

Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model

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ABSTRACT: This paper aims to predict consumer acceptance of e-commerce by proposing a set of key drivers for engaging consumers in on-line transactions. The primary constructs for capturing consumer acceptance of e-commerce are intention to transact and on-line transaction behavior. Following the theory of reasoned action (TRA) as applied to a technology-driven environment, technology acceptance model (TAM) variables (perceived usefulness and ease of use) are posited as key drivers of e-commerce acceptance. The practical utility of TAM stems from the fact that e-commerce is technology-driven. The proposed model integrates trust and perceived risk, which are incorporated given the implicit uncertainty of the e-commerce environment. The proposed integration of the hypothesized independent variables is justified by placing all the variables under the nomological TRA structure and proposing their interrelationships. The resulting research model is tested using data from two empirical studies. The first, exploratory study comprises three experiential scenarios with 103 students. The second, confirmatory study uses a sample of 155 on-line consumers. Both studies strongly support the e-commerce acceptance model by validating the proposed hypotheses. The paper discusses the implications for e-commerce theory, research, and practice, and makes several suggestions for future research.

KEY WORDS AND PHRASES: Consumer behavior, perceived ease of use, perceived risk, perceived usefulness, technology acceptance, transaction intentions, trust.

The outlook for business-to-consumer (B2C) electronic commerce depends not only on consumer acceptance of Internet technologies as viable transaction means, but on consumer recognition of Web retailers as reliable merchants. In light of this, a comprehensive model describing the factors that drive consumers to accept e-commerce and on-line transactions would be useful for both academicians and practitioners, in that it would help them to better understand consumer on-line behavior in the emerging B2C e-commerce environment. In order to provide a solid theoretical basis for selecting influential driving factors, this paper integrates two important streams of literature under the nomological structure of the theory of reasoned action (TRA) [3, 33, 71]: (a) the technology acceptance model (TAM) [24, 25, 26], and (b) the literature on trust and risk [7, 29, 30, 47, 53, 58, 59]. TAM's value in technology-driven contexts has been consistently important [11, 41, 65, 77], so employing it in the technology-driven context of e-commerce is a rational undertaking. Similarly, employing trust and risk perceptions in the uncertain context of e-commerce is also reasonable. Drawing upon these literatures, this paper theoretically develops and empirically validates a research model that predicts consumer acceptance of e-commerce.

The spatial and temporal separation between consumers and Web retailers and the unpredictability of the Internet infrastructure generate an implicit

uncertainty around on-line transactions [14]. First, there is the risk of monetary loss, since consumers have to rely on electronic information and thus become vulnerable to incomplete or distorted information provided by Web retailers and third parties [56]. Second, there is the risk of loss of privacy associated with providing (whether intentionally or involuntarily) personal information to Web retailers [23, 32]. Hence, B2C e-commerce is associated with an important delegation of authority that consumers surrender during on-line transactions. In sum, the open nature of the Internet as a transaction infrastructure and its global nature create uncertainty around on-line transactions, and this makes trust and risk crucial elements of e-commerce [46]. Stewart, Pavlou, and Ward argue that the notion of trust is perhaps the most important component of consumer-marketer transactions [73]. Therefore, perceptions of trust and risk are likely to be important factors in predicting B2C e-commerce acceptance.

Trust has long been regarded as a catalyst for buyer-seller transactions that can provide consumers with high expectations of satisfying exchange relationships. Many researchers maintain that trust is essential for understanding interpersonal behavior and economic exchanges [e.g., 29, 58, 60, 67]. The importance of trust is elevated in e-commerce because of the high degree of uncertainty and risk present in most on-line transactions [9, 35]. Jarvenpaa et al. empirically showed the favorable effect of trust on consumer purchase intentions [49, 50]. Thus, the role of trust is of fundamental importance for adequately capturing consumer behavior in e-commerce. Perceived risk is also an important element of B2C e-commerce that is likely to affect consumer behavior [50, 65]. Since trust and perceived risk are essential constructs when uncertainty is present [58, 59], these beliefs are integrated in the proposed e-commerce acceptance model.

Business-to-business e-commerce is the ability of consumers to purchase products and services on-line using Internet technologies and associated infrastructure [63]. As with most information systems, Internet technology acceptance and use can be partially explained by the technology acceptance model. While this model initially focused on system usage in the workplace, recent research has applied it to understand Web site use [45, 62]. Therefore, intentions to use the Internet for on-line transactions should consider the major TAM constructs, which theorize that perceived usefulness and perceived ease of use determine actual system use [24]. The research presented in this paper aims to predict consumer acceptance of e-commerce by integrating TAM with the constructs of trust and risk, both of which are essential when uncertainty is present in the technology-driven environment of e-commerce.

The proposed e-commerce acceptance model draws from the theory of reasoned action, which has been extensively validated on consumer intentions [3, 33, 71]. The major building blocks of the TRA model are salient beliefs, which are used to ascertain attitudes, consequently determining intentions and behavior. TRA has been successfully applied in consumer behavior, technology acceptance and system use, and a variety of instances of human behavior. By closely adhering to the nomological structure of TAR, the proposed model integrates a set of salient beliefs, drawing upon TAM and the trust and risk literatures, which are jointly proposed to influence on-line transaction

intentions and behavior. In addition, the proposed model describes the complex set of interrelationships among the key e-commerce drivers—trust, perceived risk, usefulness, and ease of use.

In short, this research aims to provide a basic model that predicts consumers' acceptance of e-commerce by explaining their intentions when using Internet technology for transactions. The main research issues are:

- Predicting the drivers of consumer intentions to accept e-commerce and engage in on-line transaction behavior.
- Deciding whether and how to integrate TAM with the trust and risk literature under the nomological structure of TAR to jointly predict consumer on-line behavior.

Conceptual Development

Figure 1 presents the proposed model, referred to as the e-commerce acceptance model. The dependent variables—intention to transact and actual transaction behavior—are posited as the primary constructs to determine consumer acceptance of e-commerce. Following the application of TRA to a technology-driven environment, the TAM variables (perceived usefulness and perceived ease of use) are posited as key drivers of e-commerce acceptance. Under the aegis of TRA, the proposed model integrates additional key drivers of e-commerce acceptance, such as trust and perceived risk. All four key drivers are defined and explained, and their relationship with transaction intentions and acceptance of e-commerce is proposed. The practical utility of considering TAM stems from the fact that e-commerce is heavily technology-driven. Trust and perceived risk are considered because of the uncertainty of the e-commerce environment. Placing these variables under the nomological structure of TRA and precisely describing their interrelationships justify the proposed integration of the hypothesized key e-commerce drivers into a coherent and parsimonious research model.

Electronic Commerce Acceptance

Electronic commerce acceptance is broadly described as the consumer's engagement in electronic exchange relationships with Web retailers. Hence, on-line transactions can be viewed as instances of interactive marketing communications [66, 73]. Drawing both from the marketing and consumer behavior literature and from B2C e-commerce empiricism, consumer-retailer exchange relationships typically involve several activities along the process shown in Figure 2 [66].

Consumer-retailer exchange relationships typically involve several activities. The first step often involves basic data exchange from the retailer to the consumer, such as browsing, gathering information, and making product and price comparisons. The next step usually involves the consumer providing some personal information by registering an e-mail address, describing product preferences, and providing feedback. This step is often supplemented by

