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RESEARCH ARTICLE

Trust in and Adoption of Online Recommendation Agents*

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Abstract

Online product recommendation agents are becoming increasingly prevalent on a wide range of websites. These agents assist customers in reducing information overload, providing advice to find suitable products, and facilitating online decision-making. Consumer trust in recommendation agents is an integral factor influencing their successful adoption.

However, the nature of trust in technological artifacts is still an under-investigated and not well understood topic. Online recommendation agents work on behalf of individual users (principals) by reflecting their specific needs and preferences. Trust issues associated with online recommendation agents are complicated. Users may be concerned about the competence of an agent to satisfy their needs as well as its integrity and benevolence in regard to acting on their behalf rather than on behalf of a web merchant or a manufacture. This study extends the interpersonal trust construct to trust in online recommendation agents and examines the nomological validity of trust in agents by testing an integrated Trust-TAM (Technology Acceptance Model). The results from a laboratory experiment confirm the nomological validity of trust in online recommendation agents. Consumers treat online recommendation agents as "social actors" and perceive human characteristics (e.g., benevolence and integrity) in computerized agents. Furthermore, the results confirm the validity of Trust-TAM to explain online recommendation acceptance and reveal the relative importance of consumers' initial trust vis-à-vis other antecedents addressed by

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TAM (i.e. perceived usefulness and perceived ease of use). Both the usefulness of the agents as "tools" and consumers' trust in the agents as "virtual assistants" are important in consumers' intentions to adopt online recommendation agents.

Keywords: Trust, Technology Adoption Model (TAM), recommendation agents, online decision support, online shopping

Introduction

Good customer service and support are the key factors that attract consumers and keep them loyal to an online store (Reibstein, 2002). Currently, the proliferation of and advances in Web-based technologies are providing many opportunities for online firms to better serve their customers. In particular, online recommendation agents are becoming increasingly available on websites to provide customers with shopping assistance (Rust and Kannan, 2003), to help buyers and sellers reduce information overload (Maes, 1994), and to improve consumers' decision quality (Haubl and Trifts, 2000). Acting on behalf of consumers, recommendation agents provide advice to assist in shopping activities (Maes et al., 1999). Without proper support, in contrast, consumers may be limited in their abilities to evaluate products, inasmuch as they cannot consult with salespeople as they can in conventional shopping environments (Kim and Yoo, 2000). Thus, the challenge of choosing a product on the Web can be alleviated by an interface with a recommendation agent that guides and directs customer choices (Grenci and Todd, 2002).

Content-filtering product recommendation agents are one type of agent. They are software entities that carry out some set of operations on behalf of consumers, or another program, and provide shopping advice about what product(s) consumers should purchase based on their needs and/or preferences (Ansari et al., 2000). Such agent technologies, for example those provided by www.ActiveDecisions.com, have been utilized to provide value-added services for consumers in a variety of firms, including Yahoo! and Amazon.com.

However useful these recommendation agents are, one of the most prominent issues involved in their adoption is *consumers' trust* in them. Consumers delegate a range of tasks to the agents that act on their behalf. If consumers do not trust the agents, they are likely to reject their recommendations and advice. Moreover, trust is becoming increasingly important in online shopping environments because there are no guarantees that the e-vendors or agent providers will refrain from opportunistic behaviors (e.g., by taking advantage of consumers and providing biased recommendations), and no cues available to assess the quality of recommendation services (Gefen et al., 2003b). In a focus group experiment, Andersen, Hansen and Andersen (2001) found that trust in recommendation agents is the most important expectation users have.

Nevertheless, the nature of trust in technological artifacts such as online recommendation agents is still an under-studied area: are the dimensions of trust in the agents similar to those of interpersonal trust? Furthermore, when consumers interact with the online recommendation agents provided in e-vendors' websites, do they form their trust in the agents or in the e-vendors? If consumers form their trust in the agents, how important is the social and relational aspect of trust in their decision to adopt the agents?

This paper focuses on *initial* trust beliefs that are formed after customers have a first experience with online recommendation agents. While we recognize the importance of the evolving nature of trust, our focus on initial trust is justified for two main reasons. First, when consumers are not familiar with online recommendation agents during the initial contact, their perceptions of uncertainty and risk about using computer agents are especially salient (McKnight et al., 2002b). Therefore, sufficient initial trust in agents is needed to overcome these perceptions. Although initial trust beliefs may grow or change over time and with repeated interactions (McKnight et al., 1998; Rempel et al., 1985), consumers will first determine the extent to which future interactions will take place (Koufaris and Hampton-Sosa, 2004; McKnight et al., 2002b). Second, consumers' low switching costs in online environments and Web vendors' high costs to attract new customers lead to the conclusion that it is important for vendors to gain high initial trust from consumers (Koufaris and Hampton-Sosa, 2004). Otherwise, consumers can easily switch to other websites. Hence, we believe an examination of initial trust is important in online environments.

The present study extends previous observations about interpersonal trust by applying it to trust in technological artifacts. It considers the nature of the technology being studied as well as the online context, and it empirically examines the nomological validity of trust in agents by testing the integrated Trust-TAM model for online recommendation agents. In so doing, this research reveals the relative importance of initial trust vis-à-vis other use antecedents in TAM, i.e. *perceived usefulness* (PU) and *perceived ease of use* (PEOU), in consumers' adoption of online recommendation agents. The research results indicate that interpersonal trust applies to trust in online recommendation agents, and consumers' initial trust plays an important role in their decisions to adopt online recommendation agents.

The next section of this paper reviews the existing literature on trust in technological artifacts and develops hypotheses to be tested in the present study. Section 3 describes the research method used to test these hypotheses, and we report the results in section 4. We conclude with a discussion of the results and limitations of this paper and the implications of the findings.

Literature Review and Hypothesis Development

Trust in Technological Artifacts and Online Recommendation Agents

The importance of trust in online environments has been addressed in many studies (e.g., Gefen et al., 2003b; Jarvenpaa et al., 2000; McKnight and Chervany, 2001; Pavlou, 2003)). However, the trust targets in most prior studies are humans, and the nature and role of trust in technological artifacts remain unclear. Trust is a social construction that originates from interpersonal relationships (Sztompka, 1999). The connection between trust and technological artifacts has been the subject of debate in many studies that have explored whether or not technological artifacts can be recipients of trust, and if it is valid to ascribe human characteristics to technological artifacts (Chopra and Wallace, 2003; Corritore et al., 2003).

Some researchers have been opposed to attributing trustworthiness to technological artifacts and have argued that recipients of trust must possess consciousness and agency (Friedman et al., 2000). Humans exhibit these faculties, but "technological artifacts have

not yet been produced in substance and structure that warrant in any stringent sense the attribution of consciousness or agency" (Friedman et al., 2000 , p.36). Friedman and Millett (1997) have reported that among the 29 male undergraduate computer science majors they interviewed, 83 percent attributed aspects of agency – either decision-making or intentions – to computers, but only 21 percent consistently held computers *morally responsible* for errors. Thus, the study concluded that users are not totally engaged in social relationships with technology, given that computers are not perceived as completely responsible for the consequences of their use.

Other researchers have agreed that users attribute human characteristics to technological artifacts, but this has been accepted with a measure of caution. Kiesler and Sproull (1997) have argued that any such attribution is an "*as if*" response rather than a true attribution of humanity, i.e., the characterization "may not extend much further than the situation in which the user is tested" (pp. 196-197). Reeves and Nass (1996) have found that *after* participating in controlled experiments, individuals might think that their social behavior toward technological artifacts and the personality they have assigned to the technology are not wholly appropriate. Arguably, computers do not have motivations involving a "self" and dispositions toward social relationships. Nevertheless, it has been demonstrated empirically that people indeed perceive some human properties in technological artifacts *during* their interactions with the technology (Dryer, 1999; Reeves and Nass, 1996).

