondents were very heavy users of agents; they utilized agents both at work and at home. At the same time, only a few people reported the usage of the technology at school. Nobody mentioned other usage places. The results of the MANOVA test demonstrated that there was very little difference in the usage of email interface agents between the current and former users of this technology with respect to the above two figures (Wilk's Lambda = 0.807, $p < 0.000$).

Figure 5.11 and Figure 5.12 present the percentage of users who employed interface agents to announce messages and calendar reminders in MS Outlook. Figure 5.13 depicts the percentage of people who utilized interface agents to announce messages in Hotmail, and Figure 5.14 offers the percentage of individuals who used interface agents to announce read receipts in any email system.

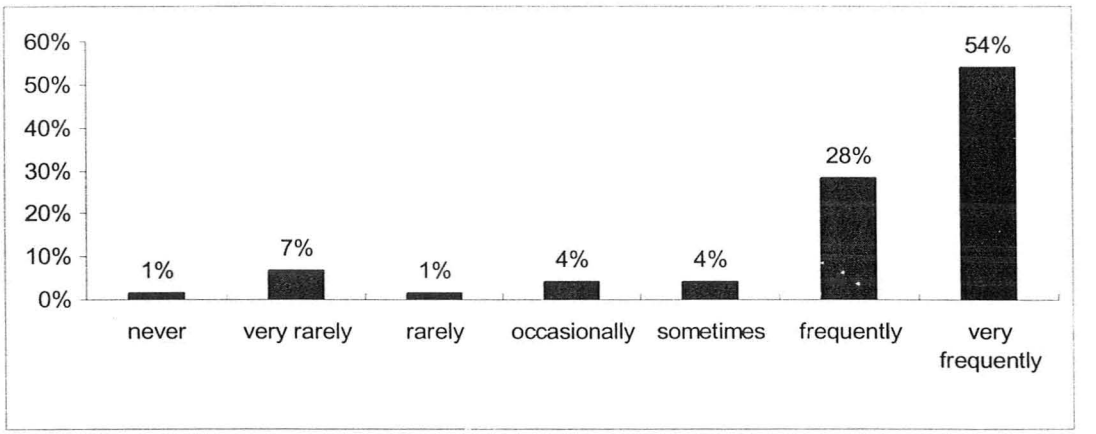

Figure 5.11: The Percentage of Users who Utilize Agents to Announce Messages in MS Outlook

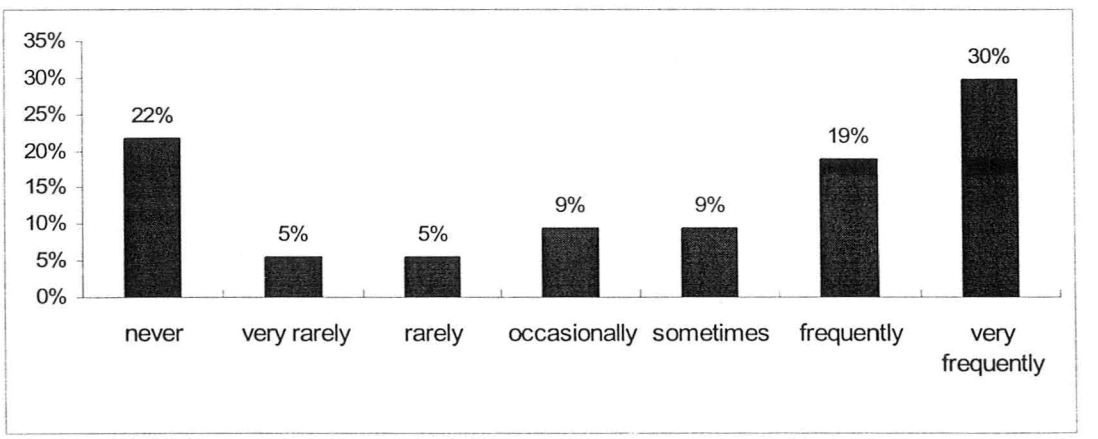

Figure 5.12: The Percentage of Users who Utilize Agents to Announce Calendar Reminders in MS Outlook

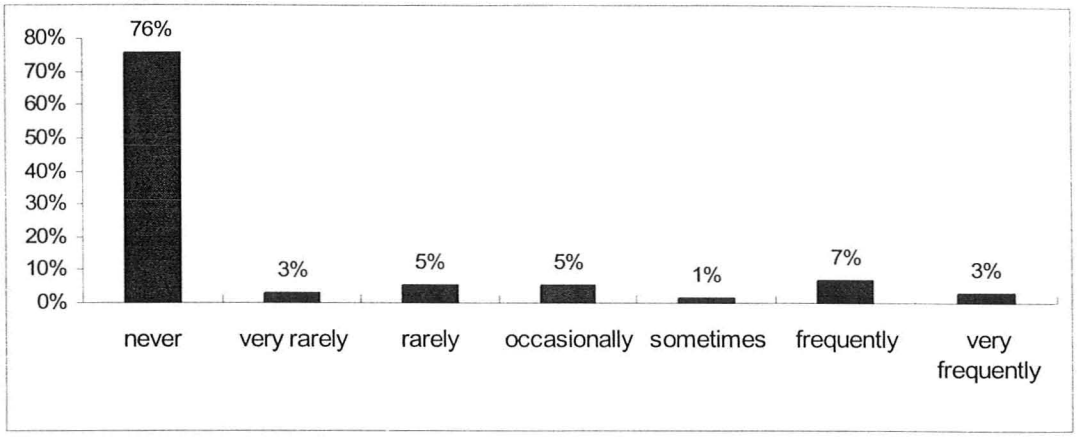

Figure 5.13: The Percentage of Users who Utilize Agents to Announce Messages in Hotmail

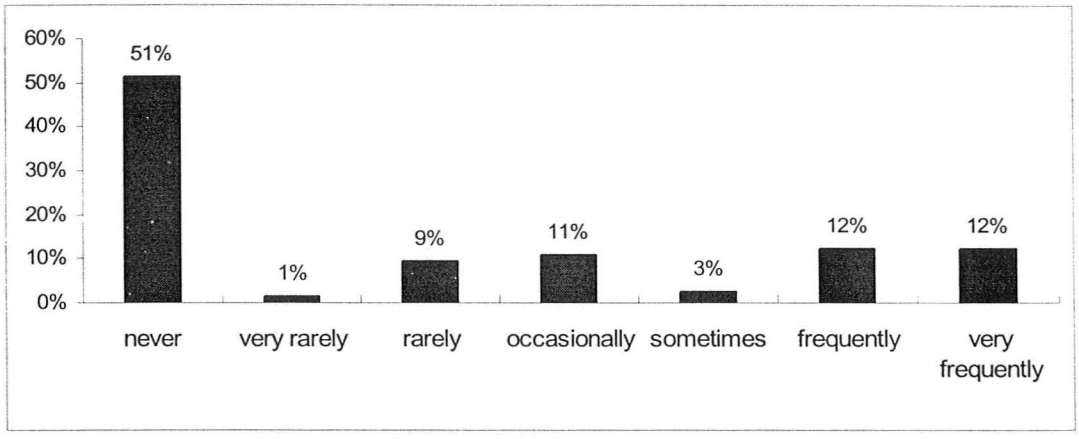

Figure 5.14: The Percentage of Users who Utilize Agents to Announce Read Receipts in MS Outlook and / or Hotmail

These figures demonstrate that most people used interface agents in MS Outlook. The announcement of incoming messages was the most frequently employed feature followed by the presentation of calendar messages. The announcement of read receipts was utilized less frequently; one-half of all email agent users never used it. The MANOVA test demonstrated that there was little difference in the extent of agent usage between current and past users with respect to the above four figures (Wilk's Lambda = 0.744, $p < 0.000$).

Figure 5.15 and Figure 5.16 present the percentage of all incoming messages and calendar announcements that were delivered by email interface agents. This confirms the earlier observation that message announcement was the most often utilized feature. Again, no difference in the extent of agent utilization between present and former users of this technology was found (Wilk's Lambda = 0.962, significance level = 0.253).

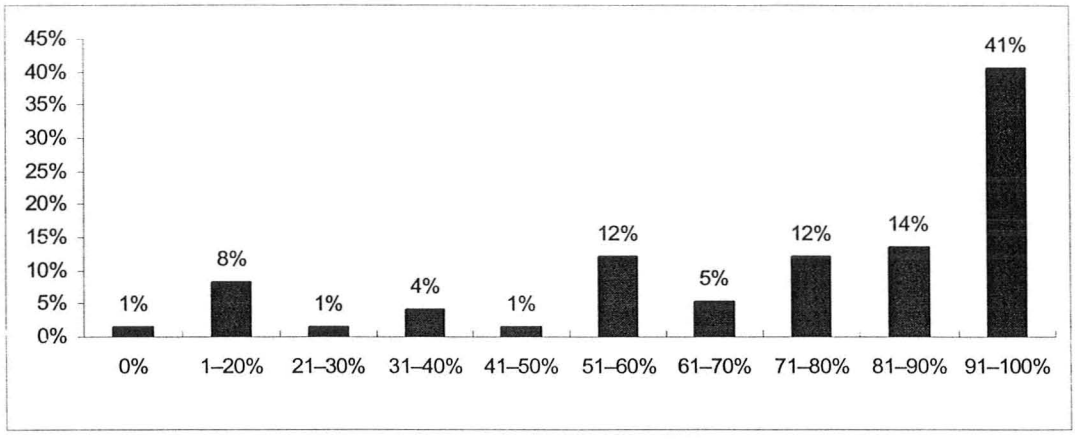

Figure 5.15: The Percentage of Incoming Email Messages Announced by Interface Agents

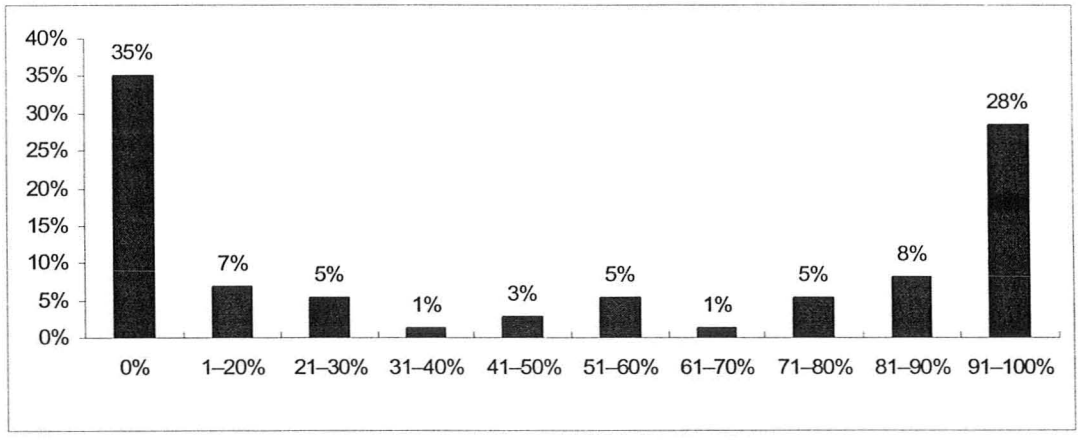

Figure 5.16: The Percentage of Calendar Reminders Announced by Interface Agents

The usage categories provided by each respondent were converted into scores. For example, the categories corresponding to Figure 5.11 were converted as follows: never – 1, very rarely – 2, rarely – 3, occasionally – 4, sometimes – 5, frequently – 6, very frequently – 7. The correlation matrix was calculated for the following items:

1) the extent of agent usage at work;
2) the extent of agent usage at home;

3) the extent of agent usage for the announcement of incoming messages in MS Outlook;
4) the extent of agent usage for the announcement of calendar reminders in MS Outlook;
5) the extent of agent usage for the announcement of incoming messages in Hotmail;
6) the extent of agent usage for the announcement of read receipts;
7) the percentage of all incoming messages announced by agents; and,
8) the percentage of all calendar reminders announced by agents.

Table 5-2 offers the Pearson correlation matrix of the variables pertaining to the various aspects of agent usage as discussed above. The Pearson correlation coefficient, also called the Pearson Product Moment correlation, is the most commonly used method of computing a correlation between variables that are linearly related (Aczel 1996, p. 438). Statistically significant correlations are presented in bold font.

Table 5-2: Agent Usage Pearson Correlation Coefficients

Correlation/ Significance	Work Usage	Home Usage	Message Announc. Outlook	Reminder Announc. Outlook	Message Announc. Hotmail	Read Receipt Announce.	% of Messages Announc.
Work Usage	1.000 –						
Home Usage	**0.282** **0.015**	1.000 –					
Message Announc. Outlook	**0.479** **0.000**	**0.290** **0.012**	1.000 –				
Reminder Announc. Outlook	**0.296** **0.010**	**0.245** **0.035**	**0.439** **0.000**	1.000 –			
Message Announc. Hotmail	0.029 0.805	**0.243** **0.037**	-0.045 0.703	0.188 0.109	1.000 –		
Read Receipt Announce.	0.179 0.128	**0.208** **0.075**	**0.276** **0.017**	**0.357** **0.002**	0.165 0.161	1.000 –	
% of Messages Announc.	**0.327** **0.004**	0.073 0.535	**0.611** **0.000**	**0.284** **0.014**	0.004 0.970	**0.226** **0.053**	1.000 –
% of Reminder Announc.	0.186 0.114	**0.206** **0.078**	**0.280** **0.016**	**0.658** **0.000**	0.096 0.415	**0.200** **0.088**	**0.422** **0.000**

Based on this correlations table, several key observations were made. First, given that almost all individuals utilized agents with MS Outlook, the announcement of incoming messages and calendar reminders in Outlook might potentially serve as a proxy for the degree to which the respondents utilized the technology under investigation in general. The results indicated a very high and significant correlation of questions pertaining to Figure 5.11 and Figure 5.15 ($r = 0.611$), and Figure 5.13 and Figure 5.16 ($r = 0.658$). This confirms the validity of the obtained data sample.

Secondly, people utilized email agents at work and at home differently. Given that the respondents to the survey were very heavy email users, they were expected to utilize a desktop email management application such as Outlook at work. The usage of a Web-based email interface would be less efficient as the volume of electronic communications increases. At the same time, the same individuals might utilize a different email application at home. Currently, Hotmail is the most frequently utilized Web-based email system (Serenko and Turel 2004b). In addition, the interface agent technology of ABC Company was compatible with both Outlook and Hotmail. Therefore, it may be assumed that the respondents utilized Outlook at work and Hotmail at home. The results indicated a strong positive correlation between work agent usage and message and reminder announcement in Outlook, and between home usage and message announcement in Hotmail. At the same time, no correlation between work usage and message announcement in Hotmail was found.

Thirdly, a strong, significant correlation between home usage and read receipt announcement demonstrated that people tended to announce read receipts more often when they utilized email agents at home. This may be partially due to the fact that time pressure was less in a home environment, and individuals might allow the announcement of non-critical information. A moderate yet statistically significant correlation was found between home and work usage.

Overall, the Pearson correlation table revealed that email agent users tended to utilize most features of this technology simultaneously.

5.3 Deductive Analysis

Recall that research questions one through four pertained to the validation of the suggested model of user adoption of interface agents for email. Before analyzing the model, the reliability of all constructs was measured. Cronbach's alpha exceeded the required threshold of 0.7 for all items that implied high internal consistency of the scales (Cronbach 1951).[59]

[59] The actual measures of reliability for each construct are presented later in the 'Construct Statistics' table.

The model was tested by using PLS-Graph Version 03.00. The following subsections describe a common method bias assessment, the measurement and structural models, the effect size, and control variables in detail.

5.3.1 Common Method Bias Assessment

With respect to this study, Harman's one-factor test was done. It was chosen over a partial correlation procedure for two reasons. First, the administration of the PLS partial correlation procedure may produce inaccurate results because the data sample for a partially correlated model would be below the required threshold.[60] Second, the employment of the partial correlation procedure is applicable when groups of respondents provide answers to dependent and independent variables that pertain to a uniform phenomenon rather than to the individuals themselves. As such, this type of the common method bias test may be successfully administered in organizations, but it is not applicable to individual-level technology adoption studies (for an example of the PLS partial correlation procedure, see Bontis et al., 2002).

In order to conduct the Harman's test, an exploratory factor analysis was done on the model's items, except for the agent usage construct because it was measured by a single indicator (Podsakoff and Organ 1986). Twenty-two items pertaining to five model's constructs were entered into the analysis. As suggested by Straub, Boudreau, and Gefen (2004), two BI items were removed from the exploratory factor analysis since they are the ultimate dependent variables that are expected to highly correlate with PE, PU, and PEOU variables. The unrotated solution produced five factors with an eigenvalue greater than one. The eigenvalue of the fifth component was 1.444. The first component comprised of items pertaining to different constructs, such as PE, PIIT, and several CPS indicators. Some of these items strongly cross-loaded on subsequent components. For example, CPS cross-loaded on component 1 and 2, PU on 1 and 3, and PEOU on 1 and 4. Several questions loaded higher on components 3 or 4 rather than 1. There was no conspicuous order in which item loadings of the unrotated factors were structured. Therefore, there is evidence to suggest that variables in the present investigation do not tend to load on a single general factor. In addition, a one-factor model explained only 35% of variance, whereas a five-factor model explained 75%. This implies that there is no common bias in the collected data.

5.3.2 Measurement Model

The estimated loadings of the total set of measurement items are summarized in Table 5-3. Two CPS items (CPS1 and CPS3) with loadings below the selected threshold of 0.7 were dropped to ensure construct validity. Once these items were removed, the

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[60] To conduct a test of common method bias, the data need to be rearranged (i.e., paired) so that every individual would provide responses to either independent or dependent variables. With respect to this dissertation, the rearranged sample would consist of 37 data points; each individual would respond to either behavioral usage intentions (BI) or other model's variables (PU, PEOU, PE, PIIT, and CPS). The correlations of factor scores should be compared to see if a significant difference exists. However, the minimum number of data points would be below the required threshold of 70.

model was re-estimated. The item-to-total correlation coefficients of all items exceeded the cut off value of 0.35. Further analysis is based on the re-estimated model (i.e., which excludes items CPS1 and CPS3).

Table 5-3: Estimated Loadings for the Total Set of Measurement Items

Item	Mean	Std. dev	Loading	Error	Item-total correlations
CPS1	5.55	1.43	0.618*	0.617	0.478
CPS2	5.99	1.16	0.831	0.309	0.780
CPS3	5.81	1.07	0.678*	0.541	0.596
CPS4	5.96	0.99	0.808	0.347	0.743
CPS5	5.59	1.20	0.732	0.464	0.517
CPS6	5.92	1.14	0.831	0.310	0.779
CPS7	6.03	1.14	0.802	0.358	0.766
PIIT1	5.97	1.01	0.863	0.256	0.726
PIIT2	5.84	1.20	0.871	0.242	0.780
PIIT3	5.95	1.16	0.866	0.218	0.793
PIIT4	5.96	1.24	0.884	0.251	0.773
PU1	4.80	1.32	0.847	0.282	0.765
PU2	4.95	1.41	0.919	0.156	0.860
PU3	5.07	1.04	0.944	0.110	0.898
PU4	5.43	1.35	0.917	0.158	0.819
PEOU1	5.77	1.13	0.835	0.302	0.655
PEOU2	5.97	1.16	0.755	0.430	0.604
PEOU3	5.84	1.23	0.860	0.261	0.760
PEOU4	5.28	1.54	0.820	0.328	0.650
PE1	5.84	1.37	0.987	0.025	0.969
PE2	5.77	1.40	0.977	0.045	0.945
PE3	5.77	1.51	0.968	0.063	0.933
BI1	5.6	1.59	0.986	0.027	0.945
BI2	5.59	1.61	0.986	0.028	0.945
USE	5.51	1.726	1.000[61]		

Note: * – removed items.

[61] This construct was measured by a single item.

A matrix of loadings and cross-loadings was used to test discriminant validity (Table 5-4). In order to evaluate the discriminant validity of measures, the loadings of an item with its associated factor (i.e., construct) to its cross-loadings were compared. All items had higher loadings with their corresponding factors in comparison to their cross-loadings. In general, it was concluded that there was some confidence in the discriminant validity of the measures and their corresponding constructs.

Table 5-4: Matrix of Loadings and Cross-loadings

	CPS	PIIT	PU	PEOU	PE	BI	USE
CPS2	**0.866**	0.451	0.179	0.147	0.218	0.234	0.164
CPS4	**0.804**	0.512	0.149	0.143	0.227	0.218	0.063
CPS5	**0.729**	0.434	0.201	0.192	0.401	0.243	0.119
CPS6	**0.865**	0.559	0.238	0.205	0.264	0.302	0.035
CPS7	**0.825**	0.415	0.194	0.124	0.133	0.206	0.026
PIIT1	0.483	**0.863**	0.244	0.318	0.464	0.420	0.052
PIIT2	0.500	**0.871**	0.307	0.179	0.244	0.337	-0.020
PIIT3	0.606	**0.866**	0.222	0.147	0.245	0.309	0.045
PIIT4	0.497	**0.884**	0.191	0.332	0.239	0.279	0.057
PU1	0.259	0.205	**0.847**	0.284	0.375	0.427	-0.017
PU2	0.214	0.230	**0.919**	0.355	0.241	0.481	0.045
PU3	0.141	0.197	**0.944**	0.369	0.315	0.517	0.043
PU4	0.261	0.341	**0.917**	0.457	0.431	0.641	0.074
PEOU1	0.176	0.224	0.480	**0.835**	0.494	0.500	0.106
PEOU2	0.078	0.264	0.253	**0.755**	0.273	0.311	0.003
PEOU3	0.124	0.207	0.264	**0.860**	0.357	0.489	0.098
PEOU4	0.289	0.271	0.314	**0.820**	0.461	0.488	0.125
PE1	0.326	0.363	0.388	0.501	**0.987**	0.782	0.107
PE2	0.333	0.325	0.408	0.490	**0.977**	0.750	0.087
PE3	0.359	0.345	0.318	0.468	**0.968**	0.678	0.028
BI1	0.287	0.355	0.581	0.564	0.748	**0.968**	0.161
BI2	0.314	0.415	0.565	0.534	0.742	**0.968**	0.188
USE	0.082	0.157	0.392	0.558	0.380	0.649	**1.000**

Table 5-5 presents construct statistics. As discussed earlier, tests for reliability of the measurement items relating to six constructs were conducted by estimating Cronbach's alpha. The Fornell and Larcker's (1981) measures of internal consistency and convergent validity of a construct were greater than 0.7 and 0.5 threshold respectively. Table 5-6 offers the correlation matrix and discriminant validity assessment. The Fornell and Larcker's (1981) measure of discriminant validity was calculated as the square root of the average variance extracted and compared to the construct correlations. All values along the diagonal were greater than those in corresponding rows and columns.

It should be noted that three perceived enjoyment items (PE1, PE2, and PE3) had relatively high cross-loadings on the BI construct, and that two behavioral intentions items had relatively high cross-loadings on the PE construct. This, however, did not

threaten the validity of the model. First, the loadings of these items on the constructs to which they belonged were higher than their cross-loadings. Second, PE and BI represented an independent and a dependent variable[62] that were assumed to be correlated. As argued by Straub, Boudreau, and Gefen (2004, p. 25), 'loadings across what are traditionally known as independent and dependent variables are not relevant to the issue of construct validity and such tests may/should be avoided in PCA [principle component analysis].'

In addition, the measure of convergent validity was estimated by reviewing the *t*-tests for the item loadings (Anderson and Gerbing 1988; Hatcher 1994). The inspection revealed that all *t*-values were significant at 0.001 level. This shows that all indicators effectively measured the construct they belonged to.

Table 5-5: Construct Statistics[63]

	CPS	PIIT	PU	PEOU	PE	BI
Arithmetic mean (used items[64])	5.90	5.93	5.06	5.72	5.79	5.71
Cronbach's Alpha	0.87	0.89	0.93	0.83	0.98	0.97
Internal Consistency	0.903	0.924	0.949	0.890	0.985	0.986
Convergent Validity	0.612	0.752	0.823	0.670	0.956	0.971

Table 5-6: Correlation Matrix and Discriminant Validity Assessment

	CPS	PIIT	PU	PEOU	PE	BI	USE
CPS	**0.783**						
PIIT	0.582	**0.867**					
PU	0.235	0.271	**0.907**				
PEOU	0.221	0.301	0.421	**0.818**			
PE	0.357	0.361	0.386	0.499	**0.978**		
BI	0.293	0.382	0.579	0.566	0.765	**0.986**	
USE	0.082	0.157	0.392	0.558	0.380	0.649	**1.000**

Based on the measurement model, several key observations were made. First, all constructs behaved very reliably and demonstrated high convergent and discriminant validity. Secondly, the correlation between CPS and PIIT was 0.582. This is relatively close to the coefficient obtained by two other studies: Agarwal and Prasad (1998) and Serenko (2004b). These investigations report their correlations to be 0.67 and 0.434 respectively, which signifies the rigor of the collected data for this dissertation. Overall, it was concluded that there is some degree of assurance that a valid set of data was collected by surveying the target agent user population.

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[62] Although PE is influenced by CPS, PE may be viewed as an independent construct with respect to BI.

[63] Note that the use of email interface agents was measured by a single item. Therefore, no construct statistics for it is available.

[64] Recall CPS1 and CPS3 items were dropped earlier to ensure construct validity.

The scores of the key constructs (CPS, PIIT, PU, PE, and BI) obtained within this study were compared with those of constructs measured in a different project conducted by Serenko, Bontis, and Detlor (forthcoming). That empirical investigation involved 261 young individuals[65] who completed the CP and PIIT scales and answered questions pertaining to PU, PE, and BI with respect to interface agents in Microsoft Office applications. Overall, the comparison or calculation of differences in scores is frequently utilized in management and sociology studies (Fuguitt and Lieberson 1973; Hofstede 1980; Myers and McCaulley 1985).

Note that the differences in factor scores could not be compared because the overall mean of the individual factor scores pertaining to a single construct is zero. Differences in the factor scores of constructs may be compared if a uniform dataset obtained from the same population is analyzed (for example, see Bontis, Crossan and Hulland (2002) and Serenko (2004a)). In the present case, two different populations were analyzed. Therefore, only construct means may be compared, where a construct mean is formed by the raw scores of its indicators.

Table 5-7 offers construct comparison statistics for both studies. As such, the construct means were compared. Overall, all item means reported by the respondents to this dissertation study were significantly higher than those reported by Serenko et al. (forthcoming).

Table 5-7: Construct Mean Comparison – All Constructs

Arithmetic mean[66]	**CPS**	**PIIT**	**PU**	**PE**	**BI**
Present study	5.90	5.93	5.06	5.79	5.71
Serenko et al. (forthcoming)	4.79	4.73	3.34	3.32	3.13
Mean difference	1.11	1.20	1.72	2.47	2.58
P-value	<.000	<.000	<.000	<.000	<.000

[65] In that study, 67 % of all respondents were from 21 to 25; 25 % were from 26 to 30; and 8% were over 30 years old.

[66] Both studies dropped several CPS items for construct validity reasons. In the calculation of construct mean differences all items were used.

In addition, the individual PIIT scores were compared with those obtained by Agarwal and Prasad (1998).[67] Subjects in their study were business professionals enrolled in a part-time MBA program. Table 5-8 outlines this comparison. Again, email interface users demonstrated a higher degree of personal innovativeness in IT.

Table 5-8: Item Mean Comparison – PIIT

		PIIT1	PIIT2	PIIT3	PIIT4
Present study	**Mean**	5.97	5.84	5.95	5.96
	Std	1.01	1.20	1.16	1.24
Agarwal and Prasad (N=175)	**Mean**	5.46	4.68	5.62	5.58
	Std	1.18	1.53	1.38	1.27
Mean difference		0.51	1.16	0.33	0.38
Z-statistics[68]		3.473	6.427	1.944	2.204
P-value		<.000	<.000	<.1	<.05

5.3.3 Structural Model

Jackknifing was done to derive t-statistics. Jackknifing is a resampling procedure for the assessment of the significance of PLS parameter estimates (Chin 2001). Figure 5.17 presents the structural model.

[67] Agarwal and Prasad (1998) do not provide the standard deviation value of the entire PIIT construct. Therefore, the scores on individual items are compared.

[68] Since no information on the nature of data distribution is available from Agarwal and Prasad, it is assumed that it follows normal distribution. For this reason, z-value is calculated. Z-statistics was calculated without the use of statistical software.

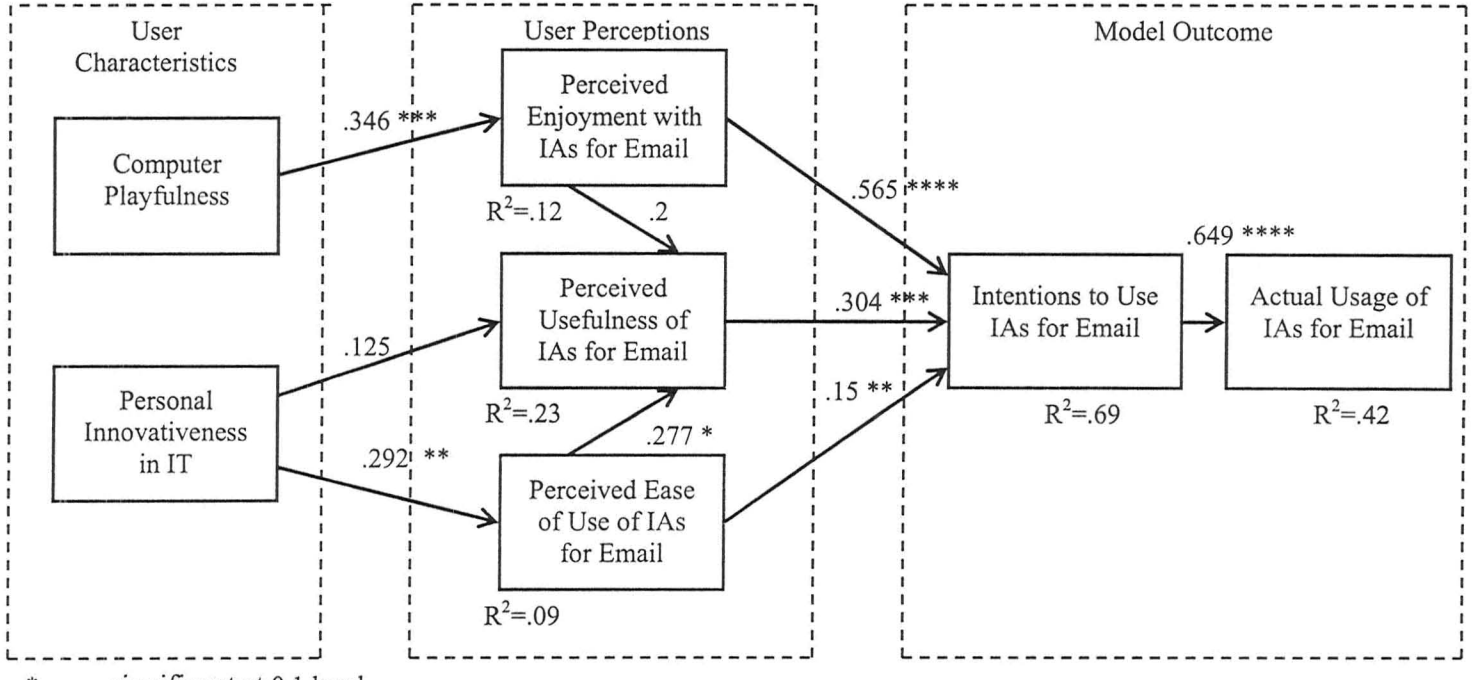

Figure 5.17: The Structural Model

According to the results, seven out of nine hypotheses were supported and two were rejected. Table 5-9 below summarizes the validation of the hypotheses.

Table 5-9: Hypotheses Validation

Hypothesis	Beta	T-value	P-value	Validation
H1: CP – PE	0.346	2.771	<0.01	supported
H2: PIIT – PU	0.125	0.945	not reported	rejected
H3: PIIT – PEOU	0.292	2.479	<0.05	supported
H4: PE – PU	0.200	1.476	not reported	rejected
H5: PEOU – PU	0.277	1.731	<0.1	supported
H6: PE – BI	0.565	5.308	<0.001	supported
H7: PU – BI	0.304	3.240	<0.01	supported
H8: PEOU – BI	0.150	1.971	<0.05	supported
H9: BI – USE	0.649	5.966	<0.001	supported

As such, most linkages were supported. The model demonstrated that behavioral usage intentions lead to the actual use of email interface agents. Behavioral intentions, in turn, were very strongly influenced by the degree of perceived enjoyment, strongly effected by perceived usefulness, and, to some extent, by perceived ease of use. The perception of an agent's usefulness was influenced by the perception of its ease of use, but not by the perception of enjoyment. Individuals who tended to interact with computers in a playful manner perceived an email agent to be more enjoyable. People, who reported a higher degree of personal innovativeness in IT, perceived an agent to be easier to use, but not necessarily more useful. In order to show the insignificance of the rejected linkages, the PIIT – PU and PE – PU links were removed and the model was re-estimated. This did not result in the further alternation of the conclusions on other hypotheses.

Recall this model is applied to a new agent-based technology. The usage of interface agents may require a different mode of human-agent interaction that does not have an extensively researched theoretical base. Therefore, to explore all possible links among constructs, the saturated model was tested. In the potentially fully saturated model, there are a total of 21 possible path relationships. Of those, one path was entirely rejected in the literature (i.e., computer playfulness has shown to be correlated with PIIT but generally no path dependency) (Agarwal and Prasad 1998), and three path were discarded consistent with MIS research principles (i.e., since the BI construct is present in the model, there is no need to test the PE – USE, PU – USE, PEOU – USE relationships). The remaining 17 paths were simultaneously estimated. Table 5-10 describes the new relationships that were added to the model, and Table 5-11 presents the changes in the previously validated links.

Table 5-10: The Saturated Model – New Relationships

Link	Beta	T-value	P-value	Validation
CP – PU	0.070	0.243	not reported	rejected
CP – PEOU	0.092	0.344	not reported	rejected
CP – BI	-0.030	0.245	not reported	rejected
CP – USE	-0.107	0.704	not reported	rejected
PIIT – PE	0.266	1.403	not reported	rejected
PIIT – BI	0.092	0.795	not reported	rejected
PIIT – USE	-0.082	0.682	not reported	rejected
PE – PEOU	0.457	3.845	<0.01	supported

Table 5-11: The Saturated Model – Previously Hypothesized Relationships

Hypothesis	Beta	T-value	Validation	Beta	T-value	Δ Beta	Validation
Non-Saturated Model				**Saturated Model**			
H1: CP – PE	0.346	2.771	supported	0.165	0.775	-0.181	*rejected*
H2: PIIT – PU	0.125	0.945	rejected	0.086	0.365	-0.039	rejected
H3: PIIT – PEOU	0.292	2.479	supported	0.137	1.010	-0.155	*rejected*
H4: PE – PU	0.200	1.476	rejected	0.186	1.025	-0.014	rejected
H5: PEOU – PU	0.277	1.731	supported	0.282	1.672	0.005	supported
H6: PE – BI	0.565	5.308	supported	0.549	4.760	-0.016	supported
H7: PU – BI	0.304	3.240	supported	0.295	2.995	-0.009	supported
H8: PEOU – BI	0.150	1.971	supported	0.141	1.778	-0.009	supported
H9: BI – USE	0.649	5.966	supported	0.697	6.547	0.048	supported

Based on the tables above, two observations can be made. First, out of eight new links, only one had a strong, significant path coefficient. On the one hand, this may indicate that those individuals who perceive email interface agents to be easier to use also perceive them to be more enjoyable. At the same time, given the lack of strong theoretical base, it may be concluded that perceived enjoyment has an impact on perceived ease of use. On the other hand, since the other seven new links were rejected, the PE – PEOU relationship may be attributed to a pure chance.

Second, the estimation of the saturated model changed the conclusions on only two out of nine hypotheses suggested in this study (i.e., the CP – PE and PIIT – PEOU initially supported links were rejected). The rejection of two hypotheses in the saturated model does not imply these relationships do not exist. In PLS, betas and significance levels of constructs depend on their position within the proposed nomological network (Carte and Russell 2003; Chin et al., 2003). In other words, if a change to the model occurs, new factor scores are derived since PLS attempts to optimize the amount of variance explained by both constructs and their related links. With respect to this dissertation, a visual inspection of item loadings of the non-saturated and saturated models demonstrated that different weights for CP and PIIT indicators were produced. After CP and PIIT were linked with a number of other constructs, and these relationships had little, if any, theoretical rationale, PLS optimized the total variance of all relationships by manipulating with the CP and PIIT item weights. In other words, part of the CP – PE and PIIT – PEOU variance was re-assigned to other CP and PIIT relationships.

The model demonstrated high explanatory power. R-square of the BI construct was 0.69 that means that it explained 69% of the variance in user intentions to adopt an email agent. R-square of actual usage of agents was 0.42.

Note that the R-square values of PE and PEOU constructs were relatively small (i.e., 0.12 and 0.09 respectively). This, however, did not represent a threat to the model's validity. Cohen (1988, p. 532-535) suggests that in many circumstances, the amount of actual association between constructs is, in fact, greater that the proportion of variance accounted for by measuring R-square. In general, low R-square values are common in behavioral science research. Many TAM-based investigations report low R-squares (for example, see Chau and Hu 2002; Moon and Kim 2001). Even Davis and his colleagues (1989) and Davis (1993) observed R-squares below 0.1. In addition, both PE and PEOU were influenced by a single construct (i.e., CPS-PE and PIIT-PEOU). Such construct associations tended to provide low R-square values compared to multi-relationship models (Nunnally 1978).[69] If, for example, another antecedent, which correlated significantly with both PE and PEOU but did not correlate with CPS and PIIT, was added to the model, the R-square values of PE and PEOU would increase substantially.

Overall, despite the rejection of two hypotheses, it was believed that the dissertation model adequately explained reasons for which people accept or reject interface agents for electronic mail.

5.3.4 The Effect Size

Often, the quality and predictive power of TAM-based models are measured by the analysis of R-square values of the BI construct. The interpretation of R-squares in PLS is identical to that in linear regression. According to Chin (1998), in order to estimate the predictive power of independent constructs, the effect size of each independent construct[70] should be estimated by the following formula:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}} \qquad (5.1)$$

Where f^2 is the effect size of an independent construct, $R^2_{included}$ is the R-square value of a dependent construct when the tested independent construct is included in the model, and $R^2_{excluded}$ is the R-square value of a dependent construct when the tested independent construct is excluded from the model.

As such, one PE, PU, or PEOU link was removed at a time, and R-square values of BI were recorded. As recommended by Cohen (1988), the effect size values of 0.02,

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[69] Note that the R-square of PU is higher (0.23) because it was influenced by two independent constructs.

[70] Although PE, PU, and PEOU were influenced by other constructs (i.e., CP and PIIT), they were considered independent with respect to BI in the effect size test.

0.15, and 0.35 may be viewed as a gauge whether a predictor has a small, medium, or large effect at the structural level.

Table 5-12 presents the R-squared values and the effect sizes. It demonstrates that the degrees of perceived enjoyment, usefulness, and ease of use had very large, medium, and small effects on behavioral intentions respectively.

Table 5-12: The Size Effects

$R^2_{included} = 0.687$	PE	PU	PEOU
$R^2_{excluded}$	0.46	0.62	0.67
f^2	0.50	0.18	0.04
Effect	large	medium	small

5.3.5 Control Variables

The respondents to the survey were also asked about their current or past usage of email interface agents. Fifty-four percent of them indicated that they were using this technology at the day of the survey and 46% were not. Recall Section 5.2.1 indicated that 20% and 80% of users were female and male, and Section 5.2.3 showed that 55% of all respondents worked in the information technology / information systems field. This allows employing three control variables: 1) current vs. past users (1 – current user, 0 – past user), 2) gender (1 – male, 0 – female), and 3) IS/IT vs. non-IS/IT users (1 – IS/IT field, 0 – non-IS/IT field). These control variables were entered into the PLS model one at a time. Table 5-13 presents the difference in R-square values for three models with control variables. As suggested by Chin (1998, p. 316), "the change in R-squares can be explored to see whether the impact of a particular independent [construct] on a dependent [construct] has substantial impact." A visual inspection of the values indicated that the employment of the Current vs. Past User control variable improved the total variance of each construct that is explained by other constructs leading to it (i.e., R-square values were substantially higher). More importantly, R-squares of the BI and USE constructs increased. At the same time, the employment of the gender and IS/IT vs. non-IS/IT control variables provided only an incremental, if any, improvement. It should be noted that the implementation of the gender control variable increased the amount of variance accounted for by PE (R-square = 0.22) and PEOU (R-square = 0.12).[71]

Table 5-13: The Use of Control Variables: R-square

	PU	PEOU	PE	BI	USE
Uncontrolled Model	0.23	0.09	0.12	0.69	0.42
Current vs. Past User	0.27	0.16	0.2	0.72	0.51
Gender	0.23	0.12	0.22	0.69	0.42
IS/IT vs. non-IS/IT	0.28	0.12	0.12	0.69	0.43

[71] CPS and PIIT do not present in Table 5-13 because there is no R-square values for them available in the uncontrolled model.

Table 5-14 offers a list of path coefficients and significance levels for relationships between the control variable and all other model constructs. The strong, positive Beta coefficients indicated that current email agent users formed more positive perceptions of this technology, and they intended to use it more extensively. Again, the IS/IT vs. non-IS/IT variable had no statistically significant effect on the model. At the same time, although the inclusion of the gender variable did not have a statistically significant impact on behavioral intentions and actual usage of email agents, the perceptions of ease of use and enjoyment were statistically different between male and female users. Strong negative beta coefficients between the gender control variable and PEOU (-0.208) and PE (-0.320) demonstrated that women perceived interface agents to be easier to use and more enjoyable than men.

Table 5-14: The Use of Control Variables: Path Coefficients between the Control Variable and the Model Constructs

		CPS	PIIT	PU	PEOU	PE	BI	USE
Current vs. Past User	**Beta**	-0.025	0.048	0.216	0.281	0.281	0.185	0.324
	T-value	0.022	0.476	1.674	2.834	2.775	2.406	3.382
	P-value<	n/a	n/a	0.1	0.01	0.01	0.05	0.001
	Validation	n.s.	n.s.	sign.	sign.	sign.	sign.	sign.
Gender	**Beta**	0.081	0.237	0.094	-0.208	-0.320	0.004	-0.024
	T-value	0.503	1.294	0.451	1.672	3.072	0.039	-0.193
	P-value<	n/a	n/a	n/a	0.1	0.01	n/a	n/a
	Validation	n.s.	n.s.	n.s.	sign.	sign.	n.s.	n.s.
IS/IT vs. non-IS/IT	**Beta**	-0.016	0.077	-0.221	0.194	-0.054	-0.054	-0.085
	T-value	0.263	0.372	1.265	1.606	0.466	0.422	0.541
	P-value	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Validation	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

5.4 Inductive Analysis

5.4.1 Effects of Interface Agents

Recall respondents were asked to rate their perceptions of the importance of eight effects of interface agents on a seven-point Likert-type scale. The purpose was to understand what effects were more or less imperative from the end-user's point of view. Figure 5.18 visualizes the results, and Table 5-15 presents the list of questions sorted by the mean.