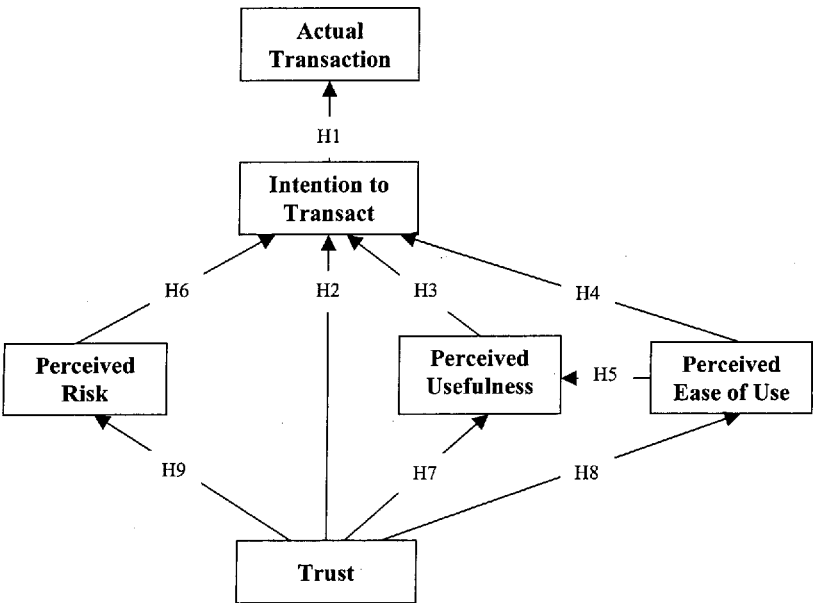


Figure 1. Conceptual Model and Research Hypotheses

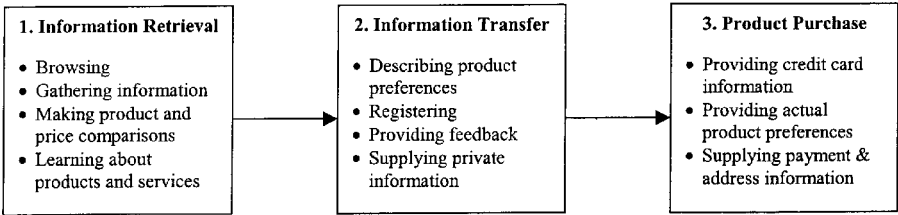


Figure 2. The Consumer Online Transaction Process

automatic information exchange that is intentionally or involuntarily captured through cookies, log-data, and data-mining tools. The final step involves provision of private and monetary information, such as credit card information, actual purchase preferences, and payment and address information, in order to complete the purchase of a product or service.

Intention to Transact

Following Zwass [82], intention to transact is defined as the consumer’s intent to engage in an on-line exchange relationship with a Web retailer, such as sharing business information, maintaining business relationships, and conducting business transactions. Based upon the description of the on-line transaction process (see Figure 2), B2C e-commerce acceptance necessitates that the consumer intend to use a retailer’s Web site to obtain and provide information and then complete a transaction by purchasing a product or service. Al-

though the number of Internet users is constantly increasing [22], a recent study found that more than 75 percent of on-line consumers abandoned their shopping carts before purchase [13]. This poses a tremendous problem for Web retailers, since they prefer buyers and not just browsers. However, as is true of traditional shopping, even if consumers finally decide not to purchase, their initial intentions when engaging in information exchange are typically to complete the ongoing transaction process if everything occurs according to their confident expectations [48]. The “intention to transact” construct aims to encompass intentions regarding the entire on-line transaction process, and proposes that intentions span the entire process, whereas actual activities may often cease during the process. Even if information exchange and product purchase may be theoretically distinct intentions, they are posited, without loss of generality, as practically indistinguishable in on-line transactions.

The positive relationship between behavioral intentions and actions is extensively described by the theory of reasoned action [3, 31] and the theory of planned behavior [1, 2]. Research following TRA and TAM consistently showed a high correlation between intentions and actual use [11]. Drawing upon TRA's theoretical rationale and abundant empirical evidence, this paper proposes that there is a positive relationship between transaction intentions and actual on-line transaction behavior.

H1: Consumer transaction intentions positively influence actual transaction behavior.

In contrast to traditional consumer behavior, on-line transactions have certain unique dimensions, such as (a) the extensive use of technology for transactions, (b) the distant and impersonal nature of the on-line environment, and (c) the implicit uncertainty of using open technological infrastructures for transactions. More specifically, (a) consumers must actively engage in technology use by interacting with the retailer's Web sites, (b) the spatial and temporal separation between consumers and marketers increases fears of Web retailer opportunism arising from product and identity uncertainty [6, 56], and (c) there is concern about the reliability of the Internet itself and the related infrastructure that Web retailers employ to interface with consumers (e.g., the open infrastructure raises the fear that third parties or hackers may threaten consumer privacy and monetary information). Overall, these three unique differences reduce consumer perceptions of control over on-line transactions, thereby increasing their apprehension about acceptance of B2C e-commerce. In terms of Web retailer opportunism and related risks, theories regarding trust and risk in B2C e-commerce are employed. In terms of technology use for on-line transactions, TAM is employed to describe and predict system use.

There is a broad consensus that both traditional merchants and Web-exclusive retailers have widely embraced the low-cost Internet infrastructure to increase their consumer reach. However, consumers have not adopted B2C e-commerce to the same degree, primarily because of risk concerns and trust-related issues [13, 15, 46, 64]. Therefore, uncertainty around consumer transaction intentions is fundamental in predicting acceptance of B2C e-commerce. In order to understand better the role of uncertainty in the proposed

e-commerce acceptance model, the constructs of trust and perceived risk are put forward as fundamental in predicting B2C e-commerce acceptance. The practical utility of proposing trust and perceived risk as salient beliefs stems from the fact that Web retailers have considerable influence on these variables, mainly through their trustworthiness and ability to mitigate risk.

Trust

Trust is a defining feature of most economic and social interactions in which uncertainty is present. Practically all interactions require an element of trust, especially those conducted in the uncertain environment of e-commerce [6, 56]. Trust has long been regarded as a catalyst in consumer-marketer relationships because it provides expectations of successful transactions [70]. For instance, trust has always been an important element in influencing consumer behavior and has been shown to be of high significance in uncertain environments, such as the Internet-based e-commerce context [41, 49, 50, 62]. Lack of trust has been touted as one of the main reasons for consumers not engaging in e-commerce [52]. Thus one may reasonably argue that the importance of trust has been elevated in e-commerce because of the high degree of uncertainty present in most on-line transactions [35]. Several researchers, in fact, have proposed trust as an important element of B2C e-commerce. For instance, Palmer, Bailey, and Faraj argue that building consumer trust in Web retailers is essential for the growth of B2C e-commerce [64]. Jarvenpaa and Tractinsky empirically showed that trust has a direct effect on consumer purchase intentions in multiple cultures [49]. Gefen showed that trust is instrumental in the acceptance of Internet technologies [39]. Stewart et al. argued that trust is fundamental in consumer-marketer communications [73]. Finally, Keen argued that trust is the foundation of e-commerce, focusing on the strategic implications of trust for consumer-marketer relationships [52]. All this shows that developing consumer trust in Web retailers is critical for the continued growth of B2C e-commerce.

Trust can be described as the belief that the other party will behave in a socially responsible manner, and, by so doing, will fulfill the trusting party's expectations without taking advantage of its vulnerabilities [39, 59]. Following the work of McKnight and his colleagues [60, 61], trust in B2C e-commerce is defined here as the belief that allows consumers to willingly become vulnerable to Web retailers after having taken the retailers' characteristics into consideration. This definition is consistent with the construct of trust as a salient belief that which includes goodwill trust (benevolence) and credibility (honesty, reliability, and integrity). This definition captures two distinct but nonseparable facets of trust in e-commerce. First, it involves the traditional view of trust in a specific party (the Web retailer), and second, it implicitly encompasses trust in the integrity of the transaction medium (trust in the infrastructure). This view of trust is consistent with the generic model of trust [74], which also conjectures two targets of trust, party trust (trust in another party) and control trust (trust in the control mechanisms). Since a certain level of uncertainty is a prerequisite for trust to exist [53], the proposed conceptualization of trust suggests that when consumers willingly become

vulnerable to a Web retailer, they consider both the characteristics of the Web retailer (due to behavioral uncertainty) and the characteristics of the related technological infrastructure (due to environmental uncertainty).

Whereas trust has essentially two targets in e-commerce [74], Web retailers can substantively affect trust in the infrastructure by facilitating encrypted transactions, installing firewalls, utilizing authentication mechanisms, and ensuring privacy seals and disclosures [9, 12, 16]. Therefore, environmental uncertainty is strongly influenced by behavioral actions of Web retailers that aim to reduce infrastructure-related concerns and increase trust in e-commerce. Subsequently, trust in the Web retailer encompasses a substantial portion of trust in the focal transaction, even if the retailer has no absolute control over the Internet infrastructure. Without loss of generality, the research described in this paper focuses on the Web retailer, rather than the Internet infrastructure, as the major target of trust, arguing that consumer trust perceptions are heavily influenced by the actions of Web retailers. However, this focus is not meant to discount the role of trust in the infrastructure (interface), which has been extensively described elsewhere [16].