The other side of the academic debate, favoring the attribution of trustworthiness to technological artifacts, is supported by a large amount of evidence. Conceptually, Sztompka (1999) has argued that trust in a person and trust in a technology are not fundamentally different, because behind all human-made technologies, there stand people who design, operate, and control them. Empirically, Reeves and Nass are among the most prominent researchers who have argued convincingly that people treat computers as social actors and apply social rules to them (Reeves and Nass, 1996). After conducting more than 30 empirical studies on this issue, they have found that even technologically sophisticated people treat technological artifacts (e.g., computers) as if they were human beings, rather than simple tools. People are polite to computers, respond to praise they receive from computers, view them as teammates, and easily assign personalities (e.g., dominance, friendliness and helpfulness) to them. Such social responses apply not only to sophisticated conversational computer agents (Cassell and Bickmore, 2000), but even to computer systems with simple text interfaces (Nass et al., 1997; Reeves and Nass, 1996). Thus, there is ample and convincing evidence that justifies the treatment of technological artifacts as recipients of social and relational aspects of trust. Furthermore, a variety of studies has extended the attribute of trustworthiness to abstract and technical systems, as well as intelligent computer agents (Komiak and Benbasat, 2004; Muir and Moray, 1996). For example, Muir and his collaborators (e.g., Muir, 1987; Muir, 1994; Muir and Moray, 1996) have included a dimension of *morality* (e.g., responsibility) in their definition of trust in machines and automation. In their experiments, participants were able to evaluate the responsibility of machines in processes of building users' trust. Similarly, in a study of embodied conversational agents by Cassell and Bickmore (2000), trust was defined as a composite of *benevolence* and *credibility*. An agent's benevolence was demonstrated through past examples of benevolent behavior such as third-party affiliations or participation in interaction-based social rituals, such as greetings. Additionally, empirical evidence has indicated that there are no significant differences between the *components* of trust in humans and those in technological artifacts. Notably, Jian, Bisantz and Drury (2000) conducted a word-elicitation study to understand the similarities and differences among human-human trust, trust in human-machine relationships, and trust in general.

Their results indicate that particular components of trust are *similar* across these three types of trust (i.e., human-human trust, trust in human-machine relationships, and trust in general). Even in cases of trust in machines, participants use words like "integrity," "honesty," "cruelty," and "harm" to characterize machine behavior.

To summarize, while it may at first appear debatable that technological artifacts can be objects of trust, and that people assign human properties to them, evidence from a variety of relevant literature supports this argument. People respond socially to technological artifacts and perceive that they possess human characteristics (e.g., motivation, integrity, and personality). In particular, research findings have demonstrated that components of trust in humans and in technological artifacts do not differ significantly. This indicates that people not only utilize technological artifacts as tools, but also form social and trusting relationships with them.

Based on supporting evidence, we define trust in online recommendation agents as an extension of interpersonal trust that has been extensively studied in the recent literature of IS and other disciplines.

Adapting the definitions of trust from Xiao and Benbasat (2002) and McKnight et al. (2002a), the current study defines trust in a recommendation agent as an individual's beliefs in an agent's competence, benevolence, and integrity. These three trusting beliefs have been well accepted in many recent studies (McKnight et al., 2002a). According to McKnight et al. (2002a), *competence-belief* means that an individual believes that the trustee has the ability, skills, and expertise to perform effectively in specific domains; *benevolence-belief* means that an individual believes that the trustee cares about her and acts in her interests; and *integrity-belief* means that an individual believes that the trustee adheres to a set of principles (e.g., honesty and promise keeping) that she finds acceptable. As mentioned earlier, our study concentrates on initial trust. Generally the definition of trust discussed here applies to different temporal contexts including the initial stage of trust formation (Koufaris and Hampton-Sosa, 2004). More detailed discussions of the meaning of trust and general approaches to conceptualizing it can be found in several other studies that have comprehensively reviewed the trust literature (e.g., Gefen et al., 2003b; Mayer et al., 1995; McKnight et al., 2002a).

However, the *nomological validity* of trust in technological artifacts has not been empirically examined yet. That is, if consumers form their trust in online recommendation agents, trust in agents should correlate with other consumer beliefs and be able to predict consumer behavior (e.g., agent adoptions). However, little empirical evidence exists regarding whether people form their trust in humans (e.g., designers or e-vendors) only or in recommendation agents as well. The former is backed by Sztompka (1999), who argues that it is the designers and operators of the technology who are ultimately endowed with users' trust, while the latter is supported by the Theory of Social Response to Computers (Reeves and Nass, 1996). Furthermore, empirical testing is needed regarding whether or not all of the three trusting beliefs discussed earlier hold true for online recommendation agents. It is possible that consumers may attribute different trusting beliefs to different trust objects (technology versus human). Therefore, the relative importance of the three trusting beliefs in agents might be different. To examine the nomological validity of trust in agents and reveal the relative importance of different trusting beliefs, we tested an integrated Trust-TAM in the context of online recommendation agents.

Agent Adoption: An Integrated Trust-TAM

TRA (Ajzen and Fishbein, 1980) is generally recognized as the best starting point for studying determinants of individuals' behavior, including their adoption of technology (Sheppard et al., 1988). TAM, which is based on TRA, identifies two key use antecedents (i.e., PU and PEOU) for users' adoption of a technology. The predictive power of PU and PEOU for individuals' technology acceptance has been empirically confirmed by numerous studies (e.g., Lee et al., 2003). A comprehensive discussion is found in Venkatesh et al. (2003).

Previous TAM studies have examined a variety of information technologies (IT) (Venkatesh et al., 2003). In particular, Gentry and Calantone (2002) tested three models explaining behavioral intentions to adopt shopbots (recommendation agents): Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), Theory of Planned Behavior (TPB) (Ajzen, 1985; Ajzen, 1989; Ajzen, 1991), and TAM (Davis, 1989). They found that TAM explains more variance of shopbot adoption than TRA and TPB.

Online recommendation agents are, in essence, Web-based technologies. Consumers can use recommendation agents to get shopping advice regarding what product to buy as well as where to buy it. The virtual advisor investigated in this study is owned by the e-vendor and only provides shopping advice on what product to buy.

According to TAM, more useful and easy to use agents will be employed more readily. Additionally, PU is influenced by the amount of effort users must expend to use the technology (Davis, 1989). An agent that requires less effort and is easier to use will be perceived to be more useful. Therefore,

> H_1: PU of an online recommendation agent will positively affect consumers' intentions to adopt the agent.
> H_2: PEOU of an online recommendation agent will positively affect consumers' intentions to adopt the agent.
> H_3: PEOU of an online recommendation agent will positively affect PU of the agent.

Although TAM is considered to be the dominant model for Information Technology (IT) acceptance research (Gefen et al., 2003b; Koufaris, 2002), as pointed out by Davis (1989), more research is needed to address how other variables may influence usefulness, ease of use, and acceptance. In addition to the constructs that are part of the TRA and TPB, other factors that contribute to the explanatory power of TAM could be considered in light of user characteristics, task contexts, and the nature of particular technologies (Moon and Kim, 2001). We identify these factors in Appendix A, which provides a non-exhaustive summary of studies that have focused on TAM and its extensions.[1]

To account for user characteristics, researchers have examined TAM with the inclusion of constructs such as gender (Gefen et al., 1997; Venkatesh and Morris, 2000), culture (Gefen et al., 1997), training and prior experience with the technology being studied (Davis, 1989; Davis et al., 1989; Gefen et al., 2003a; Igbaria et al., 1995; Taylor and Todd, 1995a; Venkatesh and Morris, 2000; Venkatesh et al., 2003), and Web skills (Koufaris, 2002).

