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**Consumer Intentions to Adopt Electronic Commerce –
Incorporating Trust and Risk in the Technology Acceptance Model**

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To be presented in the ‘DIGIT Workshop’

December 2001

Consumer Intentions to Adopt Electronic Commerce – Incorporating Trust and Risk in the Technology Acceptance Model

Abstract

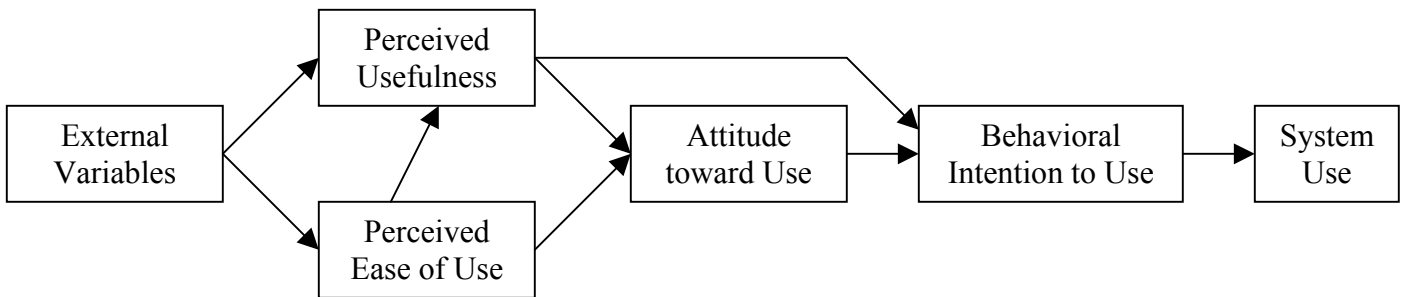
This research describes consumer intentions to adopt e-commerce by predicting behavioral intentions to use Internet technologies for online transactions, drawing upon Ajzen's (1985, 1988, 1991) theory of planned behavior (TPB). Consumer intention to adopt e-commerce is proposed as a behavioral intention to exchange information online, share confidential and monetary information, and engage in product purchases. Drawing upon the Technology Acceptance Model (TAM), since online transactions entail consumers to use Internet technologies to a great extent, e-commerce adoption intentions essentially necessitate that consumers perceive Web interfaces to be useful and easy to use. In addition, the novel and impersonal nature of online transactions and the technological unpredictability of the Internet reduce consumer perceptions of control over their online transactions, making trust and risk beliefs inevitable elements of online consumer behavior. This research incorporates the constructs of trust and perceived risk with TAM major constructs to predict e-commerce adoption intentions, following TPB. Consequently, a set of testable hypotheses that interrelate intentions to transact online with perceived usefulness, perceived ease of use, perceived risk, and trust is proposed. The resulting research model is validated using data from three exploratory experiential studies with 103 subjects using three different scenarios. The results give substantial support for the proposed hypotheses, while explaining 64% of the variation for consumer intentions to adopt e-commerce. The paper discusses several insights from this exploratory study, proposes several future research directions, and concludes with implications for theory and research.

Keywords: Transaction Intentions, Trust, Perceived Risk, Technology Adoption, Electronic Commerce, Online Consumer Behavior, Perceived Usefulness, Perceived Ease of Use.

Introduction

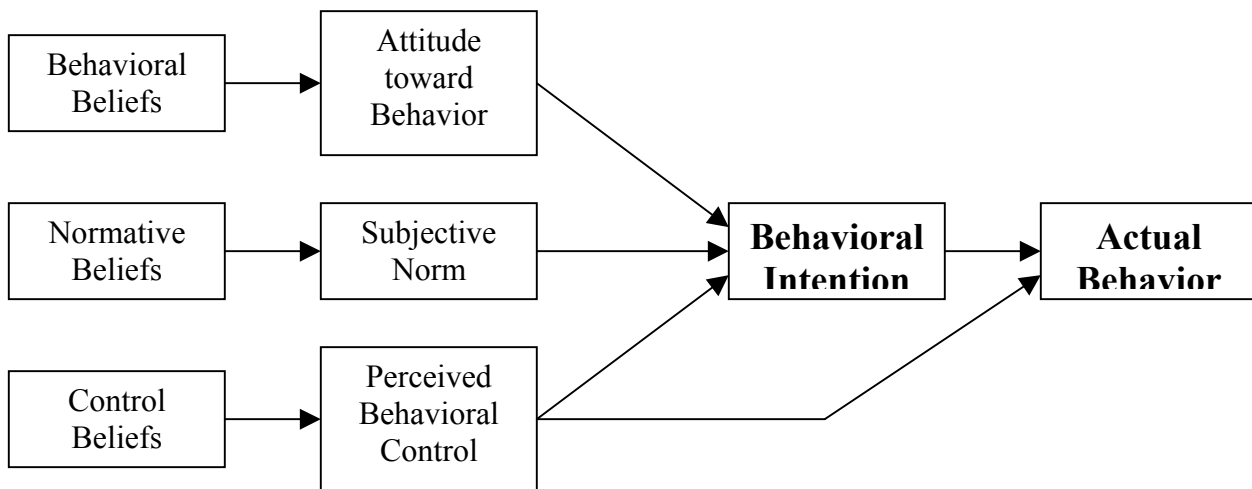
Business-to-consumer (B2C) e-commerce is the ability of consumers to purchase products and services online using Internet technologies and associated infrastructure (Olson and Olson 2000). The outlook of B2C e-commerce not only depends on consumers accepting Web retailers as acceptable merchants similar to traditional stores, but primarily on recognizing Internet technologies as viable transaction means. As with most information systems, Internet technology adoption and use could be predicted by the Technology Acceptance Model (TAM), shown in Figure 1. While TAM has initially focused on system usage in the workplace, recent research has successfully employed TAM to understand website use (Moon and Kim 2001, Teo, Lim, and Lai 1999). Therefore, intentions to use the Internet for online transactions should consider the major constructs of TAM, which theorizes that perceived usefulness and perceived ease of use determine actual intentions and behavior (Davis 1989). Additionally, the spatial and temporal separation between consumers and Web retailers, the unpredictability of the Internet infrastructure, and the newness of this transaction medium generate an implicit uncertainty around online transactions (Brynjolfsson and Smith 2000). Hence, online transactions enclose the notion of uncertainty, which has not been a critical factor in traditional technology adoption. For example, there is a risk for monetary loss since consumers have to rely on electronic information and become vulnerable to potentially incomplete or distorted information provided by Web retailers and third parties (Lee 1998), and also a risk for loss of privacy associated with providing personal information (intentionally or involuntary) to Web retailers (Culnan and Armstrong 1999). Hence, B2C e-commerce assumes a major delegation of authority that consumers need to surrender during online transactions with Web retailers. This research aims to predict consumer adoption of e-commerce by integrating TAM with the constructs of trust and risk, which become particularly essential constructs when uncertainty is present.