Hoffman et al. argued that lack of trust prevents consumers from engaging in on-line transactions because they are unlikely to transact with a Web retailer that fails to convey a sense of its trustworthiness, mainly because of fears of seller opportunism and concerns about the utilization of the associated Internet infrastructure [46]. Following the theory of reasoned action, trust creates positive attitudes toward Web retailers that are likely to reduce fears of retailer opportunism and attenuate infrastructure concerns. As a result, trust in a Web retailer is viewed as a salient behavioral belief that, by influencing positive consumer attitudes, has an effect on behavioral intentions for on-line transactions with Web retailers. There is a consensus, in the large body of literature on the subject, that trust is related to positive attitudes [38, 49, 50, 72]. Therefore, through attitude, trust is likely to influence favorably transaction intentions. Moreover, trust reduces behavioral uncertainty related to the actions of the Web retailer, giving a consumer a perception of some control over a potentially uncertain transaction. This sense of overall control over their on-line transactions positively influences consumers' purchase intentions. In general, the proposed relationship between trust and attitude is justified by placing party trust in the context of TRA as a behavioral belief [3, 33, 71]. Trust creates positive attitudes and perceived behavioral control toward transactions with Web retailers, reducing uncertainty and providing expectations for a satisfactory transaction, thus positively influencing consumer behavioral intentions to transact.

H2: Consumer intentions to transact on-line are positively related to trust in e-commerce.

Technology Use and Intention to Transact

Virtually every step in the proposed on-line transaction process requires consumers to interact with Web sites and use Internet technologies. Since intentions to transact entail technology use, it is justifiable to consider the variables

of the technology acceptance model in predicting intentions to use Internet technology for on-line transactions. TAM has received substantial attention in the information systems literature because it focuses on system use, has reliable instruments with excellent measurement properties, is parsimonious, and is empirically sound. It has been shown to apply to a wide range of information technologies, including e-commerce. For example, Gefen and Straub examined the effect of perceived ease of use on e-commerce acceptance [40], and Moon and Kim investigated the impact of perceived usefulness and ease of use on consumer use of the Internet [62]. Therefore, even if TAM was originally intended to predict technology use in the workplace, the TAM variables can also be employed to predict consumer behavior in e-commerce.

The technology acceptance model would argue that two external variables (i.e., perceived usefulness and perceived ease of use) influence the acceptance of Internet technology. Following Davis, perceived usefulness will be defined as the degree to which consumers believe that a particular technology will facilitate the transaction process [25, p. 320]. Perceived ease of use will be defined as the degree to which a consumer believes that using a particular technology will be effortless. Applied to on-line consumer behavior, a Web interface that is perceived as facilitating the transaction process and easy to operate is likely to be accepted by consumers. Previous research has consistently argued that there is a positive relationship between perceived usefulness and perceived ease of use with acceptance of information technology [e.g., 28, 40, 77], and this finding has also been validated in Internet technology use [e.g., 55, 41, 62]. The general premise is that perceived usefulness directly influences intention, but perceived ease of use acts indirectly through usefulness [24]. Gefen and Straub extensively discuss this relationship, showing that in most cases perceived ease of use should affect use intentions through perceived usefulness [40]. Given the wide variety of technologies, applications, and information systems for which TAM has been validated, Internet technology and Web interfaces, even if they are being used mainly for transactions, should also adhere to the major TAM predictions. Therefore, it is hypothesized that perceived usefulness and perceived ease of use have a positive influence on intentions to transact with Web retailers, suggesting that these variables contribute to consumer acceptance of e-commerce. The practical relevance of the TAM variables stems from the fact that they can be influenced by the Web retailer's actions through external variables. A Web interface that is perceived as facilitating the on-line transaction process and easy to use is likely to influence consumer behavioral intentions. The previous arguments lead to the following hypotheses:

H3: Consumer intention to transact is positively related to the perceived usefulness of the Web interface.

H4: Consumer intention to transact is positively related to the perceived ease of use of the Web interface.

H5: The perceived usefulness of a Web interface is positively related to its perceived ease of use.

Perceived Risk

The distant and impersonal nature of the on-line environment and the implicit uncertainty of using a global open infrastructure for transactions have rendered risk an inevitable element of e-commerce. Two forms of uncertainty are naturally present in on-line transactions: behavioral uncertainty and environmental uncertainty [10]. Similarly, in Ring and Van de Ven's classification, risks are either technology-driven, and thus derived from the underlying infrastructure (environmental risks), or relational, resulting from the trading partner (behavioral risks) [67]. Behavioral uncertainty arises because Web retailers have the chance to behave in an opportunistic manner by taking advantage of the distant and impersonal nature of e-commerce and the government's inability to monitor adequately all transactions. Examples of opportunistic behavior by Web retailers include product misrepresentations, false identity demonstrations, private information leaks, misleading advertising, and denunciations of warranties. Therefore, behavioral uncertainty primarily creates

1. economic risk, because of the possibility of monetary losses
2. personal risk, because of potentially unsafe products and services
3. seller performance risk, because of imperfect monitoring
4. privacy risk, because of the opportunity to disclose private consumer information

Environmental uncertainty exists mainly because of the unpredictable nature of the Internet, which is beyond the full control of the Web retailer or the consumer. Although retailers have an important influence on the security of the transaction medium (e.g., encryption, authentication, firewalls), there is still the possibility of third parties compromising the transaction process. Examples of environmental uncertainty include theft of credit card information, breaches of private information, and stealing of personal information by hackers. Hence, environmental uncertainty mainly includes

1. economic risk, because of the opportunity for monetary losses
2. privacy risk, because of the possibility of theft of private information or illegal disclosure

The behavioral and environmental forms of uncertainty are typically intertwined because the actions of Web retailers have an important bearing on the extent of third-party risk, through encryption, firewalls, and authentication [12].

When engaging in an on-line transaction process, consumers are rightly alarmed about the different types of risks that confront them. However, since risk is difficult to capture as an objective reality, the literature predominantly has addressed the notion of perceived risk, which will be defined as the consumer's subjective belief of suffering a loss in pursuit of a desired outcome [7]. Thus, consumers have personal beliefs regarding the inherent risks involved in every transaction based on the limited information available to them [30]. Without loss of generality, the proposed forms of behavioral and

environmental uncertainty should be considered collectively, since a consumer has certain overall expectations regarding the Web retailer's behavior and ability to protect critical information during the transaction process [67]. Even if risk increases during the progression of the transaction process from information retrieval and exchange to product purchase, it can still be captured as an overall belief. Thus, perceived risk associated with the on-line transaction process is a higher-order unidimensional construct that encompasses the two proposed forms of uncertainty.

Consumer transaction intentions are contingent upon beliefs about Web retailers that are partly determined by behavioral and environmental factors. Given the uncertain context of e-commerce, it is expected that perceived risk would lower consumers' intentions to use Internet sites for transactions. For example, consumers are not likely to engage in on-line transactions with a Web retailer thought to be opportunistic. Similarly, fears that a Web retailer has not taken adequate steps to reduce infrastructure-related risks will also negatively affect transaction intentions. The relationship between perceived risk and transaction intentions can be explained by the notion of perceived behavioral control, described in the theory of planned behavior [1, 2]. Since attitudes typically lead to actions, reduction of perceived risk is expected to influence willingness to transact. In fact, Jarvenpaa et al. suggested that reducing the risk associated with buying from an Internet store would increase the probability of a consumer purchasing from it [49, 50]. Perceived risk has been shown to negatively influence transaction intentions with Web retailers [31, 49, 65]. The perceived risk associated with on-line transactions may reduce perceptions of behavioral and environmental control, and this lack of control is likely to negatively influence transaction intentions. However, consumers are likely to transact on-line if their risk perceptions about behavioral and environmental uncertainties are alleviated, so that they gain control over their on-line transactions. The theory of reasonable action predicts that consumers would be willing to transact if their risk perceptions were low [3, 33].

H6: Consumer intentions to transact are negatively related to perceived risk.