[1] Due to the large number of articles that have been published using TAM, an exhaustive review of TAM studies is beyond the scope of this study.

With regard to contexts, issues that have been studied include: 1) voluntary versus mandatory use (e.g., Venkatesh et al., 2003), and 2) offline versus online use for work or shopping (e.g., Gefen et al., 2003b). Recently, a growing number of studies have examined TAM in the context of online shopping. A key question here is whether or not online consumers think and behave differently from their offline counterparts, and researchers have identified several characteristics of online environments that may lead them to do so.

First, the impersonal and virtual nature of the Internet involves a physical distance between buyers and sellers, and between buyers and products in online shopping environments (Ba, 2001; Yoon, 2002). The distance between buyers and products is emphasized by the absence of direct methods for online buyers to evaluate products, whereas in physical stores they can understand products better by touching or feeling them. Furthermore, online shopping environments lack human network attributes. Unlike physical shopping environments, where consumers can communicate with salespersons face-to-face, on the Internet fewer audio, visual, and other sensory channels are available for consumers to interact with salespersons and vendors. Consumers are consequently less able to judge product quality and vendor credibility prior to completing purchases, hence facing high uncertainty in their online shopping (e.g., Ba, 2001).

Second, online shopping environments have produced a new spectrum of unregulated activities, but e-vendor behavior is difficult to monitor, and legislation governing online shopping, both in substance and enforcement, is still far from mature (Hamelink, 2001). E-vendors can easily take advantage of online consumers (Gefen et al., 2003b), generating high consumer risk.

Third, online consumers can easily switch among different online vendors, and thus can access more product and vendor choices. This makes consumers more powerful. Consequently, for e-vendors, maintaining high consumer loyalty is difficult in online shopping environments (Koufaris, 2002). Simultaneously, it compels buyers to consider more options, making their decision-making processes more complicated (Maes et al., 1999).

Researchers have considered the nature of online environments, consequently extending TAM with constructs such as *trust* (Gefen et al., 2003a; Gefen et al., 2003b), *playfulness* (Moon and Kim, 2001), and *flow* (Koufaris, 2002). Specifically, trust is well-recognized as a key success factor for e-commerce (e.g., Gefen et al., 2003b; McKnight and Chervany, 2001; Ratnasingham, 1998; Urban et al., 2000). Research has shown that trust can effectively address the main issues in relation to the three characteristics discussed above by reducing environmental uncertainty, complexity, and risk, and by enhancing consumer loyalty (Jarvenpaa and Tractinsky, 1999; Jarvenpaa et al., 2000). If online shoppers do not trust an e-vendor, they will generally stay away from its online store (Jarvenpaa and Tractinsky, 1999; Reichheld and Schefter, 2000).

Arguably, the issues related to the online context also apply to online recommendation agents. Therefore, as asserted by Gefen et al. (2003a; 2003b), in the present study, trust is expected to operate as an antecedent of consumers' intentions to adopt online recommendation agents.

TAM has satisfactory explanatory power for various technologies. However, the impact of the nature of particular technology utilized is not yet well understood thus there is a need for extensions of TAM.

Online recommendation agents are perceived to be more than just technologies or tools. They are virtual shopping agents and advisors. Recommendation agents elicit consumer needs and preferences and act on behalf of a principal (consumer) by reflecting her specific needs and preferences. According to Reeves and Nass's Theory of Social Responses to Computers (Reeves and Nass, 1996), consumers treat computerized agents as social actors, and form social relationships that involve trust.

Moreover, web-based recommendation agents are not owned by individual users, and there is an agency relationship between an agent and its users (Bergen and Dutta, 1992). Therefore, trust issues associated with recommendation agents are important and complicated, inasmuch as users may have concerns about the *competence* of an agent to satisfy their needs, as well as concerns about whether an agent is working on their behalf rather than on behalf of a web merchant or manufacturer. Trust can help consumers overcome these concerns, and encourage them to adopt the agents. The benevolence of agents can be engendered by informing users that the agents care about user needs and preferences, and their integrity can be promoted by providing unbiased recommendations and guidance for users (Wang and Benbasat, 2004).

In sum, although TAM can explain technology acceptance across different technologies, user populations, and contexts, the disparities between online and offline contexts and the special nature of recommendation agent technologies indicate that, in addition to PU and PEOU, trust also contributes to explaining the user acceptance of Web-based technologies for online shopping. The integrated Trust-TAM provides a framework to test the nomological validity of trust in technological artifacts. If the construct of trust in online recommendation agents- defined to include three trusting beliefs (competence, benevolence, and integrity)-is valid, it should have predictive power for consumers' adoption of the agents.

Trust has been empirically validated as an important predictor of intended website use by online shoppers (Gefen et al., 2003a; Gefen et al., 2003b; Pavlou, 2003). These studies have considered the characteristics of online shopping environments as discussed earlier, and employed trust as a proxy to deal with these characteristics. Consumers' trust in an e-vendor reduces their concerns about the uncertainty, complexity, and risk of online shopping, thus increasing their intentions to use the e-vendor's website (Gefen et al., 2003a; Gefen et al., 2003b). Gefen et al. (2003b), conducted a field study targeted at experienced online shoppers, regarding their online book- or CD-shopping experiences. They found that consumer trust in e-vendors is as important to e-commerce adoption intentions as other TAM use antecedents – PU and PEOU. In another study, Gefen et al. (2003a) conducted a free-simulation experiment to compare the relative importance of consumer trust in an e-vendor vis-à-vis TAM use antecedents for new and repeat customers. They found that repeat consumers' purchase intentions were influenced both by their trust in the e-vendor and their perceptions of the website usefulness, while potential consumers were influenced only by their trust in the e-vendor.

Trust is particularly important when consumers interact with recommendation agents for the first time and have a limited understanding of the agents' behavior. During the initial time frame, consumers' perceptions of uncertainty and risk in using the agents are

particularly salient (McKnight et al., 2002b). If consumers do not have sufficient initial trust toward a website or an online recommendation agent, they can easily switch to others (Koufaris and Hampton-Sosa, 2004). McKnight, Cummings and Chervany (1998) have found that high initial trust is not only necessary, but also pragmatic and possible. In the context of an organization, high initial trust generally exists among new employees (McKnight et al., 1998). In the online recommendation agent context, Xiao and Benbasat (2002) have found that consumers form a certain level of trust in recommendation agents from their initial interactions with them, and this initial trust significantly influences their intentions to adopt the agents, although their study examined only one antecedent (i.e., trust). Similarly, we hypothesize that:

> H_4: Initial trust in an online recommendation agent will positively affect consumers' intentions to adopt the agent.

It is worthwhile to point out that in prior studies that integrate trust into TAM, the trust objects are e-vendors rather than technologies. To the best of our knowledge, this is the first study to examine the validity of integrated Trust-TAM to explain online recommendation agent adoption with computerized agents as the object of trust. Also, prior studies examined consumers' intentions to purchase through a website, while this study focuses on consumers' intentions to adopt recommendation agents to get shopping advice. Table 1 summarizes the key differences between the Trust-TAM models examined in this study and in prior studies.