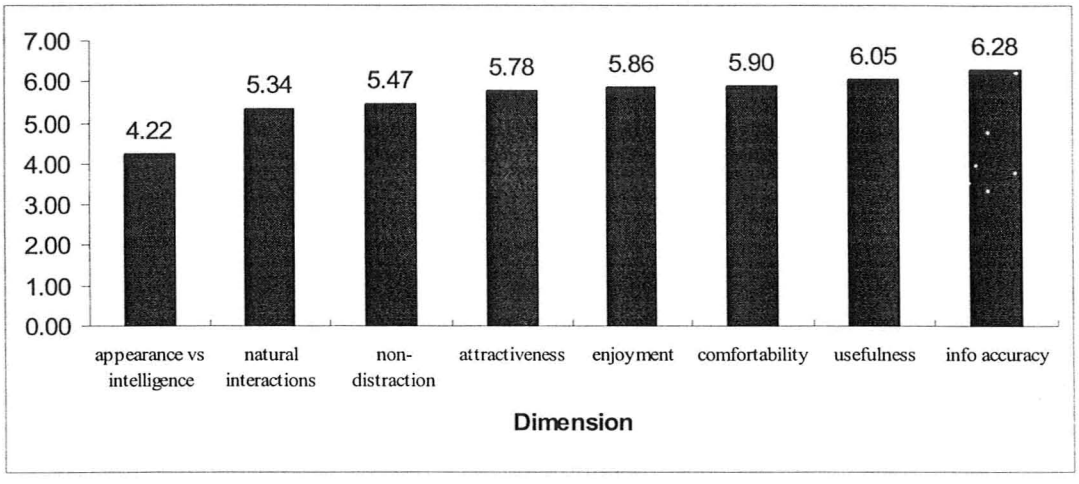

Figure 5.18: User Perceptions of the Importance of Interface Agent Effects

Table 5-15. User Perceptions of the Importance of Interface Agent Effects

Based on your experience with interface agents for email, how important is it for you:	**Mean**	**Std**
to believe that the information provided by an interface agent is accurate?	6.28	1.04
to perceive an interface agent useful?	6.05	1.13
to feel comfortable with an interface agent?	5.90	1.10
to perceive an interface agent enjoyable?	5.86	1.13
to like the appearance of an interface agent?	5.78	1.17
to avoid being distracted by an interface agent while engaged in important tasks?	5.47	1.74
to perceive all interactions with an interface agent as natural?	5.34	1.36
to believe that an interface agent's appearance should correspond to its level of intelligence?	4.22	1.86

To analyze whether there were differences in these eight means, the One-Way ANOVA test was conducted. The goal of this statistical method is to determine the existence of differences among several population means (Aczel 1996, p. 358). This technique is an extension of the two-sample *t* test. The results demonstrated that there was a high degree of confidence that at least some of the means differed from one another ($F = 12.846$, d.f. = 7, significance level = 0.000).

The Levene (1960) test was conducted to analyze the equality of group variances since this is a key requirement for the applicability of the Tukey test. As such, the homogeneity of variances of all groups of questions was confirmed (Levene Statistics = 8.503, d.f.1 = 7, d.f.2 = 456, significance level = 0.000).

After it was determined that differences existed among the means, the Tukey Honestly Significant Difference test was done. The Tukey post hoc test is a statistical method of pairwise comparisons of the population means. It allows comparing every possible pair of means using a selected single level of significance. With respect to this dissertation study, the 0.1 significance level was chosen.

SPSS was used to conduct the Tukey test. The software tool yielded a matrix where asterisks (*) indicated significantly different group means at an alpha level of 0.1. Table 5-16 below presents the results of mean comparisons.

Table 5-16. The Tukey Test

(I) EFFECT	(J) EFFECT	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower Bound	Upper Bound
1 appearance vs. intelligence	2	-2.05(*)	.251	.000	-2.75	-1.35
	3	-1.55(*)	.251	.000	-2.25	-.85
	4	-1.67(*)	.251	.000	-2.37	-.97
	5	-1.83(*)	.251	.000	-2.53	-1.13
	6	-1.64(*)	.251	.000	-2.34	-.94
	7	-1.12(*)	.251	.000	-1.82	-.42
	8	-1.24(*)	.251	.000	-1.94	-.54
2 information accuracy	1	2.05(*)	.251	.000	1.35	2.75
	3	.50	.251	.486	-.20	1.20
	4	.38	.251	.800	-.32	1.08
	5	.22	.251	.986	-.48	.92
	6	.41	.251	.719	-.29	1.11
	7	.93(*)	.251	.006	.23	1.63
	8	.81(*)	.251	.028	.11	1.51
3 attractiveness	1	1.55(*)	.251	.000	.85	2.25
	2	-.50	.251	.486	-1.20	.20
	4	-.12	.251	1.000	-.82	.58
	5	-.28	.251	.956	-.98	.42
	6	-.09	.251	1.000	-.79	.61
	7	.43	.251	.674	-.27	1.13
	8	.31	.251	.920	-.39	1.01
4 comfortability	1	1.67(*)	.251	.000	.97	2.37
	2	-.38	.251	.800	-1.08	.32
	3	.12	.251	1.000	-.58	.82
	5	-.16	.251	.999	-.85	.54
	6	.03	.251	1.000	-.66	.73
	7	.55	.251	.353	-.15	1.25
	8	.43	.251	.674	-.27	1.13
5 usefulness	1	1.83(*)	.251	.000	1.13	2.53
	2	-.22	.251	.986	-.92	.48
	3	.28	.251	.956	-.42	.98
	4	.16	.251	.999	-.54	.85
	6	.19	.251	.995	-.51	.89
	7	.71(*)	.251	.092	.01	1.41
	8	.59	.251	.275	-.11	1.29
6 enjoyment	1	1.64(*)	.251	.000	.94	2.34
	2	-.41	.251	.719	-1.11	.29
	3	.09	.251	1.000	-.61	.79
	4	-.03	.251	1.000	-.73	.66
	5	-.19	.251	.995	-.89	.51
	7	.52	.251	.440	-.18	1.22
	8	.40	.251	.761	-.30	1.10
7 natural	1	1.12(*)	.251	.000	.42	1.82
	2	-.93(*)	.251	.006	-1.63	-.23
	3	-.43	.251	.674	-1.13	.27

(I) EFFECT	(J) EFFECT	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower Bound	Upper Bound
interactions	4	-.55	.251	.353	-1.25	.15
	5	-.71(*)	.251	.092	-1.41	-.01
	6	-.52	.251	.440	-1.22	.18
	8	-.12	.251	1.000	-.82	.58
8	1	1.24(*)	.251	.000	.54	1.94
	2	-.81(*)	.251	.028	-1.51	-.11
little distraction	3	-.31	.251	.920	-1.01	.39
	4	-.43	.251	.674	-1.13	.27
	5	-.59	.251	.275	-1.29	.11
	6	-.40	.251	.761	-1.10	.30
	7	.12	.251	1.000	-.58	.82

Based on these results, several statistically significant differences in item means were observed. Overall, the means of the questions positioned on the left-hand-side and right-hand-side of Figure 5.18 strongly differed from one another. This demonstrated a strong degree of confidence that respondents were able to distinguish among the questions, and that the results presented in Figure 5.18 were statistically sound.

5.4.2 Open-Ended Items Analysis

Recall the respondents were asked to provide the following information in the form of open-ended questions:

Q1. An explanation why they stopped using interface agents in their email applications (only for those who indicated they were not using an agent at the time of the survey).

Q2. At least three reasons why they like to use interface agents in their email applications.

Q3. At least three reasons why they do not like to use interface agents in their email applications.

Q4. A brief description of at least three tasks that they would like an 'ideal email interface agent' to perform in their email applications.

Q5. Any recommendations for interface agent designers, which come from user experience with interface agents in their email applications. (Optional)

Q6. Any recommendations for interface agent marketers, which come from user experience with interface agents in their email applications. (Optional)

Q7. Any other thoughts, concerns, or recommendations on this technology. (Optional)

Q8. One last most significant POSITIVE or NEGATIVE incident of usage of interface agents in their email applications.

In order to analyze the open-ended items, a codebook was developed by the researcher. At the first stage of codebook development, several first-level general a priori categories were formed. The utilized sets of the MIS literature embraced individual-level technology adoption and innovation theories, and the interface agent literature included academic works that were discussed in Section 2.1 of this dissertation. For example, it was assumed that some response items may pertain to user perceptions of interface agents, and the 'Perceptions' category was formed up front based on Davis' works. In another situation, the 'Environment' category was suggested because innovation scholars often emphasize the influence on external environments on user adoption behavior. This is a valid technique in qualitative research (Miles and Huberman 1994). At the second phase, the researcher conducted successive rounds of coding, developed new codes, modified earlier codes, grouped codes together, discarded repeated codes, and aligned code labels and descriptions with concepts and definitions in the existing MIS and interface agent literature. On average, from five to ten rounds of consecutive reviews for the codebook were made. At the third stage, the draft version of the codebook was evaluated by an MIS professor (the supervisor), and two rounds of revisions were made until mutual agreement on item classification was reached. Appendix 8 provides the final version of the codebook used.

By following the principles of classical content analysis, all items were coded on the lowest level, and only one code was assigned to a particular text unit. To address the issue of reliability, item coding was performed by three independent coders. During a training session, the researcher demonstrated the interface agent developed by ABC Company to the coders. They were also instructed about the use of the codebook and presented with a number of hypothetical responses.[72] Applying Krippendorff's (1980) agreement coefficient calculation showed that high consistency on coding most items was reached (Keaveney 1995; Ronan and Latham 1974). Table 5-17 outlines the agreement coefficients. After completion of coding, all discrepancies were discussed, and a final agreement on the classification of all items was reached. When the response was unclear, and the coders failed to agree on which category it belongs to, it was classified as 'Other.' Note that the same three coders performed qualitative data analysis in the subsequent parts of this dissertation.

Table 5-17: The Krippendorff's Agreement Coefficient

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Coder Agreement	0.81	0.84	0.77	0.83	N/A	N/A	N/A	See Section 5.4.2.5

[72] No actual responses were utilized during the training session. Therefore, all items were employed in the calculation of the agreement coefficient.

5.4.2.1 Reasons for Agent Usage Termination

Figure 5.19 and Table 5-18 show the results for agent usage termination. Figure 5.19 summarizes the data coded on the first level, and Table 5-18 on the second, last level.[73]

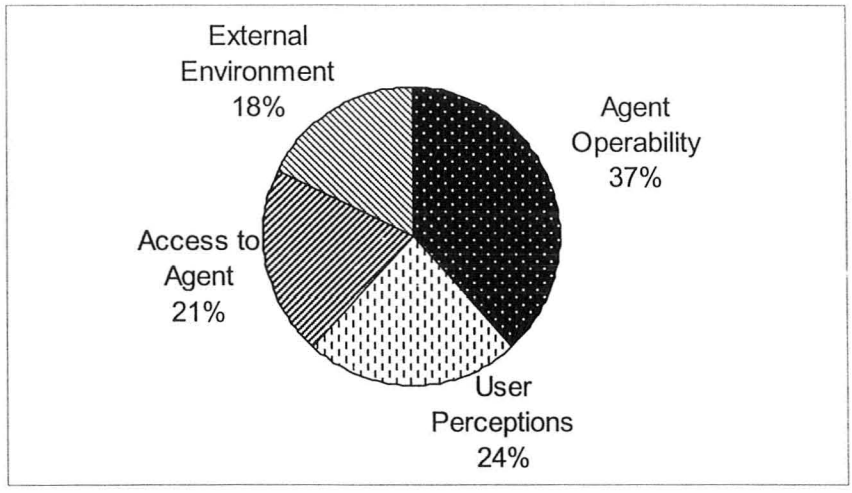

Figure 5.19: Reasons for Agent Usage Termination (Level 1)

[73] Table 5-18 presents all categories that emerged. This also refers to all similar tables in the 'Results' section.

Table 5-18: Reasons for Agent Usage Termination (Level 2)

Rank	Code	N (%)[74]	May Developers Control it?
1	INCOMPATIBLE	7 (20%)	Yes
2	INTRUSIVE	4 (11%)	Yes
3	NOT_INSTALL	4 (11%)	No
4	INTERFERENCE	3 (9%)	Yes
5	NOT_USEFUL	3 (9%)	Yes
6	LOSTKEY	2 (6%)	Yes
7	POLICY	2 (6%)	No
8	SECURITY	2 (6%)	Yes
9	SUBSTITUTE	2 (6%)	No
10	UNATTRACTIVE	1 (3%)	Yes
11	NO_ACCESS	1 (3%)	No
12	NOISE	1 (3%)	No
13	PRIVACY	1 (3%)	No
14	UNRELIABLE	1 (3%)	Yes
15	OTHER	1 (3%)	N/A
Total:		**35 (100%)**	

In total, 35 causes were provided. Agent manufacturers may potentially impact at least 26 (74%) of these reasons. For example, agent designers may improve an agent's compatibility, reliability, and visual attractiveness; this in turn may reduce the number of people who terminate use of the agent. At the same time, agent developers have no control over the situations in which individuals were forced to stop usage because of company policies, lack of physical access to a computer with an agent, complaints from neighboring people, and privacy concerns. However, these factors constituted a minority of all responses.

According to the findings, an **agent's operability**, which is defined as factors pertaining to the operational characteristics of an agent, was the most frequent reason for which people stopped using the email interface agent developed by ABC Company (37%). Under this category, respondents mentioned the agent's incompatibility with other software programs, especially with MS Outlook XP (i.e., the agent was compatible with MS Outlook but not with MS Outlook XP), the agent's interference with other applications or the entire computer, unreliability, and security issues. Below is an example of a user response pertaining to the agent's incompatibility:

> (P164): *"Upgraded to Outlook 2003 and found the software was not compatible."* (INCOMPATIBLE)

Negative user perceptions towards an agent were the second most common reason for usage termination (24%). The factors that comprised this category were high degree of perceived intrusiveness or distraction caused by the agent, low degree of

[74] Note that the sum of the percentage may be slightly different from 100 because of rounding. The same applies to other tables with similar data.

perceived agent usefulness, and perceived unattractiveness of the agent interface. It should be noted that those who abandoned the usage of an agent because of negative perceptions utilized an agent for only five months on average. For instance, some respondents said:

(P54): *"Found it a[n] unnecessary distraction."* (INTRUSIVE)

(P115): *"No productivity enhancement."* (NOT_USEFUL)

User access to an agent was the third most common reason for usage termination (21%). Three factors embraced this group. This first was that a user did not install the agent after a system re-configuration, for example, after a computer crash[75] or an update. There was no particular reason why a person did not install an agent; for example, a user was too busy re-installing other software. Lost or misplaced license keys were the second reason. Users downloaded the agent software off the company website, installed it on their computers, and entered the purchased license key to operate the agent. However, two people said they failed to locate the key when they needed to re-install the agent. The lack of access to a computer at which the agent was installed was the third reason cited by users for agent usage termination. For example, subjects indicated:

(P57): *"[I] re-built [the] computer and didn't re-load [the] agent software."* (NOT_INSTALL)

(P86): *"Viruses kept attacking my machine[,] and it was tiresome to get new codes (license keys) every time it was deleted."* (LOSTKEY)

Effects of the **external environment** that influenced a user's adoption decision were the last category (18%). Under this category, respondents referred to the policies of their companies that did not allow the employment of unauthorized software, substitute software products (e.g., currently MS Outlook has a non-agent based email notification system), noise constraints, and user privacy concerns. Noise constraints and privacy problems arose because the agent communicated with users in natural voice. This bothered other people, particularly those who shared the same work or home space, and threatened user privacy because other people might overhear the details of electronic communication. For instance, the respondents stated:

(P70): *"The information systems people asked me to remove it from my computer."* (POLICY)

(P140): *"Built-in function of Outlook 2003. Used it [the agent] until the release of Office 2003 which contains a new alert system for inbound email."* (SUBSTITUTE)

(P153): *"The voice annoyed the other occupants in the household ... personally I liked it!!!"* (NOISE)

---

[75] In this case, a system crash was not caused by the agent software.

Overall, the data showed that most respondents were willing to continue using the email interface agent. Only 24% of them discontinued the usage because of their negative perceptions of the agent. The other people suspended their usage because of the problems they faced operating the agent, for example, the agent's incompatibility or unreliability, situational factors, and under the influence of an external environment.

5.4.2.2 Reason Why Users Like Email Interface Agents

Agent users were asked to provide at least three reasons why they liked to use interface agents in their email applications. The respondents provided 146 reasons, and four people indicated that they could not recall one. Figure 5.20 and Table 5-19 outline the findings. Agent manufacturers may influence almost all of these reasons.

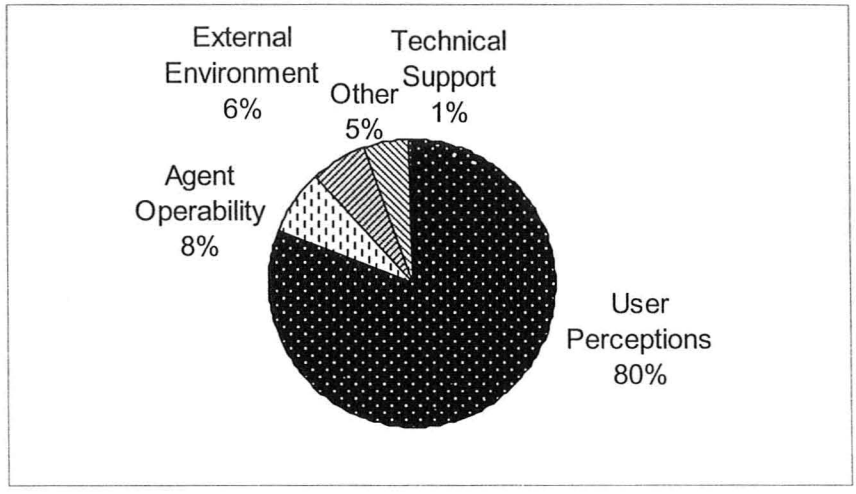

Figure 5.20: Reasons Why Respondents Like to Utilize Email Agents (All Categories – Level 1)

Table 5-19: Reasons Why Respondents Like to Utilize Email Interface Agents (Level 3)

Rank	Code	N (%)	May Developers Control it?
1	USEFUL	53 (36%)	Yes
2	ENJOYMENT	28 (19%)	Yes
3	ATTRACTIVE	12 (8%)	Yes
4	EASE_OF_USE	11 (8%)	Yes
5	IMAGE	9 (6%)	No
6	PERSONALITY	4 (3%)	Yes
7	P_CHARACTER	4 (3%)	Yes
8	ACCESSIBLE	3 (2%)	Yes
9	NON_INTRUDE	3 (2%)	Yes
10	P_GENERAL	3 (2%)	Yes
11	COMPATIBLE	2 (1%)	Yes
12	IMAGINATION	2 (1%)	Yes
13	GOOD_INTERRUPTION	2 (1%)	Yes
14	P_VOICE	1 (1%)	Yes
15	RELIABLE	1 (1%)	Yes
16	TECSUPPORT	1(1%)	Yes
17	OTHER	7(5%)	N/A
Total:		**146 (100%)**	

The results show that **user perceptions** of an agent were the major reason why people liked to utilize email interface agents. This group comprised 80% of all responses. A detailed description of the items in this category is presented later in this section.

User perceptions are followed by an **agent's operability**. The users revealed they liked personalization, compatibility, and reliability of this technology. Overall, personalization statements constituted most responses in this category:

(RL39): *"I can choose whatever agent I want ..... so I'm not stuck with a specific agent ."* (P_CHARACTER)

(RL95): *"You [have] some control in personalizing the interface agent."* (P_CHARACTER)

Social image of an agent user represented 6% of responses.[76] Nine people stated they liked to utilize an email interface agent because this improved their image of being a highly innovative individual within their social group:

(RL49): *"[The use of an agent] makes me look more intelligent [compared] to other [email] users."* (IMAGE)

(RL82): *"[I am] unique compared to co-workers."* (IMAGE)

(RL104): *"People thought it [the agent] was cool."* (IMAGE)

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[76] Only one item constitutes the ENVIRONMENT category (i.e., ENVIRONMENT_SOCIAL_IMAGE).

In addition, one person emphasized good **technical support** provided by ABC Company.

Given that 80% of all responses related to **user perceptions** of an agent, a detailed review of this category was done. Figure 5.21 presents the breakdown of the items pertaining to the user perceptions category aggregated on the second level of coding.

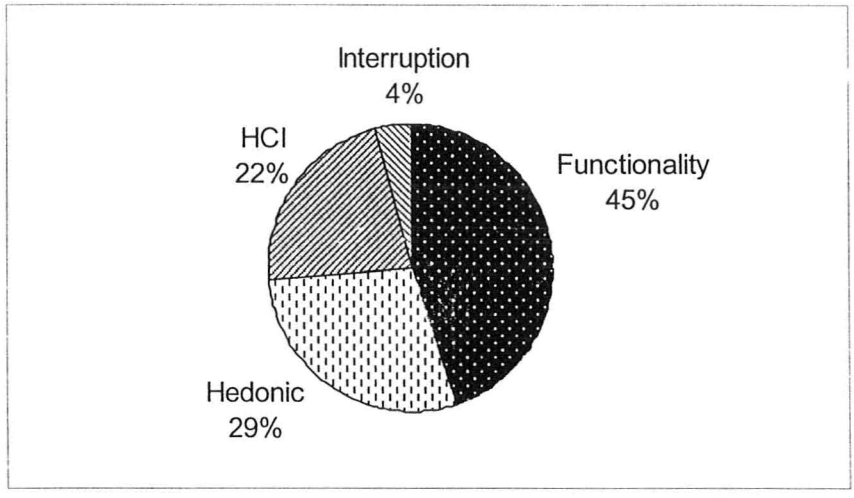

Figure 5.21: Reasons Why Respondents Like to Utilize Agents (User Perceptions – Level 2)

According to the findings, **the perceptions of an agent's usefulness** (functionality) were a leading factor.[77] They represented 45% of all user perceptions and 36% of all answers. Users perceived themselves to become more productive and efficient with the usage of their email because agents allowed them to engage in multi-tasking. By using this technology, they did not have to interrupt their current non-email or even non-computer related activities. For example, when a person was working with a MS Word processing application, an agent popped up and informed him or her about a new message. Based on user preferences, the agent might announce a sender, a subject line, or even read the entire message. The individual did not have to switch from a Word processing program to an email system to be aware of incoming messages. Moreover, the user might be away from the computer and hear email, calendar, and event announcements that saved time and increased productivity:

> (RL83):[78] *"I can listen to the agent read[ing] the email while not having to stop what I am doing to open the mail and read it."* (USEFUL)

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[77] Only one item constitutes the perceptions of an agent's functionality (i.e., PERCEPTION_FUNCTION_USEFUL).

[78] R stands for 'reasons,' L stands for 'like' (i.e., RL refers to a response for which a person likes to utilize agents), and numeric portion is a unique identifier, i.e., RL83 refers to response # 83.

(RL86): *"I can be away from the computer and learn who is sending an email. The interface agent pronounces very clearly the sender[,] and it identifies if the email is urgent."* (USEFUL)

(RL51): *"[I] don't need to open the message if [it is] not important."* (USEFUL)

(RL67): *"[The agent provides a] non-obtrusive view into your email. You don't have to check email every time you hear the message arrival – the agent tells you."* (USEFUL)

Hedonic reasons, which were independent of the outcome of agent usage, constituted 29% of user perceptions. Under this category, most users mentioned that agent usage was fun, amusing, and entertaining. It made them laugh and gave them pleasure:

(RL58): *"[The use of agent allows] to inject some humor into a mundane task."* (ENJOYMENT)

(RL125): *"[The agent] makes my work in the PC fun."* (ENJOYMENT)

Four respondents indicated that the presence of an agent gave their computer some personality, and two users said the agent boosted their imagination:

(RL39): *"It [the agent] gives the computer a 'personality'."* (PERSONALITY)

(RL47): *"It [the agent] adds a more human element to the interaction."* (PERSONALITY)

Human-computer interaction factors comprised 22% of reasons relating to user perceptions of agents. Respondents positively perceived an agent's attractiveness, ease of use, and accessibility. Most respondents referred to visual attractiveness of the agent:

(RL153): *"[I] love the cute characters."* (ATTRACTIVE)

Although only four percent of perceptual reasons for liking email agents referred to **interruptions**[79] initiated by an agent, a brief overview of this category is important since it describes a novel phenomenon that was not discussed in the prior MIS literature.

Three people said they liked that an agent was non-invasive, and it did not distract them:

(RL103): *"It [the agent] goes away after it announces."* (NON_INTRUDE)

At the same time, two respondents indicated they liked when an agent interrupted their current activities because it initiated breaks and provided good distraction from routine tasks:

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[79] The INTERRUPTION category consists of two codes: NON_INTRUDE and GOOD_INTERRRUPTION.

(RL80): *"They [agents] provide good interruptions from work."* (GOOD_INTERRUPTION)

Overall, the results show that most respondents liked to use email interface agents because they perceived agents to be useful (36%), enjoyable (19%), attractive (8%), and easy to use (8%). In addition, users believed that the employment of a new agent-based technology made them unique compared to other people (6%).

5.4.2.3 Reason Why Users Do Not Like Email Interface Agents

In addition, respondents to the survey were asked to provide at least three reasons why they did not like to use interface agents in their email systems. The subjects offered 116 reasons, and 12 individuals said they could not provide one. Figure 5.22 and Table 5-20 outline these reasons. Agent developers may influence most of these negative factors. Note that agent designers cannot currently improve the vocabulary and voices of interface agents created by the MS Agent technology. The vocabulary and agent voices are included in the Microsoft Agent package, and they cannot be modified.

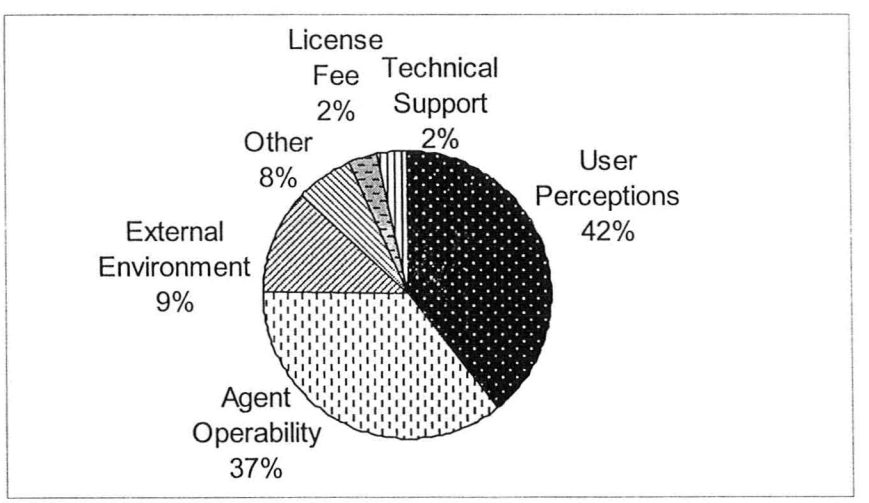

Figure 5.22: Reasons Why Respondents Do Not Like to Utilize Email Agents (All Categories – Level 1)

Table 5-20: Reasons Why Respondents Do Not Like to Utilize Email Agents (Level 3)

Rank	Code	N (%)	May Developers Control it?
1	INTRUSIVE	29 (25%)	Yes
2	INTERFERENCE	11 (9%)	Yes
3	INCOMPATIBLE	10 (9%)	Yes
4	NOT_USEFUL	8 (7%)	Yes
5	UNRELIABLE	8 (7%)	Yes
6	EASE_OF_USE	7 (6%)	Yes
7	NOISE	7 (6%)	No
8	UNATTRACTIVE	6 (5%)	Yes
9	READ_ALL	4 (4%)	Yes
10	VOCABULARY	3 (3%)	No
11	FEE	2 (2%)	Yes
12	POLICY	2 (2%)	No
13	P_GENERAL	2 (2%)	Yes
14	P_CHARACTER	2 (2%)	Yes
15	P_VOICE	2 (2%)	Yes
16	TECSUPPORT	2 (2%)	Yes
17	PRIVACY	1 (1%)	No
18	SECURITY	1 (1%)	Yes
19	OTHER	9 (8%)	N/A
Total:		**116 (100%)**	

The results demonstrate that **negative user perceptions** of an agent, which constituted 42% of all responses, were the key reason. Figure 5.23 outlines the breakdown of responses pertaining to this category.

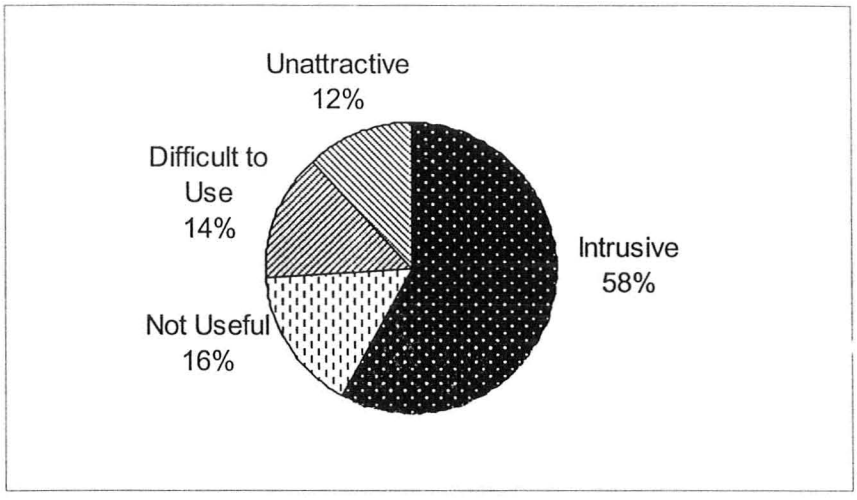

Figure 5.23: Reasons Why Respondents Do Not Like to Utilize Email Interface Agents (User Perceptions – Level 3)

According to the findings, the perception of intrusiveness comprised over one half of all answers. Users believed that an agent was sometimes annoying, interrupting, distracting, and intruding. For example, when an agent interrupted users in an inappropriate time, they lost track of their current activities, and they had to go back to re-do some work:

> (RD164):[80] *"[The agent] can be distracting if you are busy."* (INTRUSIVE)
>
> (RD153): *"Announcements can get annoying if you're receiving a lot of emails at once."* (INTRUSIVE)

Particularly, an agent was disrupting if a user was engaged in a conversation:

> (RD39): *"It [the agent] will read mail in an inappropriate time (in a meeting, or phone)."* (INTRUSIVE)
>
> (RD103): *"The voice is a pain when I am on the phone."* (INTRUSIVE)

To reduce unnecessary distraction, some users turned off either an agent or the sound when they were busy:

> (RD131): *"The only minus is I sometimes switch off the sound especially when busy."* (INTRUSIVE)

---

[80] R stands for 'reasons,' D stands for 'don't like' (i.e., RD refers to a response for which a person does likes to utilize agents), and numeric portion is a unique identifier, i.e., RL164 refers to response # 164.

Other users perceived an agent to be not useful, difficult to use, and unattractive. For instance, the agent often slowed down the execution of simple tasks, performed trivial activities, and added time. The agent's presence made the perception of the entire email application more complex.

(RD48): *"[The agent is] not as intelligent as I would like."* (NOT_USEFUL)

(RD39): *"It [the agent] can add an element of complexity."* (EASE_OF_USE)

(RD159): *"The characters are too cartoon-like."* (UNATTRACTIVE)

An **agent's operability** was the second most important factor. In this group, most respondents mentioned an agent's incompatibility, interference with the computer, applications or other software processes that slowed down the CPU performance or caused problems, and unreliability, such as bugs or crashes. These three reasons comprised 67% of all responses pertaining to an agent's operability:

(RD124): *"[The agent] does not work with Outlook 2003."* (INCOMPATIBLE)

(RD153): *"[The agent] can slow [the] performance of a PC specifically email software."* (INTERFERENCE)

(RD51): *"Sometimes[,] the menu of the IAE [the agent] will not be shown correctly in the Menu bar."* (UNRELIABLE)

Other users referred to various agent operability issues, such as limited personalization of characters and voices, inadequate vocabulary, the quality of speech, the announcement of spam messages, and security concerns. For instance, if an unsolicited message arrived into a user's Inbox, an agent treated it as a legitimate notification and announced it. Only a few responses related to each group, and no significant sub-category emerged. For example, several users were not satisfied with the degree of personalization of both agent characters and voice options:

(RD55): *"I'd like more characters to choose from."* (P_CHARACTER)

(RD159): *"The voice choices are tiny."* (P_VOICE)

The limited vocabulary of an agent also caused some inconvenience. For example, the agent incorrectly pronounced certain words and spelled out words written in capital letters:

(RD48): *"Sometimes[,] vocabulary is limited."* (VOCABULARY)

(RD127): *"It [the agent] spells out words capitalized in the subject."* (VOCABULARY)

In addition, a few respondents indicated that, sometimes, they did not understand an agent's speech and that the agent announced unsolicited messages that were missed by a junk filter. Overall, it is suggested that the degree of an agent's intrusiveness, which was

negatively perceived by many users, was the key reason why people did not like to utilize email interface agents.

5.4.2.4 Characteristics of an 'Ideal' Interface Agent

Interface agent users were asked to describe at least three tasks that they would like an 'ideal' email interface agent to perform in their email application. Although respondents were asked to present an agent's actions, many respondents provided both actions and features that an agent should possess. For this question, 126 answers were obtained. Figure 5.24 outlines the characteristics of an 'ideal' agent aggregated on the first level of coding, and Table 5-21 on the second (last) level.

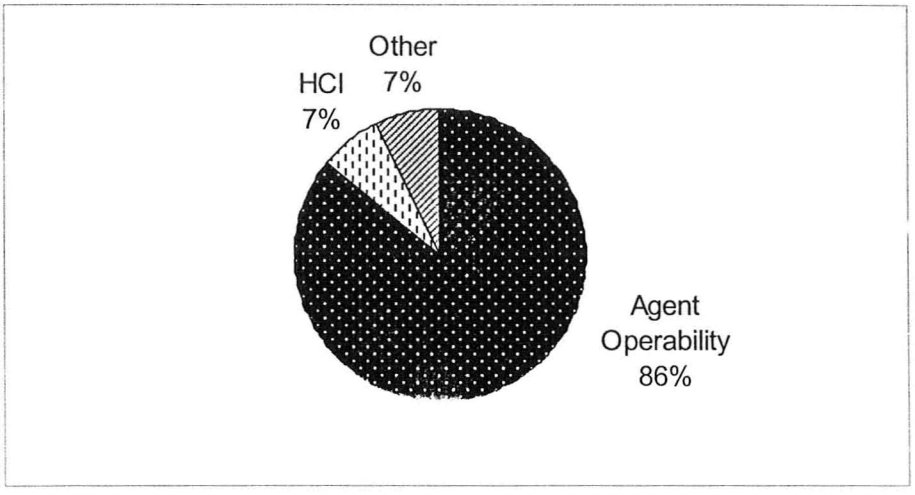

Figure 5.24: Characteristics of an 'Ideal' Interface Agent (Level 1)

Table 5-21: Characteristics of an 'Ideal' Email Interface Agents (Level 2)

Rank	Code	N (%)	May Developers Control it?
1	NOTIFICATION	38 (30%)	Yes
2	INTELLIGENCE	29 (23%)	Yes
3	PERSONALIZATION	9 (7%)	Yes
4	FILTERING	7 (6%)	Yes
5	CONTROL	7 (6%)	Yes
6	COMPATIBLE	6 (5%)	Yes
7	VOICE_REC	6 (5%)	Yes
8	VOICE	5 (4%)	No
9	NON_INTRUDE	4 (3%)	Yes
10	EASE_OF_USE	2 (2%)	Yes
11	ENJOYMENT	2 (2%)	Yes
12	ATTRACTIVE	1 (1%)	Yes
13	MOBILITY	1 (1%)	Yes
14	OTHER	9 (7%)	N/A
Total:		**126 (100%)**	

According to the findings, two distinct groups of responses emerged: items relating to an agent's operability (86%) and to human-computer interaction (7%). Thirty percent of all answers pertained to an agent's notification capabilities, which were referred to as the presentation of information, such as incoming messages, reminders, due events, etc., in a timely and persistent manner. At the time the survey was administered, the email interface agent developed by ABC Company performed basic information notification tasks. In addition to these functions, users wished to improve the way the agent performed these activities and to be able to utilize extra features. For instance, an agent should deliver more urgent notifications first, tell current time, time to take a break or go home, and due dates of critical events, such as an approaching project completion deadline. It should be more persistent, yet non-intrusive, in user notification. Ideally, after announcing an important, urgent event or message, an agent should track the completion of that task and remind a user if the activity was incomplete. At the same time, the agent should do it in a non-intrusive manner, and the user should have full control over its actions.

> (FI41):[81] *"[An agent should] be persistent in reminding me when an appointment is due. If it only announces it once, I might miss it."* (NOTIFICATION)
>
> (FI47): *"[An agent should] stay up on the screen until I had a chance to read the message."* (NOTIFICATION)

[81] F stands for 'reasons,' I stands for 'ideal' (i.e., FI refers to a response in which a person describes a feature of an 'ideal' agent), and numeric portion is a unique identifier, i.e., FI41 refers to response # 41.

Comments referring to improvements in the extent of an agent's intelligence comprised the second top category of responses (23%). Users wanted email interface agents to possess more intelligent features. These included rule-based logic, machine learning capabilities, text analysis features, automatic response to simple messages, and the dynamic adjustments of an agent's behavior, voice and appearance depending on user requirements and the type of incoming information.

Rule-based logic was defined as a set of hand-crafted meta-rules that determine an agent's actions depending on the state of the external environment. The results show that many interface agent users were ready to spend their time designing rules according to which an agent would perform various actions in their email systems. Machine learning referred to the state of a system where an agent observes user interaction with an email application, understands user goals, behaviors, preferences and interests, forms a model of user intentions, and starts mimicking user actions (Brzezinski and Dain 2001). Respondents indicated that they would benefit if their agents possessed basic machine learning capabilities and performed simple actions based on past user behaviors. Text analysis features corresponded to a higher level of an agent's intelligence. By following complex information retrieval algorithms, an agent should examine a long text message, understand its meaning, relevance and urgency, and present users with a brief summary in form of keywords or an abstract. Automatic response to simple messages or requests referred to the generation of intelligent replies to incoming messages on a user's behalf. Overall, this related to the incorporation of MailBot functions that were discussed in Section 2.2.3 ('MailBots'). The agent developed by ABC Company did not include such automatic response facilities but the users would find them very useful. The run-time adjustments of an agent's actions, voice and appearance corresponded to the dynamic changes in the state of the agent system depending on several factors, such as message sender, message contents and event type. For example, the announcement of the end of a working day or a joke from a friend might be delivered by an agent with an entertaining appearance. An urgent message from a superior might be accompanied by warning gestures.

> (FI38): *"It would be cool if the agent can learn from my actions with different types of email. When an email comes in that fits the criteria the agent should ask it should do the task."* (INTELLIGENCE)
>
> (FI2): *"[An agent should be] customizable – set up rules for mail NOT to read."* (INTELLIGENCE)
>
> (FI92): *"Multiple agents concurrently for different tasks."* (INTELLIGENCE)
>
> (FI94): *"Make the changes to agents dynamic."* (INTELLIGENCE)
>
> (FI97): *"Respond with [an] appropriate & correct answer to a request."* (INTELLIGENCE)

Answers pertaining to the degree of an agent's personalization constituted the third largest group of responses (7%). Users indicated they would like to see more

choices in types of announcements, agent appearances, voices, and languages (i.e., in addition to English, other languages should be available). For example:

> (FI97): *"Variety of choices of type of announcement and options of voice tones."* (PERSONALIZATION)

Overall, suggestions on the functions and features of an 'ideal' agent pertaining to information notification, intelligence, and personalization comprised 60% of all responses. For the other 40% of answers, data referred to 10 distinct codes, and no significant category emerged. In addition to the categories that were identified in the previous sub-sections of this dissertation, four new categories appeared.

The first category pertained to *spam filtering*. As discussed in Section 5.4.2.3, people were disappointed by the announcement of unsolicited commercial messages. Therefore, they believed that an 'ideal' interface agent should either incorporate its own email filtering facilities or work in conjunction with existing spam filters. At the date of the survey, most of the interface agent-based email announcement applications did not offer spam filtering. In this case, a short-term solution would be to utilize other anti-spam products. For example, several respondents utilized both an interface agent and a third party email blocker that scanned all incoming messages before they reached a user's computer (see Section 5.2.6). As one of the respondents indicated, the combination of both technologies created an efficient email usage environment.

The second category referred to the degree of *user control* over the agent. This concept was already explored in the MIS literature (Taylor and Todd 1995a). In the context of IS research, perceived behavioral control is the extent of user perceptions of internal and external constraints of behavior (Taylor and Todd 1995b). With respect to email interface agents, users argued that they wished to have extra functionality that enabled them to have more control over an agent's actions. For example, users needed to stop the agent at any time, to ask it to move to the next activity, or to act before the agent completes a current task.

The third category related to *voice recognition* capabilities. None of the email notification agents available on the market offered speech recognition functionality. Users clearly indicated that they wanted to communicate with their agents in natural language. This user-agent communication method would improve their efficiency with email and add some entertainment. Given the level of the development of interface agent technologies, this was a realistic expectation.[82]

The fourth, last category corresponded to an *agent's mobility*. A mobile agent is an agent that may be transferred from one software system to another in a heterogeneous network. Mobile agents appeared in the mid of 90s, and they have attracted a lot of

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[82] For an example of an interface agent that may communicate with users in natural language, visit the Peedy's Pizza Palace website developed by Microsoft. It is available at http://www.microsoft.com/agent2/sdk/samples/html/peedypza.htm. Note that in order to view the website, you may need to install additional software components.

interest in the agent research community (Glitho, Olougouna and Pierre 2002). With respect to email interface agents, mobility referred to the functionality that allowed transporting the agent from one email client to another together with the current agent state, such as user preferences, rules, interfaces, etc. Users might employ the same mobile email interface agent with different email applications, for example, MS Outlook or Hotmail. This was very important given that most email users tend to concurrently have several email addresses and to utilize several email applications.

In general, these four new categories identified additional features and functions of email interface agents that were not presented in the previous open-ended items. Below are examples of user comments:

> (FI5): *"[An 'ideal' agent should] filter and delete junk mail."* (FILTERING)
>
> (FI14): *"[An 'ideal' agent should offer] immediate actions [for example,] quick open [or] replay/forward directly from the agent, no need to open outlook."* (CONTROL)
>
> (FI135): *"It would be good if you could talk to it and tell it to delete the message or read the message to you."* (VOICE_REC)
>
> (FI12): *"[An 'ideal' agent should] be able to move to a different PC if I am using web-based mail."* (MOBILITY)

Overall, from the user's perspective, an 'ideal' interface agent for email should effectively, efficiently and persistently perform message and event notification tasks, be intelligent, personalizable, and incorporate several other important functions and features.

5.4.2.5 The Critical Incident Technique

Respondents were asked to provide the last most significant either positive or negative incident of the usage of interface agents in their email application. A positive incident referred to a situation when an agent helped a person to complete a task effectively, efficiently or enjoyably, and a negative incident corresponded to an event when an agent hindered the completion of a task. Users were provided with the necessary instructions and eight open-ended questions (see the Questionnaire in Appendix 2 for more detail). A type of an incident (i.e., positive or negative) was chosen by a respondent.

Overall, 60 critical incidents were provided, 30 of them were positive and 30 negative. This split in the type of incidents demonstrated the validity of the data. If for example, most subjects described only positive incidents, it might be assumed that they liked email interface agents to such a great extent that they tended to ignore the negative outcomes of agent usage. In contrast, if most individuals offered only negative critical incidents, it might be suggested that there were fundamental problems with the technology under investigation, for instance, it was highly unreliable.

A preliminary analysis of the open-ended responses demonstrated that answers to questions 1 (incident description), 2 (incident outcome), and 3 (incident importance) should be combined for two reasons. First, by reviewing these items simultaneously, a

more complete picture of the critical incident might be obtained. Second, most subjects provided a full description of the incident, its outcome and significance in their responses to the first item, and they repeated their answers in items 2 and 3. On the one hand, the combination of three similar responses to the same question improved the reliability and validity of the results. On the other, it increased the cognitive load on the subjects and the time they spent with the questionnaire. Implications of this finding for critical incident technique questionnaire design are discussed in Section 6.4.1 ('Methodological Contribution') of this dissertation.

Every incident was analyzed along the following dimensions: 1) incident cause (why the incident took place or what caused it); 2) user actions (what actions a user took during the incident); 3) user feelings (what a user felt about this situation, or how a user perceived this event); 4) behavior change (whether and how a user changed the way he/she used email interface agents after the incident); and, 5) ideal agent actions (actions that an 'ideal' email interface agent would take in addition). Positive and negative incidents were analyzed separately.

Three independent coders analyzed the open-ended items pertaining to **positive critical incidents** and achieved an acceptable level of agreement (see Table 5-22). The same principles for codebook development and administration were utilized (see Section 5.4.2 'Open-Ended Items Analysis.')

Table 5-22: The Krippendorff's Agreement Coefficient – Positive Critical Incidents

	Incident Cause	User Feelings	User Actions	Behavior Change	Ideal Agent
Coder Agreement	0.93	0.81	0.81	0.80	0.90

The results indicated that all users reported positive critical events that took place very recently, for example, during the last incident of agent usage, today, or within a few weeks. Respondents also indicated that similar incidents occurred very frequently, for instance, during every incident of agent use, daily, or a few times per week.