Trust and the Technology Acceptance Model

The technology acceptance model has its origins in the theory of reasonable action. In fact, TAM can be considered as a special case of the theory with two salient beliefs. Chircu, Davis, and Kauffman integrate trust with the model, arguing that trust relates to perceived usefulness and ease of use [21]. Gefen and Gefen and Straub also integrate trust, perceived usefulness, and ease of use in the context of e-services [38, 41]. There is theoretical and empirical support for integrating trust with TAM variables. Trust is one of the determinants of perceived usefulness, especially in an on-line environment, because part of the guarantee that consumers will gain their expected usefulness from the Web interface depends on the people behind the Web site [38]. If the Web retailer cannot be trusted to behave in accordance with the consumers' confident beliefs, then there is no reason why consumers should expect to gain any

utility from using the interface. Following Chircu et al. [21], this paper posits that trust positively influences perceived usefulness in that it allows consumers to become vulnerable to the Web retailer to ensure that they receive the expected useful interaction. On the other hand, if the Web retailer is not worthy of their trust, consumers may suffer a loss from the transaction when the retailer behaves opportunistically.

Chircu et al. also argued that trust in an e-commerce intermediary increases perceived ease of use [21]. Their underlying logic is that trust reduces the need for the consumer to understand, monitor, and control the situation, facilitating the transaction and making it effortless. In the e-commerce context, trust would reduce the consumer's need to monitor the Web retailer's actions and check every detail, making on-line transactions easier. On the other hand, when trust is low, consumers would be forced to give special attention to all aspects of the transaction process, increasing the time and effort required. This argument is consistent with Ring and Van de Ven, who argued that "the greater the ability to rely on trust, the lower the transactions costs (time and effort) required of parties to negotiate, reach agreements, and execute a cooperative [relationship]" [67]. The previous arguments support the following hypotheses linking trust with TAM variables.

H7: Consumer trust is positively related to the perceived usefulness of a Web interface.

H8: Consumer trust is positively related to the perceived ease of use of a Web interface.

Trust and Perceived Risk

Trust is essentially needed only in uncertain situations, since it effectively means assuming risks and becoming vulnerable to trusted parties [47]. Therefore, consumer trust could be described as a function of the degree of risk involved in the situation [53]. Trust is crucial in economic transactions because it reduces the risk of falling victim to opportunistic behavior [34, 79]. This applies to on-line consumer behavior, where transactions may be subject to seller opportunism. However, trust has also been shown to reduce the risk of being taken advantage of by sellers in channel relationships [4, 43], and it has been associated with reduced perceived risk in interorganizational exchanges [29]. Whereas research focuses on the relationship between trust and risk [59], the trust literature and empirical evidence predominantly focus on industrial relationships, but theoretical and empirical validation in B2C e-commerce is scarce. Indeed, Jarvenpaa, Tractinsky, and Vitale extended the interorganizational trust literature into consumer behavior in order to show that trust in an Internet store reduces the risks of buying from that store [50].

Trust in e-commerce reduces behavioral uncertainty and related risks associated with the possibility that a Web retailer might behave opportunistically. When people trust others, they assume that those they trust will behave as expected, reducing the complexity of the interaction. Consumers tend to

assume that a trusted Web retailer will not engage in opportunistic behavior [39]. Thus trust reduces the perceived risk [57, 58, 59]. When a Web retailer can be trusted to show competence, integrity, and benevolence, there is much less risk involved in interacting with it. Moreover, a trusted Web retailer can be expected to take steps to reduce environmental uncertainty and related risks associated with the Internet infrastructure, reducing the environmental risk associated with a focal transaction. In general, trust improves the consumer's beliefs about Web retailers and the associated infrastructure, attenuating the perceived level of risk associated with the transaction process. Hence, trust reduces the risk involved in transacting with Web retailers. Thus, trust in a Web retailer reduces risk beliefs about on-line transactions with that retailer.

H9: Consumer perceived risk is negatively related to trust in e-commerce.

Integrating Trust and Perceived Risk with TAM

Since the proposed model follows theory of reasoned action, it is important for the relatively new variables (i.e., trust and perceived risk) to be operationally consistent with other, previously described variables (i.e., usefulness and ease of use). This is consistent with Ajzen and Fishbein's assertion that, when extending a model, it is important that new variables be compatible with the model's existing ones [3, pp. 31–35]. First, trust and perceived risk in a Web retailer deal with a single transaction decision (task-specific) bounded by the surrounding circumstances (context-specific) at a single point in time (time-specific). Perceived usefulness and ease of use also deal with a single technology-acceptance decision in a given system at a single point in time. Second, while objective reality may play a role, trust and perceived risk predominantly deal with a subjective interpretation of actual trustworthiness and risk, given limited information about reality. Similarly, perceived usefulness and perceived ease of use deal with a user's subjective assessment of usefulness and ease of use, given limited knowledge of the real-world artifact (e.g., the system). Finally, trust and perceived risk are at the same level of abstraction as usefulness and ease of use, which measure general beliefs without specifying the system's precise details. Similarly, trust and perceived risk are general perceptions regardless of the precise details of the Web retailer's characteristics.

Control Variables

The ultimate dependent variables—transaction behavior and intention to transact—are likely to be influenced by several other variables in addition to those explicitly hypothesized. For example, recent market research found that on-line shopping frequency is a leading factor in determining purchase intentions [69]. In order to validate the proposed model, this study controls for the effect of reputation, satisfaction with previous on-line transactions, and Web shopping frequency. Without loss of generality, these three variables may act

as antecedents of all dependent and mediating variables in the proposed model, and thus they are controlled.

- *Web retailer reputation.* A Web retailer's reputation is an important antecedent of trust, perceived risk [29, 81], and purchase intentions [49]. Therefore, its effect is controlled for in this study.
- *Satisfaction with previous on-line transactions.* As shown by Ganesan, satisfaction with past outcomes is positively related to future intentions [36]. This study controls for the effect of experience with specific Web retailers and with on-line retailers in general.
- *Web-shopping frequency.* According to the fall 2000 Greenfield Online Shopping Index, on-line experience is the strongest indicator of a consumer's likelihood to buy [69]. Since frequent shoppers are more likely to conduct transactions, Web-shopping frequency is also controlled.

Research Methodology

Two independent studies were conducted to test the proposed research hypotheses. Study 1 was exploratory in nature. It used a student sample and did not test for actual behavior, only intentions to transact. Study 2 was confirmatory in nature. It measured and tested all the variables proposed in the conceptual model, using a generalizable on-line consumer population.

Measure Development and Validation

The principal constructs were developed based on existing measures when possible or on similar scales. The scales for perceived usefulness (USEF) and perceived ease of use (EOU) were adapted from existing studies on the technology acceptance model [25, 45, 77]. Measures for trust (TRUST), perceived risk (RISK), and reputation (REP) were adapted from Jarvenpaa et al. [50]; satisfaction with past outcomes (SAT) was based on Ganesan [36]. The scale of Web-shopping frequency (FREQ) was captured with a standard item that measured on-line shopping frequency. The dependent variable measuring intention to transact (TRANS) was captured with three items. Two were based on TAM and measured intentions to use [77], and one standard item captured likelihood to transact [8]. The reason for jointly using items spanning intentions to use and transact is to empirically validate the convergence validity of the construct. From a conceptual standpoint, information retrieval and exchange may be viewed as intentions to use a Web site, but product purchase is more applicable to intention to transact. From a measurement standpoint, convergence of these three items would support the study's proposition that the transaction process is viewed by consumers in its entirety, both as intention to use (information exchange) and intention to transact (product purchase). In addition, rather than devising a new scale for the dependent variable, this convention makes it possible to measure the dependent variable with extant scales that have proven measurement properties.

Although all the items were stimulated by previous empirical studies, the actual scales were developed to capture the context of this research in each of the three experiments. A preliminary version of the instrument was reviewed by faculty and doctoral students for precision and clearness. Subsequently, the instrument was pretested by administering it to 12 consumers of different ages, sexes, and ethnic origins in order to verify its appropriateness and comprehensiveness. None of these phases revealed any major problems, but the questionnaire was progressively refined, simplified, and shortened. The final measures for all principal constructs of this research and their internal consistency results are shown in Appendix A.

Study 1

Three experiential exploratory surveys were conducted to test the proposed e-commerce acceptance model. Since the purpose was to test the model with multiple e-commerce scenarios in order to identify the most suitable scenario for future studies, three distinct target retailers were selected. First, 36 undergraduate students were to complete a questionnaire related to Amazon.com. Second, 41 students were asked to select a Web retailer of their choice that they were familiar with, and then complete a questionnaire with regard to that retailer. Third, 25 students were asked to rate their perceptions of Web retailers in general. The rationale behind these three different scenarios with either a predetermined or self-selected Web retailer or on-line retailers in general was to test the proposed research model in several contextual bases to assess its robustness and generalizability across different targets. In the next stage, Study 2 would select the most naturally occurring scenario.