Table 1. Differences between This Study and Previous Trust-TAM Studies

	This Study	**Prior Trust-TAM Studies** (Gefen et al. 2003a; 2003b; Pavlou 2003)
Trust Targets	Online recommendation agents	e-vendors
PU and PEOU Targets	Online recommendation agents	Websites
Behavioral Intentions	Intentions to adopt agents to get shopping advice	Intentions to use a website and purchase on the website

Trust should also increase the perceived usefulness (PU) of online recommendation agents. Prior research has demonstrated that PU is determined by at least two factors. The first is the PEOU of the agent as predicted in H_3, and the other is the benefits that users expect to achieve from using agents (Davis, 1989; Gefen et al., 2003b). Users may perceive that agents are untrustworthy for a number of reasons: 1) they may not have appropriate expertise in the task domain, 2) they may function in the interests of web merchants or manufacturers rather than those of consumers, 3) they may lack integrity. Thus, consumers will believe that benefits will not be easily derived from these agents, and be less likely to adopt them, perhaps even seeing their adoptions as detrimental. The existence of an agency relationship between agents and their consumers determines that

such situations are likely to occur (Wang and Benbasat, 2003). Consumer concerns regarding these issues are not uncommon given the potential harmful opportunistic behavior and higher risks inherent in online environments (Gefen et al., 2003b). As a result, consumers' expectations of gaining benefits from using agents, leading to their perceptions of usefulness, largely depend on their trust in the agents.

> H_5: Initial trust in an online recommendation agent will positively affect PU of the agent.

The integrated Trust-TAM model investigated by Gefen et al. (2003b) also suggests that PEOU increases trust. Gefen et al. have argued that this impact is generated through consumer perceptions that a web merchant is investing in relationships with consumers, and by doing so, the merchant "signals a commitment to the relationship" (p. 65). This argument also applies to online recommendation agents. Ease of use demonstrates that agent providers have expended effort in designing the agents, and that they care about users. Conversely, users may perceive difficult-to-use agents as less capable and less considerate, and thus they may lower their trust in the agents.

> H_6: PEOU in an online recommendation agent will positively affect trust in the agent.

Research Method

Experimental Platform

We collected the data used to test the integrated Trust-TAM model for online recommendation agents through a laboratory experiment. We developed recommendation agent that provides shopping advice for digital cameras, simulating those found in other studies (Russo, 2002) and in leading commercial applications (e.g., www.ActiveDecisions.com and www.DealTime.com). Building a new agent rather than using one that is currently available from a commercial website ensured that the agent would be new to all participants, hence the study would remain focused on their initial trust in the agent.

One of the most popular approaches to elicit consumers' needs and preferences for products is to employ agent-user dialogues (Russo, 2002), where consumers answer questions regarding their needs and product preferences, and the agents provide shopping recommendations based on their answers. Figure 1 is a screen shot of the agent-user dialogue in the experimental platform developed for the current study, and Figure 2 gives an example of shopping recommendations arising from the agent-user dialogue.

One of our experimental objectives was to test to what extent trust in the agents can be enhanced by having the agent provide three types of explanation facilities (why explanations, how explanations, and guidance: see Figures 1 and 2) using a 2x2x2 full factorial design, where each explanation type was available or not (for details see Wang and Benbasat, (2003; 2004). Hence, the 2x2x2 design generated eight cells with different levels and combinations of explanation facilities.

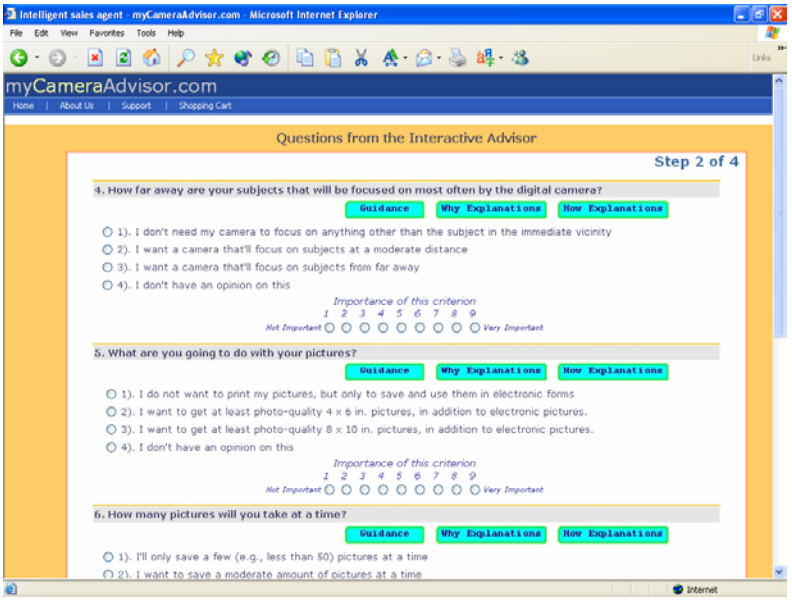

Figure 1. Agent-User Dialogue from the Experimental Agent

Figure 2. Recommendations from the Experimental Agent

Explanations have been one of the critical components of intelligent and knowledge-based systems (KBSs) since their inception (Gregor and Benbasat, 1999). They provide information to KBS users regarding why the KBS asked certain questions and how it reached conclusions. By virtue of making the performance of a system transparent to users, they influence user trust in and acceptance of the systems (Gregor and Benbasat, 1999; Hayes-Roth and Jacobstein, 1994). Wang and Benbasat (2003; 2004) have empirically confirmed that consumer trust in recommendation agents differs with different

levels of explanation facilities provided in the agents. Gregor and Benbasat (1999) also posit that KBS explanation use will lead to favorable perceptions, including increased perceived usefulness of the KBS. Hence, we expected to find variances in the trust and PU scores based on the availability of different types of explanation facilities, though not for PEOU of the agent. The results described in detail in Wang and Benbasat (2003; 2004) indicate that explanations influenced the variance in trust, but not in PU or PEOU. The distribution of the scores for the three variables showed an adequate level of variance for the purposes of model testing: average trust scores ranged from 3 to 8 (on a 9 point scale) with a mean of 5.92 and s.d. of 1.06, PU ranged from 3 to 8 with a mean of 5.68 and s.d. of 1.06, and PEOU ranged from 4 to 9 with a mean of 6.87 and s.d. of 1.02.

Participants, Incentives, and Experiment Tasks and Procedures

We recruited a total of 120 students in a large North American university for the study. To avoid potential biases in their evaluations, we only invited individuals who did not already own digital cameras to participate in the study. This filtering is further justified because most consumers may need extra shopping advice when they first buy a complex product, such as a digital camera, and might not have sufficient relevant expertise and experience to make satisfactory decisions. We randomly assigned participants to the eight experimental conditions described in the previous section.

The experiment proceeded as follows. A research assistant first trained participants how to use and navigate the Web interface assigned to them, using a tutorial agent possessing the same features as the experimental agent. During the training session, no participants reported that they had used the agent before. Next, we asked each participant to finish two tasks, first choosing a digital camera for a good friend and then selecting another camera for a close family member. We counter-balanced the order of the two tasks. After completing each task, we directed the participants to an online form to record and explain their choices. No time limit was placed on either of the tasks. We used two tasks instead of one in order to ensure that participants interacted with the agent sufficiently to offer informed judgments about the agent.[2] Finally, after they finished the two tasks, we asked the participants to complete a questionnaire, which included items to measure the experiment's dependent variables.