Regarding the **incident cause**, 24 incidents related to an event when an agent notified a user about the state of an email system. For instance, the agent presented an important incoming message event in a timely manner:

> (P83): *"I use agents to monitor various mail folders in Outlook and either announce or read the mail based on set criteria. I have unattended processes that report failures or problems encountered that spawn emails to me. Three days ago my process emailed me that one of our databases was approaching its transaction log maximum size and this was announced by an agent.*
>
> *[In the result,] I was able to clear the log before it caused the database to stop processing due to a full drive error. Obviously it would have halted one of our critical business processes."* (NOTIFY)

In another positive critical incident, an email interface agent informed a user about a due event:

> (P87): *"A few weeks ago, [the agent][83] got me out of one meeting I was asked to join because it announced the meeting I was due to go to. The customer on the phone understood that I wasn't making the other meeting up to get out of the one I was attending.*
>
> *[I] left one conference call that was not scheduled and went to the one that was. [In the result, I] made it to my meeting in time."* (NOTIFY)

Six incidents corresponded to the fact that the agent performed highly reliably over a certain period of time, for example:

> (P5): *"Yesterday 18/5 - software performed as usual, stable, did not cause problems. [It] finished as usual, nothing happened."* (RELIABLE)
>
> (P14): *"I have not had any problems with my [agent], e.g., it performs as usual informing me about important messages."* (RELIABLE)

According to the original critical incident methodology, a critical incident is a discrete episode that contains sufficient detail to be visualized by a researcher (for example, see Wang et al., 2000). On the one hand, according to this viewpoint, responses pertaining to an agent's reliability may not be classified as critical incidents. On the other hand, users clearly emphasized the importance of the fact that the agent performed highly reliably over a certain period of time (e.g., 'yesterday'). A partial explanation of this phenomenon lies in the imperfection of most contemporary software applications, including agent-based systems (Serenko 2004a; Serenko and Cocosila 2004). Currently, computer users are so accustomed to bad design, poor usability, increasing complexity, and lack of important functionality of software that they tend not to complain about it (Lieberman, Rosenzweig and Singh 2001). This is especially true regarding novel, agent-based technologies the usage of which is associated with high uncertainty and risk (Serenko and Detlor 2004). At the same time, respondents to the survey were ready to acknowledge the quality of an agent when it reliably performed the required tasks, and they considered this event critical. Therefore, the responses pertaining to an agent's reliability were included in further analysis.

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[83] The brand name of the interface agent was changed to [the agent] as per the non-disclosure agreement with the agent manufacturer.

With respect to **user feelings**, 24 usable answers were obtained. Four subjects did not answer this question. Meanings of two responses were not agreed upon by the coders; these responses were labeled as 'Other.' Figure 5.25 outlines user feelings. It shows that most users had positive feelings towards the incident, such as satisfaction and enjoyment. Four people indicated they felt that an agent was very helpful, and two felt indifferent.

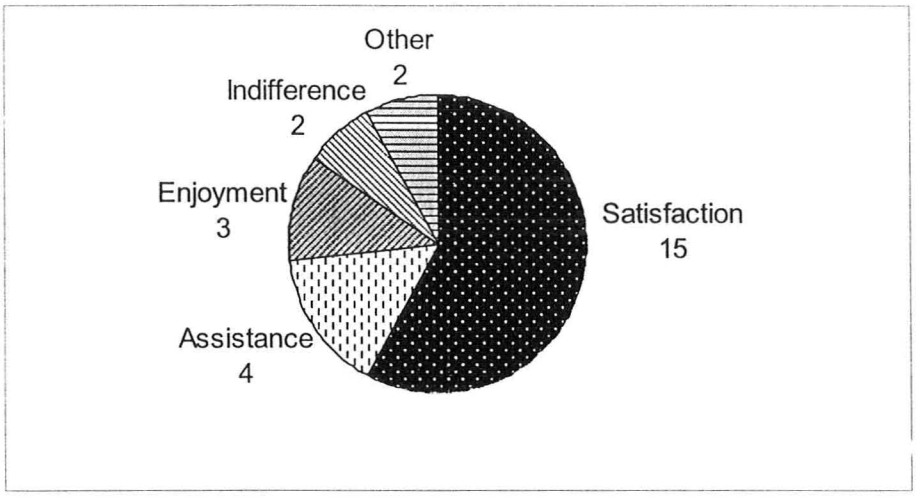

Figure 5.25: Positive Critical Incidents – User Feelings

With regards to **user actions** during the incident, 11 individuals said they immediately completed a task suggested by an agent, eight people continued doing a task they were doing before an agent's interference (i.e., they ignored the information presented by the agent), and three users made a better, more informative decision on a task they were working on. Figure 5.26 summarizes this discussion.

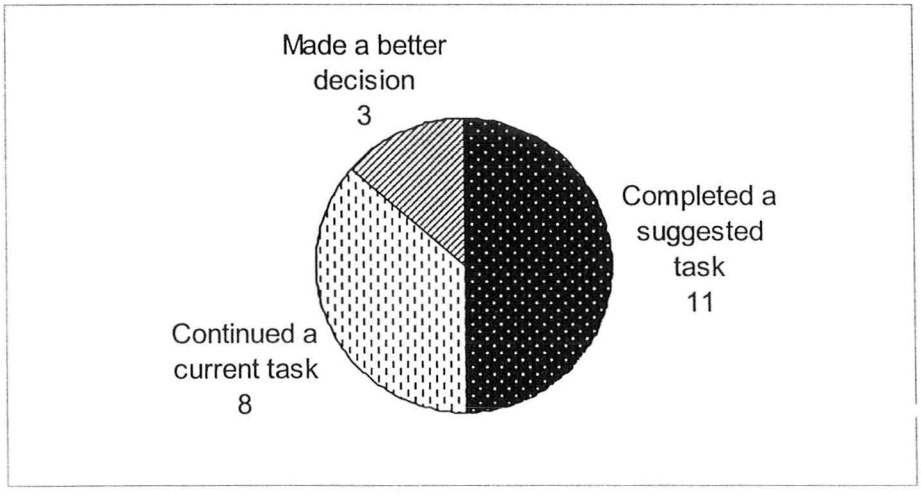

Figure 5.26: Positive Critical Incidents – User Actions

Regarding **behavior change** after the critical incident, 22 users indicated that they did not change the way they used interface agents in their email systems, three individuals said they did, and one person provided an unclear response. Four subjects did not answer this question. Out of those who reported future behavior change, one person indicted that he increased agent usage, and two individuals said they began to promote the agent among friends and colleagues. Overall, this demonstrates that the occurrence of a positive-outcome situation either caused no changes in future user behavior or caused positive changes. For example:

> (P63): *"I demonstrated the product to many friends and coworkers who thought they would pursue adding agents to their email."* (CHANGED)

In order to summarize the above discussion and to create a visual representation of user behavior under the influence of positive critical incidents, an illustration of the flow of the incident, user feelings, actions, and behavioral change is provided (see Figure 5.27).

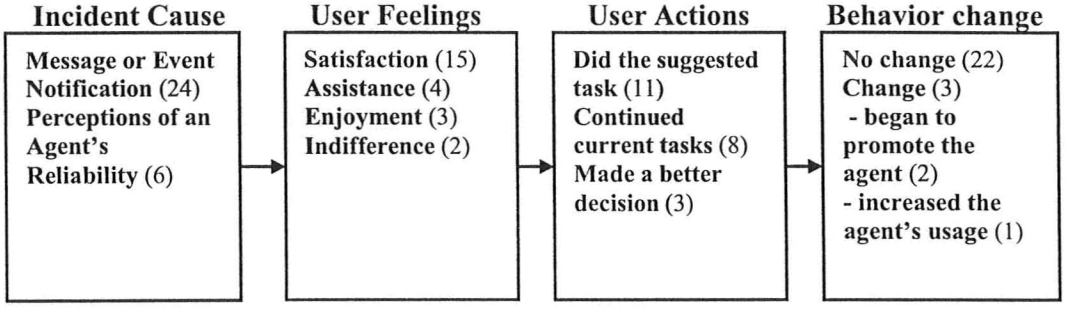

Figure 5.27: An Illustration of User Adoption Behavior – Positive Critical Incidents

According to the above figure, positive incidents were caused by the delivery of a message or event notification, which is the primary function of this technology, and by user perceptions of high reliability of an agent. Most of these incidents took place very recently, for example, within the last week, and they tended to repeat relatively often. The majority of users had positive feelings towards the incident, such as satisfaction, enjoyment, and support. Only a few people stayed indifferent to the positive-outcome situation. During a positive incident, 11 users completed a task recommended by the agent, for example, they reacted to an approaching event or responded to an urgent message. Eight users continued engaging in their current tasks because they did not find the notification urgent, important or appropriate, and three people made a better decision on the current or future task because they perceived themselves to be better-informed. After the event, all respondents continued using the agent. A few individuals reported an encouraging change in their behavior. As such, they increased agent usage and started promoting it.

With respect to the most desirable actions that an **'ideal' interface agent** would take in addition, 22 responses were obtained. Although the users were asked to provide an action, many of them described an extra feature that they wanted an agent to possess. Figure 5.28 and Table 5-23 provide these features and actions. They demonstrate that many individuals, who experienced a positive-outcome critical incident, believed that their agent might adequately perform this task, and no additional features or actions were necessary. Most users wanted to increase the degree of an agent's intelligence, to improve the way it presents notification, and to be able to utilize more personalized features. In addition, one person indicated that he would benefit if an agent was able to send text messages to cell phones (i.e., to be connected to the Short Messaging Service or SMS).

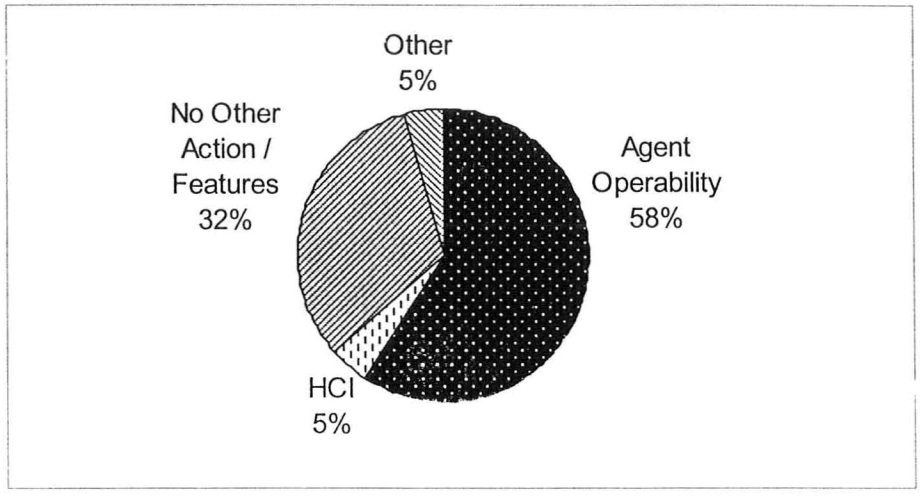

Figure 5.28: Positive Critical Incidents – an 'Ideal' Agent's Actions (Level 1)

Table 5-23: Positive Critical Incidents – an 'Ideal' Agent's Actions (Level 2)

Rank	Code	N	May Developers Control it?
1	NO_ACTION	7	N/A
2	INTELLIGENCE	5	Yes
3	NOTIFICATION	2	Yes
4	PERSONALIZATION	2	Yes
5	COMPATIBLE	1	Yes
6	EASE_OF_USE	1	Yes
7	SMS	1	Yes
8	VOICE	1	No
9	VOICE_REC	1	Yes
10	OTHER	1	N/A
Total:		**22**	

A similar analysis was performed on the open-ended items pertaining to **negative critical incidents**. Table 5-24 offers the agreement coefficients among three coders.

Table 5-24: The Krippendorff's Agreement Coefficient – Negative Critical Incidents

	Incident Cause	User Feelings	User Actions	Behavior Change	Ideal Agent
Coder Agreement	0.87	0.85	0.91	0.81	0.73

With regards to the **incident cause**, 11 distinct categories have emerged. Figure 5.29 offers these causes grouped on the first level of coding, and Table 5-25 on the second level of coding.

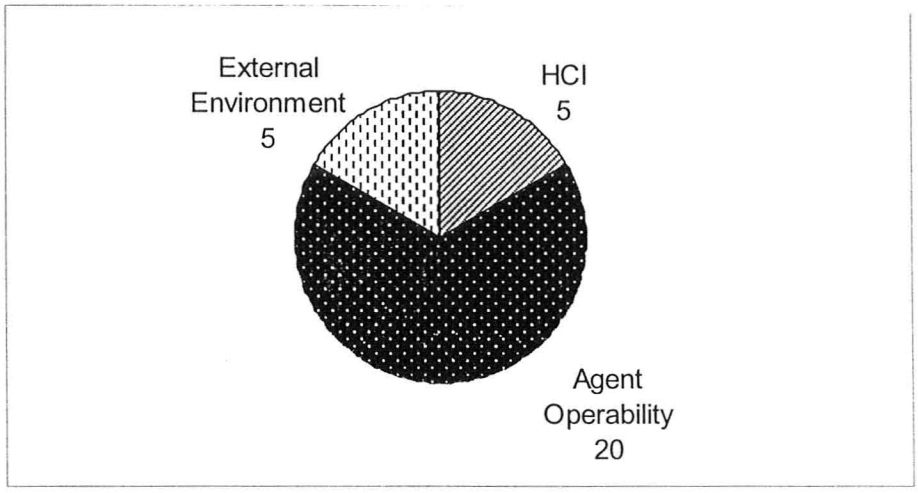

Figure 5.29: Negative Critical Incidents – Incident Cause (Level 1)

Table 5-25: Negative Critical Incidents – Incident Cause (Level 2)

Rank	Code	N	May Developers Control it?
1	INCOMPATIBLE	7	Yes
2	INTERFERENCE	5	Yes
3	INTRUSIVE	5	Yes
4	UNRELIABLE	3	Yes
5	ABUSE_OTHERS	2	Partially
6	NO_CONTROL	2	Yes
7	NOISE	2	No
8	POLICY	1	No
9	READ_ALL	1	Yes
10	UNINTELLIGENT	1	Yes
11	VOICE	1	No
Total:		**30**	

The most frequently cited cause of a critical incident was an agent's incompatibility with other software systems, especially, with email environments. A typical negative incident occurred when a user suddenly realized that the email interface agent might not be used with the email application that he or she just installed or updated and intended to use. For example, respondents say:

> (P120): *"[I am] having some trouble getting it to work with my newer version of Office software. [It] worked fine in 2000 version. In my case[,] it is preventing the use of an agent."* (INCOMPATIBLE)

> (P51): *"I remember that after a security update of outlook, Outlook asked me to "permit" de plugin [the agent] for 5 min to take control of email. [I have] no time for playing at work, [I] uninstalled IAE [the agent] and installed office 2003."* (INCOMPATIBLE)

Other regular sources of negative incidents were interference, intrusiveness, and unreliability of an agent. Sometimes, an agent interfered with other systems or the entire computer that slowed down the CPU and consumed extra resources. During a particular task, several users found an agent disturbing and annoying that distracted them from other important activities. Three users complained about the event in which an agent behaved unreliably. For instance:

> (P103): *"This is a daily occurrence. It slows my system when I am doing graphics of site construction. [In the result, I have] slower production."* (INTERFERENCE)

> (P140): *"When [the] interface [agent] would check the email box, a slight screen flash would take place causing your mouse to jump or drop focus on current window."* (INTERFERENCE)

> (P58): *"When several emails arrived at the same time[,] it was annoying to have the agent announce each one separately [because] it can distract you from your work."* (INTRUSIVE)

> (P116): *"[The agent] gives an error message when forwarding or replying to email and then stops announcing."* (UNRELIABLE)

Several incidents were caused by other people, who complained about the noise that an agent made, announcements of unnecessary messages, little control over an agent, company policies that did no allow the usage of unauthorized software, and unclear agent voice:

> (P153): *"Other occupants in the house annoyed by the voice announcing new messages, read receipts, etc."* (NOISE)

> (P39): *"I use my agent to tell me, verbally, what mail is about so I can decide whether or not to stop what I'm working on in another program to read that message. Since my agent looks at everything, it even reads SPAM and messages that I automatically file using rules, and that I don't need. [This happens] every day, all the time.*

> *I have to give the voice some attention and wait until I realize it's not relevant at all (as opposed to something I can delay till later). It sort of degrades the effectiveness of the tool."* (READ_ALL)
>
> (P49): *"[I] couldn't get [an] agent to minimize and move out of my way. I shut the agent down [with] lots of clicking and swearing."* (NO_CONTROL)
>
> (P70): *"[I] was told by Information Systems to remove [the agent] from my computer."* (POLICY)

The above categories have been already discussed in the previous sections of this dissertation (see Section 5.4.2.1 'Reasons for agent usage termination' and Section 5.4.2.3 'Reasons why users do not like interface agents'). In addition, two new categories emerged from the data. Although each category was represented by one or two cases, it is believed that they were very important and highly relevant.

The first new category related to the cases in which other individuals, who were aware of the fact that someone utilized an email interface agent, abused the user by sending irrelevant, obscene, or hard-to-read messages and made fun of the situation when an agent announced either the subject or the entire message. These messages passed through email filters since senders were known to the recipient. The victims said:

> (P47): *"Colleagues found out I was using the software at work and began sending me emails with vulgar subject lines."* (ABUSE_OTHERS)
>
> (P129): *"My co-workers every now & then send me messages that are read out & amusing or send me all capitalized letters that are spelt out individually & are annoying. [I get] laughter from all."* (ABUSE_OTHERS)

The second new category referred to an event when a user realized that an agent was not as intelligent as he or she expected it to be. According to the marketing literature, pre-purchasing expectations of product features and performance strongly influence the degree of post-purchasing customer satisfaction with this product (Anderson and Fornell 2000; Fornell et al., 1996). Any disconfirmation of customer expectations results in low satisfaction, frequent complaints, and a high propensity of switching to an alternative product. Recent empirical research shows that these marketing propositions hold true with respect to information technologies, for example electronic mail (Serenko and Turel 2004b) and cell-phones (Turel and Serenko 2004).

Agents were often labeled as novel, smart, or intelligent technologies that might substantially alleviate many problems associated with everyday computer use. Thus, many potential agent users might form unreasonably high pre-purchasing expectations of an agent-based system. However, the actual agent applications available on the market included a limited selection of intelligent features that might potentially disappoint some purchasers. In the critical incident provided by the agent user, the person clearly indicated

that he was very dissatisfied with the degree of an agent's intelligence and stopped using the product:

> (P154): *"[I] discovered [that the agent is] not intelligent enough for many tasks, needs more automation, [and I] stopped using [it]."* (UNINTELLIGENT)

Regarding **user feelings** during the incident, 25 usable responses were provided. As such, most people expressed negative perceptions of the incident, such as frustration and annoyance. Figure 5.30 visualizes this discussion.

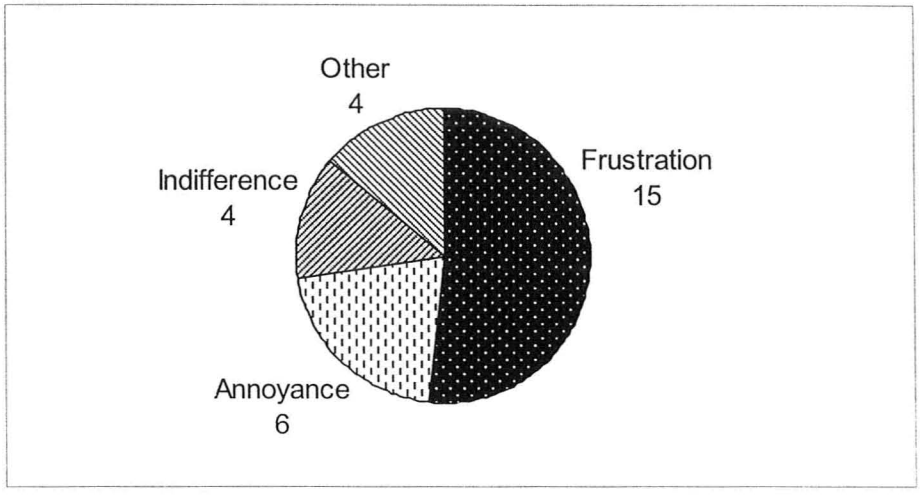

Figure 5.30: Negative Critical Incidents – User Feelings

Note that four people stated they felt indifferent towards the negative events when an agent behaved unreliably and incompatibly, or when it began to interfere with other systems. For example, in one case, an agent slowed down the CPU speed to a great extent, and a user had to temporarily turn it off. In another situation, when many messages arrived at a time, an agent began to behave unstably, and a user had to shut it down. However, these people made a conscious decision not to blame on the agent for its inadequate performance:

> (P121): *"[My feelings were] normal for using gadgets."* (INDIFFERENT)

With respect to **user actions** during negative-outcome incidents, 12 respondents either made a decision to terminate or were forced to stop the usage of an email interface agent, 15 individuals attempted to find a solution to solve the problem because they wished to continue using an agent, and two people took no action. The coders failed to reach an agreement on the classification of one item, and it was coded as 'Other' (see Figure 5.31). In general, approximately 40% of the users made an immediate decision to terminate agent usage, 50% wished to continue the employment of an agent and tried to resolve the problem, and 10% ignored the negative incident.

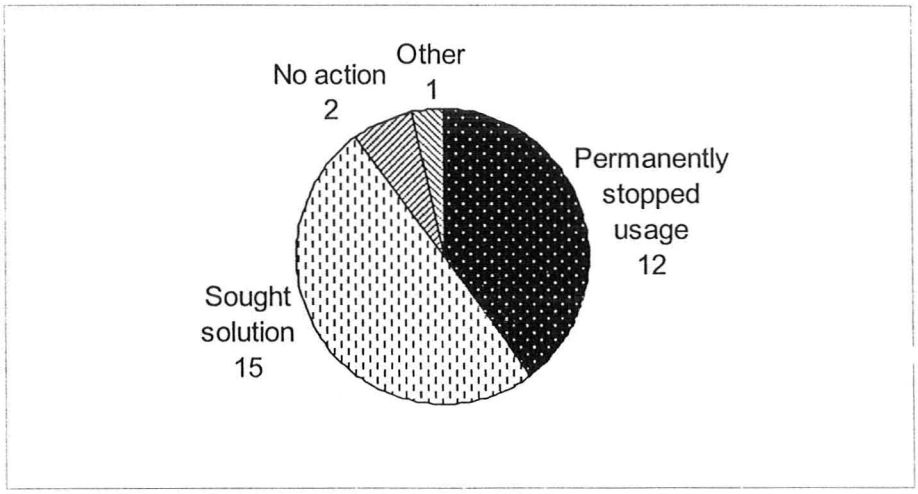

Figure 5.31: Negative Critical Incidents – User Actions (Level 1)

Figure 5.32 outlines user actions combined at the second level of coding.

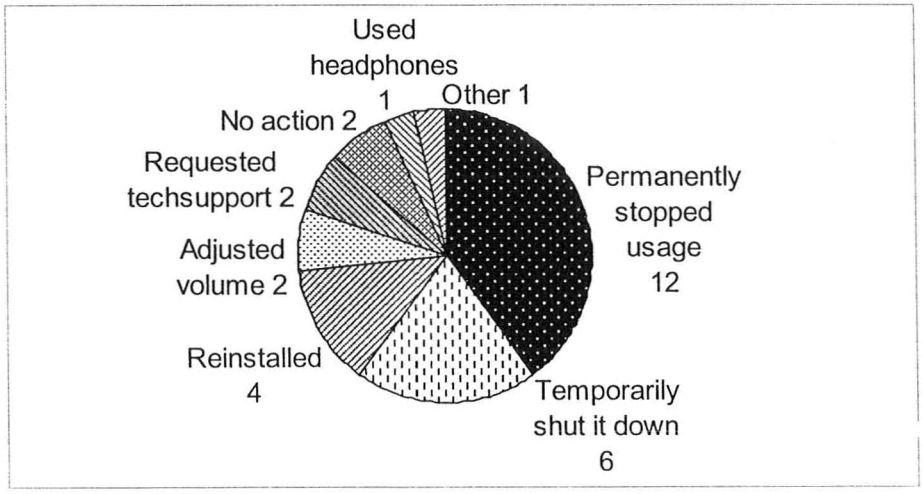

Figure 5.32: Negative Critical Incidents – User Actions (Level 2)

It demonstrates that out of 15 individuals who attempted to find a solution six temporarily shut down the agent, four reinstalled or upgraded it, two adjusted the computer volume, and two contacted technical support at ABC Company. Those who chose to temporarily turn off the agent did so because of the agent's intrusiveness, unreliability, interference with other applications, unclear speech, and limited control over its actions. Out of four people who reinstalled the agent three did so because the agent became incompatible with a new email system, and they believed that a reinstallation or an upgrade might fix the problem. One person reinstalled it because of the agent's interference with other applications. Two individuals who received complaints from people nearby reduced the volume, and two users who experienced incompatibility and interference problems requested technical assistance from the vendor. One person who was a victim of colleagues' abuse ignored the incident, and one individual began to use headphones for privacy.

For instance, the user, who tried to accommodate the needs of people within earshot, said:

(P153): *"[I] turned the volume down when they were around ... but ... alas ... they still complained."* (ADJUST_VOLUME)

With regards to **behavior change** after the critical incident, 18 individuals permanently terminated the usage, and 11 people tolerated the negative event and continued employing an agent. Out of those who continued, only two people modified their future agent usage pattern by changing the settings of the agent (see Figure 5.33).

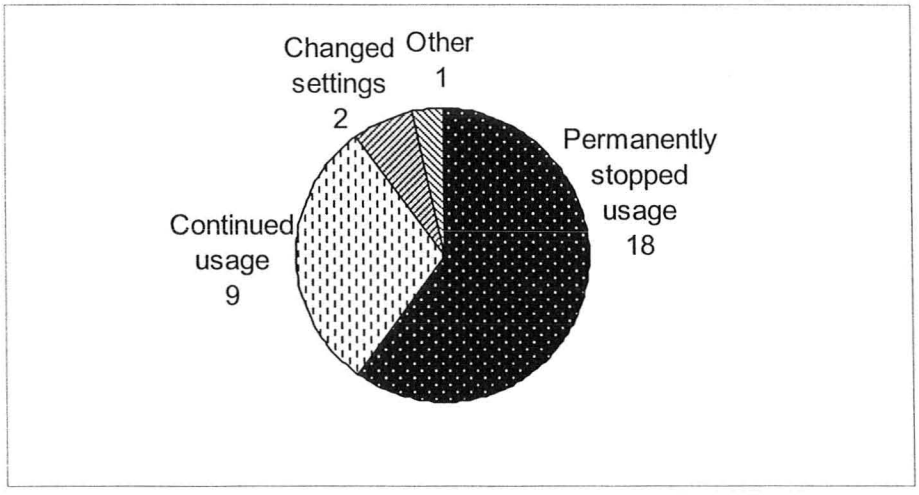

Figure 5.33: Negative Critical Incidents – Behavior Change

Out of those 18 people who terminated the usage soon after the critical incident, 12 uninstalled an agent during the incident. Six users tried to unsuccessfully fix the problem and removed the agent later. This reveals that agent users either gave up early or knew that it was impossible to solve that problem. Given that 55% of the respondents worked in the IT sector, the latter proposition seemed more credible.

Out of 15 individuals who attempted to find a solution to fix the problem with an agent during a negative critical incident six permanently stopped usage, six continued with no changes in future behavior, and two continued the employment of this technology with different agent settings.[84] This suggests that even though some users failed to solve the problem, they continued the employment of this technology. Out of those four users, who felt indifferent towards the negative incident, two people continued and two discontinued the usage of an agent. Two people, who took no action during the incident, entirely ignored this event and continued the usage of an agent.

Recall Figure 5.29 demonstrates that 20 critical incidents were perceived to be caused by an agent's operability issues, five by the HCI process, and five by an external environment. In cases that originated from an agent's operability problems, 11 users sought a solution, seven immediately abandoned the agent's employment, and one person took no action. Overall, 11 and eight people out of them discontinued and continued future usage respectively.[85]

Out of five people who experienced an incident in which an agent behaved highly intrusively,[86] four immediately terminated use, and only one person temporarily shut down the agent. This shows that approximately a half of agent users were ready to tolerate a negative event if it was caused by an agent's operability whereas most users tended to discontinue the usage if an agent behaved very intrusively.

In five critical incidents caused by an external environment, three and two individuals terminated and maintained future employment of this technology respectively. In response to these negative incidents, only one person removed an agent immediately because she was forced by the IS department of the company. Out of the other four people, three attempted to find a solution and one ignored the event. For example, to eliminate noise, they tried to utilize headphones or decrease the volume. The user, who was forced to terminate the usage because of noise constraints, indicated that she would attempt to use an agent again:

> (P153): *"[I] uninstalled the interface [agent] ... but ... planning on reinstalling it."* (STOPPED_USAGE)

Overall, the following conclusions are suggested. First, negative HCI incidents result in an immediate agent usage termination. Second, agent operability issues may or may not force people to reject the technology. Third, users will attempt to preserve the employment of an agent under the negative impacts of the external environment.

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[84] The total adds to 14 since one behavioral change was classified as 'Other,' and it was excluded from the analysis.

[85] The total adds to 19 since one behavioral change was classified as 'Other,' and it was excluded from the analysis.

[86] The HCI category is comprised from responses pertaining solely to an agent's intrusiveness.

The analysis of incident frequency and timeline indicated that two groups of data emerged. The first category pertained to the incidents that occurred in the past, usually, over one year ago, and that had occurred only once or a few times. Typically, a user terminated the employment of an agent after that event. The second group related to the incidents that took place recently, and that appeared more often, for instance, weekly or monthly. Generally, a user continued the usage of an agent after that incident.

Figure 5.34 offers an illustration of user adoption behavior in response to negative critical incidents.

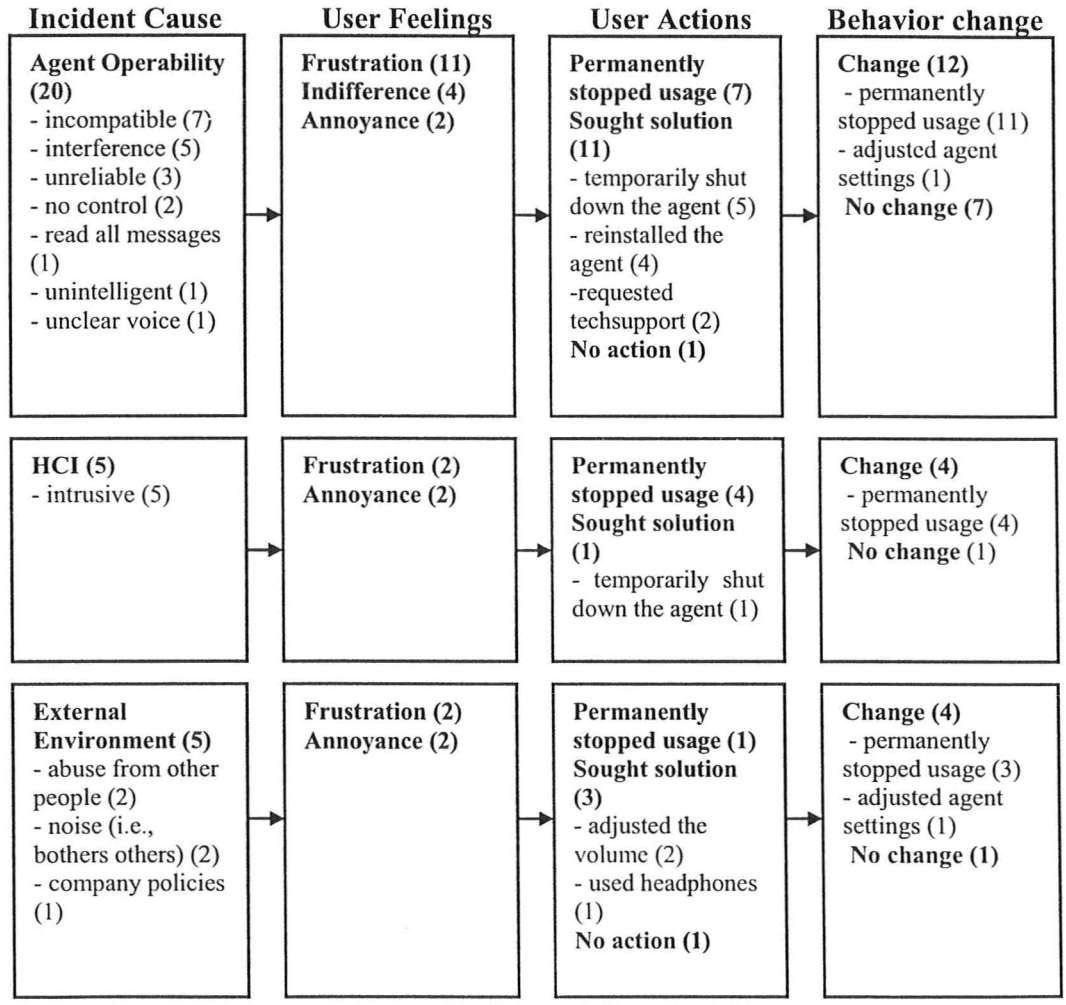


Figure 5.34: An Illustration of User Agent Adoption Behavior – Negative Critical Incidents

According to this figure, there were three causes of negative critical incidents: agent operability, human-computer interaction, and the external environment. Since each incident source triggered certain user feelings, actions, and changes in future behavior,

the illustration presents a series of separate links for each type of an incident cause. In other words, it consists of three independent series of factors and their relationships. Some of these incidents occurred long time ago, and they almost never took place again. After them, most people terminated the usage. Some incidents happened recently, and they tended to repeat. In those cases, most users continued the usage.

The events that resulted from of an **agent's operability** problems happened because the agent was incompatible, unreliable and unintelligent; it also interfered with other applications or the entire computer, presented limited control functions, announced spam and had unclear voice. Eleven users were frustrated, four indifferent, and two annoyed by the agent. During the incident, seven users immediately stopped using the agent, 11 sought a solution, and one person took no action. Out of those who attempted to solve the problem, five people temporarily shut down the agent, four reinstalled it, and two contacted technical support at ABC Company. After the incident, 12 individuals changed their behavior: 11 permanently abandoned the agent, and one adjusted the agent's settings. Generally, this set of causal links indicates that, in case of negative incidents triggered by an agent's operability problems, most users attempted to find a solution, and they terminated the usage if they failed to fix it.

All incidents associated with **human-computer interaction** issues took place because users perceived an agent to be highly intrusive in a particular situation. Individuals felt very frustrated and annoyed by the agent. During that incident, four users made a quick decision to permanently remove the agent from their computer, and only one person attempted to resolve the problem by temporarily shutting down the agent. Four individuals did not wish to continue using the agent. Overall, this causal link shows that high perceptions of an agent's intrusiveness trigger an immediate decision to abandon the agent.

Out of five critical incidents that occurred under the influence of an external environment, over which users had no control, two took place because of the deliberate abuse by other people, two because of noise constraints, and one because of company policies. These users felt frustrated and annoyed by the intervention of other individuals. Only one user immediately uninstalled the agent, whereas three looked for a solution and one ignored the event. Three of them had to terminate the usage, one adjusted the settings, and one made no changes in future behavior. In general, this shows that under the influence of the external environment, all users attempt to preserve the usage of an agent.

In addition, the respondents, who experienced a negative critical incident, provided features of an **'ideal' email interface agent**. Figure 5.35 and Table 5-26 offer these characteristics. It should be noted that none of the users indicated that no additional features or actions were required. This contradicts to the information presented by the users who experienced a positive critical incident. Recall seven of them were so satisfied with the agent's actions that they felt no need for extra assistance.

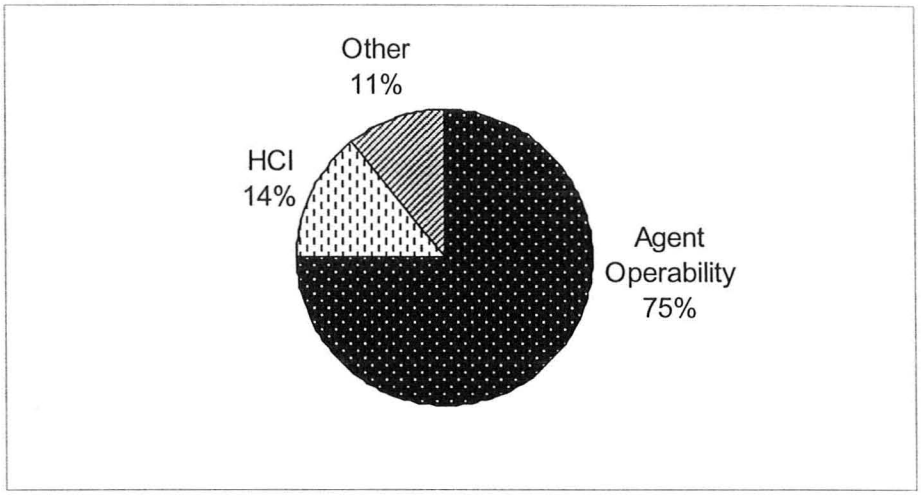


Figure 5.35: Negative Critical Incidents – an 'Ideal' Agent's Actions (Level 1)

Table 5-26: Negative Critical Incidents – an 'Ideal' Agent's Actions (Level 2)

Rank	Code	N	May Developers Control it?
1	INTELLIGENCE	7	Yes
2	PERSONALIZATION	4	Yes
3	COMPATIBILITY	3	Yes
4	CONTROL	3	Yes
5	NON_INTRUDE	2	Yes
6	NOT_INTERFERE	2	Yes
7	ATTRACTIVENESS	1	Yes
8	EASE_OF_USE	1	Yes
9	RELIABLE	1	Yes
10	VOICE_REC	1	Yes
11	OTHER	3	N/A
Total:		**28**	

5.4.2.6 Insights for Designers

Recall the questionnaire presented two optional open-ended questions soliciting user feedback for agent designers. The goal was to obtain the user views on this technology that were not identified in the previous questions. Only a minority of the

respondents provided answers to these items. As such, 28 suggestions for agent designers were offered. No content analysis of these items was done since the responses were presented in form of ready-to-use recommendations that might be grouped together and summarized.

Overall, many subjects mentioned that designers should put more efforts to improve an agent's degree of intelligence, voice quality and reliability, to add more characters and voice personalization features, voice recognition capabilities and agent control functionality, and to improve the quality of technical support. These recommendations were already identified in the earlier parts of the qualitative data analysis.

In addition to mentioning the areas for improvement, users expressed several new practical ideas. First, recall that six percent of all reasons why the users did not like to utilize email interface agents and seven percent of all characteristics of an 'ideal' agent referred to the degree of an agent's personalization. As such, many respondents wished to have more agent characters available at their disposal. Currently, MS Windows XP operating system supplies users with eight Microsoft Agent characters that are installed by default. In order to obtain new agent characters, people need to download them off different websites. These MS Agent compatible characters are created by Microsoft as well as by a variety of independent designers. As of October 2004, there were over 500 such agents available online, most of which were free.[87] However, the users of an email interface agent developed by ABC Company were faced with two problems. The first issue was the lack of information about the availability of agent characters in the Internet. The second was the lack of facilities in the agent software that would allow automatically downloading and installing new agent interfaces. A quick review of other interface agent email notification applications revealed that their users were faced with the same problems since none of them presented agent upgrade facilities. Although the manual installation process is very simple, some users may be unaware of that opportunity or may not have time to search the Internet and install new characters.

To address these issues, the respondents suggested that the interface agent-based applications should incorporate the **facilities for the quick downloading and installation of new MS Agent characters** that were accessible online. Indeed, this recommendation was reasonable and feasible. The agent character is an executable (i.e., name.exe) file, and there are websites that host those files. An agent-based system may automatically, locate, download, and install new characters when a user wants so. This would dramatically increase user perceptions of the degrees of system personalization and ease of use.

Second, the respondents indicated that they would like to assign **account-specific message processing rules** to handle multiple email accounts consolidated in one email system. Consider, for example, a person who retrieved messages from several email

[87] The list of available MS Agent characters is available on the MS Agent Ring website at http://www.msagentring.org.

accounts by using a single mail client such as MS Outlook. The interface agent application did not allow the design of account-specific rules. However, it might be beneficial for the user to utilize different agent characters, message introductions, and message processing rules for different email accounts. Overall, the respondents suggested that each email address should be tied to its own agent character and rules.

Third, the users advised that the **usage of animated, cartoon-like characters was inappropriate** in the software that was often utilized as essential business tools. Indeed, not everybody might like these entertaining interfaces; some users might prefer a simple informative box that would possess some degree of intelligence and present users with new information. Therefore, users needed to have a choice between cartoon-like agent interfaces and more conventional message presentation interfaces.

Fourth, the subjects suggested that an agent should attempt to **engage in a conversation with a user**. In addition to the usage of features and functions that increase the level of user control over the agent's actions, some people might want to engage themselves in a conversation with the agent. For example, after the agent presented a message title, the user might inquire about the sender and then ask the agent to act on a message. The incorporation of this feature would increase the extent of user perception of the personality of the agent. However, the employment of agent personification facets should be optional since many people may not appreciate them.

Fifth, according to the users, the introduction of simple **rules that specify the maximum number of message or event notifications** over a certain period of time would be very useful. If, for example, ten emails arrived at once, people might be annoyed by the announcement of all of them. In this case, an agent should inform users about the delivery of ten messages and specify their location, such as the mailbox name. It would be more productive for individuals to open that mailbox and to determine message relevance, urgency and importance, and to ask the agent to read some of them in a certain order. This would increase users' productivity and reduce the perception of the agent's annoyance.

Sixth, the respondents favored the creation of **agent characters that would evolve over time**. They indicated that some agents may resemble the virtual pets that require users to frequently interact with them by providing special care. The virtual pets are artificial creatures that 'live' on the screen of computers or mobile devices and that require constant care by the owner. Examples of virtual pets are Tamagotchi and Neopets.[88] As users cared for their interface agents, agents might care for users in return. By the employment of basic machine-learning approaches, interface agents might provide a better, personalized service over time that users would interpret as an agent's positive response on the care for it. This might be combined with additional anthropomorphized features, speech tones and nonverbal behavior, such as hand gestures, eye glaze, posture shifts, head nods, and facial expressions that have a positive impact on users (Cassell 2000). The previous literature argues that feeling cared for has a profound motivational

[88] Available at http://www.neopets.com.

effect on emotional state in humans (Marsh et al., 1997). Bickmore and Picard (2004) show that computers may instill a sense of caring. Some users make positive interpretations of this caring agent behavior, and they tend to develop strong intentions towards the future agent usage. Therefore, agent designers might explore the idea of creating interface agents that not only resemble virtual pets but also offer user care in return.

Seventh, the subjects believed that the employment of **Microsoft .NET** would eliminate a number of technical problems with this technology such as reliability, interference with other applications, and incompatibility and allowed the realization of new functions. .NET is a set of software technologies that include servers and developer toolkits.[89] It uses Extensible Markup Language (XML) that allows applications to exchange information.

Last, the users proposed that a really useful interface agent should combine as many facets in the field of agent-based computing as it would be possible to incorporate. Ideally, people should be presented with **one agent application** that would provide assistance with not only electronic mail, but also with all other applications.

5.4.2.7 Insights for Marketers

In addition to the recommendations for agent developers, users offered 12 suggestions for the marketers of email interface agents. Again, the key points are presented as they are provided, and no data coding procedures was done.

First, the users advised that agent marketers should offer **simple demos** of their products online. Recall that all online sellers of interface agent-based notification applications offered free trials (or shareware) of their products for a limited period of time. The purpose of these trials was to allow potential customers to utilize agents risk-free. However, the usage of shareware required users download and install agents on their machines. The respondents argued that those email users who were not familiar with agents were unlikely to do so. In order to motivate them, online agent distributors should offer demos of their agents in form of animated graphical images, Macromedia Flash movies, video clips, or sound files. This would increase the number of people who decide to try out this new technology and raise sales. In addition to shareware versions and online demos, potential users needed to be assured that an interface agent was **compatible** with their operating systems, and that it might be easily and safely removed from their computers at any time.

Second, the respondents suggested that agent marketers should **emphasize the functionality** of their products that was not available in conventional non-agent systems. As such, online sellers needed to highlight the usefulness, productivity, and entertainment potential of their agents. For example, the increase in email productivity might result from the reduction in unnecessary interruptions when new messages arrived, especially

[89] More information on .NET is available at the Microsoft website at http://www.microsoft.com/net.

for the power users who favored multi-tasking or utilized two computers at a time. By stressing this information, online sellers might motivate people to try out their agent software.