The 10-minute activities were meant to be typical of the three sub-processes that consumers often perform during the transaction process [49, 50], as also represented in Figure 2. Initially, subjects in a supervised lab were asked to identify the target Web retailer and visit its domain. Following this task, they were instructed to perform the following activities that were similar across all scenarios:

1. Perform the process of searching, selecting, and inquiring about a product of their choice that was available from the selected or predetermined Web retailer (information retrieval).
2. Discover what information, if any, the retailer's Web site requested or required from them during the process of learning more about the product (information exchange). They were not, however, requested or required to provide any information.
3. Learn how they could actually purchase the focal product and what information they had to provide in order to do so (product purchase).

The participants did not provide any information or purchase any products during the experiment because the study's goal was to familiarize them with the on-line transaction process with the target Web retailer and inquire about their intentions and perceptions, not their real actions.

Following the 10-minute activities in which they learned about the on-line transaction process, the participants were given a questionnaire that focused on the Web retailer they had visited (Amazon, their favorite, and general, respectively). For example, a sample item would read: "It is likely that I will transact with *Amazon/my favorite Web retailer/Web retailers in general* in the near future." The participants were instructed that "transaction" meant the entire process they had performed during the 10-minute activities. Given extra credit for their participation, 36 students completed all the tasks pertaining to Amazon for a 92 percent response rate (Scenario A). Given the same participation bonus for their favorite Web retailer, 41 students fulfilled all the tasks for a 91 percent response rate (Scenario B). In a similar setting, all 25 concluded all the tasks pertaining to Web retailers in general for a perfect response rate (Scenario C). Overall, the study included a total of 103 participants. Their average age was 21, 57 percent were male, and their work experience averaged 2.5 years. Subsequent analysis revealed that these demographic characteristics were not different across these three studies and did not differ from the demographics of the rest of the students in the class ($p < 0.1$). Therefore, nonresponse bias is not a major concern in this study.

The purpose of the 10-minute activity was not only to acquaint the respondents with the on-line transaction process, but to familiarize them with the target Web retailer so as to avoid uninformed responses. In addition to these activities, the first experiment specified a popular retailer (Amazon.com), and the second study allowed the respondents to choose a Web retailer with which they were familiar. To ensure knowledgeable responses, all the studies asked the participants to visit the target retailers and perform activities related to conducting transactions on their Web sites before completing the questionnaire. In the Amazon study, 89 percent of the respondents had visited the site before the study took place, and 47 percent had purchased a product from Amazon. In the familiar-retailer study, 61 percent had purchased something from their familiar retailer, and 93 percent had visited its Web site. Similarly, the majority of the respondents in Experiment 3 had completed on-line transactions with Web retailers in the past (56%), and all of them had visited Internet sites. Across all studies, 57 percent of the respondents had completed at least one on-line purchase before Study 1. These findings supported the thesis that the respondents were knowledgeable about their target Web retailer and about e-commerce transactions in general.

Data Analysis

Data analysis was initially performed for each experiential scenario individually. Using Chow's test and Wilks's lambda, the results of all three groups were similar and statistically inseparable. Therefore, the data were pooled for an inclusive statistical analysis. This course of action was also possible from a theoretical standpoint, since the proposed framework is hypothesized to be robust in several contextual bases. In addition, to test whether the results of the 43 percent of the students who had not purchased anything on-line were different from those who had already completed on-line transactions before Study 1,

similar tests (Chow's test and Wilks's lambda) were conducted between those who had purchased on-line versus those who had not. Pooling these two samples was also feasible from a conceptual point of view, given that all the students were knowledgeable about both their corresponding Web retailer and the nature of on-line transactions, to accurately reflect their behavioral intentions.

A three-step sequence for assessing convergent and discriminant validity was employed. First, exploratory factor analyses were conducted to detect high loadings on hypothesized factors and low cross-loadings. Second, all eigenvalues associated with the hypothesized factors were set to greater than unity, and the survey items were reduced to their principal constructs. Third, principal components analysis was used as the extraction method for factor analysis with Varimax rotation. As shown in Appendix B, the overall factor solution has an excellent loading pattern and explains 84 percent of the variation. Therefore, convergent and discriminant validity for all measures are strongly supported. It is worth mentioning that the three items spanning intentions to transact converged into a single factor explaining 93 percent of the variation. Confirmatory factor analysis was also examined using the partial least squares method to further establish the discriminant validity of the principal constructs. Discriminant validity is shown when the partial least squares indicators load much higher on their hypothesized factor than on other factors or the square root of each construct's average variance extracted (AVE) is larger than its correlations with other constructs [20]. As shown in Table 1, the square root of the AVE is much larger than all other cross-correlations. Measure validation was also examined for reliability analysis by computing Cronbach's alpha coefficient. All the measures have high levels of reliability, with an average exceeding $\alpha = 0.90$. Subsequent data analysis used variables generated by the weighted average of the items representing each construct based on the weights yielded by the factor analysis. Descriptive statistics, the correlation matrix, and the AVE for the study's principal constructs are shown in Table 1.

In order to examine the proposed hypotheses, partial least squares (PLS-Graph Version 3.0) was employed. Partial least squares allows the specification of the relationships among the principal construct and the underlying items, resulting in a simultaneous analysis of both whether the hypothesized relationships at the theoretical level are empirically true and how well the measures relate to each construct [20]. The ability to include multiple measures for each construct provides more accurate estimates of the paths among constructs, which are typically downward-biased by measurement error when multiple-regression analysis is applied. Furthermore, due to the nature of some of the measures used and the small sample size, LISREL analysis was not appropriate [19, 42].

Results

As shown in Figure 3, trust ($b = 0.18, p < 0.05$) is positively associated with intention to transact, rendering support for H2. Perceived usefulness ($b = 0.25, p < 0.01$) was also a significant predictor of behavioral intentions, supporting H3 and partly validating TAM. However, perceived ease of use ($b_2 = 0.02$) has a non-significant effect on intentions to transact. As Davis argued, ease of use

Construct	AVE	MEAN	SD	INTENT	TRUST	RISK	USEF	EOU	REP	SAT	FREQ
INTENT	0.94	5.67	1.25	0.85	0.53**	0.71**	0.63*	0.38**	0.62**	0.50**	0.37**
TRUST	0.90	5.11	1.4		0.92	0.51**	0.52**	0.56**	0.38**	0.31**	0.23
RISK	0.88	5.70	1.21			0.88	-0.56**	-0.34**	-0.64**	-0.49**	-0.37**
USEF	0.92	5.76	1.33				0.90	0.63**	0.48**	0.50**	0.28*
EOU	0.92	5.33	1.26					0.91	0.38**	0.32**	0.13
REP	0.88	5.61	1.31						0.89	0.37**	0.27*
SAT	1.0	5.51	0.97							1.0	0.46*
FREQ	1.0	3.92	1.62								1.0

Table 1. Descriptive Statistics, Correlation Matrix, and Average Variance Extracted (AVE) of Principal Constructs for Study 1 (Student Sample).

Note: * $p < 0.05$; ** $p < 0.01$; AVE values are shown in bold.