We guaranteed monetary compensation for each participant's participation ($15), and in order to motivate them to view the experiment as a serious online shopping session and to increase their involvement, we offered the top 25 percent of performers an extra amount ($25), and offered the participant with the best performance $200. We told the participants before the experiment that they would be asked to provide their justifications for their choices and that we would judge their performance based on these justifications. The main criterion for the judgment was the extent to which participants' justifications were appropriate and convincing to support their choice of a particular digital camera.

Measures

This study uses existing validated scales for all constructs. We assessed all of the items on a nine-point scale, ranging from Strongly Disagree (1) to Strongly Agree (9). Measurements of PU, PEOU, and intention to adopt have been adapted from Davis's

[2] Our pilot test showed that many participants were not very confident in evaluating the agent after completing only one task. After two tasks, participants' evaluations of the recommendation agents reached relatively stable levels, and they had no difficulties in answering the questionnaire.

scale (Davis, 1989). Measurements of trust, which is defined to include three trusting beliefs – the competence, the benevolence, and the integrity of an agent, have been developed and validated by Xiao and Benbasat (2002). We list all measurement items used in Appendix B, and report the construct means and standard deviations in Table 2.

Table 2. Construct Attributes

Variable	Mean	s.d.	Composite Reliability	Cronbach Alpha	1	2	3	4	5	6
1. Competence	5.55	1.39	.89	.85	**.79**[a]					
2. Benevolence	6.18	1.29	.87	.77	.65**	**.84**				
3. Integrity	6.04	1.21	.86	.75	.34**	.51**	**.82**			
4. PU	5.68	1.06	.93	.90	.70**	.48**	.36**	**.90**		
5. PEOU	6.88	1.02	.83	.73	.59**	.48**	.46**	.42**	**.70**	
6. Intention to Adopt	7.03	1.29	.93	.89	.48**	.46**	.21*	.54**	.42**	**.76**

a: Diagonal elements are square roots of the average variance extracted (AVE), and off-diagonal elements are inter-construct correlations.
* indicates that the correlations are significant at the .05 level (2-tailed).
** indicates the correlations are significant at the .01 level (2-tailed).

Results

We used Partial Least Squares (PLS), as implemented in PLS Graph version 3.0, for data analysis. The main reason we chose PLS is its minimal demands on sample size and residual distribution (Barclay et al., 1995). Based on a component-based estimation approach, PLS has been used to assess the psychometric properties of all measures, and subsequently to examine the structural relationships proposed earlier, as illustrated in Figure 3.

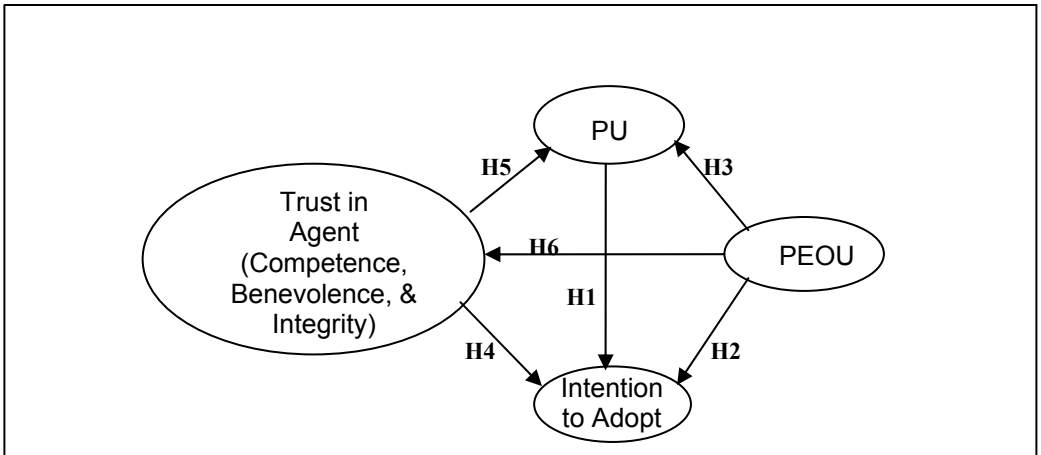

Figure 3. Research Model

Table 3. Factor Loadings and Cross-Loadings

Items	Competence (CMPT)	Benevolence (BNVL)	Integrity (INTG)	Perceived Usefulness (PU)	Perceived Ease of Use (PEOU)	Intention to Adopt (INTN)
CMPT1	**.83**	.48	.31	.59	.52	.38
CMPT2	**.89**	.54	.22	.55	.43	.32
CMPT3	**.76**	.39	.25	.58	.45	.40
CMPT4	**.76**	.61	.22	.51	.44	.38
CMPT5	**.71**	.57	.35	.58	.57	.44
BNVL1	.57	**.86**	.46	.47	.42	.50
BNVL2	.57	**.89**	.44	.41	.46	.40
BNVL3	.50	**.75**	.37	.34	.36	.25
INTG1	.31	.44	**.78**	.29	.34	.26
INTG2	.26	.40	**.87**	.27	.33	.12
INTG3	.26	.41	**.81**	.35	.46	.12
PU1	.57	.35	.24	**.78**	.50	.57
PU2	.53	.43	.35	**.78**	.60	.56
PU3	.58	.44	.32	**.84**	.62	.47
PU4	.60	.37	.25	**.86**	.64	.48
PU5	.47	.35	.23	**.66**	.62	.28
PU6	.42	.23	.23	**.68**	.47	.25
PU7	.50	.33	.36	**.65**	.45	.25
PU8	.50	.38	.23	**.70**	.52	.38
PU9	.65	.46	.32	**.88**	.63	.60
PEOU1	.51	.36	.36	.55	**.76**	.35
PEOU2	.27	.24	.23	.32	**.64**	.35
PEOU3	.34	.33	.33	.44	**.66**	.11
PEOU4	*.55*	*.44*	*.32*	*.73*	***.73***	*.46*
PEOU5	.33	.31	.38	.41	**.74**	.27
INTN1	.43	.51	.19	.45	.37	**.91**
INTN2	.47	.42	.19	.58	.46	**.93**
INTN3	.40	.42	.19	.52	.41	**.89**

Data Analysis for the Measurement Model

Because the three trusting beliefs highly correlate with each other, McKnight et al. (2002a) have suggested that trust be modeled as a reflective second order factor.[3] This second order construct of trust in online recommendation agents is composed of three sub-constructs (i.e., competence, benevolence, and integrity), which are also measured as reflective. According to previous studies that involve second order factors (e.g., Chwelos et al., 2001), in PLS we have used factor scores of each first order trusting belief as indicators for the second-order constructs of trust in agents.

To assess the reliability (individual item reliability and internal consistency) and validity of the constructs, we have examined the item loadings, composite reliability of constructs, and average variance extracted (AVE). All of the reflective constructs and sub-constructs display strongly positive loadings that are all significant at the .001 level, indicating high individual item reliability. Furthermore, all composite reliabilities and Cronbach's alphas in Table 2 are greater than .70, which is considered as a benchmark for acceptable reliability (Barclay et al., 1995). The AVE measures the variance captured by the indicators relative to measurement error (Fornell and Larcker, 1981), and it should be greater than .50 to justify using a construct (Barclay et al., 1995). Adequate AVEs for all constructs are indicated in Table 2.

Barclay et al. (1995) have suggested two criteria to examine discriminant validity. The first criterion requires that the square root of each construct's AVE is greater than the correlations between the construct and others, thereby indicating that the construct shares more variance with its own measures than it shares with other constructs. This criterion is satisfied by the current data, as demonstrated in Table 2. The second criterion requires that no item loads higher on another construct than it does on the construct it is designed to measure. The factor- and cross-loadings reported in Table 3 demonstrate adequate discriminant validity except one item PEOU4. It loads equally highly on PEOU and on PU and hence has been dropped in later analysis.