Lastly, the subjects recommended that marketers should highlight the technical support provided by agent developers. This would increase customer trust in both sellers and products. At the same time, users warned that marketers should be able to keep their promises and to offer timely, high quality technical assistance.

5.4.2.8 Other Thoughts on Agents

In addition to the above open-ended items, the respondents were asked to outline any other thoughts, concerns, or recommendations on this technology. Only 7 answers were provided. Five answers pertained to the quality of an agent's voice, the potential usefulness of voice recognition capabilities, the quality of technical support, and annoying spam that is read by an agent. These categories were identified earlier. However, two answers offered new insights on the usage of interface agents in general.

One respondent indicated that he utilized MS animated agents to design Power Point presentations for staff induction of the company IT department. As discussed in Section 2.1 ('Interface Agents and Their Characteristics'), interface agents may be employed in form of virtual speakers that do actual Power Point presentations, change slides, tell jokes, and entertain the audience. This reduces the workload on human presenters and makes attendees' experience more enjoyable.

The other users mentioned that, in the past, he utilized other technologies to create the functions currently delivered by interface agents. In fact, this person incorporated sound files that provided audio feedback on various computer processes. He felt that moving to an interface agent was a nice replacement of his own technology that further enhanced his computer capabilities.

5.4.2.9 Other User Suggestions

In answers to open-ended items in various questions, users made a number of practical recommendations to agent developers on the design and implementation of email interface agents.

As discussed in Section 5.2.8 (refer to Figure 5.9), most people utilized email interface agents in MS Outlook. MS Outlook presents the built-in message processing capabilities based on user defined rules. For instance, a person may create a rule to automatically move a message that is sent by a specific person or that contains certain keywords to a predefined folder. Outlook also offers a junk mail filter to capture unwanted commercial correspondence. The survey showed that users both employed these built-in Outlook features and utilized the agent simultaneously. This offered substantial benefits to agent designers, who did not have to implement additional interfaces and rules, and to users, who were already familiar with Outlook. However, respondents indicated that the agent started processing incoming messages before the execution of the Outlook rules was completed. For instance, when an unsolicited message

arrived, the agent announced it before Outlook classified it as spam and deleted it. This created additional interruption and increased cognitive load on users. When a person received a message from a specific sender that should be moved to a particular folder, the agent informs the user before this message was filed. In this situation, many individuals did not want to be distracted by announcements of messages that they would read later on.

Several agent users offered a simple solution to this problem. First, when a user opts to employ the MS Outlook message handling functions, an agent should delay the processing of every incoming message by several seconds. This would allow Outlook to complete the execution of rules before the agent started working. Second, an agent system should provide an interface for the creation of agent-specific rules. For example, a user might ask the agent to immediately act on or entirely ignore all messages that arrived from certain people, messages moved to specific folders, or to process due events depending on their type and keywords.

The spam filter presented by Outlook, similar to all other contemporary filters, is not perfect. It often misses to recognize unsolicited messages and leaves them in the Inbox. In this case, an agent classified those messages as legitimate and delivered them to a user. To eliminate this problem, respondents suggested the employment of 'white lists' or lists of people and message keywords that an agent should treat as legitimate. A simple short-term solution would be to allow the agent to present only correspondence from people whose names were included into the address book of Outlook.

5.4.2.10 Theoretical Saturation

Theoretical saturation is a critical point in data collection and analysis when gathering new data just keeps confirming the theory rather than modifying it (Glaser and Strauss 1967). With respect to the collection of open-ended items that form the categories of data used for the further analysis, theoretical saturation is reached when the responses obtained from additional subjects neither create new categories nor change the existing ones. In this dissertation study, two tests for theoretical saturation were conducted.

The purpose of the first test was to ensure that the increase in the number of respondents to the survey would not result in the formation of new categories. For this, the datasets were sorted in order the data were received and split into tens. The number of new categories that emerged in every cluster of ten was calculated. This test was conducted for questions pertaining to the following open-ended questions: 1) reasons for agent usage termination (Figure 5.36); 2) reasons why individuals like to use email interface agents (Figure 5.37); 3) reasons why individuals do not like to use email interface agents (Figure 5.38); 4) characteristics of an 'ideal' agent (Figure 5.39); 5) causes of positive critical incidents (Figure 5.40); and, 6) causes of negative critical incidents (Figure 5.41). The analysis was done on the lowest level of coding.

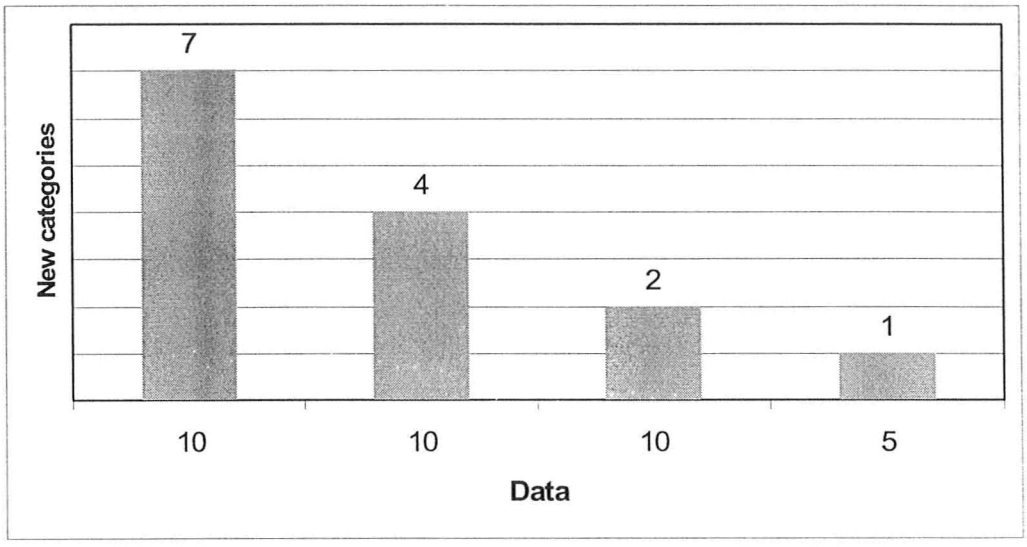


Figure 5.36: Theoretical Saturation – Reasons for Agent Usage Termination

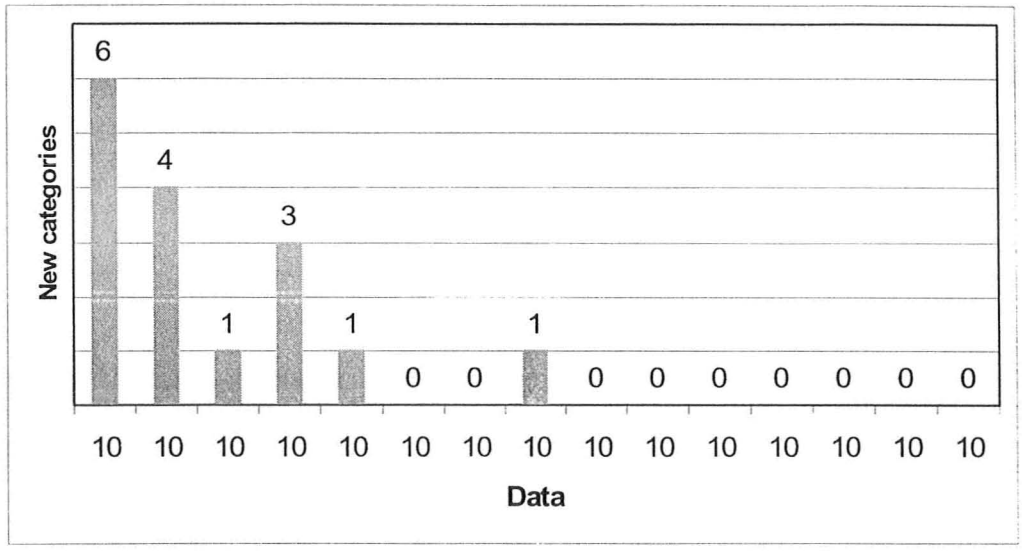


Figure 5.37: Theoretical Saturation – Reasons Why Respondents Like to Utilize Email Interface Agents

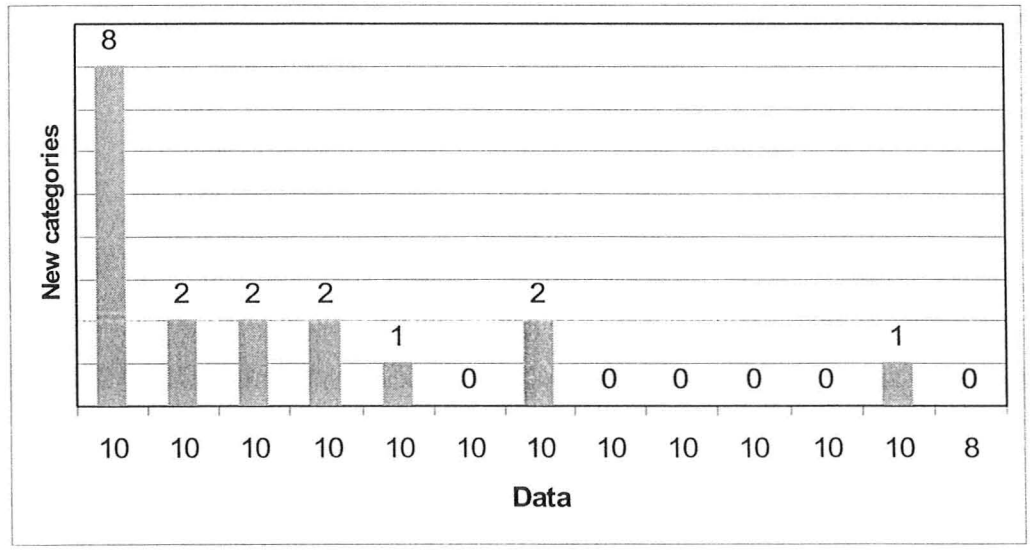


Figure 5.38: Theoretical Saturation – Reasons Why Respondents Do Not Like to Utilize Email Interface Agents

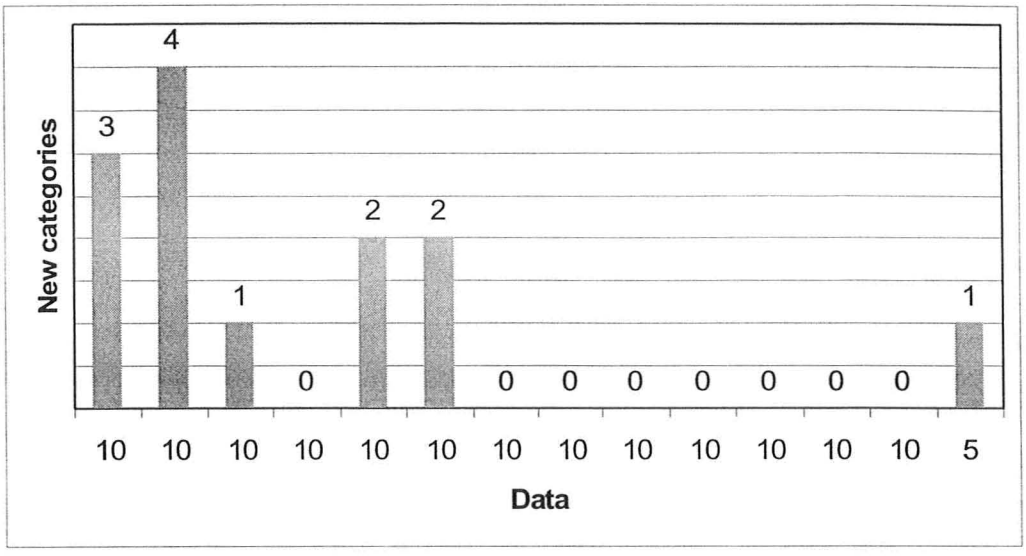


Figure 5.39: Theoretical Saturation – Characteristics of an 'Ideal' Interface Agent

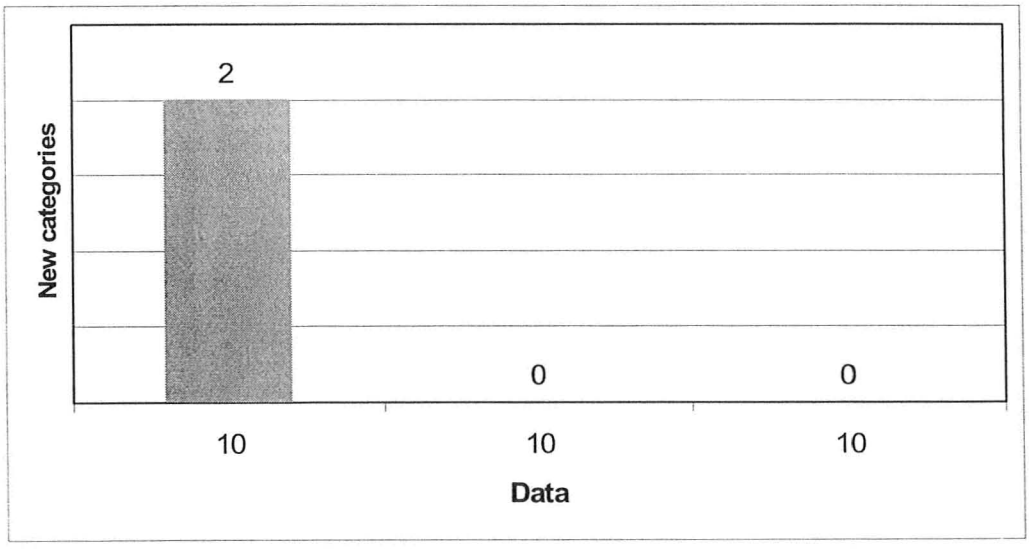


Figure 5.40: Theoretical Saturation – Cause of a Positive Critical Incident

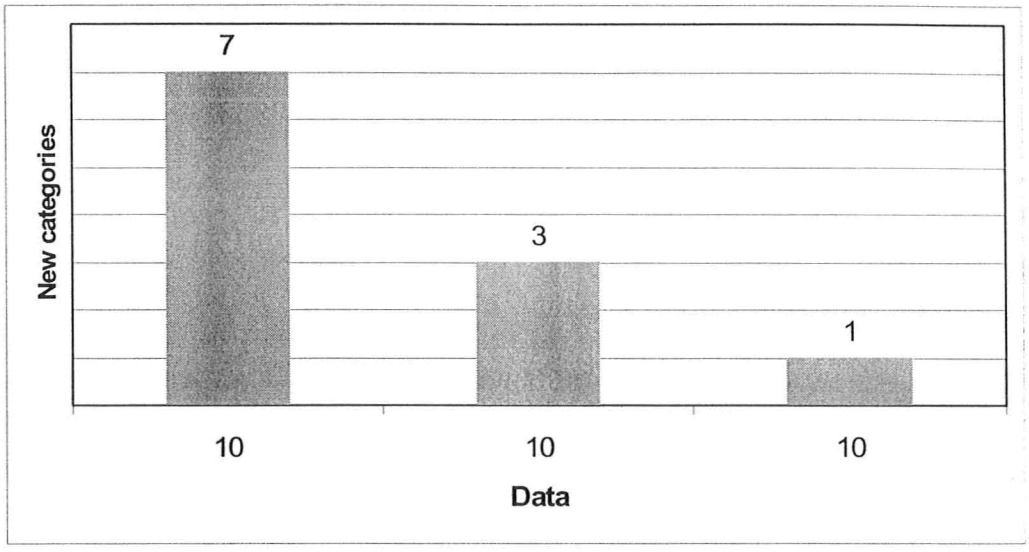


Figure 5.41: Theoretical Saturation – Cause of a Negative Critical Incident

For most questions, theoretical saturation was reached. For example, if the sample size was doubled, at most one or two new categories would appear for these questions given that the first 20 responses produced around 50% of all categories.

The goal of the second test was to verify that the augmentation of the sample size would not change the distribution of the data within the categories. In other words, the proportion of the items that belonged to each category should remain constant regardless of sample size changes. For this assessment, a split-half method was used. The data were sorted in the order they were received and split into two equal parts. The distribution of categories of the complete dataset and the first half were compared on the first level of coding. Table 5-27 through Table 5-29 present the results for the questions pertaining to reasons why people liked to utilize email agents, reasons why they did not, and features of an 'ideal' email agent. This test was not conducted with responses relating to usage termination factors and the critical incident technique because the sample sizes of split halves would fall below 30.

Table 5-27: Theoretical Saturation – Reasons Why Respondents Like to Utilize Email Interface Agents (Level 1)

	User Perceptions	Agent Operability	External Environment	Tech Support	Other
Full Set	80%	8%	6%	5%	1%
First Half	79%	12%	7%	1%	1%

Table 5-28: Theoretical Saturation – Reasons Why Respondents Do Not Like to Utilize Email Interface Agents (Level 1)

	User Perceptions	Agent Operability	External Environment	Other	License Fee	Tech Support
Full Set	42%	37%	9%	8%	2%	2%
First Half	39%	37%	12%	8%	2%	2%

Table 5-29: Theoretical Saturation – Characteristics of an 'Ideal' Email Interface Agent (Level 1)

	Agent Operability	HCI	Other
Full Set	86%	7%	7%
First Half	87%	8%	5%

The above tables further demonstrate that theoretical saturation was reached. If, for instance, only 50% of the responses were obtained, this would have only a minor effect on the distribution of categories. Therefore, it is believed that the collection of additional responses is not required to achieve the purpose of this dissertation. In other words, additional data will not reveal new important facts and will not affect the conclusions based on the analysis of open-ended items.

5.4.2.11 Data Validity Check

Recall it is relatively difficult to demonstrate the validity of a qualitative study. The collection of valid data is a required step in qualitative research. In order to analyze the quality of obtained open-ended responses, data validity check on three questions was conducted.

First, the reasons why respondents to the survey liked to use agents (Section 5.4.2.2) and the reasons why they did not (Section 5.4.2.3) were analyzed by using the paired comparison method. As such, answers to these questions provided by a single individual were compared on the lowest coding level. The rationale was that the same person should give different responses to both questions (i.e., the reasons why a person liked to use email interface agents should be fundamentally different from why he or she did not). A visual inspection of responses demonstrated that no user provided similar answers to both questions.

Secondly, a similar paired comparison of user responses was made with respect to causes for usage termination (Section 5.4.2.1) and reasons why individuals liked to use email interface agents. The expectation was that a user should not say that he or she liked a certain feature and terminates agent usage for the same reason. Again, no paired matches of responses were found.

Lastly, usage termination responses were compared with reasons why people did not like agents. The analysis demonstrated that 15 users provided answers pertaining to the same coding category for both questions. Generally, this shows some degree of confidence in the validity of the collected qualitative data.

5.5 Summary

The goal of this chapter was to outline the findings of this dissertation study. The presentation of results was accomplished through quantitative and qualitative data analysis techniques. First, this chapter described the administration of the data collection procedure. Second, it provided the descriptive statistics of interface agent users, such as their demographical information and general email usage. Third, it reported on a sound methodological testing of the suggested model. Lastly, it offered the analysis of open-ended items pertaining to actual usage of the technology of interest.

Overall, this chapter outlined a comprehensive set of findings that lay the foundation for a further discussion of user acceptance of interface agents for email. The following chapter presents this discussion.

Chapter 6: Discussion and Conclusion

6.1 Introduction

The results presented in the previous chapter offered a realistic description of the behavior of email interface agent users. The key learning of that chapter was that existing research methodologies, techniques, and instruments may be successfully applied to empirical investigations focusing on agent user behavior.

The goal of this last chapter is three-fold. The first is to answer the study's seven research questions. Four of these refer to the proposed model of user adoption of email interface agents; the other three concentrate on the analysis of agent users and the way they perceive and utilize this technology in their email systems. The second is to integrate answers to these questions into one grand model of email agent adoption and use. The third purpose of this chapter is to make several reflections on the methodology, theory and practice, outline the limitations of this empirical investigation, and suggest avenues for future research.

6.2 Answers to Research Questions

6.2.1 The Role of Individual User Characteristics

RQ1: *How well do individual characteristics of computer playfulness and personal innovativeness in the domain of information technology influence user perceptions of interface agents used in electronic mail systems?*

This research question relates to the examination of the role that individual characteristics of computer playfulness and personal innovativeness in IT play in influencing user perceptions of email interface agents. The following hypotheses were suggested:

H1: *Computer playfulness will have a positive direct effect on perceived enjoyment with interface agents for email.*

H2: *Personal innovativeness in the domain of information technology will have a positive direct effect on perceived usefulness of interface agents for email.*

H3: *Personal innovativeness in the domain of information technology will have a positive direct effect on perceived ease of use of interface agents for email.*

With respect to the role of computer playfulness, H1 was supported. It is argued that computer playfulness positively influences a user's perceptions of enjoyment with email interface agents. As theorized, those individuals who tend to interact with computer systems more flexibly, imaginatively, creatively, playfully, originally and inventively in

general tend to enjoy using email interface agents to a greater extent than people with a lower degree of computer playfulness ($\beta = 0.346$, p-value < 0.01).

Regarding the nature of personal innovativeness in IT, two key findings warrant attention. First, H2 was rejected. In contrast to prior expectations, no direct effect of PIIT on perceived usefulness of interface agents was found ($\beta = 0.125$, not significant). This suggests that more innovative people do not necessarily perceive this technology more useful than less innovative ones. Several explanations are proposed. For example, both more and less innovative people perceive the actual characteristics of agent usefulness similarly. They all look for value-added features, productivity enhancement, and higher email efficiency in the same way. People who are more adept at using new technologies do not always find them more useful than their less innovative counterparts.

Second, H3 was supported. The degree of PIIT has a strong positive direct effect on the extent of perceived ease of use of email interface agents ($\beta = 0.292$, p-value < 0.05). This finding supports much of the prior research on the role of personal innovativeness in user technology perceptions. In fact, it seems logical to suggest that if people tend to frequently explore new information technologies by experimenting with them, they become more proficient at learning the design and functionality of all new systems, including agent-based ones. Knowledge that individuals obtain from past interactions with various computer applications shapes people's actions when they interact with agent technologies. Human-computer interaction research demonstrates that users identify effective patterns of interacting with software applications, remember them, and apply those patterns across a variety of situations (Dix et al., 1989). This proposition holds true when it is applied to interface agents; people apply their general computer expertise to the human-agent interaction process as well. Therefore, highly innovative and, presumably, more technologically experienced individuals perceive email interface agents easier to use.

6.2.2 Associations Among the Constructs Reflecting User Perceptions

RQ2: *What are the possible associations among the constructs reflecting user perceptions (perceived enjoyment, perceived usefulness, and perceived ease of use)?*

This research question pertains to the investigation of interactions among three constructs corresponding to user perceptions of email interface agents: PE, PU, and PEOU. According to the dissertation model of user adoption of interface agents for email, two associations among the constructs referring to user perceptions were proposed:

H4: *Perceived enjoyment will have a positive direct effect on perceived usefulness of interface agents for email.*

H5: *Perceived ease of use will have a positive direct effect on perceived usefulness of interface agents for email.*

H4 was exploratory in nature; there were only a few investigations that studied a link between perceived enjoyment and usefulness. The major rationale behind this hypothesis was a classic study by Davis and his colleagues (1992) and a recent project by

Serenko et al. (forthcoming) that supported the existence of this relationship. H5 stated that user perceptions of an agent's ease of use would have a strong positive effect on its usefulness. This hypothesis was confirmatory; there is a growing body of MIS literature that attests to the existence of the proposed relationship.

With regards to the former hypothesis, no relationship between perceptions of enjoyment with an email interface agent and perceptions of its usefulness was found ($\beta = 0.200$, not significant). Thus, H4 was rejected. This contradicts prior research projects conducted by Davis et al. (1992) and Serenko at al. (forthcoming). Recall Davis et al. investigated the use of computers in workspace, and Serenko and his colleagues analyzed the usage of interface agents in everyday work applications. In both situations, the employment of the technology of interest was required by either an organization or a software manufacturer that corresponded to mandatory usage settings. In contrast, respondents to the dissertation survey made a personal decision to use an agent. In other words, the employment of the technology analyzed in this dissertation was entirely optional. The rejection of the previously validated hypothesis shows that the same relationship between two constructs may behave differently depending on whether usage conditions are mandatory or optional. As such, voluntariness is believed to be a moderator of the PE –PU relationship.

With respect to the latter hypothesis, a positive association between the perceptions of the ease of use of an agent and the perceptions of its usefulness was observed ($\beta = 0.277$, p-value < 0.1). As such, H5 was supported. This confirms much of the prior research that suggests that, regardless of the type of technology under investigation and usage circumstances, if individuals perceive a system to be easier to use, they also perceive it to be more useful.

Overall, regarding the possible associations between the constructs reflecting user perceptions of interface agents, two conclusions can be made. First, the influence of perceived enjoyment on the perceived usefulness of interface agents depends on whether the usage is mandatory or voluntarily. In a mandatory setting, those who find an agent more useful tend to enjoy with it to a higher extent. At the same time, those who perceive an agent to be less useful tend not to enjoy it. In a voluntarily condition, this relationship does not hold true. Since all people make a conscious decision to employ an agent, they may do so for one of the following reasons: 1) because they enjoy the usage, 2) because they find it useful, 3) for both 1 and 2. However, not all individuals who voluntarily utilize interface agents tend to find them both enjoyable and useful. Second, in concurrence with prior TAM-based investigations, perceptions of an agent's ease of use affect perceptions of its usefulness.

6.2.3 The Role of User Perceptions in Future Usage Behavior

RQ3: *How well do user perceptions of interface agents (perceived enjoyment, perceived usefulness, and perceived ease of use) impact a person's intentions regarding future usage of interface agents in electronic mail systems?*

The purpose of this research question is to analyze the influence of key user perceptions, such as enjoyment, usefulness, and ease of use, on future usage behavior of email interface agent users. Three hypotheses were proposed:

H6: *Perceived enjoyment will have a positive direct effect on behavioral intentions.*

H7: *Perceived usefulness will have a positive direct effect on behavioral intentions.*

H8: *Perceived ease of use will have a positive direct effect on behavioral intentions.*

In order to answer this research question and related hypotheses, the relationship among these constructs and behavioral usage intentions was analyzed, and the importance of each construct was studied. According to the findings, user perceptions of enjoyment with an email interface agent were the first, key influencing factor of future behavioral usage intentions towards an agent. Two arguments support this statement. First, the PE – BI association had a high, statistically significant beta coefficient of 0.565 (p-value < 0.001) that supports H6. Second, the PE –BI relationship exhibited a large effect size ($f^2 = 0.50$). The effect size signifies the amount of variance in the dependent construct (BI) that is explained by an independent construct (PE). In other words, it shows the significance of the PE construct in the model with respect to the R-square value of the BI construct. As suggested by Cohen (1988), the effect size values of 0.02, 0.15, and 0.35 correspond to low, medium, and large effect sizes. Therefore, the effect size of PE is considered very strong. This suggests that the degree of user enjoyment with an email interface agent is the major reason why they adopt this technology.

This observation is in accordance with the recent stream of HCI research that emphasizes the importance of user enjoyment with various software applications. A recent issue of *Interactions*, a new magazine on applied Human-Computer Interaction, was devoted to the discussion of 'funology' – the science of enjoyable technology (Blythe, Hassenzahl and Wright 2004). The editors argue that boundaries between work and play are increasingly being called into question and blurred. Many computer users stop differentiating between fun and work; they expect software applications to be fun to use. This dissertation study shows that interface agent users tend to utilize this technology if they perceive it to be enjoyable, even apart from all anticipated usage consequences, such as an agent's usefulness.

User perceptions of an agent's usefulness are the second, medium factor that affects usage behavior. The results show that the PU – BI association is 0.304 (p-value < 0.01) that supports H7. In addition, the effect size of this construct is slightly above the medium threshold ($f^2 = 0.18$). In accordance with previous MIS research, it is concluded that if users perceive an agent to be more useful, they develop higher behavioral intentions towards its usage.

It should be noted that the model of user adoption of interface agents in everyday work applications suggested by Serenko et al. (forthcoming) demonstrates that the PU – BI relationship ($\beta = 0.508$, p-value < 0.001) is stronger that the PE – BI relationship ($\beta = 0.428$, p-value < 0.001). This divergence may be explained by the different usage conditions. In the Serenko et al. study, agent usage was mandatory, whereas in this

dissertation investigation, agent use was optional. This indicates that interface agent users may tend to emphasize the actual usefulness of an agent in mandatory settings. At the same time, they may perceive enjoyment to be a more important factor if use is voluntary.

User perceptions of an agent's ease of use are the third, least significant factor that influences user behavioral intentions towards email interface agent usage. According to the results, the effect of PEOU is weaker than those of PE and PU. As such, the PEOU – BI association is 0.150 (p-value < 0.05) that supports H8. The PEOU construct has a relatively small effect on the predictive power of the model ($f^2 = 0.04$). This supports the prior TAM-based line of research that argues that PEOU is less influential than PU in technology adoption decisions. For example, Davis (1989) shows that perceived usefulness is 50% more significant than perceived ease of use. Subramanian (1994) and Igbaria et al. (1997) claim that perceived usefulness rather than ease of use is a determinant of predicted actual usage. This dissertation study supports that well-established view.

Overall, from this analysis, two conclusions can be made regarding user perception and agent adoption. First, the Technology Acceptance Model may be successfully applied to measure user adoption behavior towards interface agents employed in the email environment. Second, under voluntarily usage conditions, perceived enjoyment with an interface agent is a leading factor influencing adoption behavior. Currently, user adoption decisions towards email interface agents are mostly affected by perceptions of enjoyment, moderately impacted by perceptions of usefulness, and relatively weakly influenced by perceptions of the ease of use of an agent.

6.2.4 The Predictive Power of the Model

RQ4: *How appropriate is the proposed theoretical model in explaining user adoption behavior with respect to interface agents in electronic mail systems?*

The objective of this research question is two-fold. The first goal is to analyze the relationship between user behavioral intentions and actual usage of email interface agents. For this, the following hypothesis was formulated:

H9: *Behavioral intentions will have a positive direct effect on the actual use of email interface agents.*

The second purpose was to analyze the predictive power of the model by comparing it with those of previous TAM-based empirical investigations.

With respect to H9, it was found that user behavioral intentions have a strong, significant effect on actual usage of email interface agents. The results demonstrate that the BI – USE relationship is 0.649 (p-value < 0.001) that supports H9. This finding is in agreement with prior MIS research. If, for example, H9 was rejected, this phenomenon would be difficult to explain.

In terms of the predictive power of the model, the comparison of R-square values was done. Recall the R-square values of the behavioral intentions and actual usage constructs are the key predictors of the explanatory power of a TAM-based model. In

order to demonstrate the appropriateness of the dissertation model in explaining user adoption behavior towards email interface agents, the R-square values of BI and USE were compared with those of well-known MIS studies. Legris et al. (2003) present a list of the articles that utilized or adapted the Technology Acceptance Model, and that were published in the leading journals, such as MIS Quarterly, Decision Sciences, Management Science, Journal of MIS, Information Systems Research, and Information and Management. Table 6-1 outlines the predictive powers of those models in comparison to this study's R-square values.[90]

Table 6-1: Explanatory Power of Key TAM-based Studies

Article	Constructs Influencing BI	BI R-square	Constructs Influencing Use	Use R-square
Agarwal and Prasad (1997)	Perceived relative advantage, ease of use, voluntariness, compatibility, image, result demonstrability, visibility, trialability, and use	0.46	Perceived relative advantage, ease of use, voluntariness, compatibility, image, result demonstrability, visibility, and trialability	0.48
Davis (1989), study 1	Not tested	NA	Perceived usefulness and ease of use	0.38
Davis (1989), study 2	Not tested	NA	Perceived usefulness and ease of use	0.74
Davis et al. (1989)	Perceived usefulness and attitude	0.51	Use	0.40
Dishaw and Stron (1999)	Perceived usefulness and attitude	0.84	Behavioral intentions and perceived usefulness	0.36
Igbaria et al. (1997)	Not tested	NA	Perceived usefulness and ease of use	0.25
Karahanna et al. (1999)	Attitude, subjective norm, and perceived voluntariness	0.38	Attitude, subjective norm, and perceived voluntariness	0.24
Szajna (1996), pre-implement	Perceived usefulness and ease of use	0.52	Behavioral intentions	0.08
Szajna (1996), post-implement	Perceived usefulness	0.10	Behavioral intentions	0.38
Venkatesh and Davis (1996)	Perceived usefulness, ease of use	0.58	Not tested	NA
Venkatesh and Davis (2000)	Perceived usefulness, ease of use, subjective norm	0.49	Not tested	NA
Venkatesh and Morris (2000)	Perceived usefulness, ease of use, subjective norm	0.39 – 0.42	Not tested	NA
Average:		**0.48**		**0.37**
The dissertation model		**0.69**		**0.42**

[90] Only the papers that utilized linear regression or PLS are included in the table because the covariance-based data analysis techniques produce different statistics (i.e., no R-square values are available).

As such, the predictive power of the dissertation model is above the average of those of key MIS studies. The high R-square value of the BI construct may be explained by the line of reasoning offered by Nunnally (1978). He argues that there are three major contributors to the R-square values of dependent constructs: 1) the number of independent constructs that influence it, 2) the correlation of each independent and dependent construct, and 3) the correlation among these independent constructs.

First, the increase in the number of independent constructs influencing one dependent constructs may lead to a higher R-square value. The multiple correlation cannot be lower than the highest correlation of any one of the independent constructs with the dependent one. With respect to the dissertation model, three independent constructs (PE, PU, and PEOU) influence the BI construct that increases its R-square value. Second, the correlations of PE, PU and PEOU with BI are 0.765, 0.579 and 0.566 respectively (see Table 5-6). High correlations between the independent variables and the dependent variable lead to high R-square values. Third, the correlations of independent constructs with one another fall into the medium correlation range. Recall no positive association was found between PE and PU. When correlations among independent variables tend to be low, each independent construct contributes something to the predictive power obtained from the others. Overall, this justifies the high explanatory power of the behavioral intentions construct.

The high R-square value of the usage construct may be explained by its high correlation with BI (0.649). Even though there is only one variable influencing it, a strong correlation with a single independent variable[91] is often sufficient to obtain a high R-square value.

Overall, based on the above assessment of the R-square values, it appears that the dissertation model is highly appropriate in explaining user adoption behavior with respect to interface agents in electronic mail systems.

6.2.5 User Population Characteristics

RQ5: *What are the characteristics of the user population who adopt email interface agents?*

The purpose of this research question is to provide characteristics of the user population based on the demographical data obtained from the survey questions. In order to develop interface agents that meet the needs of end-users and to market this product to the appropriate category of potential adopters, it is crucial to understand who the users of this technology actually are. The results of the empirical investigation show that the current email interface agent users are innovative individuals who:

- exhibit a very high degree of personal innovativeness in IT;
- are predominantly male;

[91] With respect to USE, BI may be viewed as an independent construct.

- range in age from 31 to 50 years old;
- work in the IS/IT or engineering sector;
- utilize email very heavily;
- reside in English-speaking countries, mostly in the US;
- are well-educated; and,
- are economically well-off.

The following two subsections describe these characteristics in more detail.

6.2.5.1 Demographics

Eighty percent of the user population of email interface agents in this study were male and only twenty percent were female. Although women represent approximately half of Internet and email users, it appears that the tendency to start utilizing innovative agent technologies differs between the sexes. However, after a person has begun using interface agents, the data suggest gender differences have no impact on both behavioral intentions and actual usage behavior towards agents. At the same time, men and women differ in their perceptions of the degrees of ease of use and enjoyment with interface agents; women perceive interface agents to be easier to use and more enjoyable (see Section 5.3.5 'Control Variables'). This finding supports prior research on gender effects on the use and perceptions of various forms of information technologies, as described below.

Overall, social scientists argue that gender differences are one of the aspects of cultural differences that exist among people. According to the classic study by Hofstede (1980), the disposition of men and women towards masculine attitudes and behaviors is fundamentally different. Gender roles are transferred through socialization, and men are taught to be more assertive and women more nurturing. Men and women differ in terms of anxiety (Egloff and Schmukle 2004), social interaction, use of language (Coates 1986), conflict resolution style, and disclosure (Tannen 1990; Tannen 1996).

Despite these various gender differences, MIS scholars argue that men and women do not differ in their usage of telecommunications technologies. For example, Gefen and Straub (1997) empirically show that men and women differ in their perceptions of email but not use of email. Wachter (1999) found no effect of gender on the conflict resolution process across different communications media. Therefore, the difference in the perceptions but not use of email interface agents between male and female users supports prior non-agent specific MIS research. This suggests that the results of prior technology acceptance studies may be applicable to email interface agent technologies. More specifically, the classic categorization model of innovation adopters developed by Rogers (1983) may be applied to understand the individual characteristics of email interface agent users.

According to Rogers (1983), innovativeness is the "degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (p. 242). Based on the extent of their innovativeness, people are classified into five distinct categories: 1) innovators (2.5%); 2) early adopters (13.5%); 3) early majority (34%); 4) late majority (34%); and, 5) laggards (16%). The purpose of this classification approach is to identify different groups of individuals that guides research efforts and serves as a framework for the synthesis of research findings.

With respect to innovators, the following characteristics are identified (Rogers 1995). First, they are venturesome. These individuals are virtually obsessed with innovating, and they are always ready to try out new ideas. With respect to the present investigation, the agent users demonstrated an unexpectedly high degree of personal innovativeness in IT (5.93 / 7) which implies that these individuals were passionate with trying out new software applications, including agent-based ones. Second, innovators frequently interact with other people sharing a similar passion to innovations despite a geographical distance. As demonstrated in Section 5.2.6 'Email Usage' of this dissertation, the respondents to the survey were very heavy email users. For example, an average agent user sent between 21 and 40 messages per day and spent from two to three hours working with an email application. This suggests that these people frequently communicated with others via email. Third, innovators are either financially well-off, or they have control over substantial financial resources. Recall that 34% of the surveyed agent users belonged to middle or senior management, and that 19% of them kindly declined the compensation of $10 US for their participation in the study. This evidence reveals that they have high income. Fourth, innovators are usually well-educated, have high social standing, and belong to large organizations. Again, 81% of the respondents had a college or university degree, and all of them were employed. Last, they are ready to cope with a high degree of failure, uncertainty, and risk associated with an innovation; this also held true with respect to the respondents from the survey. Based on the above discussion, it is suggested that people who currently utilize email interface agents developed by ABC Company as well as by other manufacturers are innovators. According to Rogers (1995), innovators constitute 2.5% of the entire interface agent user population. These individuals like ventures, hazards, and perils. A decision to try an innovation is made very fast, and the period to adopt an agent is short. It is these characteristics that dramatically distinguish innovators from other categories of adopters.

Subsequent research demonstrates that these personality characteristics of consumer innovativeness appear in all market segments including computers and software applications (Foxall and Bhate 1993). Despite that, different sets of innovation characteristics influence adoption decisions regarding computer-related systems across all adopter categories (Brown and Venkatesh 2003). In their study of 733 households, Venkatesh and Brown (2001) found that, in contrast to other groups of innovation adopters, 100% of innovators indicate that they own a personal computer for hedonic reasons (i.e., for entertainment or fun) and for social outcomes (i.e., status gains from possessing current technology) whereas only 15% of innovators do so for utilitarian reasons (i.e., applications for personal use, utility for children, and utility for work-related

usage). Social influences from friends, family, or secondary information sources do not affect their decisions. Barriers to adoption, such as risk of computer obsolescence, cost, and ease of use, do not exist. This empirical evidence further validates the findings of this dissertation study because perceptions of user enjoyment with email interface agents were found to be the most significant predictor of future usage behavior.

6.2.5.2 IT / IS Professionals Characteristics

The majority of email agent users in this study work in the IS/IT (55%) and engineering (8%) fields. Therefore, the professional characteristics of these people are presented. The rationale is that the awareness of agent designers and marketers with this information may help them make better decisions on the development and marketing of email agents.

According to a classic study by Couger and Zawacki (1980), IS/IT people are fundamentally different from non-IS/IT professionals in terms of their growth and social needs. They argue that IS/IT employees demonstrate higher growth needs; they have a stronger need for personal accomplishment, constant leaning, challenge, motivation, and job satisfaction. At the same time, some IS/IT professionals exhibit low proclivity to social interaction with other people. Often, IS/IT people lack important communications skills and teamwork training, whereas they successfully apply different types of reasoning to problem-solving (Armour 2002). Empirical research shows that the style of creativity of IS/IT workers differs from that of non-IS/IT people; both groups apply creativity but in slightly different ways (Miller, Couger and Higgins 1996).

However, it should be noted that research on whether IS/IT employees are different from non-IS/IT personnel appears to be mixed and inconclusive (for example, see Ferratt and Short 1986; Ferratt and Short 1988). With respect to this dissertation, the Couger and Zawacki's views are believed to hold true. First, IS/IT is a constantly evolving and rapidly changing profession that might result in a misfit between the actual and observed situation (Myers 1991). Secondly, much of their research has been confirmed (Wynekoop and Walz 1998).

Email is the major communications medium in most contemporary organizations, and it is especially popular among IS/IT personnel. Recall from Section 5.3.2, the respondents to the survey report an unusually high degree of personal innovativeness in the domain of information technology. Therefore, it is assumed that email interface agents may potentially fit well with the growth need of IS/IT people by increasing their email productivity, requiring them to learn about new agent technologies, providing a challenge to traditional email usage, boosting creativity, and enhancing the social status of highly innovative individuals. Overall, the encouragement of IS/IT people to explore and utilize new agent-based technologies may increase their job satisfaction and reduce turnover (Mak and Sockel 2001). In addition, the use of email interface agents may increase the amount of social interaction with others. For example, two respondents noted that they tried to discuss and demonstrate this technology to colleagues. They may also send an electronic message which is read by a specific agent on a recipient's computer that increases the richness of transmitted information.

6.2.6 Email Interface Agent Usage

RQ6: *How do people typically utilize email interface agents?*

The purpose of this question is to understand how individuals employ interface agents in their email applications in order to develop recommendations for agent designers and marketers. Based on the results of the survey, four observations are outlined.

First, according to the dissertation model, the USE construct mean was found to be 5.51 out of 7. This value corresponds to halfway between 'sometimes' and 'frequently' on the scale pertaining to the current or previous usage of email interface agents, which shows that people employ interface agents on a regular basis. This likely results from high behavioral intentions towards the usage of this technology (5.71 / 7). BI, in turn, are influenced by high degrees of perceived enjoyment (5.79 / 7), usefulness (5.06 / 7), and ease of use of an agent (5.72 / 7). In other words, individuals are satisfied with several critical aspects of agent usage. They regularly employ email interface agents.

Secondly, most innovators who start using an agent made a decision whether to continue utilizing it within several months after they first installed the product. Recall 76% of the respondents who did not utilize email interface agents on the day of the survey indicated that they abandoned this technology for the reasons they did not control. As such, most people stopped using an agent because of operability problems with an agent, lack of access to an agent, or an external environment that influenced their termination decision. Those, who terminated the usage for negative perceptual reasons, utilized an agent for only five months, whereas the current users used it for almost a year and a half on average. In other words, users form reliable perceptions soon after they acquire an agent. In case of positive perceptions, people continue using it in the future, and in case of negative perceptions, individuals immediately uninstall it from their computers.

Thirdly, people utilized email agents very intensively both at work and at home. A moderate correlation between work and home usage shows that some individuals used an agent either at work or at home, whereas others did so in both environments. At work, most people employed an agent with MS Outlook; at home, they utilized it with Hotmail. Agent functions for the announcement of incoming messages were utilized most frequently, the delivery of calendar reminders was employed moderately, and the notification of read receipts was utilized very rarely.

Fourthly, the employment of the critical incident technique allowed establishing several typical scenarios of user behavior under the influence of positive and negative critical events. With regards to positive-outcome situations, one representative scenario was constructed (see Figure 6.1).

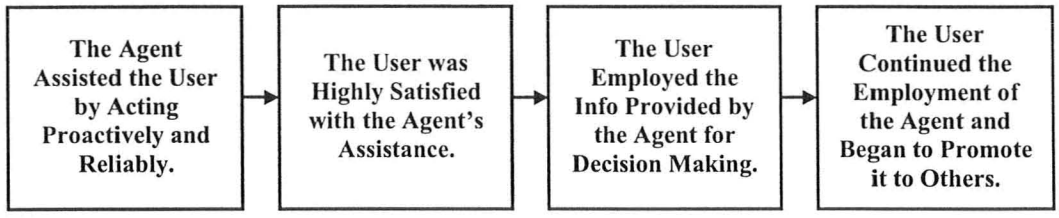


Figure 6.1: A Typical Scenario of User Behavior – Positive Critical Incidents

According to this scenario, a **positive** incident occurred when an agent presented a user with a notification in a proactive and reliable manner. For example, it read an important message from a colleague, and the user did not have to switch from a currently open application to an email system; this saved time and improved email efficiency. The person expressed positive emotions towards the critical event, such as satisfaction or enjoyment and utilized the information provided by the agent for decision making. As a result, the user continued employing the agent. In some cases, he or she began to promote the agent by demonstrating this software to peers and friends.