Figure 1. The Technology Acceptance Model



The proposed e-commerce adoption model draws from the general Theory of Planned Behavior (TPB) developed by Ajzen (1985, 1988, 1991) and its predecessor, the Theory of Reasoned Action (Ajzen and Fishbein 1980). The building blocks of the TPB model are salient beliefs, which are used to ascertain attitudes, subjective norm, and behavioral control, consecutively determining intentions and behavior (see Figure 2). The TPB has been successfully applied in technology adoption research.

Figure 2. The Theory of Planned Behavior



The original TAM posits that two salient variables, perceived usefulness and perceived ease of use determine technology acceptance behavior (Davis, Bagozzi, and Warshaw 1989), and proposes that people use technology in response to both extrinsic and intrinsic motivation. Extrinsic motivation arises when the technology is perceived to be instrumental in achieving valued outcomes that are distinct from the specific activity. For example, an online book purchase is an activity *extrinsic* to the Internet technology because the underlying technology only serves as the interface to the primary purchase activity. Intrinsic motivation arises when the task by itself reinforces the activity performance process. For instance, inquiring about a book represents an *intrinsic* motivation because the technology itself is embedded in the interface and databases to provide the actual task. This paper deals with consumer adoption of e-commerce, which assumes both extrinsic and intrinsic motivation¹. Intrinsic motivation comes primarily from perceived ease of use and perceived enjoyment, and extrinsic motivation from perceived usefulness (Teo, Kim, and Lai 1999), which influence technology use for browsing, gathering information, or making product and price comparisons (Gefen and Straub 2000). Extrinsic and intrinsic motivation may also arise from trust and risk perceptions that may extrinsically moderate the task or they may become intrinsically reinforced by the process. However, trust and perceived risk are proposed in this research as salient and control beliefs that influence attitudes and behavioral control to impact technology adoption, especially for actual monetary transactions involving private and secure information. This paper integrates the literature on trust and perceived risk to propose these two perceptual constructs that influence attitudes and behavioral control that influence consumer behavioral intentions related to e-commerce transactions.

This research aims to provide a model that predicts consumer adoption of e-commerce by explaining intentions to use Internet technology for online transactions, drawing upon Ajzen's

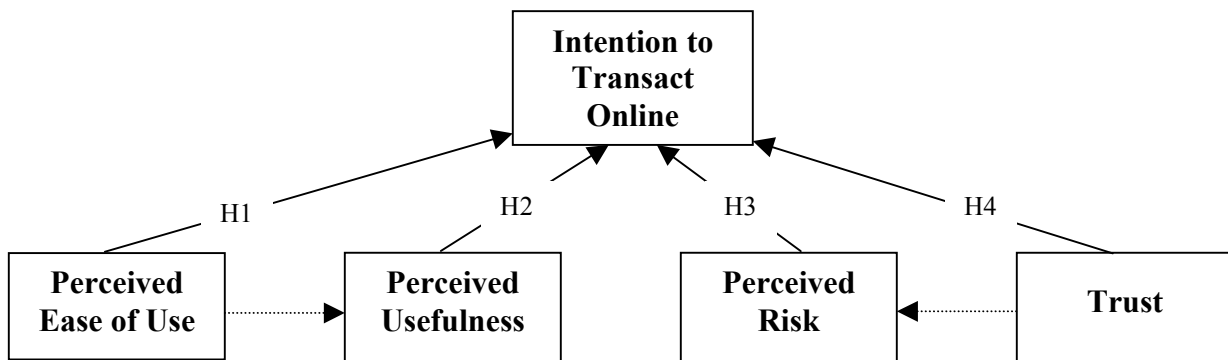
¹ While trust and risk may also be viewed as constructs affecting intrinsic and extrinsic motivation, this paper focuses on them as salient and control beliefs.