Data Analysis for the Structural Model

The results of the structural model from PLS, including path coefficients, explained variances, and significant levels, are illustrated in Figure 4. We report the total effects of the three antecedents as well as the direct and indirect effects in Table 4.

Our analysis indicates that all of the hypotheses except for H_2 are supported by data from the experiment. Consumers' initial trust and PU have significant impact on their intentions to adopt recommendation agents, while PEOU does not. Therefore, H_1 and H_4 are supported, while H_2 is not. Consumers' initial trust and PEOU influence their PU of the agents significantly, supporting H_5 and H_3. PEOU also influence consumers' trust in

[3] As argued by Chewelos et al. (2001), "the distinction between formative and reflective constructs is not always clear-cut" (p.312). Given that conceptually the three trusting beliefs should not necessarily covary, we have also tried to model the second order construct of trust as formative and the results showed the same patterns: no paths gained or lost statistical significance, no significant paths changed in sign, and the changes in the path values were very slight. Therefore, the results of this study should not be an artifact of our modeling decisions.

agents significantly, supporting H_6. The significant results regarding the impact of trust on PU and on intentions, as well as the impact of PEOU on trust, confirm the nomological validity of trust in online recommendation agents.

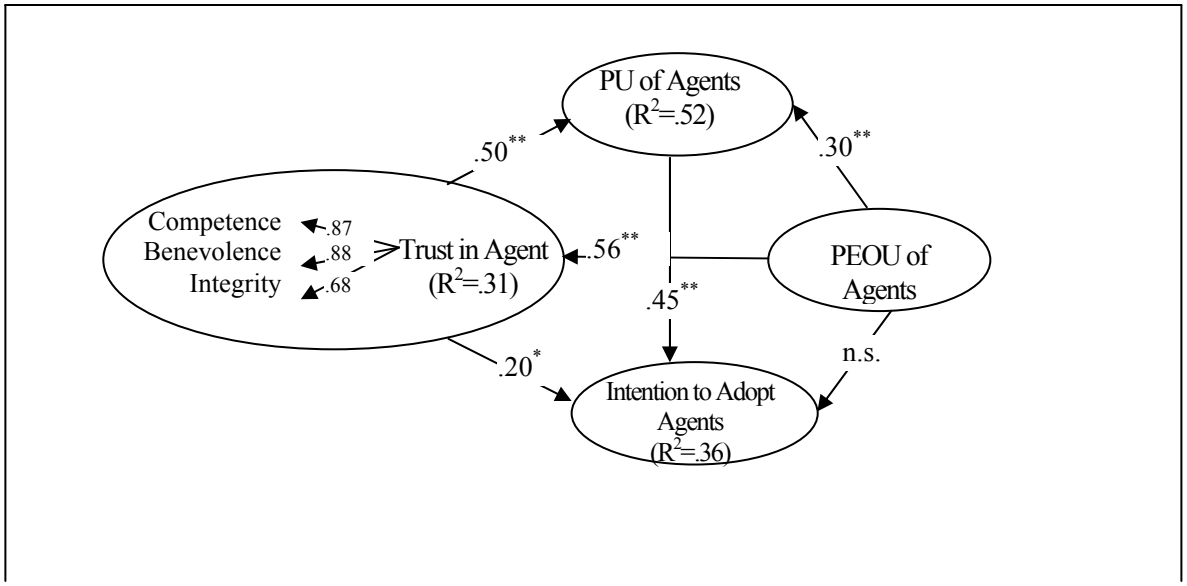

Figure 4. PLS Results

Table 4. Structural Model Results

Hypothesis	Standardized Path Coefficient (direct effect)	t-value for Path	Indirect Effect	Total Effect[a]
H_1: PU → Adoption Intention	.45	3.97	--	**.45**
H_2: PEOU → Adoption Intention	--	--	.25	**.25**
H_3: PEOU → PU	.30	3.64	.28	.58
H_4: Trust → Adoption Intention	.20	2.13	.23	**.43**
H_5: Trust → PU	.50	8.04	--	.50
H_6: PEOU → Trust	.56	7.76	--	.56

a: Total Effect = Direct Effect + Indirect Effect.

Consumers' initial trust directly influences their intentions to adopt the recommendation agents, while also exhibiting indirect effects through the consumers' increased PU of the agents. The experiment results listed in Table 4 indicate that PU exerts the most determinative influence over intentions to adopt, in terms of direct effects. The total effects of PU and trust on intentions are similar and stronger than those of PEOU. The impact of PEOU on intentions to adopt agents is fully mediated by PU and trust. This finding is not

uncommon, however, inasmuch as many other TAM studies (e.g., Davis, 1989) have found that PEOU is mediated by PU, and Gefen et al. (2003a) have also found that PEOU is mediated by trust, though this was tested only with experienced consumers.

The variance in adoption intentions explained by trust, PU, and PEOU in this study is 36 percent, which is relatively high compared to the results of Gefen et al. (2003a), who found that 27 percent of the variance in purchase intentions was explained by trust and PU. This confirms the validity of the integrated Trust-TAM to explain online recommendation agent adoption.

Furthermore, the relative importance of the three trusting beliefs in predicting adoption intentions is also revealed by the loadings of the three trusting beliefs on the second order trust, which are all significant at the level of .001. Consumers' initial beliefs in the competence (.87) and benevolence (.88) of online recommendation agents have similar but higher importance than their beliefs in the integrity (.68) of the agents, during their deliberations about adopting the agents.

Discussion

Summary and Discussion of Results

The study has explored the nature of trust in online recommendation agents. Based on the theoretical and empirical work described in the literature, we extended interpersonal trust to trust in technological artifacts. Data from this study confirm the nomological validity of trust in recommendation agents and the validity of Trust-TAM for online recommendation agents. The significant loadings of the three trusting beliefs (competence, benevolence, and integrity) indicate that all of them hold for trust in online recommendation agents. When interacting with online recommendation agents, consumers appear to treat computer agents as "social actors" and perceive human characteristics (e.g., benevolence and integrity) in the agents. Regarding the integrated Trust-TAM, this study reaches similar results as other trust and TAM studies, even though the trust objects in this study are technological artifacts.

The analysis shows that consumers' initial trust in agents affected PU of agents and their intentions to adopt the agents. However, unlike Gefen et al. (2003a) who found that potential customers' purchase intentions were only influenced by their trust in e-vendors, we found that for new consumers, both trust in agents and PU of the agents have direct effects on adoption intentions. Consumers perceive online recommendation agents not only as support tools for online shopping, but also as "social actors" (virtual advisors) with human characteristics. Both the usefulness of the agents as *tools* that provide recommendations and consumers' trust in the agents as *virtual assistants* are influential in consumers' intentions to adopt the agents.

One factor that may explain the above discrepancy is the different behavioral intentions explored in different studies as summarized in Table 1. This study focuses on consumers' intentions to use agents to get recommendations. Consumers did not delegate the whole purchase task to agents and they did not have to act upon the product recommendations provided. Therefore, relatively low risks were involved. Conversely, Gefen et al. (2003a) explored consumers' purchase intentions. Purchase behaviors involve high uncertainties and risks (e.g., financial loss, personal information and privacy concerns). In such

situations, trust might be more salient and it may constitute a powerful determinant of purchase intentions for potential consumers.

Limitations

Before discussing the implications of this study, it is important to consider its limitations.