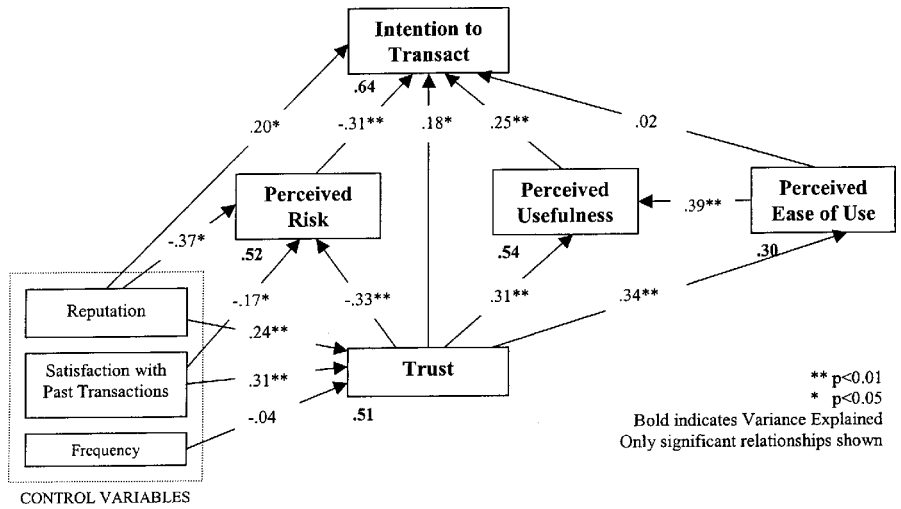


Figure 3. Partial Least Squares (PLS) Results for Study 1 (Student Sample)

may act indirectly on intentions to use through usefulness [24, 25]. In fact, ease of use has a strong effect on usefulness ($b = 0.39, p < 0.01$), validating H5 and allowing the inference that ease of use fosters a Web site's usefulness. H6 was also supported, since perceived risk ($b = -0.31, p < 0.01$) was strongly related to intentions to transact. The relatively weak effect of trust on behavioral intention (H2) suggests that trust also acts indirectly on intentions to transact through perceived usefulness ($b = 0.31, p < 0.05$), perceived ease of use ($b = 0.34, p < 0.01$), and perceived risk ($b = -0.33, p < 0.01$). These findings validate H7, H8, and H9, respectively. Reputation was a significant antecedent of intention to transact ($b = 0.20, p < 0.05$), suggesting that Web retailer reputation plays a role in consumer transaction intentions [49, 50]. Satisfaction with past outcomes and Web-shopping frequency had a positive but non-significant effect on intentions to transact. These variables, along with reputation, acted primarily as antecedents of trust, explaining much of the variance on trust ($R^2 = 0.51$). Whereas the independent variables were significantly correlated, multicollinearity was not a serious concern, since all relevant checks returned a tolerance value above 0.70 for all independent variables. Finally, the variance explained for transaction intentions was particularly high ($R^2 = 0.64$), well above the values found by other TAM researchers on intention to use, suggesting that the proposed model captures many of the significant variables that influence B2C e-commerce acceptance. Therefore, the integration of trust and perceived risk significantly adds to the explanatory value of TAM when applied to consumer on-line behavior.

Discussion

The issue of external validity was not fully addressed in Study 1 because it used a student population whose higher education, lower age, and higher

expertise in e-commerce, as compared to the general population, may limit its generalizability. For example, the nonsignificant effect of perceived ease of use might have been caused by the respondents' high expertise in using the Internet, since most of them perceived the target Web sites to be extremely easy to use ($M = 5.8$, $SD = 1.3$ on a seven-point scale). Even if none of the demographic information moderated the proposed hypotheses, the small variance in age (20–27 years) and work experience (0–7 years) could have suppressed any effects. Therefore, the generality of the findings is tested in Study 2. In addition, Study 1 did not measure actual transaction behavior and thus did not test H1. The proposed relationship between intentions and actions is tested in Study 2.

Desirability bias may be a concern for Study 1, since the respondents' desire for products from a specific Web retailer might have had a confounding effect. However, by explicitly measuring the perceived usefulness construct, the study implicitly assessed the issue of Web site desirability (value, functionality, content). As hypothesized in H3, perceived usefulness of a given Web interface is expected to influence behavioral intentions. Thus, since desirability was already accounted for, product desirability should not bias the study's results.

The participants in Study 1 were asked either to choose their favorite Web retailer, choose a popular Web retailer, or talk about Web retailers in general. Following these three scenarios and based on multiple informal discussions with the respondents, choosing their favorite Web retailer seemed to be the most natural scenario for all participants. Hence, Study 2 asked the consumer participants to pick the Web retailer of their own choice.

Study 2

Study 2 addressed the major limitations of Study 1 (i.e., external validity, actual transaction behavior) by using a consumer population. Therefore it used an on-line survey instrument that was communicated to the respondents via e-mail. The e-mail addresses of 2,000 consumers were randomly collected from multiple Web addresses using an e-mail extractor program. Invitation e-mails were sent to the selected consumers, explaining the purpose of the study and requesting their participation. The respondents were asked to click on the URL link provided in the e-mail message, which linked to the Web-based on-line survey instrument. To motivate them to participate, the respondents were offered incentives in the form of a \$250 prize to be raffled among them and a report that summarized the results of the survey—77 percent of the respondents requested the report. The invitees were assured that the results would be reported in aggregate to guarantee their anonymity.

Response Rate and Nonresponse Bias

Of the 2,000 participants, 174 e-mails were returned undeliverable and 155 responses were obtained, resulting in an effective response rate of 9 percent.

The low response rate was expected because e-mail communication was the only method for contacting the participants, the on-line questionnaire was the only means for them to complete the study, and many e-mail filters prevent the delivery of mass e-mails or qualify them as low-priority mail. A recent comparative study of on-line versus mail surveys found that an Internet methodology produced a lower response rate than a postal methodology [44]. The low response rate was comparable to similar on-line studies with random consumer populations [17, 75, 76]. However, the true purpose of Study 2 was to achieve an adequate but unbiased sample of the consumer population, following the recommendations of Johnson [51], for greater use of the Web by on-line participants and decreased reliance on student populations.

Nonresponse bias was assessed by comparing the study's respondents with the current Internet consumer population (www.bltg.com/demograf.html), and the early (65%) and late respondents (35%) [5]. These two groups were compared on the basis of their sample characteristics of age, sex, income, education, and Internet experience. All five *t*-tests for each variable showed no significant difference ($p = 0.1$). Thus, despite the low response rate, fears of nonresponse bias to the internal validity of the study's results are limited, suggesting that the respondent sample was a random subset of the total population.

Data Analysis

As in Study 1, a three-step sequence for assessing convergent and discriminant validity was employed. As shown in Appendix C, the overall factor solution had an excellent loading pattern, explaining 88 percent of the variation. Therefore, convergent and discriminant validity for all measures were strongly supported. Confirmatory factor analysis was also examined using partial least squares. As shown in Table 2, the square root of the AVE was much larger than all other cross-correlations. Measure validation was also examined for reliability analysis by computing Cronbach's alpha coefficient, when all measures had adequate reliability values. Descriptive statistics, the correlation matrix, and the AVEs for the study's principal constructs are shown in Table 2.

Results

Study 2 also employed PLS-Graph Version 3.0 to test the proposed hypotheses. As shown in Figure 4, intention to transact ($b = 0.46, p < 0.01$) was a significant predictor of actual transaction behavior, thus validating H1. Trust ($b = 0.35, p < 0.01$) was the most influential predictor of transaction intentions, thus validating H2. Since Study 2 was a more realistic scenario with actual consumers, the role of trust was comparatively more important than in Study 1. Similarly, the effect of perceived ease of use ($b = 0.12, p < 0.05$) was also statistically significant in the consumer population, as opposed to the student population in which ease of use had an insignificant effect. This finding supports H4. Perceived usefulness ($b = 0.33, p < 0.01$) was also a strong predictor of transaction intentions, thus validating H3. The effect of perceived ease of

Construct	AVE	MEAN	SD	TRANS	INTENT	TRUST	RISK	USEF	EOU	REP	SAT
TRANS	1.0	5.3	1.75	1.0	0.53**	0.35**	-0.29*	0.47**	0.44**	0.37 ^{b*}	0.04
INTENT	0.95	6.0	1.22		0.95	0.67**	-0.50**	0.64**	0.57**	0.52**	-0.17*
TRUST	0.95	6.0	1.32			0.90	-0.62**	0.70**	0.64**	0.58**	-0.29*
RISK	0.89	2.4	1.49				0.82	-0.49**	-0.45**	-0.32*	0.23*
USEF	0.83	5.8	1.27					0.79	0.72**	0.57**	-0.25*
EOU	0.93	5.9	1.36						0.88	0.40**	-0.15*
REP	0.93	5.9	1.29							0.88	-0.21*
SAT	0.93	2.1	1.64								0.93

Table 2. Descriptive Statistics, Correlation Matrix, and Average Variance Extracted (AVE) of Principal Constructs for Study 2 (Consumer Sample).

Note: *p < 0.05; **p < 0.01; AVE values are shown in bold.