(1985, 1988, 1991) theory of planned behavior. Starting with TAM, the model involves perceptions of both usefulness and ease of use, hypothesizing that these perceptions directly influence online transaction intentions. Trust and risk are also included as important components in the model as salient beliefs that shape transaction intentions by influencing consumer attitudes. More specifically, since intentions to use Internet technology for transactions entail a certain degree of uncertainty, perceived risk and trust are incorporated in the model as antecedents of intentions to transact online.

Conceptual Development

Figure 3 presents the proposed research model. The choice of dependent variable – intention to transact – is explained, which is posited as the primary construct to determine consumer adoption of e-commerce. Starting with the basic TAM variables (perceived usefulness and perceived ease of use), the proposed model integrates two additional theoretical constructs related to online transaction intentions such as perceived risk and trust. Each of these constructs is defined and explained, and their relationship with transaction intentions and e-commerce adoption is justified.

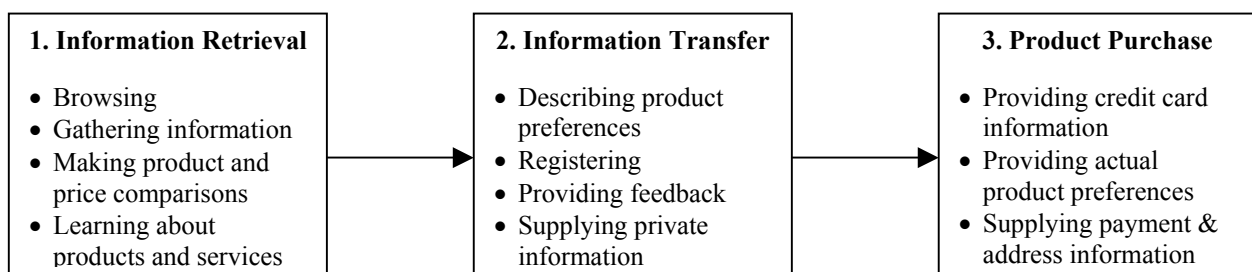
Figure 3. Conceptual Model



Intention to Transact Online

Following Zwass (1998), intention to transact online is defined as the consumer's intent to engage in an electronic exchange relationship with a Web retailer, such as sharing business information, maintaining business relationships, and conducting business transactions. Consumer-retailer exchange relationships typically involve several activities (Pavlou and Stewart 2000), as shown in Figure 4. The first step may involve basic data exchange from the retailer to the consumer through browsing, gathering information, and making product and price comparisons. The next step usually involves consumer providing some private and personal information through registering an e-mail address and other personal information, describing product preferences, and providing feedback. This step is often supplemented by automatic information exchange that is intentionally or involuntarily captured through cookies, log-data, and data mining tools. The final step typically involves provision of private and monetary information such as credit card information, actual product preferences, and payment and address information to complete a purchase.

Figure 4. The Consumer Online Transaction Process



Based upon the description of the online transaction process, B2C e-commerce adoption essentially necessitates that the consumer uses a Web retailer's website to receive and provide information, and then complete a transaction. While the number of Internet users is constantly increasing (Commerce Net 2001), according to a recent study, more than 75% of online consumers abandon their shopping carts before purchase (BizRate 2000). This poses a tremendous problem for Web retailers who prefer buyers and not browsers. However, even if consumers finally decide not to purchase, similar to traditional shopping, their initial intentions when engaging in information exchange are typically to complete the ongoing transaction process (Hoyer and MacInnis 2001). This exploratory study assumes that the proposed 'intention to transact online' construct to encompass intentions regarding the entire online transaction process (Figure 4), and proposes that intentions span the entire process, while actual activities may often seize during the process². Even if information exchange and product purchase may be theoretically distinct activities, they are practically indistinguishable in online transaction intentions since consumers start the transaction process with intentions to transact. It is beyond the scope of this research to predict actual transactions; in fact, TAM was initially introduced as intention to use technology, not actual usage. Future research on TAM shows a high correlation between intentions and actual use (e.g. Bernadette 1996). This paper aims to entice research to explain the relationship between online transaction intentions and actual behavior.

In contrast to traditional consumer behavior, online transactions have some unique dimensions, such as (a) the extensive use of technology for transactions, (b) the distant and impersonal nature of the online environment, and (c) the implicit uncertainty of using an open technological infrastructure for transactions. More specifically, consumers must first actively engage in extensive technology use through interacting with the retailer's websites. Second, the spatial and temporal separation among consumers and marketers increases fears of Web retailer opportunism arising from product

² Future extensions of this research theoretically and empirically distinguish between the three processes.

and identity uncertainty (Lee 1998). Third, there is a concern about the reliability of the underlying Internet and related infrastructure that Web retailers employ to interface with consumers. Overall, these three unique differences reduce consumer perceptions of control over their online transactions, increasing their apprehension about adopting e-commerce.

The Theory of Planned Behavior

TPB (Figure 2) is a well-established general theory of social psychology that asserts that specific salient beliefs influence given behavioral perceptions and subsequent actual behavior (Ajzen 1985, 1988, 1991). There are three types of beliefs in the TPB that impact three perceptual constructs: Behavioral beliefs that influence attitudes, normative beliefs that affect subjective norm, and control beliefs that shape perceived behavioral control. In turn, these three perception constructs determine behavioral intentions and actual behavior, as depicted in Figure 2. This paper employs TPB to propose the relationship between technology use (perceived usefulness and perceived ease of use) and uncertainty (perceived risk and trust) with behavioral intention to transact online.