First, some issues should be addressed regarding the analytic methodology used in the current study. The potential for common method variance may exist because measurements of all of the constructs in this study were collected at the same point in time and via the same instrument (Straub et al., 1995). To test common method bias, we applied Harmon's *one-factor test* to data from the current experiment (Podsakoff and Organ, 1986). We performed an exploratory factor analysis on all the variables, but no single factor was observed and no single factor accounted for a majority of the covariance in the variables, suggesting that common method bias is not a concern in the present study.

Second, participants in the present study were limited to university students. More replications to test our model in other populations are necessary to examine the external validity of our findings.

Additionally, our results are based on only one type of recommendation agent. Readers are therefore advised to be cautious about generalizing the results of this study to other types of recommendation agents such as collaborative-filtering based agents. As a source for comparison, Ansari et al. (2000) and Maes et al. (1999) identified different types of recommendation agents.

Finally, the present study focuses on the role of initial trust in consumers' decisions to adopt online recommendation agents. For all participants, interaction with the experiment agent was their first encounter with such agents. The relative importance of trust versus other TAM use antecedents may be at variance with experienced users (Gefen et al., 2003a). On one hand, consumers' "social" relationships with recommendation agents can be strengthened by further interactions, and accordingly, consumers' trust in agents might be an important determinant of their later acceptance. On the other hand, additional interaction with the agents may reduce consumers' perceptions of uncertainty and risk in using them, and as a result, the importance of trust could decrease. In addition, the relative importance of different trusting beliefs may change over time. In particular, the benevolence belief can be readily built through a series of contacts between the trustee and trustor (Mayer et al., 1995); it plays a more important role when a longer-term strategic partnership is being contemplated (Das, 1998). Therefore, the generalizability of results to consumers who have experience with agents is not immediately obvious and warrants future research.

Implications and Future Research

Due to advances in Web-based technologies, there are ample opportunities to utilize knowledge-based systems to facilitate online consumer decision making and provide recommendation services for consumers. However, because of the high risks and uncertainties inherent in online environments, consumers must trust in Web-based technologies in order for them to be effective. Interpersonal trust has been the focus of many previous studies, and trust in technological artifacts remains an under-researched

area. The present study has implications for information systems research on the nature of trust in technological artifacts, and user acceptance of Web-based technologies.

Results from this study and prior literature show that the nature of trust in technological artifacts should not be fundamentally different from interpersonal trust. Therefore, trust theories in the interpersonal domain may generally apply to trust in technological artifacts. Nevertheless, there might be unique elements for trust in technological artifacts. More research is needed to examine whether the conceptualization of trust in technological artifacts should be extended to include other relevant beliefs. For example, Lerch et al. (1993) and Muir (1994) have explored other machine trust related beliefs such as reliability, predictability, dependability, and faith as they relate to machines. In addition, to further extend the line of research on the relational aspect of trust in agents, researchers may need to identify emotional elements in consumer trust in online recommendation agents (Komiak and Benbasat, 2004; Rempel et al., 1985).

The issue of different targets of trust and, by extension, of social relationships, also deserves further research. The relative importance of different trust dimensions might be different for different trust targets. And although the effect of trust in recommendation agents on the intention to adopt agents has been confirmed in this study, the role of agents in consumers' trust in e-vendors and the reciprocal impacts of agent and vendor trust have not been studied. Urban et al. (2000) suggest that recommendation agent technology is an effective way of promoting consumer trust in e-vendors. Trust in e-vendors can also be extended to online recommendation agents via the transference process (Doney and Cannon, 1997). Especially for initial trust building, consumers rely on other relevant sources (e.g., the e-vendors and their websites) to judge the trustworthiness of recommendation agents. Additional empirical research is needed to investigate such mutual influences.

As shown in Table 1, in contrast to Gefen et al. (2003a; 2003b) and Pavlou (2003), this study focuses on trust in and adoption of online recommendation agents. These previous studies tested similar models in which e-vendors were the trust targets, and PU and PEOU were measured in relation to websites. However, the influence of consumers' perceptions and use of recommendation agents available on websites of a company on their perceptions and use of the websites themselves is still an open research question. In addition to the reciprocal impacts of agent and vendor trust, it is possible that PU, PEOU, and adoptions of the agents will influence consumers' PU, PEOU, and use of the websites. Furthermore, it is not clear whether trust in agents will influence consumers' purchase behavior directly or only indirectly through consumers' trust in the e-vendor and PU of the website. The relationships between the two adoption models (i.e., adoption of agents and websites) require future research.

This study also suggests a new perspective for studying IT acceptance research and provides an initial blueprint to investigate social relationship building with technologies in online environments. In TAM (Davis, 1989), the dominant IT adoption model, IT acceptance is determined by rational processes focusing on expected operated outcomes such as usefulness and ease of use. As summarized by Gefen and Straub (2003), "in that line of research, social aspects were secondary, if mentioned at all; social aspects were studied in the context of how they influenced perceived usefulness and ease of use" (p.21). Recently, several studies (e.g., Gefen et al., 2003a; Gefen et al., 2003b; Gefen and Straub, 2003; Pavlou, 2003) have looked into the role of social factors (e.g., trust) as direct antecedents of behavioral intentions. However, the social factors in most of these

studies were examined in the context of interpersonal relationships between consumers and e-vendors. The "social" relationships between consumers and technologies, such as agents, were largely ignored. This study, on the other hand, confirms the importance of such perceptions and highlights the role of relational factors in consumers' intention to adopt online technologies.

However, it is not clear whether all technological artifacts are equal in terms of being perceived as social actors. An online recommendation agent requires a certain level of knowledge and reasoning capability that enable it to generate shopping recommendations and work as a virtual shopping assistant (Moukas et al., 2000). Different technologies need different levels of intelligence. The characteristics of a technology (e.g., intelligence, autonomy, mobility, customization, and interface) that facilitate social relationship building between it and people need to be identified and investigated.

This study also has important practical implications for the design of effective online recommendation agents. Particularly, relational and social relationships between consumers and online recommendation agents are important, as they induce consumer trust in agents and promote agent adoption, and thus convey the value of providing recommendation services. A strong, personal connection to customers via web technologies should be one of the key goals of web vendors. Designers could employ several social relationship building mechanisms to induce consumer trust in the agents (Komiak et al., 2005). For example, designers may consider creating personalized agents that know individual users' backgrounds and greet them when they initiate agent applications. Anthropomorphic features (e.g., a human-like body with gestures and emotional reactions) can also be designed into the agents (Qiu, 2002).

There are other important agent capabilities that enhance the trustworthiness of online recommendation agents. As key trust building mechanisms, the appropriate explanation facilities mentioned earlier should be embedded in online recommendation agents. In addition, Xiao and Benbasat (2002) have investigated the internalization capabilities of recommendation agents. *Agent internalization* refers to an agent's ability to understand users' real needs, and its ability to apply those needs when generating recommendations (Xiao and Benbasat, 2002). A clear example of high internalization is an agent that effectively elicits consumers' desires by asking appropriate needs-based questions. Their results indicate that consumers invest greater trust in recommendation agents with higher internalization capabilities. By incorporating these important trust-inducing features, recommendation agents can provide more effective services, gain a higher chance of user acceptance, and further promote consumer intentions to transact with the web vendors.