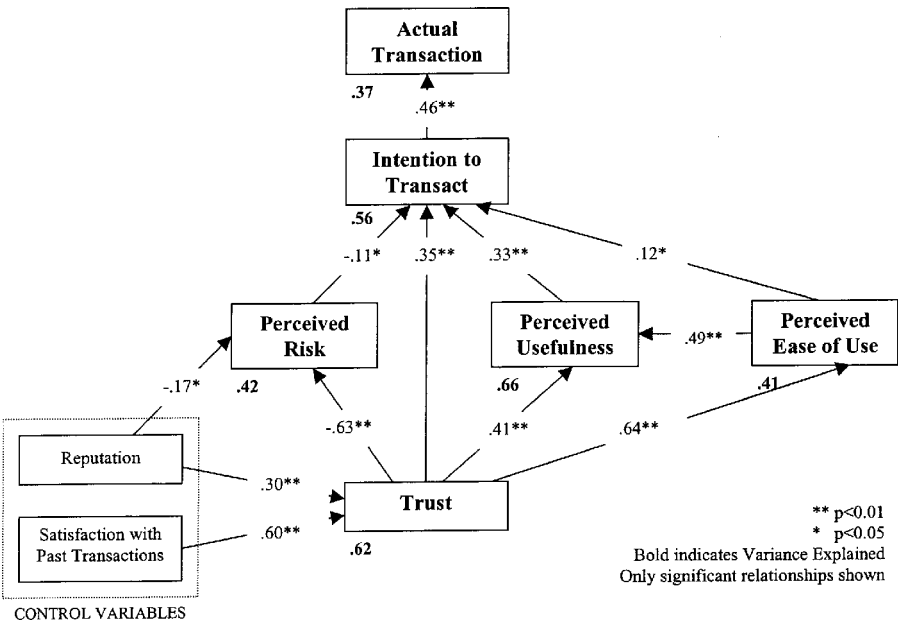


Figure 4. Partial Least Squares (PLS) Results for Study 2 (Consumer Sample)

use ($b = 0.49, p < 0.05$) on usefulness was also significant, rendering support for H5. These three results fully validate TAM on on-line transaction intentions. H6 was also supported, since perceived risk ($b = -0.11, p < 0.05$) was significantly related to intentions to transact. It is important to note that the direct effect of the four major predictors of trust, usefulness, ease of use, and perceived risk on actual transaction behavior was insignificant, suggesting that these independent variables only influence actual behavior indirectly through transaction intentions, as originally conceptualized. The effect of trust on perceived usefulness ($b = 0.41, p < 0.01$), perceived ease of use ($b = 0.64, p < 0.01$), and perceived risk ($b = -0.63, p < 0.01$) was significant, validating H7, H8, and H9, respectively. In terms of the antecedents of trust, reputation ($b = 0.30, p < 0.01$) and satisfaction with past transactions ($b = 0.60, p < 0.01$) were significant antecedents, explaining 62 percent of the variance of trust. As shown in Figure 4, the variance for all dependent and mediating variables was substantial, suggesting the predictive power of the proposed model. In addition, the results of Study 2 were similar to the those of Study 1, providing evidence for the reliability of the proposed model.

General Discussion

The primary contribution of this research is the integration of variables associated with behavioral and environmental uncertainty (trust and perceived risk) with technology acceptance constructs (perceived usefulness and ease of use)

into a coherent and parsimonious model that jointly predicts consumer acceptance of e-commerce. Drawing upon the theory of reasoned action, this paper theoretically develops an extensive set of interrelationships among these variables and their comparative effect on consumer intentions to use the Internet for on-line transactions. By indicating the relevance of TRA in the proposed model, the study makes a theoretical and empirical contribution to the emerging e-commerce literature by validating a theory-driven research model of how to influence transaction behavior in Web retailers. Two independent empirical studies jointly provide consistent empirical support for the proposed B2C e-commerce acceptance model. Given the high explanatory power of the resulting model, it is likely to serve as a basic model in predicting on-line consumer behavior and enhancing understanding of B2C e-commerce.

There are several new findings regarding the importance of certain variables in B2C e-commerce. First, trust and perceived risk are shown to be direct antecedents of intention to transact, suggesting that uncertainty reduction is a key component in consumer acceptance of e-commerce that deserves particular attention. This is consistent with recent work in e-commerce [17, 41, 49, 50, 72]. Second, while trust is hypothesized as a direct antecedent of transaction intentions, it also acts as an indirect antecedent through perceived risk, perceived usefulness, and perceived ease of use. This finding validates the conceptualization for the imperative role of trust in e-commerce and explicitly describes its precise effects. Third, perceived usefulness and ease of use have a significant effect on transaction intentions, suggesting that the technology acceptance model could also extend into consumer on-line behavior to explain acceptance of B2C e-commerce. Finally, transaction intentions did lead to actual transaction behavior, confirming the TRA and validating the practical utility of the proposed model. In sum, the present paper presents several new findings that enrich our understanding of the unique nature of e-commerce.

Implications for Theory and Research

In terms of theory building, this study attempts to develop a new theory by grounding new variables in a well-accepted general model (TRA) and applying them to a new context. It is important to note that the two new variables—trust and perceived risk—are placed within the nomological structure of the original model and are compatible with TAM variables that have already been placed within the TRA framework [24, 25]. This approach is likely to ensure a consistent model of the drivers of B2C e-commerce and stable theory development. Hence, the proposed model makes an important contribution to the emerging literature on e-commerce.

The present study has implications for information systems research on technology acceptance and diffusion. Much research on technology acceptance implicitly assumes that system use does not comprehend the notion of uncertainty. However, the advent of the Internet has introduced uncertainty in system acceptance and use because people need to use Internet technologies to communicate, collaborate, and transact with individuals within and without organizational barriers, transcending secure face-to-face interaction.

Therefore, uncertainty is becoming an important element of system use. The integration of variables that capture the notion of uncertainty in existing models of technology acceptance opens new venues for future information systems research. For example, Song and Zahedi argue that trust and risk are important elements in the acceptance and use of Web intermediaries ("info-mediaries"), a unique e-commerce phenomenon [72]. Given the findings of this study, it seems necessary for information systems researchers to examine the role of system use in which uncertainty may be present, such as in virtual teams and organizations, interorganizational collaboration, and B2B transactions, when trust and perceived risk are likely to affect system use.

The present paper has significant implications for research into on-line consumer behavior. The potential impact of technology and the Internet on consumer behavior has begun to puzzle consumer behavior researchers [27, 68]. For example, Dickson asked: "Are consumers with technical rather than liberal arts education more open to using the Internet to shop?" and "Are those who work in the cyberspace industry more open to new consumer technologies?" [27, p. 118]. These questions clearly raise the issue of consumer technology acceptance, a relatively underresearched area in the consumer behavior literature [54]. Although marketing research has experimentally shown the role of trust and risk in purchase intentions [30, 37, 80], the role of technology acceptance variables and their integration with trust, to the best of the author's knowledge, has neither been theorized nor empirically validated. In addition, the relative impact of technology acceptance across cultures will also be critical for the multinational study of consumer behavior and customer-relationship management [17]. Consequently the proposed model can serve as an initial blueprint for understanding the effects of Internet technologies on consumer behavior within and across cultures.

The construct measuring intention to transact was captured based on TAM and purchase intentions, and, following the conceptual proposition, it was shown to behave as a unidimensional factor. The proposed dependent variable yielded a reliability coefficient of 0.94 as measured by Cronbach's alpha, and the items converged into a single factor explaining 93 percent of the variation. Therefore, the construct's reliability and convergent, discriminant, and factorial validity were sufficient, despite the newness of the measure. These findings empirically support the study's proposition that consumers view the transaction process in its entirety both as intention to use (information exchange) and intention to transact (product purchase), even if theoretically the process could span different activities. The proposed measurement convention makes it possible to capture the dependent variable based on extant scales with proven measurement properties. Nevertheless, future research could attempt to distinguish different transaction activities and determine whether there is a need to further distinguish the proposed dependent variables. As consumers become more sophisticated about on-line transactions, they are more likely to differentiate distinct activities.

An interesting implication of this empirical study is the directionality of the causal relationship between trust and perceived risk. While trust and risk are interrelated constructs [59], the directionality of the causal relationship is not apparent. For trust to have a measurable effect, a certain degree of risk

must exist at the beginning [53], since the higher the initial perception of risk, the higher the trust needed to facilitate transactions. Nonetheless, the effect of perceived risk on trust was not statistically significant, suggesting that risk may not be a causal predictor of trust. On the other hand, trust is a significant antecedent of perceived risk. Therefore, the research suggests that the directionality of the causal relationship flows from trust to perceived risk. Drawing upon the empirical findings for trust and risk, it may be inferred that trust also acts indirectly on intention to transact through the mediating effect of perceived risk, on which it has a direct effect. However, future research should further examine the complex interrelationship among trust, perceived risk, and behavioral intention to reach definite conclusions.