With respect to the **negative**-outcome situations, three distinct scenarios were identified because each situation was caused by a unique type of a critical incident. Figure 6.2 offers the first scenario of user behavior that occurred because of agent operability problems.

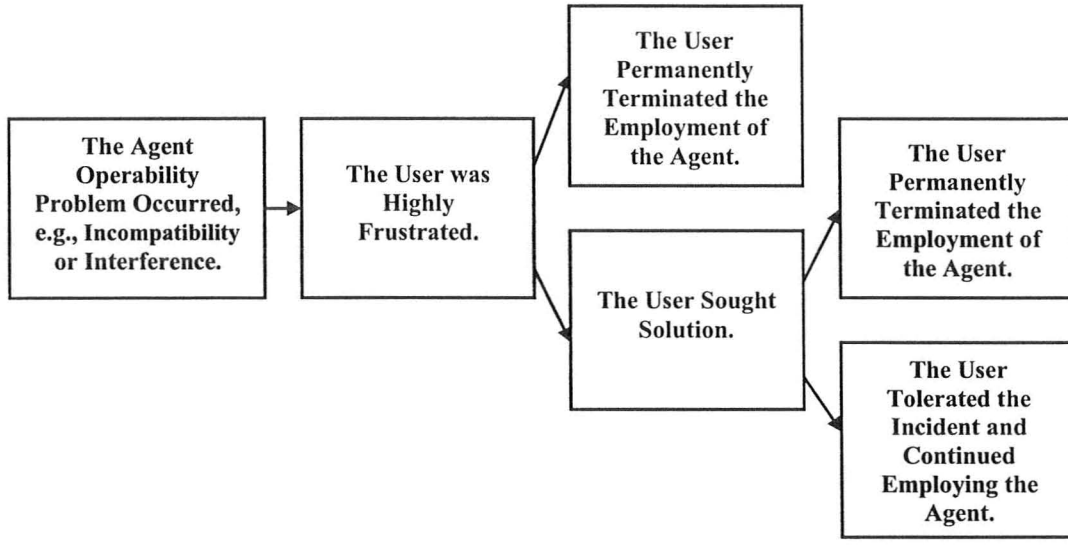


Figure 6.2: A Typical Scenario of User Behavior – Negative Critical Incidents – Agent Operability

In this scenario, most incidents took place because an agent was incompatible with a user's email client, interfered with other software applications, or behaved unreliably. All of users felt very frustrated. During the incident, some of them made an immediate decision to terminate agent usage, whereas others tried to find a solution. Those, who tried to solve the problem, either terminated agent usage at a later date or ignored the incident and continued the employment of the agent.

Figure 6.3 outlines the second scenario of a negative-outcome event that resulted from a high degree of perceived intrusiveness of an agent.

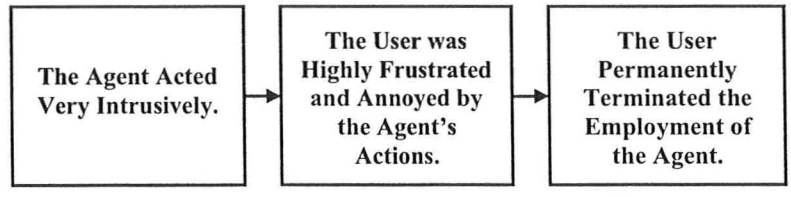


Figure 6.3: A Typical Scenario of User Behavior – Negative Critical Incidents – Perceived Intrusiveness of an Agent

According to this scenario, an incident happened because an agent behaved highly intrusively. Given a very high degree of perceived intrusiveness, a user felt very frustrated and annoyed by the actions of the agent. Immediately, he or she made a decision to permanently terminate the usage of the agent.

Figure 6.4 offers the third, last scenario of a negative-outcome incident that took place under the influence of external factors which a user could not control.

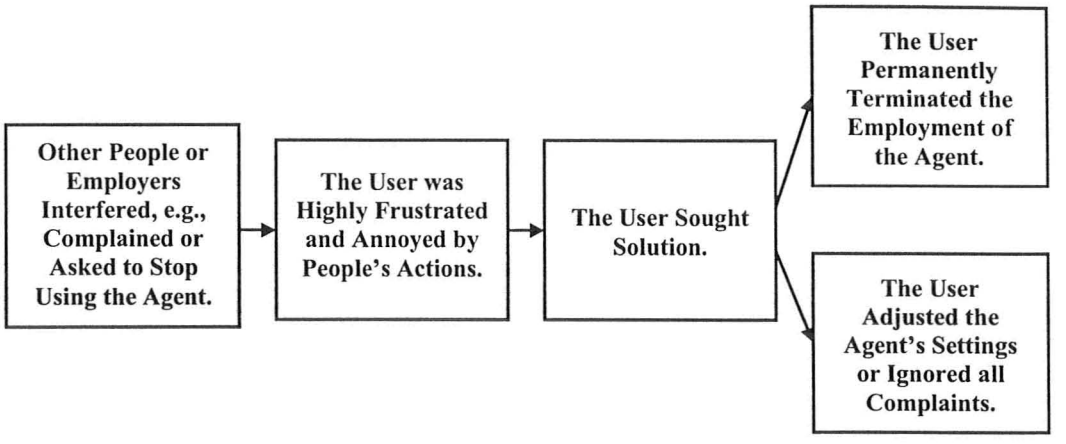


Figure 6.4: A Typical Scenario of User Behavior – Negative Critical Incidents – External Factors

In terms of this scenario, other people or employers interfered with the way a person utilized an agent. For example, peers abused the user by sending obscene messages, colleagues complained about noise, or company staff requested that the agent be removed from a computer because its employment was not authorized. An individual was very frustrated and annoyed by the actions of the peers or company personnel. In response to their actions, the user attempted to solve the problem. In most cases, he or she had to terminate the employment of the agent. Rarely, the person found a solution to the problem or ignored the incident.

Overall, it is believed that the above scenarios show a realistic picture of user behavior under the influence of positive and negative critical incidents and provide a reliable description of user feelings, actions, and adoption decisions towards email interface agents.

6.2.7 User Perceptions of Interface Agents

RQ7: *What are people's perceptions of email interface agents?*

This research question concentrates on understanding user perceptions of various aspects of email interface agents. The purpose of this question is two-fold. The first is to grasp what agent characteristics users like or dislike, and what additional features and functions they want to be able to utilize. The second goal is to comprehend the importance of different effects of interface agents that were previously identified in the HCI literature.

6.2.7.1 Interface Agent Characteristics

With respect to the reasons why individuals like to utilize interface agents in their email applications, four important points are suggested. First and foremost, the overall user perceptions of agents were very positive. According to the findings, users provided approximately the same number of reasons why they liked (146) or disliked (116) this

technology. If, for example, the number of negative answers dramatically exceeded the number of positive responses, it might be assumed that user perceptions were more negative since they tended to complain about agents to a greater extent. This claim is in accordance with the results of the assessment of the dissertation model of user adoption of agents that demonstrated high degrees of perceived enjoyment, usefulness, and ease of use of agents.

Second, with respect to the reasons why people like to use email agents, the top five categories comprised 77% of all responses, and the other 12 categories constituted only 23% of answers. The key factors were **perceived usefulness** (36%), **perceived enjoyment** (19%), **perceived ease of use** (8%), **perceived attractiveness** (8%), and **perceived image** (6%). Recall the dissertation model states that perceived enjoyment is the key influencer of adoption behavior, followed by perceived usefulness and ease of use of an agent. The triangulation of these factors further demonstrates statistical conclusion validity of both the deductive and inductive approaches. The discrepancy in the ranking of perceived usefulness and enjoyment may be explained by slight differences in the goals of analyses. In the case of the empirical model, the strength of the influence of the independent constructs (PE, PU, and PEOU) on the dependent construct (BI) was studied. In terms of the classical content analysis techniques, the number of responses pertaining to each category was counted, but no effect of one category on another was investigated. This may clarify the minor inconsistency in the ranking of PE and PU.

Perceived attractiveness relates to user perceptions of an agent's appearance; overall, the respondents indicated that an agent's interface was cool, cute, near, or versatile. The HCI literature labels this phenomenon as the degree of an agent's likeability (for example, see Dehn and van Mulken 2000; Koda and Maes 1996; Sproull et al., 1996).

Perceived image is the degree to which use of an agent is perceived to enhance one's social image or status in one's social system (the definition is adapted from Moore and Benbasat 1991, p. 195). Venkatesh and Davis (2000) demonstrate that image has a positive effect on perceived usefulness of an information system. This construct may have an explanatory power only when the use of agents is visible to other people, such as co-workers or friends. For example, it may have an impact on user perceptions if people use agents at work, but it may have no effect if individuals utilize agents at home. In this dissertation, the inclusion of the image construct in the proposed model would have only an incremental, if any, impact since many respondents to the survey used agents at home.

In addition to these five key categories, the analysis yielded three other important categories that were previously identified in the MIS and HCI literature. These are **reliability**, **compatibility**, and **personalization**. Reliability is the dependability of an agent, such as the absence of bugs and crashes. Compatibility is the degree to which an agent works well with other software applications, including email clients. The reliability and compatibility constructs were already applied to other IS systems; they constitute part of a Task-Technology Fit Instrument developed by Goodhue (1998). Personalization is the degree to which an agent's actions, appearance, and voice may be tailored according

to a user's requirements. For a detailed discussion on agent personalization, see Section 2.1.1 of this dissertation.

It should be noted that two users indicated that the usage of an agent boosted their imagination. This finding may be of interest to innovative companies that want to improve creativity in workplace, especially, to increase the degree of spontaneous creativity of their workers. Spontaneous creativity is often experienced when a person is inspired by other people or events. Creativity is rarely a primary objective of people. Usually, they need to be motivated, and the presence of email interface agents may potentially play a role of a creativity facilitator. The exploratory behavior during playful interactions with agents may enhance users' creativity. Prior research shows that creativity and productivity are positively related. When people are most creative, they also become most productive that may positively contribute in the achievement of organizational goals (Miller 1986; Miller 1998). Therefore, under appropriate conditions, the employment of this technology may serve well the overall organizational goals.

Third, with regards to the reasons why individuals do not like to utilize email interface agents, the extent of an agent's **perceived intrusiveness** was the top reason. It constituted 25% of all responses. The users stated that the agent distracted, annoyed, and irritated them. This frequently happened when an agent disrupted a conversation or popped up in an inappropriate time. This observation is consistent with the recent empirical investigation by Serenko (2004a) who surveyed 228 users of interface agent employed in a MS Office help system. In this study, subjects were presented with four vignettes on the use of interface agents in a MS help menu. The purpose was to measure people's attributional behavior in four different scenarios: 1) positive-outcome situation (i.e., when an agent facilitated the successful completion of a computer task) and low degree of an agent's autonomy (i.e., when a user initiated the human-agent communication process); 2) positive outcome situation and high degree of an agent's autonomy (i.e., when an agent initiated the human-agent communication process); 3) negative-outcome situation (i.e., when an agent failed to facilitated the successful completion of a computer task) and low degree of an agent's autonomy; and, 4) negative-outcome situation and high degree of an agent's autonomy. The vignette of the fourth situation asked respondents to visualize an event when they were concentrating on a difficult task in MS Word. Suddenly, an agent offered a tip on the more successful task completion, which users found too complicated and declined, that hindered the completion of that task. In their open-ended responses to the questionnaire, 41% of MS Office users indicated they believed that they failed to successfully finish the task because of high extent of the intrusiveness of the agent. As such, they claimed that the agent was annoying, interrupting, and disruptive. This supports the frequent complaints of email interface agent users on a high extent of an agent's perceived intrusiveness.

A number of users complained about **agent – system interference**. They stated that the agent sometimes interfered with other software applications or slowed down the entire computer (9%). Nine percent of respondents mentioned the **compatibility** of an agent. Often, an agent was incompatible with other systems, especially with MS Outlook Express. Other reasons why individuals did not like to utilize email interface agents

pertained to various, relatively small categories. Subjects mentioned limited usefulness, unreliability, difficulty of use, limited vocabulary, and unattractiveness. Overall, most negative responses related to user perceptions of agent (42%) and an agent's operability (37%) that may be influenced by agent manufacturers.

Fourth, with respect to the characteristics of an 'ideal' email interface agent, most users wished to improve the way an agent presented message and event notifications (30%), and the degree of an agent's intelligence (23%). As such, an 'ideal' agent should sort out the incoming information and present it in the order of urgency and importance. It should also provide additional information and due events in a very persistent yet non-intrusive manner and track the completion of suggested activities. Extra intelligence features encompass rule-based logic, machine learning, text analysis, automatic reply, and the real-time adjustments of an agent's behavior. Other less frequent requests referred to the improvement of personalization, spam filtering, user control, compatibility, and voice recognition. Currently, agent designers may advance all of these features.

6.2.7.2 Effects of Interface Agents

In addition to positive, negative, and the most desirable features of email interface agents, respondents' opinions on eight agent effects were solicited. The rationale was to obtain strong empirical evidence on the importance of these effects to bridge the gap in the HCI literature. The results of the survey show that trust in an agent, as well as an agent's utility, (i.e., the persona effect) were the most important factors from the users' point of view. They were followed by the degree of conformability and enjoyment with an agent.

First, agent users believed that the accuracy of any information provided by an agent was the most critical factor. This finding is consistent with prior research that points out to the importance of trustworthiness in human-agent interaction (for example, see Hertzum et al., 2002). Indeed, in order to delegate tasks to an agent, a person must believe that the agent will perform them accurately, and report back the true, rather than desirable, state.

Secondly, respondents indicated the significance of an agent's usefulness. This, again, is consistent with prior empirical research and speculations on the importance of the persona effect in agents. The persona effect emerges when an interface agent adds the positive perceptions of usefulness, ease of use, or enjoyment with an existing system. The key outcome of the persona effect is the improvement of existing software applications by embedding interface agents. By emphasizing the importance of an agent's usefulness, subjects demonstrated that value-added services were the key factors influencing their adoption decisions.

Thirdly, perceptions of the importance of comfortability and enjoyment with an agent were also high. The extent to which a user feels comfortable using an agent partially corresponds to the ease of use of the agent. This further demonstrates the fruitfulness of the selection of the constructs of the dissertation model: perceived usefulness, enjoyment, and ease of use.

Fourthly, items pertaining to non-distraction and the naturalness of interactions received lower scores. Prior work suggests that a user should perceive all interactions with an agent to be natural, and the agent is not supposed to disrupt current user activities. However, based on the analysis of open-ended questions, two types of interactions were discovered: undesirable (or perceived intrusiveness), which correspond to unnecessary, negatively interpreted interruptions, and desirable, which refer to as positively perceived intrusions into user activities that allow a person to switch from one task to another and to give a user some rest. Thus, the combination of the user perceptions of both undesirable and desirable interactions resulted in a somewhat lower score. It is recommended that future research distinguishes between these categories of agent intrusiveness.

Lastly, in contrast to prior research, respondents stated that the appearance of an agent should not necessarily correspond to its level of intelligence. Two assumptions may explain this contradiction. First, highly innovative individuals might wish to utilize an agent which looks maximally intelligent regardless of its actual degree of intelligence. Second, if users were not satisfied with the agent's appearance, they might easily replace it with another one given that there is a variety of cartoon or human-like agent characters available on the Web.[92] Thus, end-users had control over the interface of an agent that reduced their perception of the importance of the agent's appearance.

Overall, the obtained ranking of items pertaining to various aspects of agents confirms the viability of the model's constructs and points out to some discrepancies between the view of agent designers and the opinion of real-life users.

[92] In this case, individuals should be aware of the possibility to download and install new agent characters, and they should possess some basic computer skills.

6.3 The Grand Model of Email Interface Agent Adoption and Use

The purpose of this section is to present a grand model that summarizes the factors pertaining to user adoption of email interface agents. This new, extended model triangulates the key findings from the previous dissertation model that was empirically tested (Section 5.3.3 'Structural Model') and from the analysis of open-ended items provided by the respondents (Section 5.4.2 'Open-Ended Items Analysis'). It is believed that this model accurately identifies a variety of important factors, and that it may potentially serve as a guide for future researchers and practitioners. Figure 6.5 outlines this model.

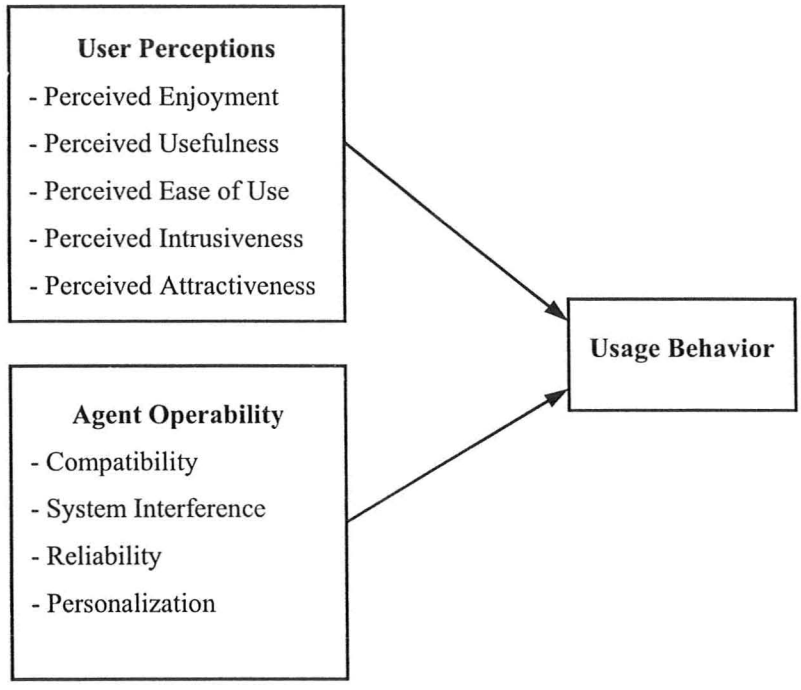


Figure 6.5: The Extended Model of Factors Influencing Usage Behavior towards Email Interface Agents

The constructs of this model are based on the dissertation model and on the most frequently reported categories provided by the respondents in this study. According to the model, there are two general types of factors – user perceptions and agent operability.

User perceptions are either positive or negative mental reflections of several properties of an agent. They include perceived enjoyment, usefulness, ease of use, intrusiveness, and attractiveness of an agent. Recall that the theoretical model of user adoption of agents presents three of these constructs (i.e., **PE**, **PU**, and **PEOU**) that were derived from the extant MIS literature. These three factors also emerged during the content analysis of the open-ended questionnaire items. The identification of these three factors through two maximally different methods of inquiry further substantiates the

validity of the model. As confirmed by Hypotheses H6, H7 and H8, PE, PU and PEOU positively influence behavioral usage intentions. **Perceived intrusiveness** is the degree of negatively interpreted, unwanted interactions that are initiated by an agent. When an agent is perceived to be highly intrusive, users perceive it to distract, bother, annoy or irritate them diverting their attention from current activities. For example, someone may concentrate on a difficult task or talk over the phone when an agent pops up and interrupts this important activity. Since agent intrusiveness is the top reason why individuals dislike using an agent, it is presumed that there is a negative relationship between perceived intrusiveness and usage behavior. **Perceived attractiveness** is the degree to which a user finds an agent's interface and voice appealing. A positive association between perceived attractiveness of an agent and usage behavior is suggested; those individuals, who find an agent more attractive, utilize it to a higher extent.

Agent operability embraces factors pertaining to operational characteristics of an agent. During the analysis of open-ended responses, a set of factors related to agent operability was discovered that are presumed to play an important role in user adoption decisions. It is for this reason agent operability factors are included in the suggested model.

Agent operability constructs differ from perceptual constructs because they can be measured directly by a researcher rather than by surveying users. They include compatibility, system interference, reliability, and personalization. **Compatibility** is the ability of an agent to work well with other software applications, for example, with various email clients. It is believed that there is a positive relationship between agent compatibility and usage; users should utilize the agent more extensively if it is compatible with a higher number of other computer applications. **System interference** is the hindrance of normal workflow of other applications. It occurs when an agent intrudes into the computer processes related to other systems, for example, MS Outlook or MS Word that slows down these systems and troubles users. Thus, a negative relationship between system interference and agent utilization is hypothesized. **Reliability** is the absence of bugs, crashes or other technical problems that take place during the employment of an agent. It is hypothesized that there is a positive relationship between agent reliability and usage; people should utilize an agent more frequently if it is more reliable. **Personalization** is the degree to which an agent's appearance, voice, and actions may be tailored to the needs of each user individually. It is presumed that there is a positive relationship between personalization and usage; the more personalized features and function an agent has, the more extensively people should utilize it.

Overall, the contribution of this extended model is two-fold. First, it confirms the fruitfulness of the selection of the PE, PU, and PEOU constructs. Second, it offers some insights on other factors of user adoption of interface agents for email that may be utilized in future investigations.

6.4 Research Contribution

Based on the results of this investigation, a number of methodological, theoretical, and practical implications are suggested that may be of interest to all individuals involved in the development, marketing, and studying of email interface agents. This sub-section reports on the research contribution of this dissertation.

6.4.1 Methodological Contribution

6.4.1.1 Critical Incident Presentation

The Critical Incident Technique (Flanagan 1954) was utilized to gather information pertaining to user interactions with email interface agents in critical situations. Three observations are suggested. First, the successful employment of a self-administered questionnaire to obtain critical incidents with agents confirms the fruitfulness of this data collection procedure. Secondly, consistent with prior research, the utilization of the classical content analysis method is believed to be adequate. Thirdly, as described in Section 6.2.6 ('Email Interface Agent Usage'), the obtained critical events may be presented in form of a model that serves as a visual representation of incidents and their outcomes. For example, in the dissertation model of user behavior under the conditions of critical incidents, a clear connection between incident cause, user feelings, user actions, and post-incident behavioral changes in the usage of interface agents was presented. Also, it is suggested that positive and negative incidents should be separated in two different models.

6.4.1.2 Critical Incident Questionnaire Design

Despite the effectiveness of the use of the Critical Incident Technique and the generation of valid results, a minor modification to the questionnaire design is suggested.

Recall Section 5.4.2.5 ('The Critical Incident Technique') indicated that many respondents provided repetitive information when they answered questions 1 (incident description), 2 (incident outcome), and 3 (incident importance). It was found that most individuals provided detailed information pertaining to these items in their response to question 1, and they simply restated their answers in their responses to questions 2 and 3. The initial rationale was to obtain a comprehensive description of a critical situation. However, very few respondents provided additional, important information in the questionnaire items 2 and 3 that made these responses redundant and increased cognitive load of the subjects. In addition, question 1 asked people to present the incident and to indicate when it happened. As such, a single question solicited two different types of information that further amplified cognitive load of respondents.

Based on this observation, Serenko and Turel (2004a) made an adjustment to the Critical Incident Technique questionnaire design. The purpose of their study was to collect critical incidents pertaining to the usage of electronic mail. Table 6-2 outlines the modification in the questionnaire.

Table 6-2: Critical Incident Technique Questionnaire Modification

Dissertation Study	
N	*Questions*
1	Provide a complete and detailed description of this incident and indicate how long ago (e.g., days, weeks, months) it took place.
2	What was the outcome of this incident?
3	Why do you consider this incident critical?
Serenko and Turel (2004a)	
N	*Questions*
1	Provide a complete and detailed description of this incident.
2	When did it take place? (e.g., days, weeks, months ago)

As such, Serenko and Turel (2004a) removed questions 2 and 3, and separated question 1 into two different questions. The preliminary analysis of 31 completed questionnaires that contained 90 descriptions of critical incidents indicated that all respondents interpreted all questions correctly and provided clear, sufficient information. Therefore, it is believed that the shorter version of the questionnaire is as efficient as the longer one, but it places less cognitive load on respondents.

6.4.2 Theoretical Contribution

6.4.2.1 Methodological Approach to Agent Studies

In terms of theoretical contribution of this dissertation, the first one is the demonstration of a methodologically grounded approach to agent studies. As indicated by Serenko (2004c), the issue of user adoption of interface agents is in the early stage of development. Agent manufacturers rarely analyze user needs nor explore current research advancements. The contemporary literature offers few theories, frameworks, or models designed to explore the phenomenon of user adoption of interface agents. Prior agent research lacks thorough end-user adoption analysis that may explain the reasons why individuals accept or reject interface agent technologies. Many previous investigations utilized very small sample sizes or applied non-validated research instruments.

This dissertation study attempts to bridge that gap by demonstrating a methodologically sound approach to the examination of the acceptance of interface agent technologies. It shows that the existing theories may be confirmed and advanced by the employment of methodologies from reference disciplines.

6.4.2.2 TAM Validity

Another theoretical contribution of this study is the extension and validation of the Technology Acceptance Model. Recall the adaptation of TAM (Davis 1989; Davis et al., 1989) was utilized in this dissertation. The perceived enjoyment construct (Davis et al.,

1992) was incorporated in the model that increased its explanatory power. Sections 3.6 and 5.3.3 describe the workings and the validation of this model.

The analysis of the relationship between user perceptions of email interface agents and behavioral intentions supports the nomological validity of the Technology Acceptance Model. Nomological validity is construct validity that devolves from the existence of a well established research stream that is often called the 'nomological network' (Straub et al., 2004; Straub 1989). The statement that the constructs constituting TAM are valid becomes more compelling if they were tested with different technologies. With respect to this study, four TAM constructs (i.e., PU, PEOU, BI, and USE) and a relatively novel PE construct were found valid. The relationships among them (PE – BI, PU – BI, PEOU – BI, PEOU – PU, and BI – USE) were identified as it was theorized based on the existing literature. This substantiates the nomological validity of the Technology Acceptance Model.

It is noted that no relationship between perceived enjoyment and usefulness was identified. This demonstrates that some individuals may utilize an agent solely because of its enjoyment potential rather than usefulness, whereas others may use an agent only because of its usefulness but not enjoyment.

The model demonstrates high explanatory power. As such, it explains 69% and 42% of the variance in the behavioral intentions and actual usage of interface agents for email that is considered high in MIS research. The triangulation of the results of both the quantitative and qualitative data confirms that the model identifies three important factors that affect user adoption decisions. In essence, it is concluded that this model may be successfully utilized in future agent adoption research.

6.4.2.3 The Role of Individual-Specific Traits

The third theoretical reflection of this investigation is the demonstration of the importance of individual characteristics of agent users. In addition to user perceptions of agents, the model utilized two individual-specific traits – personal innovativeness in the domain of IT (Agarwal and Prasad 1998) and computer playfulness (Webster and Martocchio 1992). A relationship between PIIT and perceived ease of use, and computer playfulness and perceived enjoyment was established.

Past MIS research demonstrates that prior experience with a direct manipulation interface affects user perceptions of the ease of use of a system (Wiedenbeck and Davis 1997). As such, the more a person is experienced at using information systems in general, the more he or she finds computer applications easier to use. In other words, people who exhibit a high degree of personal innovativeness in IT tend to explore all features of new software systems more often. By doing so, they become more adept at learning new features or novel applications. Therefore, they tend to perceive information systems to be easier to use.

Recall the dissertation model shows that PIIT has a strong positive direct effect on PEOU of email interface agents ($\beta = 0.292$, $p < 0.05$). This demonstrates that the above discussion holds true not only with respect to the conventional direct manipulation

applications, but also with regards to interface agent applications that exploit an indirect management approach. Overall, more innovative computer users tend to find both direct and indirect manipulations systems easier to use because they are able to apply past software experience to any novel application regardless of the nature of interaction. At the same time, more innovative people do not necessarily find interface agents more useful than their less innovative counterparts.

A strong, positive relationship was found between the degree of computer playfulness and perceived enjoyment with interface agents. This suggests that those individuals who tend to interact playfully with computers in general also tend to transfer their playful behavior on interface agents. By working with an interface agent in a playful manner, users perceive themselves to enjoy an agent to a greater extent.

Generally, it is concluded that people's individual characteristics play an essential role in user perceptions of various computer technologies, including interface agents.

6.4.2.4 The Role of Voluntariness

The comparison of results of the empirical validation of the dissertation model and the model of user adoption of interface agents in everyday work applications (Serenko et al., forthcoming) demonstrates that usage conditions play a key moderating role in affecting the relationships among several constructs. As shown in the dissertation model, in case of voluntarily use of interface agents, perceived enjoyment is the key influencer of behavioral usage intentions.[93]

Currently, the role of voluntariness in technology adoption remains ambiguous. However, there is agreement in the MIS research community that voluntariness may potentially become an important moderator of usage behavior. It is hoped that the results of the comparison of the dissertation model with the model by Serenko et al. may advance the field and inspire future researchers to embark on investigations of the moderating effects of voluntariness.

6.4.2.5 Other Constructs

The analysis of the open-ended items of the questionnaire identified several constructs that pertain to various reasons why individuals adopt or reject email interface agents. These are perceived intrusiveness, perceived attractiveness, agent compatibility, agent interference with other applications and processes, agent reliability, and agent personalization. It is believed that the inclusion of these factors in models of user adoption of interface agents may potentially improve the predictive power of these models.

In addition, four other interesting phenomena, which may be conceptualized in form of constructs, were discovered that may form the foundation for future

[93] As demonstrated by Serenko and colleagues, in case of mandatory usage, perceived usefulness is the key factor.

investigations. These factors are user image, perceived anthropomorphization, perceived imagination, and perceived behavioral control.

User image is the first construct. The importance of user image is applicable in situations where the results of using an agent are apparent to other people. For instance, some individuals may utilize an agent in workplace because they believe their colleagues perceive them to be highly innovative.

Perceived anthropomorphization is the second factor. Perceived anthropomorphization is the degree to which a user believes that an agent has some extent of personality, such as human-like features, attributes and emotions. Recall that four users stated they liked to use an agent because it gave their computers some personality (see Section 5.4.2.2). In addition, the HCI literature often claims that anthropomorphism is an important, yet not mandatory, feature of an interface agent (see Section 2.1.2). Therefore, there is a reason to hypothesize that user perception of agent anthropomorphization may potentially serve as a predictor of usage behavior.

Perceptions of improved imagination is the third interesting factor. Since the usage of an agent-based technology may potentially improve the degree of spontaneous creativity of some individuals, it is presumed that perceived imagination may also have an effect on usage behavior.

Perceived behavioral control is the last construct. It is the extent of user perceptions of internal and external constraints of interactions with an agent. This construct already exists in MIS research (see Taylor and Todd 1995b), and it may be further adapted to reflect user perceptions of behavioral control over interface agents.

Generally, it is suggested that future researchers be aware of the possibility to identify these constructs in their empirical investigations. If these factors continue to transpire in subsequent studies, they may be operationalized and included in future models of user adoption of interface agents.

6.4.2.6 Real-Life User Surveys vs. Laboratory Experiments

Recall that according to a recent meta-analysis of the interface agent literature, conducted by Dehn and van Mulken (2000), results of prior investigations appear to be mixed and inconsistent. One of the possible explanations is that all previous studies were conducted in laboratory settings. In the present dissertation investigation, a survey of actual users of interface agents was conducted. The analysis shows that current users demonstrate various perceptions of the importance of certain effects of interface agents. For example, by conducting a laboratory experiment, Hertzum et al. (2002) suggest that an agent's appearance should correspond to its level of intelligence. However, actual interface agent users assigned the lowest score to this factor. One of the possible explanations of this discrepancy may be the fact that there is a difference in the perceptions of agents between individuals, who interact with an agent during a brief controlled session, which is usually one or two hour long, and real-life adopters of agents, who use this technology for several months or years.

6.4.2.7 The Grand Model of Interface Agent Adoption and Use

The combination and triangulation of the results obtained from the initial dissertation model (Section 3.6) and the analysis of open-ended questionnaire items facilitated the generation of a new, grand model of interface agent adoption and use (Figure 6.5). The major contribution of this new, grand model is two-fold. The first is that it consists of constructs that were identified by actual end users of email agents. Therefore, it is presumed that all constructs are highly appropriate and relevant. The second contribution is that it forms the foundation for future research initiatives. It is hoped that this grand model may be employed to guide future research on agent adoption and use.

6.4.3 Practical Contribution

Practical reflections of this dissertation pertain to three areas: the accommodation of individual differences of email agent users, the elimination of agent usage termination factors, and the presentation of insights for marketers. These practical findings of the dissertation will be communicated back to ABC Company as indicated in the agreement between the researcher and the company.

6.4.3.1 Individual Differences of Email Interface Agent Users

The first practical contribution of the study relates to the importance of user characteristics. It is believed that the findings pertaining to the role of individual differences of email interface agent users, such as computer playfulness and personal innovativeness in the domain of information technology, may have practical relevance for designers who work on the creation of email interface agents.

Recall individuals who tend to interact playfully with computers, in general, also perceive email interface agents to be more enjoyable. To address the needs of playful users, agent developers may incorporate extra features that allow people to interact with agents in a more playful manner. By utilizing the playful facets of an agent, users who exhibit a high degree of computer playfulness may find the agent more enjoyable. At the same time, in order to address the needs of less playful individuals, those extra playful features should be optional. As proved by Hypothesis 1, non-playful users tend to find interface agents less enjoyable. In addition, they perceive agents to be even less enjoyable if they are forced to interact with agents in a highly playful mode. Therefore, an agent should exhibit varying degrees of playfulness.

Webster (1988) presents a list of methods for accommodating various degrees of playfulness of computer users. Based on her work, a number of practical recommendations for agent manufacturers are developed. For example, an email interface agent may be employed in different modes, such as help, learn, work or play mode. This would address the playfulness needs of various categories of users and protect non-playful individuals. By selecting an appropriate mode, a highly playful person may prefer to employ an agent in the 'play mode' whereas a less playful counterpart in the 'work mode.'

Webster (1988) also offers several techniques that may increase the degree of computer playfulness of software users. The increase of the extent of people's computer playfulness may increase their perceived enjoyment, which, in turn, may raise their intentions towards the usage. With respect to email interface agents, intuitive features and functions may be incorporated. This would allow individuals to concentrate their attention on the most enjoyable agent functions, to forget usability problems, to lose the sense of time, and to experience the state of flow while working with an agent. First, it allows highly playful users to fully experience the state of flow that increases their enjoyment with an agent. Second, non-playful individuals may gradually increase their level of computer playfulness. As suggested by Woszczynski, Roth, and Segars (2002) "flow in computer interactions is made of two distinct components: a flow state and playful behavior" (p. 375). In short-term duration, these components are highly positively correlated. The facilitation of smooth, uninterrupted flow of user interaction with an agent is expected to extend the periods of cognitive absorption of agent users that, in turn, may increase their degree of computer playfulness over time.

Fantasy-encouraging activities and curiosity-arousing features may also involve people in a more playful agent-user interaction process. Fantasy-encouraging may be achieved by the implementation of personalized features as well as randomly selected functions, actions, interfaces, and voices. Curiosity-arousing may be realized through the presentation of ambiguous messages, jokes, stories, words or wisdom, and incongruities. Fantasy and curiosity play an important role in increasing the degree of computer playfulness of agent users since general playful behavior embraces creativity, originality, and imagination (Barnett 1991; Lieberman 1977).

In addition, it is recommended that agent manufacturers review other playful features utilized by the developers of video games and animation designers. Prior experience shows that the designers of direct-manipulation interfaces often benefit from this practice (Malone 1982).

As proved by Hypothesis 3, users' perceptions of an agent's ease of use depend on their degree of personal innovativeness in IT. Therefore, to accommodate the needs of a diverse user population, multiple agent usage levels for novice, regular, or power users may be implemented; people should be able to select an appropriate level depending on their extent of expertise. Successive agent interfaces need to reveal additional functions in order of increasing difficulty, and the design of agent menus should follow that of direct manipulation interfaces. Little reliance on manuals should be required. This would allow users to explore all features of an agent gradually, reduce the anxiety of novice users, and form the natural transition from a direct manipulation to an indirect management approach. People may also refer to their mental models of other software systems to understand an agent's functionality.

Overall, it is recommended that interface agent designers study personal user characteristics and address the requirements of various categories of agent users.

6.4.3.2 The Facilitation of Agent Usage

Recall Section 5.4.2.1 presented 14 distinct reasons why users terminated the employment of an email interface agent in their email application. Out of these factors, agent manufacturers may influence at least eight by addressing several important issues as discussed below.

First and foremost, agent designers should emphasize the creation of agent-based applications **compatible** with both existing email systems and everyday work applications. In the case of the agent developed by ABC Company, the incompatibility of this software with MS Outlook Express was: the key reason for agent usage termination; the top cause of negative critical incidents; and, the third most frequently cited factor why individuals disliked this technology. The analysis of the typical critical incident scenarios showed that most people had to immediately abandon the use of an agent when they faced incompatibility issues. Therefore, the implementation of highly compatible email interface agents is the central, urgent issue for agent developers. Failure to address this concern will likely result in dramatically low diffusion rates or even in the entire rejection of this technology in the future.

Second, agent manufacturers need to identify ways of reducing **perceived agent intrusiveness**. Perceived intrusiveness is a primary factor why individuals disliked email interface agents, and one of the top reasons why they entirely rejected them. Currently, the issue of perceived intrusiveness of information technologies has not been studied by the MIS research community. The extant MIS literature does not provide a clear definition of perceived intrusiveness, misses measurement instruments, and lacks recommendations on the manipulation of user perceptions of technology intrusiveness. The two first works that report on the issue of perceived intrusiveness of mobile phones were presented by Perry et al. (2001) and Love and Perry (2004). It is recommended that agent developers start investing in research projects that investigate the influence of perceived intrusiveness of interface agents and the methods to manipulate user perceptions of an agent's intrusiveness. As a short-term solution, more personalization features need to be introduced. For example, advanced options or visual programming environments for message or event processing rules would allow individuals to precisely specify an agent's actions depending on each particular situation. They may instruct the agent to ignore messages that are automatically filed, arrive from certain people, or contain special keywords. However, the employment of such complex features should be optional. As suggested by the dissertation model of user adoption of interface agents (see Figure 5.17), those individuals who exhibit a low degree of personal innovativeness in IT may find agents too difficult to use, especially if they are forced into the usage of complicated menus and functions. As a result, they may potentially reject this technology.

Third, developers should eliminate the **interference** of an agent with other software applications and reduce CPU, memory, and system resources that it consumes. An agent's interference was an important factor for usage termination and the second key reason why respondents to the survey disliked using it.

Fourth, interface agent designers need to emphasize the existing facets of an **agent's usefulness** and to continue incorporating features that users consider important. A degree of perceived usefulness has a strong positive effect on usage intention towards an agent. Responses pertaining to an agent's extent of intelligence comprised the second top category of characteristics of an 'ideal' email interface agent. To improve the extent of an agent's usefulness, additional features and facets should be implemented. These may include, but are not limited to, machine learning capabilities, basic text analysis with automatic message response mechanisms, run-time adjustments of an agent's behavior, appearance and voice, and rule-based logic. To implement these functions, designers should review the literature and research projects in reference disciplines, such as artificial intelligence and human-computer interaction.

Fifth, agent developers should provide facilities for **license key recovery**. Recall two people were not using an email agent on the day when they filled out the survey because they lost or misplaced a license key for this software. This occurred because they either changed a computer or reinstalled an operating system, and they failed to locate the license key that they received when they purchased the agent. To help these customers, license recovery facilities should be provided. A license recovery system is a mechanism that allows individuals to obtain the serial license number for the software product. For example, a user may enter an email address that he or she used to purchase the agent and product details, and a license key will be emailed either automatically or after a company's approval. Currently, there are software vendors that provide their customers with similar functionality.

Sixth, interface agent manufacturers need to address the **security** concerns of agent users. Since the usage of new technologies is often associated with high uncertainty and risk, it is understandable that some individuals would ask whether the usage of such a novel software tool is secure. To address this fear, a description of an agent's workings should be available. For example, it may be helpful to create a webpage that lists all software components and demonstrates that they are safe.

Seventh, designers need to improve the visual **attractiveness** of an agent. As discussed in Section 2.2.4 'Interface Agents,' an email agent system consists of two parts: an agent character and an agent configuration interface. Agent characters are created by Microsoft and various independent developers; many of the characters are freeware. Agent configuration interfaces are developed by agent application manufacturers; they constitute a key part of the software product. To improve the degree of overall attractiveness of an interface agent email system, three basic approaches may be utilized. One solution is to supply the system with several agent characters developed in-house, or to offer the development of customized characters. Currently, there are a number of companies that create fully customized agent characters based on user preferences. For example, the Doell Group[94] offers the implementation of agent characters based on a drawing, sketch, or photograph. Another approach is to incorporate facilities that allow

[94] Available online at http://www.doellgroup.com.

individuals to download and install new characters automatically as presented in Section 5.4.2.6 'Insights for Designers.' The other option is to improve the visual attractiveness of an agent configuration interface.

Eighth, agent developers need to achieve high **reliability** of their products. This refers to the implementation of email interface agents that do not have bugs, and that do not crash. For this, conventional software development principles should be followed.

Overall, it is believed that by addressing the above eight issues, agent manufacturers will be able to eliminate a number of critical factors and to increase the rate of user adoption of email interface agents.

6.4.3.3 Insights for Marketers

For online vendors who advertise and sell email interface agents, three major recommendations are offered. First, marketers need to realize that offering free trial versions of agent-based software is not sufficient to ensure the awareness and diffusion of this novel technology. Internet and email users who are not familiar with interface agents are unlikely to try out this technology when they come across a website that offers agents. Many of those who wish to try it out cannot run an interface agent system because there are several additional components that need to be installed, for example, text-to-speech engine or agent characters. To facilitate the distribution of trial versions, marketers need to promote their software by educating potential users. For example, they may offer various online demos. These demos should be created in form of graphical images, Macromedia Flash movies, or videos that may be viewed on most contemporary computer systems and that do not require the installation of additional software components.

Second, email interface agent marketers should emphasize various aspects and features of this novel technology that play to user preferences and desires for interface agents identified in this study. Among these facets are agent usefulness, email productivity enhancements, entertainment, ease of use, compatibility with operating systems and email applications, general reliability, and personalization.

Third, marketers should be aware of the user characteristics presented in this investigation that include a preference for agent adoption. The findings of this project suggest that potential users are highly innovative, educated, and well-off individuals employed in the information technology sector. Therefore, to reach as many of these potential customers as possible, email interface agent marketers should promote their products through appropriate communications channels, such as websites, newspapers, magazines, and journals that are read by IT professionals. In addition, the study's survey showed that most users resided in an English-speaking country. Given that only one-third of all Web users speak English as their primary language, it is suggested that marketers should also target IT personnel in non-English speaking countries. For this, Websites need to be translated, and agent systems should be available in other languages, besides English. Overall, it is suggested that the above strategy may be successfully utilized in the short-term. However, as interface agent technology becomes widespread in the future,

other types of individuals may dominate the population of email interface agent users. In this case, it is recommended that marketers reconsider their promotional strategy.

6.5 Major Strengths and Limitations of the Study

6.5.1 Strengths

The employment of the selected methodology was beneficial in exploring the new phenomenon of user adoption of an innovative agent-based technology. The first strength of this research was the combination of both deductive and inductive approaches comprising a mixed combination of quantitative and qualitative analysis that facilitated the generation of theory, offered new insights, and improved the rigor of the findings. The comparison of the significance of key perceptual factors, such as enjoyment, usefulness, and ease of use measured by each method demonstrates a relatively reliable convergence of the results. As open-ended item analysis progressed, the observation of the previously suggested model of user adoption of agents allowed identifying several important categories and data patterns. At the end of the project, the combination of all findings facilitated the generation of a new, grand model. Overall, the triangulations of the results obtained by quantitative and qualitative data collection and analysis techniques supported the validity of the study's findings.

The second strength of this dissertation study was the implementation of maximally different open-ended questions, for example, reasons why individuals like or dislike utilizing agents. This not only facilitated the collection of a rich data set, but also allowed conducting validity checks on open-ended items.

The third strength was that the survey of current users of email interface agents took place in an environment that was not influenced by experimental design nor by situational confounding. This generated new theory that was not identified by prior experiments on agent user behavior conducted in laboratory settings. As such, this investigation is one of the first documented attempts to poll real-life interface agent users on their experience with this novel technology. This offered a unique, previously unexplored perspective on user adoption behavior towards email interface agents.