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Appendix A: Pervious TAM Extension Studies (Non-exhaustive)

Studies	Constructs[a]	Technologies	User Characteristics	Context	Findings
Davis (1989)	PU, PEOU, Usage/BI	PROFS email; XEDIT file editor; Chart-Master and Pendraw graphic systems.	Not investigated; experienced users participated in one study and new users in another	Offline, voluntary use for work	PU → Usage/BI PEOU → PU
Davis et al. (1989)	PU, PEOU, A, BI, Usage	WriteOne word processing	Experience (through a longitudinal study: both initially and one semester later)	Offline, voluntary use for work	PU → A PEOU → A[1] PEOU → PU A → BI[1] PEOU → BI[1] PU → BI BI → Usage
Mathieson (1991)	PU, PEOU, A, BI	Spreadsheet, calculator	Not investigated	Offline, voluntary use for work	PU → A PEOU → A PEOU → PU PU → BI A → BI
Adams et al. (1992)	PU, PEOU, Usage	Voice mail and email, WordPerfect, Lotus 1-2-3, Harvard Graphics	Not investigated	Offline, voluntary use for work	PU → Usage[2] PEOU → Usage[3] PEOU → PU
Igbaria et al. (1995)	EV, PEOU, PU, Usage	Micro-computer	User training, computer experience	Offline, voluntary use for work	EV → PEOU EV → PU PEOU → PU PU → Usage

Pervious TAM Extension Studies (Non-exhaustive) (cont'd)

Studies	Constructs[a]	Technologies	User Characteristics	Context	Findings
Chau (1996)	PEOU, near-term PU, long-term PU, BI	Word, Excel	Not investigated	Offline, voluntary use for work	PEOU → Near-term PU PEOU → BI Near-term PU → Long-term PU Near-term PU → BI Long-term PU → BI
Gefen et al. (1997)	PU, PEOU, SPIR, Gender, Usage	Email	Gender, culture	Offline, voluntary use for work	Gender → PU Gender → PEOU Gender → SPIR SPIR → PU PU → Usage
Taylor and Todd (1995a)	PU, PEOU, A, SN, PBC, BI, Usage	Computer resource center	Prior experience	Offline, voluntary use for work and study	PEOU → PU PU → A PEOU → A[1] PU → BI SN→ BI PBC → BI BI → Usage PBC → Usage[1]
Taylor and Todd (1995b)	PU, PEOU, A, BI, Usage	Computer resource center	Not investigated; most participants were familiar with the technologies	Offline, voluntary use for work and study	PEOU → PU PU → A PEOU → A PU → BI BI → Usage
Venkatesh and Morris (2000)	PU, PEOU, SN, BI, Gender, Experience	Various systems for data and information retrieval	Gender; experience (through longitudinal study: post training, after one month, and after three months)	Offline, voluntary use for work	PU → BI PEOU → BI PEOU → PU SN → BI[4]

Pervious TAM Extension Studies (Non-exhaustive) (cont'd)

Studies	Constructs[a]	Technologies	User Characteristics	Context	Findings
Venkatesh et al. (2003)	PU, PEOU, SN, BI	*Sophisticated* organizational technologies (e.g., Portfolio Analyzer)	Experience (through longitudinal study: post training, after one month, and after three months)	Offline, voluntary and mandatory use	PU → BI PEOU → BI[5] SN → BI[6]
Gefen et al. (2003a)	PU, PEOU, BI, Trust, Familiarity	WWW Website	Experience with online stores	Online, voluntary use for shopping	PEOU → PU PU → BI[6] Trust → BI Familiarity → BI Familiarity → PEOU Familiarity → Trust
Gefen et al. (2003b)	PU, PEOU, BI, Trust	WWW Website	Not investigated; only experienced shoppers participated	Online, voluntary use for shopping	PEOU → PU PEOU → Trust PEOU → BI PU → BI Trust → PU Trust → BI
Koufaris (2002)	PU, PEOU, BI, Flow (PC, Enjoyment, Concentration)	WWW Website	Web Skills	Online, voluntary use for shopping	PU → BI Enjoyment → BI
Lederer et al. (2000)	PU, PEOU, Usage	WWW (Work-related Internet newsgroups)	Not investigated; mostly experienced Internet users participated	Online, voluntary use for work	PU → Usage PEOU → Usage

Pervious TAM Extension Studies (Non-exhaustive) (cont'd)

Studies	Constructs[a]	Technologies	User Characteristics	Context	Findings
Moon and Kim (2001)	PU, PEOU, Playfulness, A, BI, Usage	WWW websites	Not investigated	Online, voluntary use	PU → A PEOU → A Playfulness → A Playfulness → PEOU PEOU → PU PU → BI Playfulness → BI A → BI BI → Usage
Gentry and Calantone (2002)	PU, PEOU, A, BI	Shopping Bots on WWW	Not investigated	Online, voluntary use for shopping	PEOU → PU PU → A PU → BI

Notes:

[a] Legend: A – attitude; BI – behavioral intention; SN – subjective norm; PBC – perceived behavioral control; PC – perceived control; SPIR – social presence and information richness; EV – external variables (e.g., *individual, system*, and *organizational characteristics*)

[1] The relationship is significant only when participants use the software/technology/computer center/Website for the first time.

[2] This relationship is significant, except in the WordPerfect case and the Harvard Graphics case.

[3] This relationship is significant, except in the email case and the Voice mail case.

[4] This relationship is significant only for the post training and after one month tests, but not for the last test, after three months.

[5] In the voluntary settings, this relationship is significant only for the post-training test; in the mandatory settings, this relationship is significant for the post-training and after one-month tests.

[6] This relationship is significant only for the post-training test in the mandatory settings.

Appendix B: Measurement Items

Trust – Competence

1. This virtual advisor[4] is like a real expert in assessing digital cameras.
2. This virtual advisor has the expertise to understand my needs and preferences about digital cameras.
3. This virtual advisor has the ability to understand my needs and preferences about digital cameras.
4. This virtual advisor has good knowledge about digital cameras.
5. This virtual advisor considers my needs and all important attributes of digital cameras.

[4] We used the term "virtual advisor" to refer to the recommendation agent, because in our pilot test, participants suggested that the term "virtual advisor" was easier to understand than "recommendation agent."

Trust – Benevolence
1. This virtual advisor puts my interests first.
2. This virtual advisor keeps my interests in mind.
3. This virtual advisor wants to understand my needs and preferences.
Trust – Integrity
1. This virtual advisor provides unbiased product recommendations.
2. This virtual advisor is honest.
3. I consider this virtual advisor to possess integrity.
Perceived Usefulness
1. Using this virtual advisor enabled me to find suitable digital cameras more quickly.
2. Using this virtual advisor improved the quality of analysis and searching I performed to find suitable digital cameras.
3. Using this virtual advisor made the search task for digital cameras easier to complete.
4. Using this virtual advisor enhanced my effectiveness in finding suitable digital cameras.
5. Using this virtual advisor gave me more control over the digital camera search task.
6. Using this virtual advisor allowed me to accomplish more analysis than would otherwise have been possible.
7. Using this virtual advisor greatly enhanced the quality of my judgments.
8. Using this virtual advisor conveniently supported all the various types of analysis needed to find suitable digital cameras.
9. Overall, I found this virtual advisor useful in finding suitable digital cameras.
Perceived Ease of Use
1. My interaction with the virtual advisor is clear and understandable.
2. It is easy to get the virtual advisor to do what I want it to do.
3. Learning to use the virtual advisor was easy.
4. It was easy for me to find a suitable digital camera using the virtual advisor[5].
5. Overall, I found that the virtual advisor is easy to use.
Intention to Adopt
1. I am willing to use this virtual advisor as an aid to help with my decisions about which product to buy.
2. I am willing to let this virtual advisor assist me in deciding which product to buy.
3. I am willing to use this virtual advisor as a tool that suggests to me a number of products from which I can choose.

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[5] This item has been dropped in the data analysis because it also loads highly on PU.

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