Technology Use and Intention to Transact Online

TAM would argue that two external variables, perceived usefulness and perceived ease of use influence Internet technology adoption. Following Davis (1989, p. 320), perceived usefulness is defined here as the degree to which consumers believe that a particular technology would facilitate the transaction process. Perceived ease of use is defined here as the degree to which a consumer believes that using a particular technology would be free of effort. Drawing from TPB, perceived usefulness and perceived ease of performing the behavior would directly influence behavioral intentions and actual behavior. Applied to online consumer behavior, a web interface that is perceived to facilitate the transaction process while being easy to operate is likely to be accepted by consumers. Previous research has consistently argued for a positive relationship between perceived usefulness and perceived ease of use with acceptance of information technology (e.g. Dishaw and

Strong 1999, Venkatesh and Davis 2000), and this finding has also been validated in Internet technology use (e.g. Lederer et al. 2000, Moon and Kim 2001, Teo, Lim, and Lai 1999). Given the wide variance of technologies, applications, and information systems to which TAM has been validated, Internet technology and web interfaces should also adhere to the major TAM predictions, even in the case of online transactions.

Virtually all steps in the proposed online transaction process require consumers to interact with websites and essentially use Internet technologies. Since intentions to transact entail technology use, it is justifiable to consider TAM variables to predict intentions to use Internet technology for online transactions. In fact, Gefen and Straub (2000) examined the effect of perceived ease of use on e-commerce adoption, and Teo, Lim, and Lai (1999) investigated the impact of perceived usefulness and ease of use on consumer use of the Internet. Therefore, even if TAM was originally used to predict technology use in the workplace, TAM variables could also be employed to predict consumer behavior in e-commerce. 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 adoption of e-commerce.

H1: Consumer intention to transact online is positively related to perceived ease of use.

H2: Consumer intention to transact online is positively related to perceived usefulness.

Uncertainty and Intention to Transact Online

There is a broad consensus that both traditional merchants and also purely Web retailers have widely embraced the low-cost Internet infrastructure for reaching consumers and increasing their buyer reach (Alba et al. 1996). However, consumers have not adopted B2C e-commerce in the same degree (Hoffman et al. 1999), primarily because of risk concerns (Chellappa and Pavlou 2001) and trust-related issues (Palmer, Bailey, and Faraj 2000). Therefore, uncertainty around consumer online transaction intentions is fundamental in predicting B2C e-commerce adoption.

Perceived Risk

The distant and impersonal nature of the online environment and the implicit uncertainty of using a global open infrastructure for transactions have rendered risk as an inevitable element of e-commerce. Two forms of uncertainty are naturally present in online transactions, (a) behavioral uncertainty, and (b) environmental uncertainty (Bensaou and Venkatraman 1995). Similarly, Ring & Van de Ven (1994), classified risks as technology-driven risks derived from the underlying infrastructure and relational risks resulting from the trading partner. 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 adequately monitor all transactions. Examples of opportunistic behavior by Web retailers include product misrepresentation, false identity demonstration, denunciation of warranties, and outright fraud. Therefore, behavioral uncertainty primarily creates (i) economic risk because of the possibility of monetary losses, (ii) personal risk because of potentially unsafe products, (iii) seller performance risk because of imperfect monitoring, and (iv) privacy risk because of the opportunity to disclose private information. On the other hand, environmental uncertainty mainly exists because of the unpredictable nature of the Internet technology that is beyond the full control of the Web retailer or the consumer. While retailers have an important influence on the security of the transaction medium through encryption, authentication, and firewalls, there is still a possibility for third parties to compromise the transaction process. Examples of environmental uncertainty include theft of credit card information, breach of private information, and stealing of personal information by hackers. Hence, environmental uncertainty mainly includes (i) economic risk and (ii) privacy risk.

When engaging in an online transaction process, consumers are rightfully alarmed about the different types of risks present. However, since risk is difficult to be captured as an objective reality, the literature has predominantly addressed the notion of perceived risk, which is defined here as the

consumer's subjective expectation of suffering a loss in pursuit of a desired outcome. Without loss of generality, the proposed forms of behavioral and environmental uncertainty should collectively behave since a consumer has certain overall expectations regarding the Web retailers' behavior and their ability to protect critical information (Ring and Van de Ven 1994)³. Even if risk increases from information sharing to product purchase, perceived risk associated with the online transaction process is proposed to be a unidimensional control belief (Dowling and Staelin 1994).

The relationship between perceived risk and online transaction intentions is mainly justified by the notion of perceived behavioral control (Ajzen 1985, 1988, 1991), described in TPB. Consumer behavioral intentions are contingent upon perceptions about the Web retailer, which are partially determined by behavioral and environmental factors (control beliefs). Perceived risk may reduce consumers' perception of behavioral and environmental control (perceived behavioral control), and this will negatively influence behavioral (transaction) intentions. Hence, reduction in perceived risk is posited as a control belief that is expected to influence behavioral control and behavioral intentions. In fact, Jarvenpaa, Tractinsky, and Vitale (1999) suggested that reduced risk associated with buying from an Internet store would likely increase the likelihood a consumer purchases from that store. Similarly, fears that a Web retailer has not taken adequate steps to reduce infrastructure-related risks will also negatively affect control beliefs, perceived behavioral control, and transaction intentions. However, if consumers gain perceived behavioral control over their online transactions by alleviating risk perceptions about behavioral and environmental uncertainties, TPB would predict that consumers would be willing to transact (Ajzen 1991).