The fourth strength was the neutrality of ABC Company in this research investigation. As such, ABC management did not perceive the researcher as 'hired help,' did not attempt to influence survey design, and did not suggest the expected outcomes. This allowed the research to accurately observe and document the phenomenon under investigation.

The fifth strength was the appropriate use of email as a medium for communication with potential respondents. Since most study participants were heavy email users, it was believed that they felt comfortable utilizing this communications channel, and that almost all potential respondents were reached. Overall, the use of email proved to be a reliable approach to contact busy individuals who are heavy electronic mail users.

The last, but not the least, strength was the adaptation of the Dillman's Tailored Design Method. The employment of three follow-up reminders as part of the data collection procedure generated over one-half of all responses. This dramatically increased response rate and reduced self-selection bias.

6.5.2 Limitations

The results of this investigation are constrained by several limitations. Perhaps the most salient is the generalizability of results to all types of agents. Although it is presumed that the dissertation model adequately explains the usage behavior of email interface agent users, it is unclear whether this model may be applied to other types of interface agents – for example, electronic shopping or personal assistance agents. The practical recommendations are targeted to developers and marketers of email interface agents only. The new, grand model generated within this study (Figure 6.5) also relates to this one type of an agent. Additional empirical evidence is needed to test the generalizability of the findings with respect to other interface agent-based applications.

The second constraint of this project was that users of only one interface agent-based email system were surveyed. To strengthen the validity of the findings, a survey of users of an email agent notification application developed by another manufacturer should be conducted. Unfortunately, it is unlikely that such a study may be undertaken in the short-term. It was impossible to extend this dissertation study because the entire customer database of ABC Company was utilized to contact the potential respondents. For a future post-dissertation follow-up project, the researcher approached all other manufacturers of email interface agents listed in Appendix 3. Sadly, all of them ultimately rejected the researcher's proposal to conduct a user survey.

The third weakness is that both quantitative and qualitative data were provided by the same respondents. In an 'ideal' study, each person should offer only either quantitative or qualitative data that would further ensure results validity. Regrettably, a uniform data collection procedure was applied because of the small number of potential respondents.

The fourth drawback is that that Hypothesis 4 (i.e., the link between perceived enjoyment and perceived usefulness) was not supported even though the path was in the appropriate direction (i.e., 0.20) and the t-value was 1.476 which is only slightly below the lowest p-value threshold. This t-value may have risen above the threshold if the sample size was significantly larger or the respondent profile was slightly different.

The fifth limitation is that the data were collected at one particular point in time. The majority of MIS projects conducted user surveys in one period of time only. However, a longitudinal study may demonstrate that user perceptions and usage intentions change over time.

Despite the above limitations, it is believed that this dissertation investigation uncovered a number of important issues that may be of interest to both researchers and practitioners.

6.6 Directions for Future Research

With respect to future investigations, several avenues may be explored. The first way is to duplicate the study with email interface agents developed by other manufacturers. This would further validate the model and strengthen the findings. Such a study would also address the issue of generalizability which is one of the methodological limitations of this work.

The second direction is to include other constructs in the model that were recently developed and validated in other agent adoption studies. For example, one could add the animation predisposition construct that is believed to predict the degree of user enjoyment with interface agents in MS Office (see Serenko 2004c).

The third approach is to consider this dissertation a pilot study that revealed a list of factors that may potentially explain the issue of user adoption of email interface agents. These factors are based on user feedback (see Figure 6.5). MIS researchers have already operationalized some of these constructs, such as compatibility, reliability and personalization. Several factors are entirely new and require methodologically thorough conceptualization, operationalization, and validation, such as perceived intrusiveness, perceived attractiveness or agent-system interference. It is suggested that researchers not constrain themselves by the existing constructs of the Technology Acceptance Model and continue seeking technology-specific factors that may better explain user adoption decisions towards a wide range of computer applications.

The fourth route is to develop new individual-specific constructs that would better predict user perceptions of interface agents. For example, the construct measuring the degree of personal innovativeness in the domain of interface agents may be created. The purpose of this user-specific trait would be to determine types of people who are more or less predisposed towards the employment of interface agent-based technologies. The scale measuring the extent of interface agent playfulness may also be developed. The goal of this construct would be to identify groups of users who interact with interface agents in different playful modes.

The fifth way is to obtain a more detailed understanding of the innovative individuals who currently utilize email interface agents in group or organizational settings. For this, ethnographic research may be conducted. To conduct an ethnographic study, a researcher would need to spend a considerable amount of time with email interface agent users, interact with them, and monitor how they actually utilize this technology. The application of ethnography would provide in-depth insights on user characteristics and social aspects of agent usage. Data would be collected via participant observation, interviews, and informal social contact with interface agent users.

The fifth direction is to further explore the viability of the Critical Incident Technique to analyze user behavior with email agents. One option would be to conduct one-on-one interviews with email interface agent users. Another alternative would be to operationalize the constructs pertaining to the suggested scenarios of user behavior

(Figure 6.1 through Figure 6.4) in form of close-ended questionnaire items. It would be interesting to test the strength and statistical significance of the causal links among these constructs by the employment of Structural Equation Modeling techniques, such as PLS or LISREL. In addition, future scholars may attempt to validate these Critical Incident User Behavior Models with respect to other types of agents.

The sixth avenue is to test the value of the practical recommendations elicited from this study. To obtain strong empirical evidence, two user satisfaction surveys need to be conducted: 1) prior to the implementation of recommendations, and 2) after the implementation of recommendations. As a lens of analysis, the American Customer Satisfaction Model (Anderson and Fornell 2000; Fornell et al., 1996) may be adapted. The application of this model yields the score of user satisfaction with various products, including information technologies.

The seventh route is to apply the findings of this dissertation to study user adoption of various types of interface agents. For example, interface agents are currently employed in help menus, electronic commerce applications, and entertainment interfaces. It would be interesting to see whether the dissertation model holds true with respect to other interface agents, how relationships among the existing constructs change, and what other important agent-specific factors emerge.

The eighth direction is to explore the role of voluntariness as a key moderator of user perceptions of interface agents. Currently, this issue is not well understood by the MIS research community. To obtain strong empirical evidence that would explain this phenomenon, another study should be conducted. One way to do this would be to run an experiment where two groups of users utilizing the same type of an agent are compared. One group would utilize an agent in voluntarily conditions and the other in mandatory settings. It is believed that an analysis of differences in user responses would clarify the preliminary findings made through this dissertation.

The last, but not the least, approach is to continue combining quantitative and qualitative research methods to further explore the question of user adoption of various computer technologies, including interface agents. As argued by Miles and Huberman (1994) and demonstrated in this dissertation study, the triangulation of results obtained by both approaches strengthens the validity of the scientific findings and reveals new, unexpected phenomena. As such, further investigations conducted by the researcher will hopefully incorporate both quantitative and qualitative techniques.

6.7 Conclusions

This dissertation was positioned to advance empirical research in the field of user adoption of email interface agents. A research instrument was administered to 75 current or past users of this technology, and the results of a deductive and an inductive analyses were triangulated. This methodology provided a fruitful setting for understanding why people accept or reject email interface agents.

The theoretical goal of this investigation was to suggest and empirically test a model of user adoption of interface agents for email. This model was based on the combination of the Technology Acceptance Model with three additional MIS constructs. As hypothesized, most relationships were strong, significant, and in the predicted direction. The psychometric properties of the research instrument pertaining to the model were successfully assessed and validated. This shows that TAM may be fruitfully applied to measure user acceptance of interface agent-based systems. According to the findings, the degree of user enjoyment with an agent is the most important factor influencing behavioral intentions towards the agent, followed by the degrees of the agent's usefulness and ease of use. Individual user characteristics, such as the extent of Computer Playfulness and Personal Innovativeness in IT, influence user perceptions of an email agent.

The combination and triangulation of the key findings from the TAM-based dissertation model and from the analysis of open-ended questionnaire items provided by respondents facilitated the generation of a new, grand model of factors influencing user adoption behavior towards email interface agents. This model showed that user behavioral intentions are influenced by two groups of factors. The first group relates to user perceptions, such as perceived enjoyment, usefulness, ease of use, intrusiveness, and attractiveness of an agent. The second group refers to agent operability, such as compatibility, system interference, reliability, and personalization. It is believed that this model adequately explains the reasons why individuals accept or reject email interface agents and forms the foundation for future empirical investigations.

The practical contribution of this dissertation was to produce recommendations for manufacturers of email interface agents. The findings were mostly based on the results of the analysis of open-ended questionnaire items. As such, a number of realistic, useful suggestions were offered. Particularly, agent developers should better address the individual differences of users and reduce the number of factors leading to the termination of agent usage. Agent marketers need to demonstrate the functionality of interface agents by the employment of non-agent technologies, such as graphics, video or Macromedia Flash movies, to emphasize various aspects and outcomes of agent usage, and to target this technology to IT professionals around the globe.

This work represents an initial attempt to understand the issue of user adoption of interface agents for electronic mail and to produce guidelines for developers of this technology. It is recommended that future researchers continue investigating factors that influence user adoption decisions by conducting empirical investigations that involve real-life users. It is also suggested that agent manufacturers recognize the importance of these research projects, provide academics with necessary assistance and support, and incorporate their findings in agent-based applications. The results of this dissertation demonstrate that doing so can enhance our understanding of various aspects of interface agent technologies and hopefully facilitate the creation of really useful agent applications that are accepted by end-users.

APPENDIX 1
GLOSSARY OF ACRONYMS

A	Attitude
AiA	Adaptive InfoBahn Access
AVE	Average Variance Explained
BI	Behavioral Intentions
BSD	Berkeley Software Design
CIT	Critical Incident Technique
CPS	Computer Playfulness Scale
Email	Electronic Mail
ICQ	"I seek you" – an online instant messaging system
IS	Information Systems
IT	Information Technology
MailBot	Mailing Bot or Autoresponder
MASS	Microsoft Agent Scripting Software
MIS	Management Information Systems
MS	Microsoft
OS	Operating System
PE	Perceived Enjoyment
PEOU	Perceived Ease of Use
PIIT	Personal Innovativeness in the Domain of Information Technology
PLS	Partial Least Squares
PU	Perceived Usefulness
SEM	Structural Equation Modeling
SMS	Short Messaging Service
SSCI	Social Sciences Citation Index
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model 2
TRA	The Theory of Reasoned Action

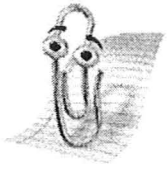
APPENDIX 2
INSTRUCTIONS AND QUESTIONNAIRE

Instructions

The purpose of this questionnaire is to collect information to describe and understand reasons why individuals adopt or reject interface agents in email systems.

An email system is a software application for facilitating computer-mediated communication between people, for example, Microsoft Outlook or Hotmail.

An interface agent (also called a Microsoft character or a Microsoft agent) is an interactive character, for example, Paper Clip, Genie, Merlin, etc., and a configuration environment used to set user preferences. Please see the pictures below.



Paper Clip

Genie

Peedy

Merlin

Screenshot of the configuration environment of the agent system (removed as per the Non-Disclosure Agreement with ABC Company)

Questionnaire

A. Please answer all questions based on your experience with the email notification program developed by ABC Company. Please indicate the number that best matches your opinion (7-item Likert-type scale: from strongly disagree to strongly agree). Note: item numbers (e.g., PU1, PU2, etc.) did not appear in the online questionnaire.

PU1. Using interface agents improves my performance in the email system.
PU2. Using interface agents in the email system increases my productivity.
PU3. Using interface agents enhances my effectiveness with the email system.
PU4. I find interface agents useful in the email system.
PEOU1. My interaction with interface agents is clear and understandable.
PEOU2. Interacting with interface agents does not require a lot of my mental effort.
PEOU3. I find interface agents easy to use.
PEOU4. I find it easy to get interface agents to do what I want them to do.
PE1. I find using interface agents to be enjoyable.
PE2. Using interface agents is pleasant.
PE3. I have fun using interface agents.
BI1. Assuming I have access to interface agents, I intend to use them in future.
BI2. Given that I have access to interface agents, I predict that I would use them in future.

B. The questions below ask you to describe your behaviors in the context of **information technologies**. Information technologies are computer systems concerned with all aspects of managing and processing information. Information technologies include personal computers, software applications, telecommunications networks (e.g., the Internet and Email), etc. Please indicate the number that best matches your opinion (7-item Likert-type scale: from strongly disagree to strongly agree).

PIIT1. If I heard about a new information technology, I would look for ways to experiment with it.
PIIT2. Among my peers, I am usually the first to try out new information technologies.
PIIT3. In general, I am hesitant to try out new information technologies. (R)
PIIT4. I like to experiment with new information technologies.

(R) – reverse scaled items. (Note: (R) did not appear in the online questionnaire)

C. The following questions ask you how you would characterize yourself when you use personal computers. For each adjective listed below, please indicate the number that best matches a description of yourself **when you interact with computers** (7-item Likert-type scale: from strongly disagree to strongly agree).

CPS1. Spontaneous.
CPS2. Unimaginative. (R)
CPS3. Flexible.
CPS4. Creative.
CPS5. Playful.
CPS6. Unoriginal. (R)
CPS7. Uninventive. (R)

(R) – reverse scaled items. (Note: (R) did not appear in the actual questionnaire)

D. Current and Past Usage of Email Interface Agents. (Note: the heading of the sub-category did not appear in the actual questionnaire). The wording was adjusted depending on whether the respondent was a current or past user (e.g., '…how often you use interface agents…' for current users, and '…how often you used interface agents…' for past users.)

D1. Are you currently using interface agents in your email application? (Yes/No)

D2. Please specify where and how often you use interface agents. (Likert-type scale for each selection below: very frequently, frequently, sometimes, occasionally, rarely, very rarely, never)

At work

At home

In school

Other (explain)

D3. Given your overall experience with interface agents, please specify the functions of interface agents that you most frequently utilize (Likert-type scale for each selection below: very frequently, frequently, sometimes, occasionally, rarely, very rarely, never).

Announce messages in Outlook

Announce reminders in Outlook

Announce messages in Hotmail

Announce read receipts

Other (explain)

D4. Given your overall experience with interface agents, what percentage of all messages that you receive are announced by interface agents? (from 0% to 100%, increment by 10%)

D5. Given your overall experience with interface agents, what percentage of all calendar reminders is announced by interface agents? (from 0% to 100%, increment by 10%)

D6. How long have you been using interface agents? (months) – For current users only.

D7. How long had you been using interface agents before you stopped doing so? (months) – For past users only.

D8. Please explain why you stopped using interface agents in your email application. – For past users only.

E. The Critical Incident Technique. (Note: the heading of the sub-category did not appear in the actual questionnaire)

Please answer the eight questions below with respect to the last most significant **POSITIVE** or **NEGATIVE** incident of usage of interface agents in an email application (e.g., a positive incident might be when an interface agent helped you to complete a task in your email application effectively, efficiently, or enjoyably. A negative incident might be when an interface agent hindered the completion of a task in your email application).

Was this incident positive or negative? (positive / negative checkboxes)

E1. Provide a complete and detailed description of this incident and indicate how long ago (e.g., days, weeks, months) it took place.

E2. What was the outcome of this incident?

E3. Why do you consider this incident critical?

E4. What were you feelings and perceptions of this situation?

E5. What actions did you take during the incident?

E6. Did you change the way you use interface agents after that? If yes, please specify.

E7. From your point of view, what are the most desirable actions that an 'ideal' interface agent would take in addition? (in the case of positive incidents)

From your point of view, what are the most desirable actions that an 'ideal' interface agent would take instead? (in the case of negative incidents)

E8. How often does a similar situation occur(ed) when you use(d) interface agents in your email applications (e.g., days, weeks, months, never again)?

F. Interface Agent Characteristics (Note: the heading of the sub-category did not appear in the actual questionnaire)

F1. Provide at least three reasons why you like to use interface agents in your email application. (open-ended)

F2. Provide at least three reasons why you do **NOT** like to use interface agents in your email application. (open-ended)

F3. Describe at least three tasks that you would like an 'ideal email interface agent' to perform in your email application. (open-ended)

G. Effects of Interface Agents (Note: the heading of the sub-category did not appear in the actual questionnaire)

Based on your experience with interface agents for email, how **important** is it for you: (seven-item important / unimportant Likert-type scale)

a) to believe that an interface agent's appearance should correspond to its level of intelligence
b) to believe that the information provided by an interface agent is accurate
c) to like the appearance of an interface agent
d) to feel comfortable with an interface agent
e) to perceive an interface agent useful
f) to perceive an interface agent enjoyable
g) to perceive all interactions with an interface agent as natural
h) to avoid being distracted by an interface agent while engaged in important tasks

H. Insights for Developers (Note: the heading of the sub-category did not appear in the actual questionnaire)

H1. Based on your experience with interface agents in your email applications, provide recommendations for interface agent designers. (open-ended)

H2. Based on your experience with interface agents in your email applications, provide recommendations for interface agent marketers (i.e., online businesses that sell but not necessarily manufacture the technology). (open-ended)

H3. Outline any other thoughts, concerns, or recommendations on this technology. (open-ended)

J. User Background Information (Note: the heading of the sub-category will not appear in the actual questionnaire)

Please circle the number that best matches your email activities.

J1. The average number of emails you receive per day is						
1-5	6-10	11-20	21-40	41-80	81-150	over 150
J2. The average number of emails you send per day is						
1-5	6-10	11-20	21-40	41-80	81-150	over 150
J3. How much time do you spend working with your email per day?						
less 0.5 hour	0.5-1 hour	1-2 hours	2-3 hours	3-5 hours	5-8 hours	over 8 hours

Please indicate your age and gender.

J4. Your age. (from under 20 to over 65, increment by 5)

J5. Your gender. (male/female)

J6. Your occupation. (open-ended)

J7. Your education. (elementary school, secondary/high school, college university degree)

K. Respondents' Feedback (Note: the heading of the sub-category did not appear in the actual questionnaire)

K1. Have you experienced difficulty understanding the instructions for one or more questions of this survey? (yes/no, if yes, please specify (open-ended)

K2. Have you experienced difficulty understanding one or more questions of this survey? (yes/no, if yes, please specify (open-ended)

K3. Please provide any comments on the content, design, or administration of the questionnaire. (open-ended)

APPENDIX 3

EMAIL NOTIFICATION PROGRAMS

The products are presented in alphabetical order.

N	Product Name	URL	Description	Price[95]	Free Trial
1	Agent Mail	www.softnik.com	Reads messages from POP E-mail accounts.	Free	N/A
2	Email Announcer	www.blindbat.com	Reads emails and reminders. Warns if there are 'read' receipts attached. Works with Hotmail. Highly personalizable.	$19.95	Yes
3	CyberBuddy	www.thecyberbuddy.com	Reads emails, reminders, and ICQ messages. Implements email filtering rules. Allows sending voice messages.	Free	N/A
4	E-mail Talker	www.scosoft.com	Reads emails, web pages, documents, help files, clipboard content or just about any other text. Supports multiple POP3 accounts. Implements email filtering rules. Works with MSN Hotmail.	$19.95	Yes
5	GearVox Talking E-mail	www.gearheadforhire.com	Reads emails, announces time and clipboard content. Implements email filtering rules. Teaches tutorials. Supports multiple POP3, IMAP4, and Exchange Servers.	$14.95	Yes
6	Talking Box Pro	www.mindbeat.com/agent.shtml	POP3 email notification agent periodically checks and announces new messages. Can read virtually any text.	Free Beta Release	N/A
7	Talking e-mail	www.4dev.com/talkmail	Reads incoming emails, reminders, announces time, highly personalizable.	$19.95	Yes
8	TalkyMail	www.talkysoft.com	Reads emails, web pages, documents, help files, clipboard content or just about any other text. Works with AOL and Yahoo!	$19.95	Yes

[95] All prices are in US Dollars. One-time-fee.

N	Product Name	URL	Description	Price[95]	Free Trial
9	TalkToMe	www.talk-to-me.net	Reads emails, web pages, documents, and reminders. Allows sending animated messages.	$29.95	Yes
10	Speak and Mail	www.shadisoft.com	Reads emails, web pages, documents, help files, clipboard content or just about any other text. Supports multiple POP3 accounts, may randomly select a character.	$29.95	Yes
11	Speaking Email Deluxe	www.uk-software.com	Reads emails and attachments. Allows sending voice messages and attachments.	$19.99	Yes

APPENDIX 4

INITIAL REQUEST (ELECTRONIC MAIL)

Dear (First and Last Name):

Intelligent agents are an emerging technology which has already drawn the attention of millions of computer users around the globe. As of today, many agent-based software applications have been delivered on the market. For example, agents are implemented in the form of e-shopping companions, Web guides, and email assistants. However, no one really knows what kinds of agents people want and what are the reasons why individuals use agents in computer environments.

Your name was provided by ABC Company because you are one of a small number of people who recently purchased an agent-based email notification program. Your name was randomly drawn from their customer database. Given the limited number of innovative individuals who decided to try out this new technology, it is important that each questionnaire be completed by (date). The questionnaire takes around twenty minutes to complete.

All your information from the survey will be kept confidential by the researcher. It will not be released back to ABC Company or any third party. Note that I do not ask for any personal information and I am not interested in identifying your personal profile. The data and findings will be released in aggregate form only.

I hope that the results of this study will identify the reasons why people choose to adopt or reject agent-based technologies in email systems. Such insights will lead to the creation of useful software agents. If you choose to participate in the study, you will be sent a money order of $10 US one month after you complete the online questionnaire. To fill out the questionnaire, go to (URL is provided).

I would be most happy to answer any questions you might have. You may email me at research@ABCCompany.com or serenkav@mcmaster.ca, or phone 1 (905) 525 9140 ext. 26179. Also feel free to contact my supervisor Dr. Brian Detlor at detlorb@mcmaster.ca or Mr. (Name of the Manager) at ABC Company at email@ABCCompany.com. If you have any concerns over the ethical side of this research, please contact Mr. Michael Wilson at the McMaster Office of Research Services at ethicsoffice@mcmaster.ca or phone 1 (905) 525 9140 ext. 23242.

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APPENDIX 5

FIRST REMINDER (EMAIL MESSAGE)

Dear (First and Last Name):

This is Alexander Serenko from the DeGroote School of Business, McMaster University, Canada. I am asking for your assistance with my PhD dissertation entitled "User adoption of interface agents for email." In my dissertation, I am surveying the individuals who purchased (name of the software product) developed by ABC Company upon the approval of the company. I obtained your email from their customer database because you purchased this software product in (Month and Year when this person purchased the product).

Dear (First Name), I understand that you are very busy, but I am asking you to find twenty minutes to fill out an online questionnaire which asks about your experiences and perceptions of (name of the software product). The survey is targeted to those who are either currently using or ever used this software product in the past. Your personal information (e.g., this email address) will be kept confidential. The data and findings will be released in aggregate form only.

As a token of my appreciation, I will compensate everyone who completes the questionnaire at the amount of $10 US that you may consider a rebate for purchasing this software. I will send this amount within one month after you fill out the questionnaire. I will also send you a report upon the completion of this study. The questionnaire consists of three webpages, and it takes around twenty minutes to complete. It is available at (URL is provided).

If there is any particular reason why you cannot participate in the survey, I will highly appreciate if you inform me by simply replying to this email.

I would be most happy to answer any questions you might have. You may email me at research@ABCCompany.com or serenkav@mcmaster.ca, or phone 1 (905) 525 9140 ext. 26179. Also feel free to contact my supervisor Dr. Brian Detlor at detlorb@mcmaster.ca or Mr. (Name of the Manager) at ABC Company at email@ABCCompany.com. If you have any concerns over the ethical side of this research, please contact Mr. Michael Wilson at the McMaster Office of Research Services at ethicsoffice@mcmaster.ca or phone 1 (905) 525 9140 ext. 23242.

Thank you for your assistance,
Alexander Serenko, M.Sc., MBA, Ph.D. candidate MS/S
Michael G. DeGroote School of Business
McMaster University (Canada's most innovative university)
1280 Main Street West, Hamilton, Ontario, Canada L8S 4M4
Home page: http://www.business.mcmaster.ca/msis/phd/serenkav/
905-525-9140 x26179 email: serenkav@mcmaster.ca

APPENDIX 6

SECOND REMINDER (EMAIL MESSAGE)

Dear (First and Last Name):

About a week ago, I wrote you seeking your experiences with an agent-based email notification program (name of the software product) developed by ABC Company. As of today, I have not received your completed questionnaire.

The large number of questionnaires completed is very encouraging. But whether it will be possible to explain accurately the reasons why individuals accept or reject agent technologies depends upon you and the others who have not yet responded. This is because previous research suggests that those people who respond later may have quite different experiences and opinions about the technology of interest than those who reply early.

The major problem facing today's agent-based research is that all previous studies have been conducted in laboratory settings. In those investigations, subjects interact with a technology for a short period of time, and then the researchers ask those people about their experiences and intentions to use agents in the future. I personally believe that this is not the way to go since only real-life users may provide a true assessment and accurate feedback on the reasons why people accept or reject these technologies.

It is for these reasons I am sending you this email in case my other correspondence did not reach you in person. I will mail you a check of $10 US soon after I receive your response. The questionnaire is available online at (URL is provided).

Sincerely,
Alexander Serenko, M.Sc., MBA, Ph.D. candidate MS/S
Michael G. DeGroote School of Business
McMaster University (Canada's most innovative university)
1280 Main Street West, Hamilton, Ontario, Canada L8S 4M4
Home page: http://www.business.mcmaster.ca/msis/phd/serenkav/
905-525-9140 x26179 email: serenkav@mcmaster.ca

APPENDIX 7

THIRD REMINDER (EMAIL MESSAGE)

Dear (First and Last Name):

Last week a request on seeking your experiences with an agent-based email notification program developed by ABC Company was emailed to you. Your name was randomly drawn from their customer database.

So far, I have collected most of the required responses, and I am very close to my goal. In order to complete my dissertation, I need to collect only a few more responses. I will mail you a money order of $10 US as soon as I receive it. Because the requests were sent to only a small, but representative, sample of users, it is extremely important that your opinion be included in the study if the results are to accurately offer insights on the usefulness, quality, and adoption of agent technologies. The questionnaire is available online at (URL is provided).

If by some chance you did not receive the previous email, please contact me at research@ABCCompany.com or serenkav@mcmaster.ca, or phone 1 (905) 525 9140 ext. 26179. Also feel free to contact my supervisor Dr. Brian Detlor at detlorb@mcmaster.ca or Mr. (Name of the Manager) at ABC Company at email@ABCCompany.com. If you have any concerns over the ethical side of this research, please contact Mr. Michael Wilson at the McMaster Office of Research Services at ethicsoffice@mcmaster.ca or phone 1 (905) 525 9140 ext. 23242.

Sincerely,
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APPENDIX 8

CODEBOOK

Please explain why you stopped using interface agents in your email application. (for past users only)

Level 1	Level 2	Description
1. PERCEPTION		A user's perceptions of an agent.
	1.1 NOT_USEFUL	Low perceived usefulness, no value-added, no productivity (e.g., agent performs trivial tasks or even slows down the user), limited set of actions, decreased user efficiency with email tasks, an agent does not facilitate multi-tasking, lower speed of email processing and exchange.
	1.2 UNATTRACTIVE	Perceived unattractiveness, bad appearance, bad interface, unprofessional look and feel of the software (e.g., an agent is unprofessional, poor interface, etc).
	1.3 INTRUSIVE	Perceived intrusiveness or distraction caused by an agent (e.g., annoying, noisy, bad timing of notifications).
2. OPERABILITY		An agent's operability (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 INCOMPATIBLE	An agent's incompatibility with or inextendibility to other agent and/or software applications (e.g., email systems, Outlook XP).
	2.2 UNRELIABLE	Poor reliability of an agent (e.g., bugs, crashes).
	2.3 INTERFERENCE	An agent's interference with other applications or the entire computer system of a user or email recipient.
	2.4 SECURITY	Threats to security of a user or an email recipient.
3. ACCESS		A user currently does not have access to an agent.
	3.1 LOSTKEY	A user lost or misplaced an agent's license key (e.g., after upgrading the system).
	3.2 NOT_INSTALL	A user did not install an agent after a system change (e.g., after upgrading the system).
	3.3 NO_ACCESS	A user does not have physical access to the computer where an agent is installed.

Level 1	Level 2	Description
4. ENVIRONMENT		External environment (a user has no control over it).
	4.1 NOISE	An agent bothers other people around because it communicates with a user in a natural voice and people around may hear it.
	4.2 PRIVACY	An agent threats a user's privacy because it communicates with a user in a natural voice and people around may hear it.
	4.3 POLICY	Policies in the work environment do not allow the use of unauthorized software including email agents.
	4.4 SUBSTITUTE	The appearance of a substitute product (non-agent) that may perform similar (but not necessarily all) functions.
5. OTHER	5.1 OTHER	The reason is not clear based on the respondent's comments.

Provide at least three reasons why you like to use interface agents in your email application.

Level 1	Level 2	Level 3	Description
1. PERCEPTION			A user's perceptions of an agent.
	1.1 FUNCTION		Perceptions resulting from an agent's functionality.
		1.1.1 USEFUL	Perceived usefulness, value-added, productivity, efficiency with email tasks, an agent facilitates multi-tasking, the increased speed of email processing and exchange (e.g., no need to look at incoming emails or check reminders), timely notifications about emails/events (e.g., a user is always informed on time).
	1.2 HCI		Perceptions of human-computer interaction.
		1.2.1 ATTRACTIVE	Perceived attractiveness, appearance, interface, professional look and feel of the software (e.g., an agent is cool, cute, neat, versatile, etc).
		1.2.2 EASE_OF_USE	Ease of use of an agent (e.g., an agent is simple, easy, friendly,[96] flexible, etc).
		1.2.3 ACCESSIBLE	The perception of an agent's availability and accessibility (e.g., an agent is always around).

[96] According to the Merriam-Webster Online Dictionary (available at http://www.webster.com), the friendliness of computer software refers to its ease of use (e.g., friendly computer software – easy to use and understand).

Level 1	Level 2	Level 3	Description
	1.3 HEDONIC		Hedonic perceptions.
		1.3.1 ENJOYMENT	Perceived enjoyment, fun, entertainment, tendency to enjoy using this agent and all agents in general.
		1.3.2 IMAGINATION	Perceived imagination. An agent makes a user to utilize his/her imagination or to raise some interest in boring email activities.
		1.3.3 PERSONALITY	Gives the computer or other non-agent applications a personality. (a user likes it)
	1.4 INTERRUPTION		Perceived interruption or distraction caused by an agent.
		1.4.1 NON_INTRUDE	Non-intrusiveness of an agent in current tasks, smooth, non-intrusive information.
		1.4.2 GOOD_INTERRUPTION	The perception of positive, desired distraction from current activities (i.e., the generation of unexpected breaks).
2. OPERABILITY			An agent's operability (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 RELIABLE	2.1.1 RELIABLE	Good reliability of an agent.
	2.2 COMPATIBLE	2.2.1 COMPATIBLE	An agent's compatibility with or extendibility to other agent and/or software applications (e.g., email systems).
	2.3 PERSONALIZE		Personalization.
		2.3.1 P_CHARACTER	The selection of new agent characters.

Level 1	Level 2	Level 3	Description
		2.3.2 P_VOICE	The selection of agent voices.
		2.3.3 P_GENERAL	Personalization of the entire agent-based system (e.g., the user did not specify the personalizable features he/she likes).
3. ENVIRONMENT			External environment (a user has no control over it).
	3.1 SOCIAL		Social environment.
.		3.1.1 IMAGE	The degree to which the employment of agents is perceived to enhance a user's status in the social system, e.g., among colleagues or friends.
4. TECSUPPORT	4.1 TECSUPPORT	4.1.1 TECSUPPORT	Good level of technical support by the manufacturer.
5. OTHER	5.1 OTHER	5.1.1 OTHER	The reason is not clear based on the respondent's comments.
6. NO_REASON	6.1 NO_ REASON	6.1.1 NO_ REASON	No reason is provided (e.g., a user said "NA, none, can't think of any reasons").

Provide at least three reasons why you do NOT like to use interface agents in your email application.

Level 1	Level 2	Level 3	Description
1. PERCEPTION			A user's perceptions of an agent.
	1.1 FUNCTION		Perceptions resulting from an agent's functionality.
		1.1.1 NOT_USEFUL	Low perceived usefulness, no value-added, no productivity (e.g., agent performs trivial tasks or even slows down the user), limited set of actions, decreased user efficiency with email tasks, an agent does not facilitate multi-tasking, lower speed of email processing and exchange.
	1.2 HCI		Perceptions of human-computer interaction.
		1.2.1 UNATTRACTIVE	Perceived unattractiveness, bad appearance, bad interface, unprofessional look and feel of the software (e.g., an agent is unprofessional, poor interface, etc), unpleasant voice (i.e., the voice is unattractive but clear).
		1.2.2 EASE_OF_USE	Difficult to use an agent (hard to use or learn how to use), perceived complexity of the entire email system because of the addition of the agent.
	1.3 INTRUSIVE	1.3.1 INTRUSIVE	Perceived intrusiveness or distraction caused by an agent (e.g., annoying, noisy, bad timing of notifications).
2. OPERABILITY			An agent's operability (i.e., factors pertaining to the operational characteristics of an agent).

Level 1	Level 2	Level 3	Description
	2.1 SECURITY	2.1.1 SECURITY	Threat to security or the user or email recipient.
	2.2 UNRELIABLE	2.2.1 UNRELIABLE	Poor reliability of an agent (e.g., crashes, bugs).
	2.3 INCOMPATIBLE	2.3.1 INCOMPATIBLE	An agent's incompatibility with or inextendibility to other agent and/or software applications (e.g., email systems, Outlook XP).
.	2.4 PERSONALIZATION		Poor personalization of an agent.
		2.4.1 P_CHARACTER	Limited selection of new agent characters.
		2.4.2 P_VOICE	Limited selection of agent voices, only English is available.
		2.4.3 P_GENERAL	Personalization of the entire agent-based system (e.g., the user did not specify the personalizable features he/she likes).
	2.5 INTERFERENCE	2.5.1 INTERFERENCE	Interference with the computer (e.g., slows it down, consumes extra resources) or applications (e.g., slows an email system down).
	2.6 VOCABULARY	2.6.1 VOCABULARY	Limited vocabulary of an agent, spelling out words in caps.
	2.7 READ_ALL	2.7.1 READ_ALL	The announcement of all incoming messages, including spam (if the filter failed to sort them out).
	2.8 VOICE	2.8.1 VOICE	Voice capabilities need improvement (e.g., unclear speech).
3. ENVIRONMENT			External environment (a user has no control over it).
	3.1 NOISE	3.1.1 NOISE	An agent bothers other people around

Level 1	Level 2	Level 3	Description
			because it communicates with a user in a natural voice and people around may hear it.
	3.2 PRIVACY	3.2.1 PRIVACY	An agent threats a user's privacy because it communicates with a user in a natural voice and people around may hear it.
	3.3 POLICY	3.3.1 POLICY	Policies in the work environment do not allow the use of unauthorized software including email agents.
4. TECSUPPORT	4.1 TECSUPPORT	4.1.1 TECSUPPORT	Inadequate technical support of the manufacturer.
5. FEE	5.1 FEE	5.1.1 FEE	License fee (a user has to pay for a license to upgrade a system to continue running the agent).
6. OTHER	6.1 OTHER	6.1.1 OTHER	The reason is not clear based on the respondent's comments.
7. NO_ REASON	7.1 NO_ REASON	7.1.1 NO_ REASON	No reason is provided (e.g., a user said "NA, none, can't think of any negative reasons").

Describe at least three tasks that you would like an 'ideal' email interface agent to perform in your email application.

Level 1	Level 2	Description
1. HCI_FEATURES		An agent should incorporate the features pertaining to human-computer interaction.
	1.1 EASE_OF_USE	An agent should be easy to use and re-install.
	1.2 ATTRACTIVE	An agent should be more attractive to a user (e.g., it should have a more attractive interface and/or voice).
	1.3 ENJOYMENT	An agent should be very enjoyable (e.g., by incorporating more animation, entertaining functions, etc.)
	1.4 NON_INTRUDE	An agent should not intrude in current user tasks, provide smooth information, and disappear when the task is complete.
2. OPERABILITY		An agent should exhibit other operability features (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 COMPATIBLE	An agent should be compatible and/or extendable to other agent and/or software applications (e.g., email systems).
	2.2 PERSONALIZE	An agent should be more personalizable (e.g., it should have a large selection of characters, interfaces, voices, and multi-language support).
	2.3 VOICE	An agent should have good voice capabilities (i.e., clear, understandable, high quality voice).
	2.4 MOBILITY	A user should be able to move an agent from one computer to another together with its current state (e.g., user preferences).
	2.5 VOICE_REC	An agent should incorporate voice recognition capabilities (i.e., a user may communicate with an agent in natural language, e.g., the agent may type emails).
	2.6 CONTROL	An agent should present the functionality that gives a user more control over the agent (e.g., the user should be able to stop the agent at any time or to act before the agent completes a notification task).
	2.7 FILTERING	An agent should perform spam filtering (i.e., spam is filtered out and not

Level 1	Level 2	Description
		announced).
	2.8 INTELLIGENCE	An agent should have more intelligent features such as rule-based logic, machine learning capabilities (i.e., an agent follows user-specific rules), text analysis features, and autoreply. The agent's interface, actions, or behaviors should depend on user requirements and the type of incoming information (e.g., different agents for different senders, message contents, types of events, etc.)
	2.9 NOTIFICATION	An agent should notify a user about the state of an email system (e.g., to present incoming messages or due events in a timely manner).
3. OTHER	3.1 OTHER	The task/feature is not clear based on the respondent's comments.
4. NO_TASK	4.1 NO_TASK	No task description is provided (e.g., a user said "NA, none, blank, can't think of any improvements").

The Critical Incident Technique. Positive Incidents.

Cause of an incident (i.e., why the incident took place).

Level 1	Level 2	Description
1. OPERABILITY		The incident was caused by an agent's operability (i.e., factors pertaining to the operational characteristics of an agent).
	1.1 NOTIFICATION	An agent notified a user about the state of an email system (e.g., presented incoming messages or due events in a timely manner).
.	1.2 RELIABLE	An agent was found to be very reliable.
2. OTHER	2.1 OTHER	The cause is not clear based on the respondent's comments.

User feelings and perceptions of a positive-outcome situation.

Level 1	Description
1. SATISFIED	A user felt very satisfied with the agent's help, e.g., satisfied, happy, or glad.
2. ASSISTED	A user felt that an agent helped him/her to complete a task.
3. ENJOYMENT	A user felt entertained.
4. INDIFFERENT	A user felt indifferent (i.e., the user clearly indicated that he/she did not have any feelings towards the incident).
5. OTHER	The feelings/perceptions are not clear based on the respondent's comments.
6. NO_INFO	A user did not specify his/her feelings/perceptions.

Actions that a user took during a positive incident.

Level 1	Description
1. TASK_COMPLETION	A user completed the task suggested by the agent, e.g., read or replied to a message, did an urgent task, etc.
2. ROUTINE	A user continued doing routine tasks (the tasks he/she had been doing before an agent's actions). A user did not take any actions during the incident.
3. BETTER_DECISION	A user made a better, more informative decision after an agent's actions.
4. OTHER	A user's actions are not clear based on the respondent's comments.
5. NO_INFO	A user did not specify his/her actions.

How a user changed the way he/she used interface agents after a positive critical incident.

Level 1	Description
1. CHANGED	A user changed the way he/she used interface agents (i.e., reacted to the positive incident).
2. DIDN'T_CHANGE	A user didn't change the way he/she used interface agents (i.e., ignored the negative incident).
3. OTHER	The behavior is not clear based on the respondent's comments.
4. NO_INFO	No information is provided (e.g., a user said "NA, none, blank, can't think of any").

Most desirable actions that an 'ideal' interface agent would take in addition.

Level 1	Level 2	Description
1. HCI_FEATURES		An agent should incorporate the features pertaining to human-computer interaction.
	1.1 EASE_OF_USE	An agent should be easy to use and re-install.
	1.2 ATTRACTIVE	An agent should be more attractive to a user (e.g., it should have a more attractive interface and/or voice).
.	1.3 ENJOYMENT	An agent should be very enjoyable (e.g., by incorporating more animation, entertaining functions, etc.)
	1.4 NON_INTRUDE	An agent should not intrude in current user tasks, provide smooth information, and disappear when the task is complete.
2. OPERABILITY		An agent should exhibit other operability features (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 COMPATIBLE	An agent should be compatible and/or extendable to other agent and/or software applications (e.g., email systems).
	2.2 PERSONALIZE	An agent should be more personalizable (e.g., it should have a large selection of characters, interfaces, voices, multi-language support, and verbal announcements).
	2.3 VOICE	An agent should have good voice capabilities (i.e., clear, understandable, high quality voice).
	2.4 VOICE_REC	An agent should incorporate voice recognition capabilities (i.e., a user may communicate with an agent in natural language).
	2.5 SMS_MESSAGE	An agent should be able to send SMS (short messaging services) messages (i.e., to be connected to a cell-phone).
	2.6 INTELLIGENCE	An agent should have more intelligent features such as rule-based logic, machine learning capabilities (i.e., an agent follows user-specific rules), text analysis features, and autoreply. The agent's interface, actions, or behaviors should depend on user requirements and the type of incoming information (e.g., different agents for different senders, message contents, types of events,

Level 1	Level 2	Description
		etc.)
	2.7 NOTIFICATION	An agent should notify a user about the state of an email system (e.g., present incoming messages or due events in a timely manner).
3. NO_ACTION	3.1 NO_ACTION	No additional actions are necessary, the agent does everything this user needs.
4. OTHER	4.1 OTHER	The reason is not clear based on the respondent's comments.
5. NO_INFO	5.1 NO_INFO	No information is provided (e.g., a user said "NA, don't know, not sure, blank").

The Critical Incident Technique. Negative Incidents.

Cause of an incident (i.e., why the incident took place).

Level 1	Level 2	Description
1. HCI_FEATURES		The incident was caused by agent features pertaining to human-computer interaction.
	1.1 INTRUSIVE	High intrusiveness or distraction caused by an agent (e.g., annoying, noisy, bad timing of notifications).
2. OPERABILITY		The incident was caused by an agent's operability (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 UNRELIABLE	Poor reliability of an agent (e.g., crashes, bugs).
	2.2 INCOMPATIBLE	An agent's incompatibility with or inextendibility to other agent and/or software applications (e.g., email systems, Outlook XP).
	2.3 PERSONALIZE	Limited personalization of the entire agent-based system, e.g., very few characters, interfaces, voices, no multi-language support, and non-personalizable verbal announcements).
	2.4 INTERFERENCE	Interference with the computer (e.g., slows it down, consumes extra resources) or applications (e.g., slows an email system down).
	2.5 READ_ALL	The announcement of all incoming messages, including spam (if the filter failed to sort them out).
	2.6 VOICE	Voice capabilities need improvement (e.g., unclear speech).
	2.7 NO_CONTROL	There is little functionality that gives a user more control over the agent, e.g., the user cannot stop the agent at any time or act before the agent completes a notification task.
	2.8 UNINTELLIGENT	An agent is not intelligent enough to perform basic tasks that require some degree of reasoning capabilities.
3. ENVIRONMENT		The incident was caused by external environment (a user has no control over it).
	3.1 NOISE	An agent bothers other people around because it communicates with a

Level 1	Level 2	Description
		user in a natural voice and people around may hear it.
	3.2 POLICY	Policies in the work environment do not allow the use of unauthorized software including email agents.
	3.3 ABUSE_OTHERS	People, who know that a person utilizes an agent, attempt to abuse the use of this agent by sending irrelevant, obscene, or hard-to-read messages that upset or embarrass the individual (i.e., when the agent loudly pronounces those messages, the user is humiliated).
4. OTHER	4.1 OTHER	The cause is not clear based on the respondent's comments.

User feelings and perceptions of a negative-outcome situation.

Level 1	Description
1. ANNOYANCE	A user felt annoyed or distracted.
2. FRUSTRATION	A user felt frustrated, upset, or disappointed.
3. ENJOYMENT	A user felt entertained.
4. INDIFFERENT	A user felt indifferent (i.e., the user clearly indicated that he/she did not have any feelings towards the incident).
.5. OTHER	The feelings/perceptions are not clear based on the respondent's comments.
6. NO_INFO	No information is provided (e.g., a user said "NA, none, blank, can't think of any").

Actions that a user took during a negative incident.