H5 hypothesizes that perceived ease of use is positively associated with intention to transact. This hypothesis received weak support, suggesting that ease of use may not be an important factor that directly influences consumer perceptions to accept e-commerce. This finding may be explained by Gefen and Straub, who would argue that perceived ease of use directly influences e-commerce acceptance only when the task is intrinsic to e-commerce [40]. In other words, they hypothesized that perceived ease of use influences technology acceptance only when the technology itself provides the primary product or service. Their findings showed that perceived usefulness influences Web site acceptance for both purchase and inquiry purposes, whereas perceived ease of use induces acceptance of the Web site only for inquiries. Given that the proposed dependent variable in this study included both purchase and inquiry concurrently, perceived ease of use would be unlikely to influence e-commerce acceptance in this context, following Gefen and Straub [40]. However, future research could attempt to differentiate transaction activities and more precisely examine the effect of the proposed independent variables on them.

The results from these two independent studies suggest that the proposed model possesses substantial explanatory power and is robust under several circumstances. Not only is the integration of uncertainty with TAM theoretically appealing under the TAR aegis, but it is also empirically significant, since it explains why much of the variation for intention to transact is much higher than indicated by previous TAM research on usage intentions. This finding also suggests that TAM could be useful in explaining purchase intentions when technology is present, since perceived usefulness has been shown to be a strong predictor of intentions to transact in e-commerce.

Implications for Practice

The study has important practical implications for influencing on-line consumer purchasing behavior. Web retailers should acknowledge that consumer trust and risk constitute a tremendous barrier to on-line transactions. However, this research shows that on-line retailers are not powerless. It gives practical guidelines as to how Web retailers can build trust and positively influence consumer intentions and actions. Web retailers could employ several trust-building mechanisms to manipulate favorable consumer attitudes and ultimate transaction behavior.

Limitations and Suggestions for Future Research

The term “e-commerce acceptance” suggests actual behavior, not just intentions. Study 1 (the student sample) did not measure actual behavior, and any indications regarding acceptance were inferred from the participants’ intentions (in the sense that intentions are positively related to behaviors). Given the limitation of this argument, Study 2 addressed the issue by measuring actual transaction behavior. However, given the cross-sectional design of the study and the inability to perfectly observe actual behavior, the relationship between intentions and behavior needs further validation. Future research could take a longitudinal perspective and use alternative statistical methods (e.g., LISREL) to convincingly determine this crucial relationship.

The four proposed key drivers of e-commerce acceptance are merely representative of the notions of uncertainty and technology diffusion, and are not exhaustive of other potential drivers of e-commerce [e.g., 75, 76]. Despite the high variance explained by the proposed model, it is possible to identify additional factors that influence consumers to adopt e-commerce. In addition, it would be useful to identify external variables that may influence the four proposed key drivers [72]. Future research could explore other related constructs that better predict e-commerce acceptance, calling for a comprehensive model of e-commerce adoption.

This research shows that reducing perceived risk is an important factor in e-commerce acceptance. As argued in this paper, there are many types of risks. Yet the study theorizes about risk at an abstract level, only making a distinction between behavioral and environmental risk. The examination of more detailed facets of perceived risk would be a promising area for future research. Risk can be perceived as a second-order factor, comprising multiple first-order dimensions, such as performance, financial, time, psychological, social, and privacy risk among others. For example, Featherman and Pavlou examined a multifaceted model of perceived risk and theorized the relationship between the multidimensional construct of risk with other variables [31]. Given the importance of risk reduction in on-line consumer behavior, future research should examine the nature and role of risk at a more detailed level.

Common-method variance might also have been a concern for this study, since the participants could choose a favorable or unfavorable target and provide overall positive or negative evaluations for all the variables. Despite the danger of common-method variance (which is very common in single-informant studies), there were no signs of lack of discriminant validity or multicollinearity among the principal constructs, the usual sign of common-method variance. Nevertheless, future research could employ a more controlled experimental manipulation to avoid allowing the respondents to provide uniform responses across all constructs.

Ward and Lee argue that novice consumers tend to rely on reputation and brand names, whereas experienced consumers rely more on other factors [78]. Since trust, perceived risk, and ease of use may all be influenced by experience, future research could examine the behavioral differences between experienced and novice consumers. Moreover, relevant cultural and ethnic characteristics could be investigated to provide a richer understanding of on-

line purchase intentions across nations. For example, Jarvenpaa and Tractinsky and Teo and Jing examined the role of trust in e-commerce in several national cultures and identified differences and similarities among consumers from diverse cultures [50, 75]. The degree of acceptance of the Internet in a specific country may play a role in transaction intentions. Future research could investigate the proposed model in different countries to understand cross-cultural effects on e-commerce acceptance.

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Appendix A. Measurement Scales and Reliabilities for Principal Constructs

Actual transaction behavior

I have frequently used this retailer’s Web site to conduct product purchases or monetary transactions during the last six months.

Intention to transact

Given the chance, I intend to use this retailer’s Web site.
Given the chance, I predict that I should use this retailer’s Web site in the future.
It is likely that I will transact with this Web retailer in the near future.

Trust

This Web retailer is trustworthy.
This Web retailer is one that keeps promises and commitments.
I trust this Web retailer because they keep my best interests in mind.

Perceived risk

How would you characterize the decision to transact with this Web retailer? (Significant risk/insignificant risk)
How would you characterize the decision to transact with this Web retailer? (Very negative situation/Very positive situation)
How would you characterize the decision to buy a product from this Web retailer? (High potential for loss/High potential for gain)

Perceived usefulness

Overall, I find this retailer’s Web site useful.
I think this retailer’s Web site is valuable to me.
The content on this retailer’s Web site is useful to me.
This retailer’s Web site is functional.

Perceived ease of use

My interaction with this retailer’s Web site is clear and understandable.
Interacting with this retailer’s Web site does not require a lot of mental effort.
I find this retailer’s Web site easy to use.
I find it easy to locate the information that I need in this retailer’s Web site.

Web retailer reputation

This Web retailer is known to be dependable.
This Web retailer has a poor reputation in the market. (reverse scale)
This Web retailer has a reputation for dependability.

Satisfaction with past on-line transactions

I am satisfied in general with my past transactions with this Web retailer.
I am satisfied with the products or services I have received from this Web retailer in the past.

Web-shopping frequency

I use the Internet for product purchases: (Never/Once a year/Few times a year/Once a month/Once a week/Few times a week/Daily)

Note: Items in italics were only in used in Study 1; items in bold were used only in Study 2.

Appendix B. Factor Analysis with Varimax Rotation for Multi-item Principal Constructs (Study 1)

Item	TRANS	RISK	USEF	EOU	TRUST	REP	SAT	FREQ
TRANS1	0.753							
TRANS2	0.785							
TRANS3	0.876							
RISK1		0.727						
RISK2		0.707						
RISK3		0.656						
USEF1			0.757					
USEF2			0.741					
USEF3			0.806					
USEF4			0.784					
EOU1				0.711				
EOU2				0.876				
EOU3				0.898				
EOU4				0.818				
TRUST1					0.711			
TRUST2					0.748			
TRUST3					0.656			
REP1						0.757		
REP2						0.795		
SAT1							0.583	
FREQ								0.451

Note: Only values above 0.45 are shown for clarity (Variance Explained 84%).

Appendix C. Factor Analysis with Varimax Rotation for Multi-item Principal Constructs (Study 2)

Item	TRANS	INTENT	TRUST	RISK	USEF	EOU	REP	SAT
TRANS	.771							
INTENT1		0.684						
INTENT2		0.705						
TRUST1			0.759					
TRUST2			0.722					
TRUST3			0.751					
RISK1				-0.889				
RISK2				-0.829				
RISK3				-0.792				
USEF1					0.600			
USEF2					0.778			
USEF3					0.484			
EOU1						0.773		
EOU2						0.865		
EOU3						0.875		
REP1							0.895	
REP2							0.893	
REP3							0.832	
SAT1								0.946
SAT2								0.957

Note: Only values above 0.45 are shown for clarity (Variance explained 88%).