H3: Consumer intention to transact online is positively related to perceived risk reduction.

³ While this study assumes that risk primarily focuses on behavioral risk due to the Web retailer's actions, future extensions of this paper theoretically and empirically distinguish between risk due to the retailer and risk due to the environmental (technological) infrastructure and related control mechanisms.

Trust

The open nature of the Internet as a transaction infrastructure and its global nature have made trust a crucial element of e-commerce (Hoffman, Novak, and Peralta 1999). The importance of trust has elevated in e-commerce given the high degree of uncertainty and risk present in most online transactions (Fung and Lee 1999). In fact, Stewart, Pavlou, and Ward (2002) argue that perhaps the most important component of consumer-marketer transactions is the notion of trust. Lack of trust has been touted as one of the main reasons for consumers not engaging in e-commerce (Keen 1999). Trust has always been an important element in influencing consumer behavior (Schurr and Ozanne 1985); hence, developing consumer trust in Web retailers is critical for the continued growth of B2C e-commerce (Palmer, Bailey, and Faraj 2000). For example, Ba and Pavlou (2001) show that auction sellers take advantage of their trustworthiness to collect price premiums by consumers. In sum, the role of trust in consumer behavior is associated with a series of favorable outcomes, and it is of fundamental importance for accurately capturing consumer intentions in e-commerce.

Practically all transactions require an element of trust, especially those conducted in the uncertain environment of e-commerce (Lee 1998). Following Stewart et al. (2001), trust in e-commerce is defined as here the subjective probability with which consumers believe that a particular online transaction will occur in a manner consistent with their confident expectations. This definition captures both the traditional view of trust in a specific party (Web retailer), and also encompasses trust in the reliability of the transaction medium (trust in the infrastructure). This conceptualization of trust is consistent with the generic model of trust (Tan and Thoen 2001), which also views two targets of trust, trust in another party and trust in the control mechanisms. Whereas trust in e-commerce has essentially two targets, Web retailers have substantial effect on influencing trust in the control mechanisms by facilitating encrypted transactions, installing firewalls, and utilizing authentication mechanisms (Chellappa and Pavlou 2001). Therefore, environmental uncertainty is

influenced by the Web retailers' actions that aim to reduce infrastructure-related concerns and increase trust. Koller (1988) posits that the degree of trust an individual forms toward a transaction partner (Web retailer) is a function of the degree of risk involved in the situation. Without loss of generality, this research focuses on the Web retailer as the major target of trust, arguing that consumer trust attitudes are heavily influenced by behavioral beliefs about Web retailers. However, this focus does not mean to discount the role of trust in the infrastructure (interface) that has been described elsewhere (Cassell and Bickmore 2000)⁴.

The relationship between trust and online transaction intentions is justified by the notions of behavioral beliefs and attitudes described in TPB (Ajzen 1985, 1988). Trust is posited as a salient behavioral belief that influences consumer attitude about Web retailers and subsequent behavioral intentions for online transactions. Hence, consumers would be hesitant to transact with a Web retailer that fails to signal a sense of trustworthiness (behavioral belief) because of fears of seller opportunism and concerns about the utilization of the associated Internet infrastructure. On the other hand, trust creates positive attitudes towards Web retailers, which are likely to reduce fears of retailer opportunism, attenuate infrastructure concerns, and favorably influence transaction intentions with Web retailers. In fact, Jarvenpaa and Tractinsky (1999) and Hoffman et al. (1999) argue that lack of trust prevents consumers from engaging in online transactions. Additionally, trust gives consumers a sense of an overall control over their online transactions (control beliefs) that positively influences perceived behavioral control, transaction intentions, and subsequent actual intentions (Ajzen 1991). In general, behavioral intention about online transactions is likely to be influenced by attitude and perceived behavioral control drawn upon trust and control beliefs.

H4: Consumer intention to transact online is positively related to trust in e-commerce.

⁴ While this study assumes that trust in e-commerce primarily focuses on trust in the Web retailer, future extensions of this paper theoretically and empirically distinguish between the two targets of trust.

Control Variables. The main dependent variable – intention to transact, is likely to be influenced by several other variables other than those explicitly hypothesized in this research. For example, a recent market research by the Greenfield Online Shopping Index finds that online shopping frequency is an influential factor in determining purchase intentions. Also, reputation has been regarded as an important antecedent of purchase intentions (Javernpaa and Tractinsky 1999). Ganesan (1994) shows that satisfaction with past outcomes is positively related to future intentions. Therefore, in order to validate the proposed model, this study controls for the effect of Web shopping frequency, reputation, and satisfaction with previous online transactions.

Research Methodology

Three exploratory experiential surveys were conducted to validate the proposed e-commerce adoption model. Three distinct target Web retailers were selected to validate the model in different common e-commerce scenarios, following a ten-minute activity that aimed to familiarize subjects with these three Web retailers. First, 36 undergraduate students were asked to complete a questionnaire related to Amazon.com (www.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 regards to that retailer; third, 25 students were asked to rate their perceptions about Web retailers in general. The rationale behind selecting these three different scenarios with either a predetermined or self-selected Web retailer or online retailers in general was to test the proposed research model in several contextual bases to assess its robustness and generalizability across different targets.