Level 1	Level 2	Description
1. STOPPED_PERM	1.1 STOPPED_USAGE	A user permanently stopped using an agent, e.g., uninstalled or removed from a computer.
2. SEEK_SOLUTION		A user looked for a solution to fix the problem or address the issue (i.e., a user wanted to continue using the agent and tried to solve the problem).
	2.1 REINSTALLED	A user reinstalled or upgraded an agent (e.g., downloaded a new version and installed it on his/her computer).
	2.2 ADJUST_VOLUME	A user adjusted (i.e., reduced) the volume of an agent's voice.
	2.3 TECSUPPORT	A user contacted ABC Company to receive technical support.
	2.4 STOPPED_TEMP	A user temporarily shut down an agent but continued using later.
	2.5 HEADPHONES	A user began to use headphones.
3. NO_ACTION	3.1 NO_ACTION	A user did not take any actions during the incident.
4. OTHER	4.1 OTHER	The behavior is not clear based on the respondent's comments.
5. NO_INFO	5.1 NO_INFO	No information is provided (e.g., a user said "NA, none, blank, can't think of any").

How a user changed the way he/she used interface agents after a negative critical incident.

Level 1	Level 2	Description
1. CHANGED		A user changed the way he/she used interface agents (i.e., reacted to the negative incident).
	1.1 SETTINGS	Adjusted an agent's settings or disabled the feature but continued using an agent.
	1.2 STOPPED	A user stopped using interface agents.
2. DIDN'T_CHANGE		A user didn't change the way he/she used interface agents (i.e., ignored the negative incident).
	2.1 CONTINUED	A user continued using interface agents.
3. OTHER	3.1 OTHER	The behavior is not clear based on the respondent's comments.
4. NO_INFO	4.1 NO_INFO	No information is provided (e.g., a user said "NA, none, blank, can't think of any").

Most desirable actions that an 'ideal' interface agent would take instead.

Level 1	Level 2	Description
1. HCI_FEATURES		An agent should incorporate the features pertaining to human-computer interaction.
	1.1 EASE_OF_USE	An agent should be easy to use and re-install.
	1.2 ATTRACTIVE	An agent should be more attractive to a user (e.g., it should have a more attractive interface and/or voice).
	1.3 ENJOYMENT	An agent should be very enjoyable (e.g., by incorporating more animation, entertaining functions, etc.)
	1.4 NON_INTRUDE	An agent should not intrude in current user tasks, provide smooth information, and disappear when the task is complete.
2. OPERABILITY		An agent should exhibit other operability features (i.e., factors pertaining to the operational characteristics of an agent).
	2.1 COMPATIBLE	An agent should be compatible and/or extendable to other agent and/or software applications (e.g., email systems).
	2.2 RELIABLE	An agent should be very reliable (e.g., it should not have bugs or crash).
	2.3 PERSONALIZE	An agent should be more personalizable (e.g., it should have a large selection of characters, interfaces, voices, multi-language support, and verbal announcements).
	2.4 INTELLIGENCE	An agent should have more intelligent features such as rule-based logic, machine learning capabilities (i.e., an agent follows user-specific rules), text analysis features, and autoreply. The agent's interface, actions, or behaviors should depend on user requirements and the type of incoming information (e.g., to have different agents for different senders, message contents, types of events, etc.)
	2.5 CONTROL	An agent should present the functionality that gives a user more control over the agent, e.g., the user should be able to stop the agent at any time or to act before the agent completes a notification task.
	2.6 NOT_INTERFERE	An agent should not interference with the computer (e.g., not to slow it

Level 1	Level 2	Description
		down, or consume extra resources) or applications (e.g., not to slow an email system down).
	2.7 FILING	An agent should process incoming authorized messages, e.g., file, organize or prioritize them.
	2.8 VOICE_REC	An agent should incorporate voice recognition capabilities (i.e., a user may communicate with an agent in natural language).
3. NO_ACTION	3.1 NO_ACTION	No additional actions are necessary, the agent does everything this user needs.
.4. OTHER	4.1 OTHER	The reason is not clear based on the respondent's comments.
5. NO_INFO	5.1 NO_INFO	No information is provided (e.g., a user said "NA, don't know, not sure, blank").

References

Abu-Hakima, S., McFarland, C., and Meech, J.F. "An agent-based system for email highlighting," Proceedings of the 5th International Conference on Autonomous Agents, The ACM Press, New York, 2001, pp. 224-225.

Aczel, A.D. *Complete business statistics,* Irwin, Chicago, 1996.

Adams, D.A., Nelson, R.R., and Todd, P.A. "Perceived usefulness, ease of use, and usage of information technology: A replication," *MIS Quarterly* (16:2) 1992, pp. 227-247.

Agarwal, R. and Karahanna, E. "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage," *MIS Quarterly* (24:4) 2000, pp. 665-694.

Agarwal, R. and Prasad, J. "The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies," *Decision Sciences* (28:3) 1997, pp. 557-582.

Agarwal, R. and Prasad, J. "A conceptual and operational definition of personal innovativeness in the domain of information technology," *Information Systems Research* (9:2) 1998, pp. 204-215.

Agarwal, R. and Prasad, J. "Are individual differences germane to the acceptance of new information technologies?," *Decision Sciences* (30:2) 1999, pp. 361-391.

Agarwal, R., Sambamurthy, V., and Stair, R.M. "Research report: The evolving relationship between general and specific computer self-efficacy - An empirical assessment," *Information Systems Research* (11:4) 2000, pp. 418-430.

Ajzen, I. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50) 1991, pp. 179-211.

Ajzen, I. and Fishbein, M. *Understanding attitudes and predicting social behavior,* Prentice-Hall, Englewood Cliffs, N.J., 1980.

Allport, F.H. *Social psychology,* Houghton Mifflin Company, Boston, 1924.

Allport, F.H. and Allport, G.W. "Personality traits: Their classification and measurement," *Journal of Abnormal and Social Psychology* (16) 1921, pp. 6-10.

Anandarajan, M., Simmers, C., and Igbaria, M. "An exploratory investigation of the antecedents and impact of internet usage: An individual perspective," *Behaviour*

& Information Technology (19:1) 2000, pp. 69-85.

Anderson, E.W. and Fornell, C. "Foundations of the American Customer Satisfaction Index," *Total Quality Management & Business Excellence* (11:7) 2000, pp. 869-882.

Anderson, J.C. and Gerbing, D.W. "Structural Equation Modeling in practice: A review and recommended two-step approach," *Psychological Bulletin* (103:3) 1988, pp. 411-423.

Andersson, B.-E. and Nilsson, S.-G. "Studies in the reliability and validity of the critical incident technique," *Journal of Applied Psychology* (48:6) 1964, pp. 398-403.

André, E. and Rist, T. "From adaptive hypertext to personalized Web companions," *Communications of the ACM* (45:5) 2002, pp. 43-46.

André, E., Rist, T., and Muller, J. "Employing AI methods to control the behavior of animated interface agents," *Applied Artificial Intelligence* (13:4) 1999, pp. 415-448.

Armour, P.G. "The business of software: The organism and the mechanism of projects," *Communications of the ACM* (45:5) 2002, pp. 17-20.

Asch, S.E. "Forming impressions of personality," *The Journal of Abnormal and Social Psychology* (41) 1946, pp. 258-290.

Atkinson, M. and Kydd, C. "Individual characteristics associated with World Wide Web use: An empirical study of playfulness and motivation," *Communications of the ACM* (28:2) 1997, pp. 53-62.

Babin, B.J., Darden, W.R., and Griffin, M. "Work and/or fun: Measuring hedonic and utilitarian shopping," *Journal Of Consumer Research* (20:4) 1994, pp. 644-656.

Balabanovid, M. and Shoham, Y. "Learning information retrieval agents: Experiments with automated web browsing," Proceedings of the American Association for Artificial Intelligence Spring Symposium on Information Gathering from Heterogeneous, Distributed Environments, 1995, pp. 13-18.

Ball, G., Ling, D., Kurlander, D., Miller, J., Pugh, D., Skelly, T., Stankosky, A., Thiel, D., Dantzich, M.V., and Wax, T. "Lifelike Computer Characters: the Persona project at Microsoft Research," in: *Software Agents,* J.M. Bradshaw (ed.), The AAAI Press / The MIT Press, Menlo Park, CA, 1997, pp. 191-222.

Ballin, D., Lawson, M., Lumkin, M.A., and Osborne, J. "Personal virtual humans - Inhabiting the TalkZone and beyond," *BT Technology Journal* (20:1) 2002, pp. 115-129.

Barnett, L.A. "The playful child: Measurement of a disposition to play," *Play and Culture* (4:1) 1991, pp. 51-74.

Baskerville, R.L. "Investigating information systems with action research," *Communications of the Association for Information Systems* (2:3, Article No. 4) 1999.

Bates, J. "The role of emotion in believable agents," *Communications of the ACM* (37:7) 1994, pp. 122-125.

Benbasat, I., Goldstein, D.K., and Mead, M. "The case research strategy in studies of information systems," *MIS Quarterly* (11:3) 1987, pp. 369-386.

Berelson, B. *Content analysis in communication research,* Free Press, Glencoe, IL, 1952.

Bergman, R., Griss, M., and Staelin, C. "A personal email assistant", Technical Report HPL-2002-236, Hewlett-Packard Company, 2002.

Bernard, H.R. *Research methods in anthropology: Qualitative and quantitative approaches*, (2 ed.) Sage Publications, Thousand Oaks, CA, 1994.

Bhattacherjee, A. "Understanding information systems continuance: An expectation-confirmation model," *MIS Quarterly* (25:3) 2001, pp. 351-370.

Bickmore, T.W. and Picard, R.W. "Towards caring machines," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Vienna, Austria, 2004, pp. 1489-1492.

Biemans, W.G. "User and third-party involvement in developing medical equipment innovations," *Technovation* (11:3) 1991, pp. 163-182.

Blythe, M., Hassenzahl, M., and Wright, P. "More funology," *Interactions* (11:5) 2004, pp. 36-37.

Bodkin, C.D. and Perry, M. "Goods retailers and service providers: Comparative analysis of web site marketing communications," *Journal of Retailing and Consumer Services* (11:1) 2004, pp. 19-29.

Bontis, N., Crossan, M.M., and Hulland, J. "Managing an organizational learning system by aligning stock and flows," *Journal of Management Studies* (39:4) 2002, pp. 437-469.

Bontis, N., Fearon, M., and Hishon, M. "The eFlow Audit: An evaluation of e-mail flow within and outside a high-tech firm," *Journal of Knowledge Management* (7:1) 2003, pp. 6-19.

Bontis, N. and Fitz-enz, J. "Intellectual Capital ROI: A causal map of human capital antecedents and consequents," *Journal of Intellectual Capital* (3:3) 2002, pp. 223-247.

Boone, G. "Concept features in Re:Agent, an intelligent email agent," Proceedings of the Second International Conference on Autonomous Agents, The ACM Press, New York, 1998, pp. 141-148.

Bourdeau, L., Chebat, J.-C., and Couturier, C. "Internet consumer value of university students: E-mail-vs.-Web users," *Journal of Retailing and Consumer Services* (9:2) 2002, pp. 61-69.

Bozionelos, N. and Bozionelos, G. "Playfulness: Its relationship with instrumental and expressive traits," *Personality and Individual Differences* (26:4) 1999, pp. 749-760.

Bradshaw, J.M. "An Introduction to software agents," in: *Software agents,* J.M. Bradshaw (ed.), The AAAI Press / The MIT Press, Menlo Park, CA, 1997, pp. 3-46.

Bretherton, I. (ed.) *Symbolic play: The development of social understanding.* Academic Press, Orlando, Florida, 1984.

Brown, S.A. and Venkatesh, V. "Bringing non-adopters along: The challenge facing the PC industry," *Communications of the ACM* (46:4) 2003, pp. 76-80.

Browning, B.M. "Getting rid of spam: Blackmail," *Linux Journal* (1998:47, Article No. 9) 1998.

Brusilovsky, P. "Adaptive hypermedia," *User Modeling and User-Adapted Interaction* (11:1-2) 2001, pp. 87-110.

Brzezinski, J. and Dain, M. "MEME - a society of virtual characters in an adaptive information sharing system," Proceedings of the 10th IEEE International Conference on Fuzzy Systems, IEEE, Melbourne, Vic., Australia, 2001, pp. 1343-1346.

Budd, R.W. and Thorp, R.K. *An introduction to content analysis, including annotated bibliography,* University of Iowa School of Journalism, Iowa City, Iowa, 1963.

Budd, R.W., Thorp, R.K., and Donohew, L. *Content analysis of communications,* The Macmillan Company, New York, 1967.

Burgoon, J.K., Bonito, J.A., Bengtsson, B., Cederberg, C., Lundeberg, M., and Allspach, L. "Interactivity in human–computer interaction: A study of credibility, understanding, and influence," *Computers in Human Behavior* (16:6) 2000, pp. 553-574.

Cai, K.-Y. and Zhang, C.-Y. "Towards a research on information pollution," IEEE International Conference on Systems, Man, and Cybernetics, IEEE, Beijing, China, 1996, pp. 3124-3129.

Calder, B.J. and Staw, B.M. "Self-perception of intrinsic and extrinsic motivation," *Journal of Personality and Social Psychology* (31:4) 1975, pp. 599-605.

Callan, R.J. "The critical incident technique in hospitality research: An illustration from the UK lodge sector," *Tourism Management* (19:1) 1998, pp. 93-98.

Campbell, D.T. and Fiske, D.K. "Convergent and discriminant validation by the multitrait-multimethod matrix," *Psychological Bulletin* (56:2) 1959, pp. 81-105.

Caplan, F. and Caplan, T. *The power of play,* Anchor Press, N.Y., 1973.

Carlson, J.R. and Zmud, R.W. "Channel expansion theory: A dynamic view of media and information richness perceptions," in: *Academy of Management: Best papers proceedings,* D.P. Moore (ed.), 1994, pp. 280-284.

Carlson, J.R. and Zmud, R.W. "Channel expansion theory and the experiential nature of media richness perceptions," *Academy of Management Journal* (42:2) 1999, pp. 153-170.

Carte, T.A. and Russell, C.J. "In pursuit of moderators: Nine common errors and their solutions," *MIS Quarterly* (27:3) 2003, pp. 479-501.

Cassell, J. "Embodied conversational interface agents," *Communications of the ACM* (43:4) 2000, pp. 70-78.

Castillo, J.C., Hartson, H.R., and Hix, D. "Remote usability evaluation: Can users report their own critical incidents?," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Los Angeles, CA, 1998, pp. 253-254.

Cattell, R.B. *Description and measurement of personality,* World Book Company, Yonkers-on-Hudson, N.Y., 1946.

Cavazza, M., Charles, F., and Mead, S.J. "Character-based interactive storytelling," *IEEE Intelligent Systems* (17:4) 2002, pp. 17-24.

Chalmers, P.A. "The role of cognitive theory in human-computer interface," *Computers in Human Behavior* (19:5) 2003, pp. 593-607.

Charney, T. and Greenberg, B.S. "Uses and gratifications of the Internet," in: *Communication technology and society: Audience adoption and uses,* C.A. Lin and D.J. Atkin (eds.), Hampton Press, Cresskill, N.J., 2002, pp. 379-407.

Chau, P.Y.K. and Hu, P.J. "Examining a model of information technology acceptance by individual professionals: An exploratory study," *Journal of Management Information Systems* (18:4) 2002, pp. 191-229.

Chell, E. and Pittaway, L. "A study of entrepreneurship in the restaurant and café industry: Exploratory work using the critical incident technique as a methodology," *International Journal of Hospitality Management* (17:1) 1998, pp. 23-32.

Chen, H., Wigand, R.T., and Nilan, M.S. "Optimal experience of Web activities," *Computers in Human Behavior* (15:5) 1999, pp. 585-608.

Cheyer, A. and Julia, L. "InfoWiz: An animated voice interactive information system," Proceedings of the Third International Conference on Autonomous Agents, The ACM Press, Seattle, Washington, 1999.

Childers, T.L., Carr, C.L., Peck, J., and Carson, S. "Hedonic and utilitarian motivations for online retail shopping behavior," *Journal of Retailing and Consumer Services* (77:4) 2001, pp. 511-535.

Chin, W.W. "The Partial Least Squares approach for Structural Equation Modeling," in: *Modern methods for business research,* G.A. Marcoulides (ed.), Lawrence Erlbaum Associates, Mahwah, N. J., 1998, pp. 295-336.

Chin, W.W. "PLS-Graph User's Guide, Version 3.0", Soft Modeling Inc., 2001.

Chin, W.W. and Gopal, A. "Adoption intention in GSS: Relative importance of beliefs," *Data Base for Advancements in Information Systems* (26:2-3) 1995, pp. 42-64.

Chin, W.W., Marcolin, B.L., and Newsted, P.R. "A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion / adoption study," *Information Systems Research* (14:2) 2003, pp. 189-217.

Choi, H., Choi, M., Kim, J., and Yu, H. "An empirical study on the adoption of information appliances with a focus on interactive TV," *Telematics and Informatics* (20:2) 2003, pp. 161-183.

Chou, C. and Hsiao, M.-C. "Internet addiction, usage, gratification, and pleasure experience: The Taiwan college students' case," *Computers & Education* (35:1) 2000, pp. 65-80.

Clancy, R.E. (ed.) *A nation online: How Americans are expanding their use of the Internet.* U.S. Dept. of Commerce, National Telecommunications and Information Administration, Economics and Statistics Administration, Washington, DC, 2002.

Coates, J. *Women, men, and language: A sociolinguistic account of sex differences in language,* Longman Publishing Group, New York, 1986.

Cohen, J. *Statistical power analysis for the behavioral sciences*, (2 ed.) Lawrence Erlbaum Associates, Hillsdale, NJ, 1988.

Compeau, D.R. and Higgins, C.A. "Computer self-efficacy: Development of a measure and initial test," *MIS Quarterly* (19:2) 1995, pp. 189-211.

Cooper, D.R. and Schindler, P.S. *Business Research Methods*, (6 ed.) McGraw-Hill Companies, Toronto, 1998.

Cooper, R.G. and Brentani, U. "New industrial financial services: What distinguishes the winners," *Journal of Product Innovation Management* (8:2) 1991, pp. 75-137.

Corsini, R.J. (ed.) *Concise Encyclopedia of psychology*. John Wiley and Sons, New York, 1987.

Couger, J.D. and Zawacki, R.A. *Motivating and managing computer personnel,* John Wiley & Sons, New York, 1980.

Cowie, H., Naylor, P., Rivers, I., Smith, P.K., and Pereira, B. "Measuring workplace bullying," *Aggression and Violent Behavior* (7:1) 2002, pp. 33-51.

Creswell, J.W. *Research design: Qualitative, quantitative, and mixed methods approaches*, (2 ed.) Sage Publications, Thousand Oaks, CA, 2003.

Cronbach, L.J. "Coefficient alpha and the internal structure of tests," *Psychometrika* (16:3) 1951, pp. 297-334.

Csikszentmihalyi, M. *Beyond boredom and anxiety,* Jossey-Bass Publishers, San Francisco, CA, 1975.

Csikszentmihalyi, M. *Flow: The psychology of optimal experience,* Harper & Row, New York, 1990.

Dabbish, L.A., Kraut, R.E., Fussell, S., and Kiesler, S. "Understanding email use: Predicting action on a message," Proceedings of the SIGCHI Conference on Human Factors and Computing Systems, The ACM Press, Portland, Oregon, 2005, pp. 691-700.

Daft, R.L. and Lengel, R.H. "Organizational information requirements, media richness and structural design," *Management Science* (32:5) 1986, pp. 554-571.

Daft, R.L., Lengel, R.H., and Trevino, L.K. "Message equivocality, media selection, and manager performance: Implications for information systems," *MIS Quarterly* (11:3) 1987, pp. 355-366.

Davis, F.D. *A technology acceptance model for empirically testing new end-user information systems: Theory and results,* Doctoral dissertation. Massachusetts Institute of Technology, Cambridge, MA, 1986.

Davis, F.D. "Perceived usefulness, perceived ease of use and user acceptance of information technology," *MIS Quarterly* (13:3) 1989, pp. 319-340.

Davis, F.D. "User acceptance of information technology: System characteristics, user perceptions and behavioral impacts," *International Journal of Man-Machine Studies* (38:3) 1993, pp. 475-487.

Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. "User acceptance of computer technology: A comparison of two theoretical models," *Management Science* (35:8) 1989, pp. 982-1003.

Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. "Extrinsic and intrinsic motivation to use computers in workplace," *Journal of Applied and Social Psychology* (22:14) 1992, pp. 1111-1132.

de Charms, R. *Personal causation: The internal affective determinants of behavior,* Academic Press, New York, 1968.

de Laere, K.H., Lundgren, D.C., and Howe, S.R. "The electronic mirror: Human-computer interaction and change in self-appraisals," *Computers in Human Behavior* (14:1) 1998, pp. 43-59.

de Souza Dias, D. "Managers' motivation for using information technology," *Industrial Management & Data Systems* (98:7) 1998, pp. 338-342.

December, J. "Challenges for Web information providers," *Computer-Mediated Communication Magazine* (1:6) 1994, pp. 8-14.

Deci, E.L. *Intrinsic motivation,* Plenum Press, New York, 1975.

Dehn, D.M. and van Mulken, S. "The impact of animated interface agents: A review of empirical research," *International Journal of Human-Computer Studies* (52:1) 2000, pp. 1-22.

Denning, P.J. "ACM president's letter: Electronic junk," *Communications of the ACM* (25:3) 1982, pp. 163-165.

Descamps, S. and Ishizuka, M. "Bringing affective behaviour to presentation agents," Proceedings of the 21st International Conference on Distributed Computing Systems, Mesa, Arizona, 2001, pp. 332-337.

Descamps, S., Prendinger, H., and Ishizuka, M. "A Multimodal presentation mark-up language for enhanced affective presentation," Proceedings of the International Conference on Intelligent Multimedia and Distant Learning, Fargo, North Dakota, 2001, pp. 9-16.

Detlor, B., Sproule, S., and Gupta, C. "Pre-purchase online information seeking: Search versus browse," *Journal of Electronic Commerce Research* (4:2) 2003, pp. 72-84.

Devaraj, S., Fan, M., and Kohli, R. "Antecedents of B2C channel satisfaction and preference: Validating e-commerce metrics," *Information Systems Research* (13:3) 2002, pp. 316-333.

Digman, J.M. "Personality structure: Emergence of the 5-Factor Model," *Annual Review of Psychology* (41) 1990, pp. 417-440.

Dillman, D.A. *Mail and telephone surveys: The Total Design Method,* John Wiley & Sons, New York, 1978.

Dillman, D.A. *Mail and Internet surveys: The Tailored Design Method*, (2 ed.) John Wiley & Sons, New York, 1999.

Dimmick, J., Kline, S., and Stafford, L. "The gratification niches of personal e-mail and telephone," *Communication Research* (27:2) 2000, pp. 227-248.

Dimmick, J., Sikand, J., and Patterson, S. "The gratifications of the household telephone: Sociability, instrumentality and reassurance," *Communication Research* (21:5) 1994, pp. 643-663.

Dishaw, M.T. and Strong, D.M. "Extending the technology acceptance model with task – technology fit constructs," *Information & Management* (36:1) 1999, pp. 9-21.

Dix, A., Finlay, J., Abowd, G., and Beale, R. *Human-Computer Interaction*, (2 ed.) Prentice Hall, 1989.

Dohi, H. and Ishizuka, M. "Visual software agent interface with a user-tracking flat panel display for continuous eye contact," Proceedings of the Joint 3rd World Multiconference on Systems, Cybernetic and Information and 5th International Conference on Information Systems Analysis and Synthesis, Orlando, FL, 1999, pp. 242-247.

Ducheneaut, N. and Bellotti, V. "E-mail as habitat: An exploration of embedded personal information management," *Interactions* (8:5) 2001, pp. 30-38.

Duffy, B.R. "Anthropomorphism and the social robot," *Robotics and Autonomous Systems* (42:3-4) 2003, pp. 177-190.

Egloff, B. and Schmukle, S.C. "Gender differences in implicit and explicit anxiety measures," *Personality and Individual Differences* (36:8) 2004, pp. 1807-1815.

Eighmey, J. and McCord, L. "Adding value in the information age: Uses and gratifications of sites on the World Wide Web," *Journal of Business Research* (41:2) 1998, pp. 187-194.

Ellis, M.J. *Why people play?,* Prentice-Hall, Englewood Cliffs, N.J., 1973.

EmTec *MailBell product description,* EmTec Innovative Software. Available at http://www.emtec.com/mailbell/features.html. Retrieved March 12, 2003, 2003.

English, H.B. and English, A.C. *A comprehensive dictionary of psychological and psychoanalytical terms: A guide to usage*, (1 ed.) David McKay Company, New York, 1958.

Etzioni, O. and Weld, D.S. "Intelligent agents on the Internet: Fact, fiction, and forecast," *IEEE Expert* (10:4) 1995, pp. 44-49.

Eysenck, H.J. "Genetic and environmental contributions to individual differences: The three major dimensions of personality," *Journal of Personality* (58) 1990, pp. 245-261.

Eysenck, H.J. and Eysenck, S.B.G. *Personality structure and measurement*, (1 ed.) R. R. Knapp, San Diego, CA, 1969.

Ferratt, T.W. and Short, L.E. "Are Information Systems people different: An investigation of motivational differences," *MIS Quarterly* (10:4) 1986, pp. 377-387.

Ferratt, T.W. and Short, L.E. "Are Information Systems people different? An investigation of how they are and should be managed," *MIS Quarterly* (12:3) 1988, pp. 427-443.

Finch, I., Coenen, F., Bench-Capon, T., and Shave, M. "Using cooperating knowledge-based systems to reduce information overload," in: *IEE Colloquium on Information Overload*, 1995, pp. 8/1-8/3.

Fishbein, M. and Ajzen, I. *Belief, attitude, intention, and behavior: An introduction to theory and research,* Addison-Wesley Pub. Co., Reading, MA, 1975.

Flanagan, J.C. "The critical incident technique," *Psychological Bulletin* (5:4) 1954, pp. 327-358.

Florea, A.M. and Moldovanu, A. "An intelligent email agent," Proceedings of the 4th Romanian Conference on Open Systems, Bucharest, 1996.

Flynn, L.R. and Goldsmith, R.E. "A validation of the Goldsmith and Hofacker innovativeness scale," *Educational and Psychological Management* (53:4) 1993, pp. 1105-1116.

Fornell, C., Johnson, M.D., Anderson, E.W., Cha, J., and Bryant, B.E. "The American Customer Satisfaction Index: Nature, purpose, and findings," *Journal of Marketing* (60:7) 1996, pp. 7-18.

Fornell, C. and Larcker, D.F. "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research* (18:1) 1981, pp. 39-50.

Foxall, G.R. and Bhate, S. "Cognitive style and use-innovativeness for applications software in home computing: implications for new product strategy," *Technovation* (13:5) 1993, pp. 311-323.

Frank, D., Lucic, H., Opsenica, M., Puksec, J., Zic, M., Brajkovic, S., Maricic, V., and Tesla, E.N. "The EMA system: a CTI based e-mail alerting service," *IEEE Communications Magazine* (38:2) 2000, pp. 122 -128.

Freud, S. *Beyond the pleasure principle,* The International Psycho-Analytical Press, London, 1922.

Frohlich, M.T. "Techniques for improving response rates in OM survey research," *Journal of Operations Management* (20:1) 2002, pp. 53-62.

Fuguitt, G.V. and Lieberson, S. "Correlation of ratios or difference scores having common terms," *Sociological Methodology* (5) 1973, pp. 128-144.

Fukayama, A., Ohno, T., Mukawa, N., Sawaki, M., and Hagita, N. "Messages embedded in gaze of interface agents - impression management with agent's gaze," Proceedings of the ACM Conference on Human Factors and Computing Systems: Changing our world, changing ourselves, Minneapolis, Minnesota, The ACM Press, 2002, pp. 41-48.

Fulk, J. "Social construction of communication technology," *Academy of Management Journal* (36:5) 1993, pp. 921-950.

Fulk, J., Schmitz, J., and Steinfield, C.W. "A social influence model for technology use," in: *Organizations and communications technologies,* J. Fulk and C.W. Steinfield (eds.), Sage Publications, Newbury Park, 1990, pp. 117-140.

Fulton, J. and Swick, R. *Documentation for XFree86[tm] version 4.2.0. xbiff - mailbox flag for X,* The XFree86 Project. Available at http://www.xfree86.org/4.2.0/xbiff.1.html. Retrieved March 15, 2003, 2002.

Gaines, B.R. "Knowledge management in societies of intelligent adaptive agents," *Journal of Intelligent Information Systems* (9:3) 1997, pp. 277-298.

Gebhard, P., Kipp, M., Klesen, M., and Rist, T. "Interfaces: Authoring scenes for adaptive, interactive performances," Proceedings of the Second International Joint Conference on Autonomous Agents and Multiagent Systems, The ACM Press, Melbourne, Australia, 2003, pp. 725-732.

Gefen, D. and Keil, M. "The impact of developer responsiveness on perceptions of usefulness and ease of use: An extension of the technology acceptance model," *The Data Base for Advances in Information Systems* (29:2) 1998, pp. 35-49.

Gefen, D. and Straub, D. "Gender differences in the perception and use of e-mail: An extension to the technology acceptance model," *MIS Quarterly* (21:4) 1997, pp. 389-400.

Gefen, D. and Straub, D. "The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption," *Journal of the Association for Information Systems* (1:8) 2000, pp. 1-28.

Gefen, D., Straub, D., and Boudreau, M.-C. "Structural Equation Modeling and Regression: Guidelines for research practice," *Communications of the Association for Information Systems* (4:7) 2000, pp. 1-77.

Gilbert, D., Aparicio, M., Atkinson, B., Brady, S., Ciccarino, J., Grosof, B., O'Connor, P., Osisek, D., Pritko, S., Spagna, R., and Wilson, L. *IBM intelligent agent strategy. White paper,* IBM Corporation, 1995.

Gilbert, J.T. "Reducing the risks from innovation," *Journal of Systems Management* (47:1) 1996, pp. 12-15.

Glaser, B.G. *Theoretical Sensitivity: Advances in the methocology of grounded theory,* Sociology Press, Mill Valley, CA, 1978.

Glaser, B.G. *Basics of grounded theory analysis: Emergence vs. forcing,* Sociology Press, Mill Valley, CA, 1992.

Glaser, B.G. and Strauss, A.L. *Awareness of dying,* Aldine Pub. Co., Chicago, IL, 1965.

Glaser, B.G. and Strauss, A.L. *The discovery of grounded theory: Strategies for qualitative research,* Aldine Pub. Co, Chicago, 1967.

Glitho, R.H., Olougouna, E., and Pierre, S. "Mobile agents and their use for information retrieval: A brief overview and an elaborate case study," *IEEE Network* (16:1) 2002, pp. 34 - 41.

Global Research "Global Internet statistics by language," Global Business Centre, Global Research, available online at http://www.global-reach.biz/globstats/index.php3. Retrieved July 12, 2004, 2004.

Glynn, M.A. and Webster, J. "The adult playfulness scale: An initial assessment," *Psychological Reports* (71:1) 1992, pp. 83-103.

Goldsmith, R.E., Freiden, J.B., and Eastman, J.K. "The generality/specificity issue in consumer innovativeness research," *Technovation* (15:10) 1995, pp. 601-612.

Goldsmith, R.E. and Hofacker, C.F. "Measuring consumer innovativeness," *The Journal of Academy of Marketing Science* (19:3) 1991, pp. 209-222.

Gong, L. "Towards a theory of social intelligence for interface agents," Proceedings of the Human Factors Conference, Melbourne, Australia, 2002.

Goodhue, D.L. "Development and measurement validity of a task-technology fit instrument for user evaluations of information systems," *Decision Sciences* (29:1) 1998, pp. 105-138.

Goodwin, J.E. *E-Mail 101,* NetLibrary, Boulder, Colorado, 1993.

Gottschalk, L.A. *Content analysis of verbal behavior: New findings and clinical applications,* Lawrence Erlbaum Associates, Hillsdale, N.J., 1995.

Greenberg, B.S. "Gratifications of television viewing and their correlates for British children," in: *The uses of mass communications: Current perspectives on gratifications research,* J.G. Blumler and E. Katz (eds.), Sage Publications, Beverly Hills, CA, 1974.

Griss, M., Letsinger, R., Cowan, D., Sayers, C., VanHilst, M., and Kessler, R. "CoolAgent: Intelligent digital assistants for mobile professionals - Phase 1 retrospective", HP Laboratories report HPL-2002-55(R1), Hewlett-Packard Company, 2002.

Groos, K. and Baldwin, E.L. *The play of man,* D. Appleton and company, New York, 1901.

Groos, K., Baldwin, E.L., and Baldwin, J.M. *The play of animals,* D. Appleton and company, New York, 1898.

Gruen, D., Sidner, C., Boettner, C., and Rich, C. "A collaborative assistant for email," Proceedings of the Conference on Human Factors and Computing Systems, The ACM Press, Pittsburg, Pennsylvania, 1999, pp. 196-197.

Gulz, A. "Benefits of virtual characters in computer based learning environments: Claims and evidence," *International Journal of Artificial Intelligence in Education* (14) 2004, pp. 313-334.

Gwynne, S.C. and Dickerson, J.F. "Lost in the E-mail," *Time Magazine* (149:16) 1997, pp. 88-90.

Hackbarth, G., Grover, V., and Yi, M.Y. "Computer playfulness and anxiety: Positive and negative mediators of the system experience effect on perceived ease of use," *Information & Management* (40:3) 2003, pp. 221-232.

Harman, H.H. *Modern factor analysis*, (2 ed.) University of Chicago Press, Chicago, 1967.

Harré, R. and Lamb, R. (eds.) *The Encyclopedic dictionary of psychology*. The MIT Press, Cambridge, Mass, 1983.

Hassenzahl, M., Platz, A., Burmester, M., and Lehner, K. "Hedonic and ergonomic quality aspects determine a software's appeal," Proceedings of the Conference on Human Factors and Computing Systems, The ACM Press, New York, 2000, pp. 201-208.

Hatcher, L. *A step-by-step approach to using the SAS system for factor analysis and structural equation modeling,* SAS Publishing, Cary, NC, 1994.

Hayes-Roth, B. "An architecture for adaptive intelligent systems," *Artificial Intelligence* (72:2) 1995, pp. 329-365.

Head, M.M. *User interface features: Facilitating information access and decision making,* Doctoral Dissertation. McMaster University, Hamilton, Canada, 1998, p. 228.

Heeter, C. "Implications of new interactive technologies for conceptualizing communication," in: *Media use in the information age: Emerging patterns of adoption and consumer use,* J.L. Salvaggio and J. Bryant (eds.), Lawrence Erlbaum Associates, Hillsdale, N.J., 1989, pp. 217-235.

Helfman, J.I. and Isbell, C.L. "Ishmail: Immediate Identification of Important Information", Technical Report, AT&T Bell Laboratories, 1995.

Henderson, R., Rickwood, D., and Roberts, P. "The beta test of an electronic supermarket," *Interacting with Computers* (10:4) 1998, pp. 385-399.

Hendrickson, A.R., Massey, P.D., and Cronan, T.P. "On the test-retest reliability of perceived usefulness and perceived ease of use scales," *MIS Quarterly* (17:2) 1993, pp. 227-230.

Hertzum, M., Andersen, H.H.K., Andersen, V., and Hansen, C.B. "Trust in information sources: Seeking information from people, documents, and virtual agents," *Interacting with Computers* (14:5) 2002, pp. 575-599.

Herzberg, F., Mausner, B., and Snyderman, B.B. *The motivation to work*, (2 ed.) John Wiley and Sons, New York, 1959.

Hillman, D.J. "Problems of the information age," Proceedings of the Association for Computing Machinery Conference, The ACM Press, 1982, pp. 190-191.

Hirschman, E.C. "Innovativeness, novelty seeking, and consumer creativity," *The Journal of Consumer Research* (7:3) 1980, pp. 283-295.

Hoch, S.J. and Deighton, J. "Managing what consumers learn from experience," *Journal of Marketing* (53:2) 1989, pp. 1-20.

Hoffer, E. "Automation is here to liberate us," in: *Technology and social change,* W.E. Moore (ed.), Quandrangle Books, Chicago, 1972.

Hoffman, D.L. and Novak, T.P. "Marketing in hypermedia computer-mediated environments: Conceptual foundations," *Journal of Marketing* (60:3) 1996, pp. 50-68.

Hofstede, G.H. *Culture's consequences: International differences in work-related values,* Sage Publications, Beverly Hills, CA, 1980.

Hong, W., Thong, J.Y., Wong, W.-M., and Tam, K.-Y. "Determinants of user acceptance of digital libraries: An empirical examination of individual differences and systems characteristics," *Journal of Management Information Systems* (18:3) 2001, pp. 97-124.

Hornby, G.S. and Pollack, J.B. "Evolving L-systems to generate virtual creatures," *Computers & Graphics* (25:6) 2001, pp. 1041-1048.

Houari, N. and Far, B.H. "Application of intelligent agent technology for knowledge management integration," Proceedings of the Third IEEE International Conference on Cognitive Informatics, IEEE Computer Society, Victoria, Canada, 2004, pp. 240-249.

Howard, G.S. "Why do people say nasty things about self-reports?," *Journal of Organizational Behavior* (15:5) 1994, pp. 399-404.

Hurt, H.T., Joseph, K., and Cook, C.D. "Scales for the measurement of innovativeness," *Human Communication Research* (4) 1977, pp. 58-65.

Igbaria, M. "A motivational model of microcomputer usage," *Journal of Management Information Systems* (13:1) 1996, pp. 127-143.

Igbaria, M., Iivari, J., and Maragahh, H. "Why do individuals use computer technology? A Finnish case study," *Information & Management* (29:5) 1995, pp. 227-238.

Igbaria, M., Schiffman, S.J., and Wieckowski, T.J. "The respective roles of perceived usefulness and perceived fun in the acceptance of microcomputer technology," *Behaviour and Information Technology* (13:6) 1994, pp. 349-361.

Igbaria, M., Zinatelli, N., Cragg, P., and Cavaye, A.L.M. "Personal computing acceptance factors in small firms: A structural equation model," *MIS Quarterly* (21:3) 1997, pp. 279-302.

Ireland, P.S. "A management paradigm to reduce information overload-the introduction of the intranet into BT," in: *IEE Colloquium on IT Strategies for Information Overload (Digest No: 340)*, 1997, pp. 1-6.

Isbister, K. and Nass, C. "Consistency of personality in interactive characters: Verbal cues, non-verbal cues, and user characteristics," *International Journal of Human-Computer Studies* (53:2) 2000, pp. 251-267.

James, M.L., Wotring, C.E., and Forrest, E.J. "An exploratory study of the perceived benefits of electronic bulletin board use and their impact on other communication activities," *Journal of Broadcasting and Electronic Media* (39:1) 1995, pp. 30-50.

Jennings, N.R. "An agent-based approach for building complex software systems," *Communications of the ACM* (44:4) 2001, pp. 35-41.

Jennings, N.R. and Wooldridge, M.J. "Applications of intelligent agents," in: *Agent technology: Foundations, applications, and markets,* N.R. Jennings (ed.), Springer Verlag, 1998, pp. 3-28.

Jick, T.D. "Mixing qualitative and quantitative methods: Triangulation in action," *Administrative Science Quarterly* (24:4) 1979, pp. 602-611.

Jobber, D., Saunders, J., and Mitchell, V.-W. "Prepaid monetary incentive effects on mail survey response," *Journal of Business Research*) 2002.

Johnson, B.L., Jr and Fauske, J.R. "Principals and the political economy of environmental enactment," *Educational Administration Quarterly* (36:2) 2000, pp. 159-185.

Johnson, C. and Dunlop, M.D. "Subjectivity and notions of time and value in interactive information retrieval," *Interacting with Computers* (10:1) 1998, pp. 67-75.

Johnson, W.L., Rickel, J.W., and Lester, J. "Animated pedagogical agents: Face-to-face interaction in interactive learning environments," *International Journal of Artificial Intelligence in Education* (11) 2000, pp. 47-78.

Jones, M.A. "Entertaining shopping experiences: An exploratory investigation," *Journal of Retailing and Consumer Services* (6:3) 1999, pp. 129-139.

Kanfer, A., Sweet, J., and Schlosser, A. "Humanizing the Net: Social navigation with a 'Know-who' email agent," Proceedings of the 3rd Conference on Human Factors & the Web, Designing for the Web, Denver, Colorado, 1997.

Kanungo, R.N. and Mendonca, M. *Compensation: Effective reward management*, (2 ed.) John Wiley and Sons, Toronto, 1997.

Karahanna, E., Ahuja, M., Srite, M., and Galvin, J. "Individual differences and relative advantage: The case of GSS," *Decision Support Systems* (32:4) 2002, pp. 327-341.

Karahanna, E., Straub, D., and Chervany, N.L. "Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs," *MIS Quarterly* (23:2) 1999, pp. 183-213.

Karnouskos, S. and Vasilakos, A. "Neuro-fuzzy applications: Active electronic mail," Proceedings of the 2002 ACM symposium on applied computing, The ACM Press, New York, 2002, pp. 801-806.

Katz, E., Blumler, J.G., and Gurevitch, M. "Utilization of mass communication by the individual," in: *The uses of mass communications: Current perspectives on gratifications research,* J.G. Blumler and E. Katz (eds.), Sage Publications, Beverly Hills, CA, 1974.

Kautz, H., Selman, B., and Milewski, A. "Agent amplified communication," Proceedings of the Thirteenth National Conference on Artificial Intelligence, AAAI Press, Portland, OR, 1996, pp. 3-9.

Kautz, H., Selman, B., and Shah, M. "Referral Web: combining social networks and collaborative filtering," *Communications of the ACM* (40:3) 1997, pp. 63-65.

Kautz, H.A., Selman, B., and Coen, M. "Bottom-up design of software agents," *Communications of the ACM* (37:7) 1994, pp. 143-146.

Keaveney, S.M. "Customer switching behavior in service industries: An exploratory study," *Journal of Marketing* (59:2) 1995, pp. 71-82.

Keeble, R.J. and Macredie, R.D. "Assistant agents for the world wide web intelligent interface design challenges," *Interacting with Computers* (12:4) 2000, pp. 357-381.

Kemmis, S. and McTaggart, R. (eds.) *The action research planner*. Deakin University Press, Geelong, Australia, 1988.

Kendall, J.E. "Examining the relationship between computer cartoons and factors in information systems use, success, and failure: Visual evidence of met and unmet expectations," *The Data Base for Advances in Information Systems* (28:2) 1997, pp. 113-126.

Kerlinger, F.N. *Foundations of behavioral research*, (2 ed.) Holt, Rinehart and Winston, New York, 1973.

Khare, R. "The spec's in the mail," *IEEE Internet Computing* (2:5) 1998, pp. 82-86.

Kiesler, S., Sproull, L., and Waters, K. "A prisoner's dilemma experiment on cooperation with people and human-like computers," *Journal of Personality and Social Psychology* (70:1) 1996, pp. 47-65.

King, W.J. and Ohya, J. "The representation of agents: A study of phenomena in virtual environments," Proceedings of the 4th IEEE International Workshop on Robot and Human Communication, IEEE, Tokyo, Japan, 1995, pp. 199 -204.

King, W.J. and Ohya, J. "The representation of agents: Anthropomorphism, agency, and intelligence," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Vancouver, BC, Canada, 1996, pp. 289-290.

Kirk, J. and Miller, M.L. *Reliability and validity in qualitative research,* Sage Publications, Beverly Hills, CA, 1986.

Kitchenham, B.A. and Pfleeger, S.L. "Principles of survey research part 2: Designing a survey," *Software Engineering Notes* (27:1) 2002a, pp. 18-20.

Kitchenham, B.A. and Pfleeger, S.L. "Principles of survey research part 3: Constructing a survey instrument," *Software Engineering Notes* (27:2) 2002b, pp. 20-24.

Kitchenham, B.A. and Pfleeger, S.L. "Principles of survey research part 5: Populations and samples," *Software Engineering Notes* (27:5) 2002c, pp. 17-20.

Koda, T. and Maes, P. "Agents with faces: The effect of personification," Proceedings of the 5th IEEE International Workshop on Robot and Human Communication, IEEE, Tsukuba , Japan, 1996, pp. 189-194.

Koenemann-Belliveau, J., Carroll, J.M., Rosson, M.B., and Singley, M.K. "Comparative usability evaluation: Critical incidents and critical threads," Proceedings of the ACM Conference on Human Factors in Computing Systems, The ACM Press, Boston, Massachusetts, 1994, pp. 245-251.