The ten-minute activities were typical of activities that consumers perform during the transaction process, as represented in Figure 4. Initially, subjects in a supervised lab were asked to visit the domain of the target Web retailer and were instructed to perform the following activities that were the same across all three studies. First, the participants were asked to search, select, and inquire

about a product of their choice that was available by the selected or predetermined Web retailer (information retrieval). Second, they were asked to discover what information the Web retailers may request or necessitate from them (if any) during the process of learning more about the product (information exchange). However, the students were not required or requested to provide any information. Third, participants were asked to learn how they could actually purchase the focal product and what information they had to provide in order to do so (product purchase). Again, the students were not required to complete a transaction nor provide any monetary information. In fact, none of the students provided any information or purchased any products during the study since the study's goal was to familiarize the participants about the online transaction process with the target Web retailer and inquire about the participants' intentions, not their actual behavior.

Following these activities, the students were given a questionnaire whose items focused on their Web retailer they visited (Amazon, their favorite, and general, respectively). For example, a sample item would read: "It is likely that I 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 performed during the ten-minute activities. Given class bonus for their participation, thirty-six students completed all tasks pertaining to Amazon for a 92% response rate (Study A). Given the same participation bonus for their favorite Web retailer, forty-one students fulfilled all tasks for a 91% response rate (Study B). In a same setting, all twenty-five concluded all tasks pertaining to Web retailers in general for a 100% response rate (Study C). Overall, the study included a total of 103 participants whose average age was 21, had an average of 2.5 years of work experience, and 57% of them were males. 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, non-response bias does not seem to be a major concern in these exploratory studies.

The purpose of the ten-minute activity was not only to acquaint the respondents with the online transaction process, but also to make them familiar with the target Web retailer to avoid uninformed responses. In the Amazon study, 89% of the respondents visited the site before the study, and 47% purchased a product. In the familiar-retailer study, 93% conducted a transaction with their familiar retailer. Similarly, the majority of the respondents had completed online transactions with Web retailers in the past (57%). These informal manipulation checks support the thesis that the respondents were knowledgeable about the target Web retailers.

Measure Development and Validation

The principal constructs were developed based on existing measures where possible, or they were generated based on similar scales. The scales for perceived usefulness (USEF) and perceived ease of use (EOU) were adapted from existing studies on TAM (Davis 1989, Venkatesh and Davis 2000). Measures for trust (TRUST), perceived risk (RISK), and reputation (REP) were adapted from Jarvenpaa and Tractinsky (1999), while satisfaction with past outcomes (SAT) was based on Ganesan (1994) and Web shopping frequency (FREQ) was captured with a standard item.

The dependent variable measuring intention to transact online (TRANS) was captured with three items. Two items were based on TAM and measured intentions to use (Venkatesh and Davis 2000), and one standard item captured likelihood to transact (Ohanian 1991). The reason for jointly using items spanning intentions to use and transact jointly is to empirically validate the convergence validity of this construct. From a conceptual standpoint, information retrieval and exchange may be viewed as intentions to use a website, while product purchase is more applicable to intentions to transact. From a measurement standpoint, convergence of these three items would render support of the study's proposition that the transaction process is viewed by consumers at its entirety, both as intentions to use (information retrieval and exchange) and also as intentions to transact (product

purchase). In addition, rather than devising a new scale for the dependent variable, this convention allows measuring the dependent variable with extant scales with proven measurement properties.

Although most items were stimulated by previous empirical studies, the actual scales were developed to capture the context of this research of each of the three experiments. A preliminary version of the instrument was generated, which was reviewed by faculty and doctoral students for precision and clearness. Subsequently, the instrument was pretested by personally administering it to twelve consumers that varied in age, sex, and ethnic origin 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 constructs of this research and their internal consistency results across all three studies are shown in Appendix A.

Data analysis was initially performed for each study individually. Given that the results across all studies were remarkably similar, the data were pooled together for an overall statistical analysis. A statistical test was performed to assure that this procedure was possible with these data sets, and the three individual studies were similar at the $p < .1$ level. This course of action is also possible from a theoretical standpoint since the proposed framework is hypothesized to be robust in several contextual bases. While only the results of the overall test are reported in detail for brevity, the most important findings for the individual studies are also reported⁵.

All items were submitted to an exploratory factor analysis, and based on factor loadings and a priori theoretical expectations; indicators for the hypothesized principal constructs were identified. To address the issue of convergent and discriminant validity, a three-step procedure was employed.

First, exploratory factor analysis was conducted to detect high loadings on hypothesized factors and

⁵ The results of all three individual studies will be presented at the DIGIT workshop, and they are available by the author upon request.

low cross-loadings. Second, all eigenvalues associated with the 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 confirmatory factor analysis with Varimax rotation. The overall factor solution has an excellent loading pattern and explains 87% of the variation. As shown in Table 1, all items loaded on their hypothesized factors, and the estimates were positive and significant. Hence, convergent and discriminant validity for all constructs is supported. Measure validation was also examined for reliability analysis by computing Cronbach’s alpha coefficient, where all measures have high levels of reliability with an average exceeding $\alpha=0.91$. 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.

Table 1. Factor Analysis with Varimax Rotation for multi-item Principal Constructs

Item	TRANS	RISK	USEF	EOU	TRUST	REP
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

Descriptive statistics and the correlation matrix for the study's principal constructs are shown in Table 2.

Table 2. Descriptive Statistics and Correlation Matrix of Principal Constructs

Construct	Mean	STD	TRANS	RISK	USEF	EOU	TRUST	REP	SAT	FREQ
TRANS	5.67	1.25	1.0	.714	.631	.382	.372	.621	.502	.366
RISK	5.11	1.4		1.0	.563	.347	.512	.640	.492	.366
USEF	5.70	1.21			1.0	.630	.519	.475	.500	.279
EOU	5.76	1.33				1.0	.562	.375	.319	<i>.134</i>
TRUST	5.16	1.25					1.0	.461	.305	<i>.234</i>
REP	5.61	1.31						1.0	.370	.274
SAT	5.51	0.97							1.0	.456
FREQ	3.92	1.62								1.0

Significant at $p < 0.01$ level ($r > 0.25$) are shown in bold; Significant at $p < 0.05$ level ($r > 0.20$) are shown in italics.

Results

As shown in Table 3, perceived usefulness ($b_1=.31$, $t=3.28$, $p<.01$) is positively associated with intention to transact online, rendering strong support for H1. The results are consistent across all three individual studies ($b_{1a}=.31$, $b_{1b}=.33$, $b_{1c}=.27$). However, perceived ease of use ($b_2=.01$) has a non-significant effect on intentions to transact online. However, as Davis (1989) argued, ease-of-use may act on behavioral intentions indirectly through usefulness. In fact, ease of use has a strong correlation with usefulness ($r=.63$, $p<.001$), allowing us to infer that ease-of-use fosters the website's usefulness. H3 was supported since perceived risk reduction ($b_3=0.40$, $t=4.27$, $p<.01$) is significantly related to intentions to transact online. This finding was consistent across studies ($b_{3a}=.27$, $b_{3b}=.44$, $b_{3c}=.66$). Trust was marginally related to intention to transact online ($b_4=.14$, $t=1.75$, $p<.1$), partially validating H4. The weak effect of trust on the dependent variable may suggest that trust primarily acts indirectly on transaction intentions through perceived risk ($r=.46$, $p<.001$), following Mayer, Schoorman, and Davis (1995).

Reputation was a significant antecedent of intention to transact online ($b_5=.24$, $t=2.84$, $p<.01$), validating the expectation that Web retailer reputation plays an important role in consumer behavior (Jarvenpaa et al. 1999). Satisfaction with past outcomes and web-shopping frequency had a positive, yet non-significant effect on the dependent variable. Whereas the independent variables were correlated, multicollinearity was not a serious concern since all relevant checks returned a tolerance value above .70 for all seven independent variables. Finally, the variance explained by this regression was particularly high ($R^2=.64$, $F=23.89$, $p<.001$), suggesting that the proposed model captures many of the significant variables that influence B2C e-commerce adoption.

Table 3. Regression Analysis Results for Intention to Transact

Variables	Construct	Intention to Transact	t-value	Hypothesis	Support?
Independent	Perceived Usefulness	0.31	3.28***	H1	Yes
	Perceived Ease of Use	0.01	0.90	H2	No
	Perceived Risk (Reduction)	0.40	4.27***	H3	Yes
	Trust	0.14	1.75*	H4	Partial
Control	Reputation	0.24	2.84***		
	Satisfaction	0.07	0.93		
	Frequency	0.07	0.97		
	R-squared	0.64	0.61 (adjusted)		
	F ratio	$F_{7,95} = 23.89^{***}$			

Note: * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$

While hypothesis testing was performed with the pooled numbers, all three studies individually render substantial support to the research model. The regression coefficients for all three dependent variables are similar to the ones reported by the pooled data. This finding suggests that the proposed model is robust under several contextual bases and holds well irrespective if the intention to transact online is for a specific, self-chosen, or general Web retailer.

Discussion

The primary contribution of this research is the integration of two important variables associated with behavioral and control beliefs (trust and perceived risk) with the two basic TAM variables (perceived usefulness and perceived ease of use) to predict behavioral intentions to transact online. The proposed model of consumer adoption of e-commerce has received substantial empirical support, engendering several new findings regarding the importance of certain variables in B2C e-commerce adoption. First, perceived risk reduction is shown to be a direct antecedent of intention to transact online, suggesting that this form of perceived behavioral control is a key factor in consumer adoption of e-commerce. Second, trust also influences online transaction intentions, inferring that this behavioral and control belief is important for e-commerce adoption. Third, perceived usefulness and perceived ease of use collectively influence intention to transact online, validating TAM outside the workplace in the B2C e-commerce context. Finally, given the high variance explained for consumer adoption of e-commerce, the proposed variables are likely to become essential components in understanding online consumer behavior.

Implications for Theory

This research shows that perhaps the most important factor in e-commerce adoption is consumer perceived control beliefs, mainly represented by perceived risk and secondarily by trust. This finding suggests a series of implications regarding the role of uncertainty in e-commerce and opens new research avenues. There are many types of risks (economic, performance, privacy, etc.), and this study has addressed this issue at an abstract level. For example, different types of risk could have a greater impact on online transaction intentions, and in turn, different antecedents could influence them. Given the apparent importance of trust and risk reduction in online consumer behavior, future research could examine the nature and role of trust and risk at a more detailed level.