Kolbe, R.H. and Albanese, P.J. "Man to man: A content analysis of sole-male images in male-audience magazines," *Journal of Advertising Research* (25:4) 1996, pp. 1-20.

Koufaris, M. "Applying the Technology Acceptance Model and flow theory to online consumer behavior," *Information Systems Research* (13:2) 2002, pp. 205-223.

Kracker, J. "Research anxiety and students' perceptions of research: An experiment. Part I: Effect of teaching Kuhlthau's ISP model," *Journal of the American Society for Information Science and Technology* (53:4) 2002a, pp. 282-294.

Kracker, J. "Research anxiety and students' perceptions of research: An experiment. Part II: Content analysis of their writings on two experiences," *Journal of the American Society for Information Science and Technology* (53:4) 2002b, pp. 295-307.

Kraut, R., Mukhopadhyay, T., Szczypula, J., Kiesler, S., and Scherlis, B. "Information and communication: Alternative uses of the Internet in households," *Information Systems Research* (10:4) 1999, p. 287–303.

Krim, J. "Spam's cost to business escalates: Bulk e-mail threatens communication arteries," in: *The Washington Post*, 2003, p. A01.

Krippendorff, K. *Content analysis: An introduction to its methodology,* Sage Publications, Beverly Hills, CA, 1980.

Krupa, T. "Triple play: Delivering effective & key communication," Proceedings of the 29th Annual ACM Conference on User Services, Portland, Oregon, 2001, pp. 73-79.

Lang, K. "NewsWeeder: Learning to filter Netnews," Proceedings of the 12th International Conference on Machine Learning, San Francisco, CA, 1995, pp. 331-339.

LaRose, R., Mastro, D., and Eastin, M.S. "Understanding Internet usage: A social-cognitive approach to uses and gratifications," *Social Science Computer Review* (19:4) 2001, pp. 395-413.

Larson, P.D. and Chow, G. "Total cost/response rate trade-offs in mail survey research: Impact of follow-up mailings and monetary incentives," *Industrial Marketing Management* (32:7) 2003, pp. 533-537.

Lashkari, Y., Metral, M., and Maes, P. "Collaborative interface agents," Proceedings of the Twelfth National Conference on Artificial Intelligence, AAAI Press, Seattle, Washington, 1994, pp. 444-450.

Laurel, B. "Interface agents: Metaphors with character," in: *Software Agents,* J.M. Bradshaw (ed.), The AAAI Press / The MIT Press, Menlo Park, Ca, 1997, pp. 67-78.

Lee, W.J., Kim, T.U., and Chung, J.-Y. "User acceptance of the mobile Internet," Proceedings of the First International Conference on Mobile Business, Mobiforum, Athens, Greece, 2002.

Legris, P., Ingham, J., and Collerette, P. "Why do people use information technology? A critical review of the technology acceptance model," *Information & Management* (40:3) 2003, pp. 191-204.

Leonard-Barton, D. and Deschamps, I. "Managerial influence in the implementation of new technology," *Management Science* (34:10) 1988, pp. 1252-1265.

Lesh, N., Rich, C., and Sidner, C.L. "Using plan recognition in human-computer collaboration," Proceedings of the Seventh International Conference on User Modelling, Springer, Banff, Canada, 1999, pp. 23-32.

Lester, J.C., Converse, S.A., Kahler, S.E., Barlow, S.T., Stone, B.A., and Bhoga, R.S. "The persona effect: Affective impact of animated pedagogical agents," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Atlanta, Georgia, 1997, pp. 359-366.

Lester, J.C., Voerman, J.L., Towns, S.G., and Callaway, C.B. "Deictic believability: Coordinated gesture, locomotion, and speech in lifelike pedagogical agents," *Applied Artificial Intelligence* (13:4-5) 1999, pp. 383-414.

Leung, L. "College student motives for chatting on ICQ," *New Media & Society* (3:4) 2001, pp. 483-500.

Leung, L. and Wei, R. "The gratifications of pager use: Sociability, information-seeking, entertainment, utility, and fashion and status," *Telematics and Informatics* (15:4) 1998, pp. 253-264.

Leung, L. and Wei, R. "More than just talk on the move: Uses and gratifications of the cellular phone," *Journalism and Mass Communication Quarterly* (77:2) 2000, pp. 308-320.

Levene, H. "Robust tests for the equality of variance," in: *Contributions to probability and statistics: Essays in honor of Harold Hotelling,* I. Olkin (ed.), Stanford University Press, Palo Alto, CA, 1960, pp. 278 -292.

Levy, J. *Play behavior,* John Wiley & Sons, Toronto, Canada, 1978.

Lewis, W., Jr. *Technology beliefs, belief antecedents, and IT usage: A study of the World Wide Web,* Doctoral Dissertation. Florida State University, Tallahassee, FL, 1999, p. 174.

Libes, D. "Tcl/Tk-based agents for mail and news notification," *Software: Practice and Experience* (27:4) 1997, pp. 481-493.

Lieberman, H. "Letizia: An agent that assists Web browsing," Proceedings of the International Joint Conference on Artificial Intelligence, Montreal, Canada, 1995, pp. 924-929.

Lieberman, H. "Interfaces that give and take advice," in: *Human-Computer Interaction in the New Millennium,* J.M. Carroll (ed.), The ACM Press, New York, 2001, pp. 475-484.

Lieberman, H., Rosenzweig, E., and Singh, P. "Aria: An agent for annotating and retrieving images," *IEEE Computer* (34:7) 2001, pp. 57-62.

Lieberman, H. and Selker, T. "Agents for the user interface," in: *Handbook of Agent Technology,* J.M. Bradshaw (ed.), The MIT Press, 2003.

Lieberman, H. and Wagner, E. "End-user debugging for electronic commerce," Proceedings of the ACM Conference on Intelligent User Interfaces, The ACM Press, Miami Beach, 2003, pp. 257-259.

Lieberman, J.N. "Playfulness and divergent thinking: An investigation of their relationship at the kindergarten level," *Journal of Genetic Psychology* (107) 1965, pp. 219-224.

Lieberman, J.N. *Playfulness: Its relationship to imagination and creativity,* Academic Press, New York, 1977.

Liebowitz, J. "Knowledge management and its link to artificial intelligence," *Expert Systems with Applications* (20:1) 2001, pp. 1-6.

Limayem, M., Khalifa, M., and Frini, A. "What makes consumers buy from Internet? A longitudinal study of online shopping," *IEEE Transactions on Systems, Man, and Cybernetics* (30:4) 2000, pp. 421-432.

Lin, C.A. "Online-service adoption likelihood," *Journal of Advertising Research* (39:2) 1999, pp. 79-89.

Lin, C.A. "Perceived gratifications of online media service use among potential users," *Telematics and Informatics* (19:1) 2002, pp. 3-19.

Lisetti, C.L. "Personality, affect and emotion taxonomy for socially intelligent agents," Proceedings of the 15th International Florida Artificial Intelligence Research Society Conference, AAAI Press, Menlo Park, CA, 2002, pp. 397-401.

Loch, K.D. and Conger, S. "Evaluating ethical decision making and computer use," *Communications of the ACM* (39:7) 1996, pp. 74-83.

Loia, V., Senatore, S., and Sessa, M.I. "Given a message, find legitimate readers: A 'flexible' mailbot-based approach," Proceedings of the IEEE International Conference on Systems, Man, and Cybernetics, Tucson, AZ, 2001a, pp. 2581-2586.

Loia, V., Senatore, S., and Sessa, M.I. "Similarity-based agents for e-mail mining," Proceedings of the Joint 9th International Fuzzy Systems Association World Congress and the 20th North American Fuzzy Information Processing Society International Conference, Vancouver, BC, Canada, 2001b, pp. 417-422.

Love, S. and Perry, M. "Dealing with mobile conversations in public places: Some implications for the design of socially intrusive technologies," Proceedings of the ACM Conference on Human Factors and Computing Systems, The ACM Press, Vienna, Austria, 2004, pp. 1195-1198.

Lucas, W. "Effects of E-Mail on the organization," *European Management Journal* (16:1) 1998, pp. 18-30.

Lund, H.H. "Adaptive robotics in entertainment," *Applied Soft Computing* (1:1) 2001, pp. 3-20.

Lüthje, C. "Characteristics of innovating users in a consumer goods field: An empirical study of sport-related product consumers," *Technovation* (24:9) 2004, pp. 683-695.

Maes, P. "Agents that reduce work and information overload," *Communications of the ACM* (37:7) 1994, pp. 31-40.

Maes, P. "Artificial life meets entertainment: Lifelike autonomous agents," *Communications of the ACM* (38:11) 1995, pp. 108-114.

Maes, P., Guttman, R.H., and Moukas, A.G. "Agents that buy and sell," *Communications of the ACM* (42:3) 1999, pp. 81-91.

Maes, P. and Kozierok, R. "Learning interface agents," Proceedings of the Eleventh National Conference on Artificial Intelligence, The MIT Press, Washington, D.C., 1993, pp. 459-465.

Magnusson, D. (ed.) *Toward a psychology of situations: An interactional perspective*. L. Erlbaum Associates, Hillsdale, N.J., 1981.

Mak, B.L. and Sockel, H. "A confirmatory factor analysis of IS employee motivation and retention," *Information & Management* (38:5) 2001, pp. 265-276.

Malone, T.W. "Heuristics for designing enjoyable user interfaces: Lessons from computer games," Proceedings of the Conference on Human Factors and Computing Systems, The ACM Press, Gaithersburg, Maryland, 1982, pp. 63-68.

Malone, T.W., Grant, K.R., Turbak, F.A., Brobst, S.A., and Cohen, M.D. "Intelligent information-sharing systems," *Communications of the ACM* (30:5) 1987, pp. 390-402.

Manco, G., Masciari, E., Ruffolo, M., and Tagarelli, A. "Towards an adaptive mail classifier," Proceedings of the Italian Association for Artificial Intelligence Conference, Siena, Italy, 2002.

Marakas, G.M., Johnson, R.D., and Palmer, J.W. "A theoretical model of differential social attributions toward computing technology: When the metaphor becomes the model," *International Journal of Human-Computer Studies* (52:4) 2000, pp. 719-750.

Markus, M.L. "Toward a 'Critical Mass' theory of interactive media," in: *Organizations and communications technologies,* J. Fulk and C.W. Steinfield (eds.), Sage Publications, Newbury Park, 1990, pp. 194-218.

Marsh, H.W., Hau, K.-T., Chung, C.-M., and Siu, T.L.P. "Students' evaluations of university teaching: Chinese version of the students' evaluations of educational quality instrument," *Journal of Educational Psychology* (89:3) 1997, pp. 568-572.

Martocchio, J.J. and Webster, J. "Effects of feedback and playfulness on performance in microcomputer software training," *Personnel Psychology* (45:3) 1992, pp. 553-578.

Maslow, A.H. "A Theory of Human Motivation," *Psychological Review* (50:4) 1943, pp. 370-396.

Mason, R.O. and Mitroff, I.I. "A program for research on management information systems," *Management Science* (19:5) 1973, pp. 475-487.

Mathieson, K. "Predicting user intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior," *Information Systems Research* (2:3) 1991, pp. 173-191.

McBreen, H.M. and Jack, M.A. "Evaluating humanoid synthetic agents in e-retail applications," *IEEE Transactions on Systems, Man, and Cybernetics* (31:5) 2001, pp. 394-405.

McKnight, D.H., Choudhury, V., and Kacmar, C. "Developing and validating trust measures for e-commerce: An integrative typology," *Information Systems Research* (13:3) 2002, pp. 334-359.

Menczer, F., Street, W.N., and Monge, A.E. "Adaptive assistants for customized e-shopping," *IEEE Intelligent Systems* (17:6) 2002a, pp. 12-19.

Menczer, F., Street, W.N., Vishwakarma, N., Monge, A.E., and Jakobsson, M. "IntelliShopper: A proactive, personal, private shopping assistant," Proceedings of the First International Joint Conference on Autonomous Agents and Multiagent Systems, The ACM Press, Bologna, Italy, 2002b, pp. 1001-1008.

Midgley, D.F. and Dowling, G.R. "Innovativeness: The concept and its measurement," *The Journal of Consumer Research* (4:4) 1978, pp. 229-242.

Midgley, D.F. and Dowling, G.R. "A longitudinal study of product form innovation: The interaction between predispositions and social messages," *The Journal of Consumer Research* (19:4) 1993, pp. 611-625.

Miles, M.B. and Huberman, A.M. *Qualitative data analysis: An expanded sourcebook*, (2 ed.) Sage Publications, Thousand Oaks, 1994.

Miller, W.C. *The creative edge: Fostering innovation where you work,* Addison-Wesley Publishing Company, Reading, MA, 1986.

Miller, W.C. *Flash of brilliance: Inspiriting creativity where you work,* Perseus Books, Reading, MA, 1998.

Miller, W.C., Couger, J.D., and Higgins, L.F. "Innovation styles profile of IS personnel vs other occupations," *Creativity and Innovation Management* (5:4) 1996, pp. 226-233.

Miranda, F.R., Kögler, J.E., Jr, Hernandez, E.D.M., and Netto, M.L. "An artificial life approach for the animation of cognitive characters," *Computers & Graphics* (25:6) 2001, pp. 955-964.

Mitchell, K.E., Alliger, G.M., and Morfopoulos, R. "Toward an ADA-appropriate job analysis," *Human Resource Management Review* (7:1) 1997, pp. 5-26.

Mönks, F.J., Hartup, W.W., and deWit, J. (eds.) *Determinants of behavioral development*. Academic Press, New York, 1972.

Moon, J.-W. and Kim, Y.-G. "Extending the TAM for a World-Wide-Web context," *Information and Management* (38:4) 2001, pp. 217-230.

Moore, G.C. and Benbasat, I. "Development of an instrument to measure the perceptions of adopting an information technology innovation," *Information Systems Research* (2:3) 1991, pp. 192-222.

Moore, J.E. "One road to turnover: An examination of work exhaustion in technology professionals," *MIS Quarterly* (24:1) 2000, pp. 141-168.

Moundridou, M. and Virvou, M. "Evaluating the persona effect of an interface agent in a tutoring system," *Journal of Computer Assisted Learning* (18:3) 2002, pp. 253-261.

Müller, W., Spierling, U., Alexa, M., and Rieger, T. "Face-to-face with your assistant. Realization issues of animated user interface agents for home appliances," *Computers & Graphics* (25:4) 2001, pp. 593-600.

Murphy, J. and Tan, I. "Journey to nowhere? E-mail customer service by travel agents in Singapore," *Tourism Management* (24:5) 2003, pp. 543-550.

Murray, J.H. *Hamlet on the holodeck: The future of narrative in cyberspace,* The MIT Press, Cambridge, Massachusetts, 1997.

Muylle, S., Moenaert, R., and Despontin, M. "The conceptualization and empirical validation of web site user satisfaction," *Information & Management* (41:5) 2004, pp. 543-560.

Myers, I.B. and McCaulley, M.H. *Manual: A guide to the development and use of the Myers-Briggs type indicator,* Consulting Psychologists Press, Palo Alto, CA, 1985.

Myers, M. "Qualitative research in information systems," *MIS Quarterly Discovery.* (Third edition. Available online at http://www.misq.org/discovery/MISQD_isworld. Retrieved January 11, 2004.) 1998.

Myers, M. "Investigating information systems with ethnographic research," *Communications of the Association for Information Systems* (2:4, Article No. 1) 1999.

Myers, M.E. "Motivation and performance in the information systems field: A survey of related studies," *Computer Personnel* (13:3) 1991, pp. 44-49.

Nass, C., Fogg, B.J., and Moon, Y. "Can computers be teammates?," *International Journal of Human-Computer Studies* (45:6) 1996, pp. 669-678.

Nass, C., Steuer, J., Henriksen, L., and Dryer, D.C. "Machines, social attributions, and ethopoeia: Performance assessments of computers subsequent to 'self-' or 'other-' evaluations," *International Journal of Human-Computer Studies* (40:3) 1994, pp. 543-559.

Nass, C., Steuer, J., Tauber, E., and Reeder, H. "Anthropomorphism, agency, and ethopoeia: Computers as social actors," Proceedings of the Joint International Conference on Human-Computer Interaction and Human Factors in Computing Systems Conference, The ACM Press, Amsterdam, The Netherlands, 1993, pp. 111-112.

Negroponte, N. "Agents: From direct manipulation to delegation," in: *Software agents,* J.M. Bradshaw (ed.), The AAAI Press / The MIT Press, Menlo Park,CA, 1997, pp. 57-66.

Nemeth, E., Snyder, G., Seebass, S., and Hein, T.R. *UNIX system administration handbook*, (3 ed.) Prentice Hall, Upper Saddle River, NJ, 2000.

Ngwenyama, O.K. "Communication richness in electronic mail: Critical social theory and the contextuality of meaning," *MIS Quarterly* (21:2) 1997, pp. 145-167.

NotifyMail *NotifyMail Data Sheet,* Available at http://www.notifymail.com. Retrieved March 12, 2003, 2003.

Nunnally, J.C. *Psychometric theory*, (2 ed.) McGraw-Hill, New York, 1978.

Nwana, H.S. "Software agents: An overview," *Knowledge Engineering Review* (11:3) 1996, pp. 205-244.

Orlikowski, W.J. "The duality of technology: Rethinking the concept of technology in organizations," *Organization Science* (3:3) 1992, pp. 398-427.

Orlikowski, W.J., Yates, J., Okamura, K., and Fujimoto, M. "Shaping electronic communication: The metastructuring of technology in the context of use," *Organization Science* (6:4) 1995, pp. 423-444.

Parise, S., Kiesler, S., Sproull, L., and Waters, K. "Cooperating with life-like interface agents," *Computers in Human Behavior* (15:2) 1999, pp. 123-142.

Payne, T.R. and Edwards, P. "Interface agents that learn: An investigation of learning issues in a mail agent interface," *Applied Artificial Intelligence* (11:1) 1997, pp. 1-32.

Payne, T.R., Edwards, P., and Green, C.L. "Experience with rule induction and k-nearest neighbor methods for interface agents that learn," *IEEE Transactions on Knowledge and Data Engineering* (9:2) 1997, pp. 329-335.

Pazzani, M.J. and Billsus, D. "Adaptive Web site agents," *Autonomous Agents and Multi-Agent Systems* (5:2) 2002, pp. 205-218.

Perry, E.L. and Ballou, D.J. "The role of work, play, and fun in microcomputer software training," *The Data Base for Advances in Information Systems* (28:2) 1997, pp. 93-112.

Perry, M., O'Hara, K., Sellen, A., Brown, B., and Harper, R. "Dealing with mobility: understanding access anytime, anywhere," *ACM Transactions on Computer-Human Interaction* (8:4) 2001, pp. 323-347.

Person, N.K., Craig, C., Price, P., Hu, X., Gholson, B., and Greasser, A.C. "Incorporating human-like conversational behaviors into AutoTutor," Proceedings of the Workshop on Achieving Human-like Behavior in the Interactive Animated Agents at the Agents 2000 Conference, The ACM Press, Barcelona, Catalonia, Spain, 2000, pp. 85-92.

Persson, P. "AGNETA & FRIDA: Browsing, narrative and emotion," Proceedings of the i3 Spring Days Workshop on Behaviour Planning for Lifelike Characters and Avatars, Sitges, Spain, 1999.

Pfleeger, S.L. and Kitchenham, B.A. "Principles of survey research part 1: Turning lemons into lemonade," *Software Engineering Notes* (26:6) 2001, pp. 16-18.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., and Podsakoff, N.P. "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *Journal of Applied Psychology* (88:5) 2003, pp. 879-903.

Podsakoff, P.M. and Organ, D.W. "Self-report in Organizational Research: Problems and prospects," *Journal of Management* (12:4) 1986, pp. 531-544.

Pollock, S. "A rule-based message filtering system," *ACM Transactions on Information Systems* (6:3) 1988, pp. 232-254.

Potosky, D. "A field study of computer efficacy beliefs as an outcome of training: The role of computer playfulness, computer knowledge, and performance during training," *Computers in Human Behavior* (18:3) 2002, pp. 241-255.

Prendinger, H., Descamps, S., and Ishizuka, M. "Scripting affective communication with life-like characters in Web-based interaction systems," *Applied Artificial Intelligence* (16:7/8) 2002, pp. 519-554.

Prendinger, H. and Ishizuka, M. "Agents that talk back (sometimes): Filter programs for affective communication," Proceedings of the 2nd Workshop on Attitude, Personality and Emotions in User-Adapted Interaction, Sonthofen, Germany, 2001a.

Prendinger, H. and Ishizuka, M. "Simulating affective communication with animated agents," Proceedings of the Eighth International Federation for Information Processing Technical Committee Conference on Human-Computer Interaction, IOS Press, Tokyo, Japan, 2001b, pp. 182-189.

Puca, R.M. and Schmalt, H.-D. "Task enjoyment: A mediator between achievement motives and performance," *Motivation and Emotion* (23:1) 1999, pp. 15-29.

Raymond, L. "Organizational characteristics and MIS success in the context of small business," *MIS Quarterly* (9:1) 1985, pp. 37-52.

Reisman, S. "I have seen the future: It is flooded with email," *IEEE Software* (12:3) 1995, pp. 111 -112.

Rennie, J.D.M. "ifile: An application of machine learning to email filtering," Proceedings of the International Conference on Knowledge Discovery and Data Mining, The ACM Press, Boston, MA, 2000.

Rice, R. "Media appropriateness: Using social presence theory to compare traditional and new organization media," *Human Communication Research* (19:4) 1993, pp. 451-484.

Rice, R.E. and Shook, D.E. "Relationships of job categories and organizational levels to use of communication channels, including electronic mail: A meta-analysis and extension," *Journal of Management Studies* (27:2) 1990, pp. 195-229.

Rickel, J. and Johnson, W.L. "Task-oriented collaboration with embodied agents in virtual worlds," in: *Embodied Conversational Agents,* J. Cassell, J. Sullivan, S. Prevost and E. Churchill (eds.), The MIT Press, Boston, 2000, pp. 95-122.

Rickel, J., Marsella, S., Gratch, J., Hill, R., Traum, D., and Swartout, W. "Toward a new generation of virtual humans for interactive experiences," *IEEE Intelligent Systems* (17:4) 2002, pp. 32-38.

Riemenschneider, C.K. and Hardgrave, B.C. "Explaining software development tool use with the technology acceptance model," *Journal of Consumer Information Systems* (41:4) 2001.

Riffe, D., Lacy, S., and Fico, F.G. *Analyzing media messages: Using quantitative content analysis in research,* Lawrence Erlbaum Associates, Publisheres, Mahwah, N.J., 1998.

Rigdon, E.E. "Structural Equation Modeling," in: *Modern methods for business research,* G.A. Marcoulides (ed.), Lawrence Erlbaum Associates, Mahwah, N. J., 1998, pp. 251-294.

Rist, T., André, E., and Müller, J. "Adding animated presentation agents to the interface," Proceedings of the 2nd International Conference on Intelligent User Interfaces, The ACM Press, Orlando, Florida, 1997, pp. 79-86.

Roda, C., Angehrn, A., and Nabeth, T. "Matching competencies to enhance organizational knowledge sharing: An intelligent agents approach," Proceedings of the 7th International Networking Entities Conference, Fribourg, Switzerland, 2001, pp. 931-938.

Roda, C., Angehrn, A., Nabeth, T., and Razmerita, L. "Using conversational agents to support the adoption of knowledge sharing practices," *Interacting with Computers* (15:1) 2003, pp. 57-89.

Roehrich, G. "Consumer innovativeness: Concepts and measurements," *Journal of Business Research*) 2002.

Rogers, E.M. *Diffusion of Innovations*, (3 ed.) Free Press, New-York, 1983.

Rogers, E.M. *Diffusion of Innovations*, (4 ed.) Free Press, New-York, 1995.

Rohall, S.L. and Gruen, D. "ReMail: A reinvented email prototype", Technical Report TR2002-13, IBM Watson Research Center, 2002.

Rohner, R.P. "Advantages of the comparative method of anthropology," *Behavior Science Research* (12) 1977, pp. 117-144.

Ronan, W.W. and Latham, G.P. "The reliability and validity of the Critical Incident Technique: A closer look," *Studies in Personnel Psychology* (6:1) 1974, pp. 53-64.

Rubin, J. *Handbook of usability testing: How to plan, design, and conduct effective tests,* John Wiley & Sons, New York, 1994.

Ryan, G.W. and Bernard, H.R. "Data management and analysis methods," in: *Handbook of qualitative research,* N.K. Denzin and Y.S. Lincoln (eds.), Sage Publications, Thousand Oaks, CA, 2000, pp. 769-802.

Ryan, R.M. and Deci, E.L. "Intrinsic and extrinsic motivations: Classic definitions and new directions," *Contemporary Educational Psychology* (25:1) 2000, pp. 54-67.

Schaik, P.V., Bettany-Saltikov, J.A., and Warren, J.G. "Clinical acceptance of a low-cost portable system for postural assessment," *Behariour & Information Technology* (21:1) 2002, pp. 47-57.

Schmitt, N. "Method bias: The importance of theory and measurement," *Journal of Organizational Behavior* (15:5) 1994, pp. 393-398.

Schmitz, J. and Fulk, J. "Organizational colleagues, media richness, and electronic mail: A test of the social influence model of technology use," *Communication Research* (18:4) 1991, pp. 487-523.

Schneiderman, B. "Direct Manipulation: A step beyond programming languages," *IEEE Computer* (16:8) 1983, pp. 57-69.

Segal, R.B. and Kephart, J.O. "MailCat: An intelligent assistant for organizing e-mail," Proceedings of the Third International Conference on Autonomous Agents, The ACM Press, New York, 1999, pp. 276-282.

Segal, R.B. and Kephart, J.O. "Incremental Learning in SwiftFile," Proceedings of the Seventh International Conference on Machine Learning, Morgan Kaufmann Publishers, Standord, CA, 2000, pp. 863-870.

Segars, A.H. and Grover, V. "Re-examining perceived ease of use and usefulness: A confirmatory factor analysis," *MIS Quarterly* (17:4) 1993, pp. 517-525.

Seiji, Y. and Tomohiro, Y. "Acquiring emotion mappings through the interaction between a user and a life-like agent," Proceedings of the 9th International Conference on Human-Computer Interaction, Lawrence Erbaum Associates, New Orleans, LA, 2001, pp. 993-997.

Sekiba, J., Kitagata, G., Suganuma, T., Kinoshita, T., Okada, K., and Shiratori, N. "Design and implementation of agent-based flexible asynchronous messaging system," Proceedings of the International Conference on Parallel and Distributed Systems, IEEE Computer Society, Tainan, Taiwan, 1998, pp. 732-739.

Serenko, A. "Intelligent agents for eCommerce and privacy issues: Building a framework," Proceedings of the 24th World Congress on the Management of Electronic Business, McMaster University, Hamilton, Canada, 2003.

Serenko, A. "Are interface agents scapegoats? Attributions of responsibility in human-agent interaction", work-in-progress, 2004a.

Serenko, A. "The development of an instrument to measure animation predisposition of users of animated agents in MS Office applications," Proceedings of the Administrative Sciences Association of Canada Conference, Quebec, Canada, 2004b.

Serenko, A. "The development of an instrument to measure the degree of animation predisposition of agent users," *Computers in Human Behavior* (In press) 2004c.

Serenko, A., Bontis, N., and Detlor, B. "Understanding the user experience with interface agents in everyday work applications," forthcoming.

Serenko, A. and Cocosila, M. "The social impacts of intelligent agents on Internet use," Proceedings of the International and Interdisciplinary Conference of the Association of Internet Researchers, AoIR, Toronto, Canada, 2003.

Serenko, A. and Cocosila, M. "An exploratory investigation of the self-serving biases of interface agent users," Proceedings of the 10th Americas Conference on Information Systems, New York, 2004, pp. 1768-1777.

Serenko, A. and Detlor, B. "Agent toolkit satisfaction and use in higher education," *Journal of Computing in Higher Education* (15:1) 2003, pp. 65-88.

Serenko, A. and Detlor, B. "Intelligent agents as innovations," *AI & Society* (18:4) 2004, pp. 364-381.

Serenko, A., Ruhi, U., and Cocosila, M. "Unplanned effects of intelligent agents on Internet use: A Social Informatics approach," Proceedings of the International Conference on Politics and Information Systems, Technologies and Applications, International Institute of Informatics and Systemics, Orlando, FL, 2004, pp. 333-338.

Serenko, A. and Turel, O. "Critical incidents with electronic mail: The end-user perspective.," work-in-progress, 2004a.

Serenko, A. and Turel, O. "User satisfaction with electronic mail: Does spam really matter?" work-in-progress, 2004b.

Sharon, T., Lieberman, H., and Selker, T. "Searching the Web with a little help from your friends," Proceedings of the ACM Conference on Computer-Supported Cooperative Work, The ACM Press, New Orleans, 2002.

Shearin, S. and Lieberman, H. "Intelligent profiling by example," Proceedings of the ACM Conference on Intelligent User Interfaces, The ACM Press, Santa Fe, NM, 2001, pp. 145-151.

Sherwood, K.D. *Overcome email overload with Microsoft Outlook 2000 and Outlook 2002: Get through your electronic mail faster,* World Wide Webfoot Press, Palo Alto, CA, 2002.

Shibutani, T. *Society and personality: An interactionist approach to social psychology,* Prentice-Hall, Englewood Cliffs, N.J., 1961.

Shoham, Y. "Time for action," Proceedings of the Eleventh International Joint Conference on Artificial Intelligence, IJCAI, Menlo Park, CA, 1989, pp. 954-959.

Shoham, Y. "An overview of agent-oriented programming," in: *Software agents,* J.M. Bradshaw (ed.), The AAAI Press / The MIT Press, Menlo Park, CA, 1997, pp. 271-290.

Siewiorek, D.P. "Issues and challenges in ubiquitous computing: New frontiers of application design," *Communications of the ACM* (45:12) 2002, pp. 79-82.

Spector, P.E. "Using self-report questionnaires in OB research: A comment on the use of a controversial method," *Journal of Organizational Behavior* (15:5) 1994, pp. 385-392.

Spielberg, S. "Artificial Intelligence," S. Spielberg (ed.), DreamWorks, 2002.

Sproull, L. and Kiesler, S. "Reducing social context cues: Electronic mail in organizational communications," *Management Science* (32:11) 1986, pp. 1492-1512.

Sproull, L. and Kiesler, S.B. *Connections: New ways of working in the networked organization,* The MIT Press, Cambridge, Mass, 1991.

Sproull, L., Subramani, M., Kiesler, S., Walker, J.H., and Waters, K. "When the interface is a face," *Human-Computer Interaction* (11:2) 1996, pp. 97-124.

Staniszkis, W. and Staniszkis, E. "Intelligent agent-based expert interactions in a knowledge management portal," Proceedings of the Second International Conference on Electronic Government, Prague, Czech Republic, 2003.

Starbuck, W.H. and Webster, J. "When is play productive?," *Accounting, Management and Information Technologies* (1:1) 1991, pp. 71-90.

Steffen, T.H. *A positive approach to measuring attitudes towards computers: Microcomputer playfulness and computer efficacy in an industrial setting,* Doctoral Dissertation. University of Sarasota, Sarasota, FL, 1998, p. 100.

Straub, D., Boudreau, M.-C., and Gefen, D. "Validation guidelines for IS positivist research," *Communications of the Association for Information Systems* (13, Article 24) 2004, pp. 1-80.

Straub, D.W. "Validating instruments in MIS research," *MIS Quarterly* (13:2) 1989, pp. 147-169.

Strauss, A.L. *Qualitative analysis for social scientists,* Cambridge University Press, Cambridge, MA, 1987.

Strauss, A.L. and Corbin, J. *Basics of qualitative research: Techniques and procedures for developing grounded theory*, (2 ed.) Sage Publications, Thousand Oaks, CA, 1998.

Subramanian, G.H. "A replication of perceived usefulness and perceived ease of use measurement," *Decision Sciences* (25:5,6) 1994, pp. 863-874.

Sumi, Y. and Mase, K. "AgentSalon: Supporting new encounters and knowledge exchanges by chats of personal agents," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Seattle, Washington, 2001, pp. 191-192.

Suzuki, N., Ishii, K., and Okada, M. "Talking Eye: Autonomous creature as accomplice for human," Proceedings of the 3rd Asia Pacific Conference on Computer Human Interaction, IEEE Computer Society, Shonan Village Center , Japan, 1998, pp. 409-414.

Svensson, M., Persson, P., and Höök, K. "Using narratives, humor, and social navigation: An inspection of two systems," Proceedings of the Workshop on Attitude, Personality and Emotions in User-Adapted Interaction, Banff, Alberta, Canada, 1999.

Szajna, B. "Software evaluation and choice: Predictive validation of the technology acceptance instrument," *MIS Quarterly* (18:3) 1994, pp. 319-324.

Szajna, B. "Empirical evaluation of the revised Technology Acceptance Model," *Management Science* (42:1) 1996, pp. 85-92.

Tacit "Tacit KnowledgeMail," Tacit Knowledge Systems, Inc. Available at http://www.tacit.com/products/knowledgemail/. Accessed March 05, 2003, 2003.

Tai, H. and Yamamoto, G. "An agent server for the next generation of Web applications," Proceedings of the 11th International Workshop on Database and Expert Systems Applications, IEEE Computer Society, London, UK, 2000, pp. 717-721.

Takeuchi, A. and Nagao, K. "Communicative facial displays as a new conversational modality," Proceedings of the Conference on Human Factors in Computing Systems, The ACM Press, Amsterdam, The Netherlands, 1993, pp. 187-193.

Takeuchi, A. and Naito, T. "Situated facial displays: Towards social interaction," Proceedings of the Conference on Human factors in Computing Systems, The ACM Press, Denver, Colorado, 1995, pp. 450-455.

Tan, M. and Teo, T.S.H. "The diffusion of the Internet in a pro-IT cultural environment: A content analysis of the Singapore experience," *Communications of the Association for Information Systems* (2:3, Article No. 6) 1999.

Tannen, D. *You just don't understand: Women and men in conversation,* Morrow, New York, 1990.

Tannen, D. *Gender and discourse,* Oxford University Press, New York, 1996.

Tannenbaum, R.S. *Theoretical foundations of multimedia,* Computer Science Press, N.Y., 1998.

Tay, C. and Ang, S. "User competence in information technology: A critical incident analysis," Proceedings of the IEEE Region 10's Ninth Annual International Conference, Singapore, 1994, pp. 25-32.

Taylor, S. and Todd, P. "Assessing IT usage: The role of prior experience," *MIS Quarterly* (19:4) 1995a, pp. 561-570.

Taylor, S. and Todd, P. "Understanding information technology usage: A test of completing models," *Information Systems Research* (6:2) 1995b, pp. 144-176.

Teo, T.S.H. "Demographic and motivation variables associated with Internet usage activities," *Internet Research: Electronic Networking Applications and Policy* (11:2) 2001, pp. 125-137.

Teo, T.S.H., Lim, V.K.G., and Lai, R.Y.C. "Intrinsic and extrinsic motivation in Internet usage," *Omega: International Journal of Management Science* (27:1) 1999, pp. 25-37.

Terveen, L.G. and Murray, L.T. "Helping users program their personal agents," Proceedings of the ACM Conference on Human Factors in Computing Systems, The ACM Press, Vancouver, British Columbia, Canada, 1996, pp. 355-361.

Thai, B., Wan, S., and Seneviratne, A. "Executions of 'home applications' and service customizations in Integrated Personal Mobility Architecture," Proceedings of the Seventh International Symposium on Computers and Communications, IEEE Computer Society, Taormina-Giardini Naxos, Italy, 2002, pp. 321-326.

Thatcher, J.B. and Perrewe, P.L. "An empirical examination of individual traits as antecedents to computer anxiety and computer self-efficacy," *MIS Quarterly* (26:4) 2002, pp. 381-396.

Thong, J.Y., Hong, W., and Tam, K.-Y. "Understanding user acceptance of digital libraries: What are the roles of interface characteristics, organizational context, and individual differences?," *International Journal of Human-Computer Studies* (57:3) 2002, pp. 215-242.

Tiburon *ePrompter - Email Retrieval and Notification Program,* Tiburon Technology, Inc. Available at http://www.eprompter.com/. Retrieved March 12, 2003, 2003.

Tornatzky, L.G., Fleischer, M., and Chakrabarti, A.K. *The processes of technological innovation,* Lexington Books, Lexington, Massachusetts, 1990.

Trevino, L.K., Daft, R.L., and Lengel, R.H. "Understanding managers' media choices: A symbolic interactionist perspective," in: *Organizations and communications technologies,* J. Fulk and C.W. Steinfield (eds.), Sage Publications, Newbury Park, 1990, pp. 71-94.

Tsai, C.J., Tseng, S.S., and Cheng, H.T. "Personal rules generation for intelligent e-mail service system," *Engineering Intelligent Systems for Electrical Engineering and Communications* (8:2) 2000, pp. 127-135.

Tsutsui, T. and Ishizuka, M. "A multimodal presentation markup language MPML with controlling functions of character agent," *Transactions of the Information Processing Society of Japan* (41:4) 2000, pp. 1124-1133.

Turel, O. and Serenko, A. "User satisfaction with mobile services in Canada," Proceedings of the Third International Conference on Mobile Business, New York, 2004.

Urquhart, C., Light, A., Thomas, R., Barker, A., Yeoman, A., Cooper, J., Armstrong, C., Fenton, R., Lonsdale, R., and Spink, S. "Critical incident technique and explicitation interviewing in studies of information behavior," *Library & Information Science Research* (25:1) 2003, pp. 63-88.

van der Heijden, H. "Factors influencing the usage of websites: The case of a generic portal in The Netherlands," *Information & Management* (40:6) 2003, pp. 541-549.

van Dolen, W.M. and de Ruyter, K. "Moderated group chat: An empirical assessment of a new e-service encounter," *International Journal of Service Industry Management* (13:5) 2002, pp. 496-511.

van Mulken, S., André, E., and Müller, J. "The persona effect: How substantial is it?," Proceedings of the Human-Computer Interaction Conference on People and Computers XIII, Springer-Verlag, Berlin, Germany, 1998, pp. 53-66.

Venkatesh, V. "Creation of favorable user perceptions: Exploring the role of intrinsic motivation," *MIS Quarterly* (23:2) 1999, pp. 239-260.

Venkatesh, V. "Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the Technology Acceptance Model," *Information Systems Research* (11:4) 2000, p. 342–365.

Venkatesh, V. and Brown, S.A. "A longitudinal investigation of personal computers in homes: Adoption determinants and emerging challenges," *MIS Quarterly* (25:1) 2001, pp. 71-102.

Venkatesh, V. and Davis, F.D. "A model of the antecedents of perceived ease of use: Development and test," *Decision Sciences* (27:3) 1996, pp. 451-481.

Venkatesh, V. and Davis, F.D. "A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies," *Management Science* (46:2) 2000, pp. 186-204.

Venkatesh, V. and Morris, M.G. "Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior," *MIS Quarterly* (24:1) 2000.

Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F. "User acceptance of information technology: Towards a unified view," *MIS Quarterly* (27:3) 2003, pp. 425-478.

Venkatesh, V., Speier, C., and Morris, M.G. "User acceptance enablers in individual decision making about technology: Toward an integrated model," *Decision Sciences* (33:2) 2002, pp. 297-316.

Vorderer, P. "It's all entertainment – sure. But what exactly is entertainment? Communication research, media psychology, and the explanation of entertainment experiences," *Poetics* (29:4-5) 2001, pp. 247-261.

Vornbrock, B.M. "Encouraging spontaneity in innovation," Proceedings of the International Conference on Engineering and Technology Management:

Management Issues and Challenges in the Third Millennium, IEEE, San Juan, PR, 1998, pp. 308-310.

Voss, I. "The semantic of episodes in communication with the anthropomorphic interface agent MAX," Proceedings of the 9th International Conference on Intelligent User Interface, The ACM Press, Funchal, Madeira, Portugal, 2004, pp. 343-345.

Wachter, R. "The effect of gender and communication mode on conflict resolution," *Computers in Human Behavior* (15:6) 1999, pp. 763-782.

Walker, J.H., Sproull, L., and Subramani, R. "Using a human face in an interface," Proceedings of the Conference on Human factors in Computing Systems: Celebrating Interdependence, The ACM Press, New York, 1994, pp. 85-91.

Wang, K.-C., Hsieh, A.-T., and Huan, T.-C. "Critical service features in group package tour: An exploratory research," *Tourism Management* (21:2) 2000, pp. 177-189.

Wanous, J.P., Reichers, A.E., and Hudy, M.J. "Overall job satisfaction: How good are single-item measures?," *Journal of Applied Psychology* (82:2) 1997, pp. 247-252.

Weber, R.P. *Basic content analysis*, (2 ed.) Sage Publications, Newbury Park, CA, 1990.

Webster, J. "Making computer tasks at work more playful: Implications for systems analysts and designers," Proceedings of the ACM Special Interest Group on Computer Personnel Research Annual Conference on Management of Information Systems Personnel, The ACM Press, New York, 1988, pp. 78-87.

Webster, J. and Ho, H. "Audience engagement in multimedia presentations," *The Data Base for Advances in Information Systems* (28:2) 1997, pp. 63-77.

Webster, J. and Martocchio, J.J. "Microcomputer playfulness: Development of a measure with workplace implications," *MIS Quarterly* (16:2) 1992, pp. 201-226.

Webster, J. and Martocchio, J.J. "Turning work into play: Implications for microcomputer software training," *Journal of Management* (19:1) 1993, pp. 127-146.

Webster, J. and Trevino, L.K. "Rational and social theories as complementary explanations of communication media choices: Two policy-capturing studies," *Academy of Management Journal* (38:6) 1995, pp. 1544-1572.

Webster, J., Trevino, L.K., and Ryan, L. "The dimensionality and correlates of flow in human-computer interactions," *Computers in Human Behavior* (9:4) 1993, pp. 411-426.

Weinstein, L. "Inside risks: Spam wars," *Communications of the ACM* (46:8) 2003, p. 136.

Whittaker, S. and Sidner, C. "Email overload: Exploring personal information management of email," in: *Culture of the Internet,* S. Kiesler (ed.), Lawrence Erlbaum Associates, Mahwah, N.J., 1997, pp. 277-295.

Wiedenbeck, S. and Davis, S. "The influence of interaction style and experience on user perceptions of software packages," *International Journal of Human Computer Studies* (46:5) 1997, pp. 563-588.

Wills, G., Alani, H., Ashri, R., Crowder, R., Kalfoglou, Y., and Kim, S. "Design issues for agent-based resource locator systems," Proceedings of the Fourth Conference on Practical Aspects of Knowledge Management, Springer-Verlag Heidelberg, Vienna, Austria, 2002, pp. 156-168.

Wold, H. "Soft modeling: The basic design and some extensions," in: *Systems under indirect observation: Causality, structure, prediction. Part II.,* K.G. Jöreskog and H. Wold (eds.), North-Holland Publishing Company, Amsterdam, The Netherlands, 1982, pp. 1-54.

Woszczynski, A.B., Roth, P.L., and Segars, A.H. "Exploring the theoretical foundations of playfulness in computer interactions," *Computers in Human Behavior* (18:4) 2002, pp. 369-388.

Woszczynski, A.B. and Whitman, M.E. "The problem of common method variance in IS research," in: *The handbook of information systems research,* M.E. Whitman and A.B. Woszczynski (eds.), Idea Group Publishing, Hershey, PA, 2004, pp. 66-77.

Wynekoop, J.L. and Walz, D.B. "Revisiting the perennial question: are IS people different?," *Data Base for Advancements in Information Systems* (29:2) 1998, pp. 62-72.

Xiao, J., Stasko, J., and Catrambone, R. "An empirical study of the effect of agent competence on user performance and perception," Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems, The ACM Press, New York, 2004, pp. 178-185.

Yager, S.E., Kappelman, L.A., Maples, G.A., and Prybutok, V.R. "Microcomputer playfulness: Stable or dynamic trait?," *Communications of the ACM* (28:2) 1997, pp. 43-52.

Yammarino, F.J., Skinner, S.J., and Childers, T.L. "Understanding mail survey response behavior: A meta-analysis," *Public Opinion Quarterly* (55:4) 1991, pp. 613-639.

Yates, J. and Orlikowski, W.J. "Genres of organizational communication: A structurational approach to studying communication and media," *The Academy of Management Review* (17:2) 1992, pp. 299-326.

Yin, R.K. *Case study research: Design and methods*, (3 ed.) Sage Publications, Thousand Oaks, CA, 2003.

Zmud, R.W. "Individual differences and MIS success: A review of the empirical literature," *Management Science* (25:10) 1979, pp. 966-979.