H2 hypothesizes that perceived ease of use influences perceived behavioral intentions and it is positively associated with intention to transact online. This hypothesis received no support, suggesting that perceived ease of use may not be an important factor that influences consumer adoption of e-commerce. Yet, this finding may be explained by Gefen and Straub (2000) who would argue that perceived ease of use directly influences e-commerce adoption only when the task is intrinsic to e-commerce. In other words, the authors hypothesize that ease of use influences IT adoption only when the IT itself provides the primary product. Their findings show that perceived usefulness influences website adoption for both purchase and inquiry purposes, while perceived ease of use induces adoption of the website 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 adoption intentions in this context.

Implications for Research

The construct measuring intention to transact online was operationalized based on TAM (Venkatesh and Davis 2000) and purchase intentions (Ohanian 1991). Following the conceptual proposition, the proposed dependent variable was shown to behave in practice as a unidimensional factor representing online behavioral intention, yielding a reliability coefficient of 0.94 as measured by Cronbach's alpha, while its items converged into a single factor explaining 93% of the variation. Hence, the construct's reliability and convergent, discriminant, and factorial validity are empirically sufficient. These findings support the paper's proposition that the transaction process is practically viewed by consumers at its entirety, both as intentions to use (information exchange) and also as intentions to transact (product purchase), even if theoretically the process could span into different activities. However, other researchers (e.g. Gefen and Straub 2000, Choudhury, Karahanna, and Dumm 2001) viewed online behavioral intention as two distinct activities, distinguishing between

information and purchasing intent. Given the importance of accurately understanding consumer behavioral intentions, future research should address this issue in more detail.

Not only the incorporation of perceived risk and trust with TAM is theoretically appealing, it is also empirically strong since it cumulatively predicts 64% of the variation for intention to transact online, much higher than previous TAM research on behavioral intentions. This finding suggests that TAM could be useful in explaining purchase intentions where technology is present, since perceived usefulness has been shown to be a significant predictor of intentions to transact in this research.

Limitations and Suggestions for Future Research

Two important limitations should be mentioned. First, the issue of external validity has not been fully addressed in these studies using student populations whose higher education, lower age, and higher expertise in e-commerce compared to the general population may limit the extent of the study's generalizability. Even if none of the collected demographic information (sex, age, work experience) influences the proposed research model when controlled for, the small variance in age (20-27 years old) and work experience (0-7 years) could have suppressed any moderating effects. Therefore, the generality of the findings remains to be shown by future research. Second, the constructs capturing the notion of uncertainty are not exhaustive; similarly, only the two most basic TAM constructs are examined. Future research should explore other related constructs that could better capture consumer adoption of e-commerce.

Several variables such as Internet experience, expertise, and cultural and ethnic attributes could enrich our understanding of online consumer behavior. For example, Jarvenpaa and Tractinsky (1999) examine the role trust in e-commerce in several national cultures and identify differences

and similarities among consumers. Moreover, the relative adoption of the Internet in a specific country may play a role in transaction intentions. Since this study has been conducted in the United States, countries with less Internet penetration may reveal different results. Future research could investigate the effect of the proposed variables on online transaction intentions in different countries and ethnic origins.

Finally, the results and implications of this research are constrained by the research method employed and the small sample size. Also, the validity of the proposed causal relationships is limited by the cross-sectional nature of the methodological design that limits the ability to convincingly rule out alternative hypotheses. Though the results generally support the proposed theoretical framework, it is also possible that a different sequence of relationships is present. Therefore, longitudinal research could further enhance or refute these empirical findings.

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Appendix A. Measurement Scales and Reliabilities for Principal Constructs

Scale and Items	Cronbach's alpha			
	Overall	Amazon	Familiar	General
Intention to Transact Online				
Given the chance, I intend to use this retailer's Website.	0.94	0.96	0.90	0.91
Given the chance, I predict that I would use this retailer's Website in the future.				
It is likely that I transact with this Web retailer in the near future.				
Perceived Risk				
How would you characterize the decision to whether transact with this Web retailer? (Significant risk/insignificant risk)	0.88	0.83	0.88	0.90
How would you characterize the decision of whether to transact with this Web retailer? (Very Negative Situation/Very Positive Situation)				
How would you characterize the decision of whether to buy a product from this Web retailer? (High Potential For Loss/High Potential for Gain)				
Perceived Ease of Use				
My interaction with this retailer's Website is clear and understandable.	0.92	0.94	0.93	0.90
Interacting with this retailer's Website does not require a lot of mental effort.				
I find this retailer's Website easy to use.				
I find it easy to locate the information that I need in this retailer's website.				
Perceived Usefulness				
Overall, I find this retailer's Website useful.	0.92	0.91	0.96	0.90
I think this retailer's Website creates value to me.				
The content on this retailer's Website is useful to me.				
This retailer's Website is functional.				
Trust				
This Web retailer is trustworthy.	0.90	0.88	0.93	0.73
This Web retailer is known as one that keeps promises and commitments.				
I trust this Web retailer keeps my best interests in mind.				
Web Retailer Reputation				
This Web retailer is known to be dependable.	0.85	0.87	0.84	0.88
This Web retailer has a poor reputation in the market (reverse scale)				
Satisfaction with past online transactions				
I am satisfied in general with my transactions on the Internet in the past.	N/A			
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)	N/A			