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Online privacy and security concerns of consumers
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Abstract

Purpose – Privacy and security concerns of consumers have been touted as one of the hindrances to the growth of e-commerce. These concerns increase the risk perception of consumers. Understanding the consequences of privacy and security concerns and their relationship to risk perceptions may provide a solution. The relationship between privacy and security is investigated using the theory of planned behavior. The study aims to examine the relationship of trust, privacy and security concerns to the risk perception adoption of e-commerce. The results from a survey validate the model.

Design/methodology/approach – Data were collected using survey from undergraduate business students. The respondents were requested to select a specific product that they plan to purchase in the next six months. After selecting a product, the respondents were requested to report an online company that they have recently visited which offers the selected product. The respondents were requested to fill out the survey with regard to their selected online company. Time given was approximately 20 min.

Findings – The results suggest that privacy and security concerns and trust beliefs had effects on risk perception. Among these effects, trust had the largest effect followed by privacy and security concerns. Furthermore, risk perception and trust beliefs had effects on attitude. The effect of trust beliefs on attitude was larger than the effect of risk perception on attitude. Similarly, subjective norm, perceived behavioral control and attitude had a positive and direct effect on intention to be involved in e-commerce.

Research limitations/implications – The first limitation of this study is the use of student subjects. Because this study took place in an educational setting, its generalizability to the general population of consumers lacks to some degree. The second limitation of this study is mono-method bias.

Practical implications – The effect of privacy concerns on risk perception was larger than that of security concerns. Because the consumers get more experienced and sophisticated using the Web, the security concerns that they may have had at the beginning are not reflected in their risk perceptions. It is likely that they have adopted protective measures on their own to defend their privacy online. An example of such a measure would be providing false information to online companies when asked to submit personal information.

Originality/value – The major contributions of this study are developing and validating an integrative framework of e-commerce adoption at the individual level. The model includes privacy and security concerns, risk perception and trust beliefs. This study also highlighted the distinction of constructs of privacy and security concerns and showed their differential effects on other related constructs in the research model.

Keywords Consumer behavior, Computer security, Computer privacy, Electronic commerce

Paper type Research paper

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Introduction

Privacy concerns of consumers is one of the primary obstacles for consumers to participate in electronic commerce (e-commerce) transactions, which require them to divulge personal information, such as date of birth, social security number, home telephone number and credit card information et cetera. Therefore, protecting consumers' privacy is an important factor for the success of e-commerce (Liu *et al.*, 2004). However, gathering information about consumers is also necessary for e-commerce to gain a better understanding of consumer preferences. Therefore, the managers face a challenging task while collecting necessary consumer information that is required to maximize sales and profits. Managers have to ensure that they do not compromise the privacy of their consumers, failure of which may result in public backlash.

Primarily, privacy and security concerns are treated as a single construct in most of the privacy literature (Liu *et al.*, 2004; Xu *et al.*, 2012). Security concern is known as one of the dimensions of the overarching privacy concerns. Belanger *et al.* (2002) cite that privacy and security concerns should be conceptualized as distinct and that there is a lack of understanding of their relations. Others agree, that, privacy and security concerns are two different constructs (Chang *et al.*, 2005; Vijayasarathy, 2004). In response to general sentiment, this study attempts to provide a clear delineation of the impact of privacy and security concerns as two distinct constructs. Consumer participation in e-commerce requires the user to make decisions in an environment of opposing factors (i.e. privacy and security concerns, risk perception and trust). It is important to study the influence of the combination of factors such as privacy, security, risk and trust in the consumer decision to participate in e-commerce activity. While numerous studies have considered these factors in separate investigations (Hong and Thong, 2013; Jarvenpaa *et al.*, 2000; Luo, 2002; Malhotra *et al.*, 2004; Milne, 2000; Pavlou, 2002; Riquelme and Roman, 2014; Salisbury *et al.*, 2001; Smith *et al.*, 1996; Stewart and Segars, 2002; Suh and Han, 2003), studying these factors and their effects together can help gain insights on their combined effects and interactions. This research is intended to accomplish the goal of integrating these factors in a single study and offer some fresh insights. The main motivations for this study are:

- to provide a clear delineation of privacy and security concerns;
- to provide an integrative framework of e-commerce adoption by adapting privacy and security concerns, trust beliefs and risk perceptions; and
- empirically validate the proposed framework.

This study attempts to answer the following research questions:

RQ1. How do privacy concerns, security concerns and trust beliefs relate to attitudes of consumers?

RQ2. What are the inter-relationships of privacy concerns, risk perception and trust beliefs?

RQ3. How do these factors affect consumer behavior intention to take part in e-commerce?

In this paper, we draw upon the past research in the areas of the theory of planned behavior (TPB), privacy, and consumer research to develop and test an integrative model of e-commerce adoption at the individual level that comprises privacy and

security concerns, trust and risk beliefs. Using data from a survey, we validate and test the theoretical model. We highlight the distinction of constructs of privacy and security concerns and evaluate their differential effects on other related constructs in the research model.

The next sections present the relevant literature and theoretical background for developing a research model and the testable hypotheses. The following section describes the methodology used in the study. Then, we present the data analysis and results. Next, we provide the discussions of our results and future research streams. Finally, we discuss the implications for theory and practice.

Literature review

The levels of analysis in privacy research identified by Greenaway and Chan (2005) are as follows: individual (consumer/employee), organizational and sectoral/national. At the individual level, researchers have studied consumer attitudes about privacy (Culnan, 1993; Sheehan and Hoy, 2000). At the organizational level, important issues that have been studied are information privacy because it relates to organizational liability, decision outcome and ethical imperative (Greenaway and Chan, 2005). At the sectoral/national level, issues regarding information privacy across industries and countries have been addressed (Earp *et al.*, 2002). This study will address the privacy issues at the level of individuals.

Privacy concerns or unwillingness to disclose personal information is seen as a major threat to e-commerce and the digital economy (Culnan, 2000; Malhotra *et al.*, 2004). The perceived control over personal information was a key factor in affecting privacy concerns (Xu *et al.*, 2012). Consumers may have concerns over the flow of personal information between online consumers and websites and concerns over how personal information is managed by websites (Hong and Thong, 2013). Influence of privacy concerns on online trust may depend upon consumers' characteristics such as gender, age and education (Riquelme and Roman, 2014). Awareness of information collection and usage beyond the original transaction are the main influences on the degree to which consumers have privacy concerns (Sheehan and Hoy, 2000). Actions that are taken to protect consumer privacy include industry self-regulation and procedural fairness (Culnan, 2000; Culnan and Armstrong, 1999). However, it is doubtful that such measures to maintain privacy have been successful. Because of privacy concerns, consumers have resorted to using their own strategies to protect their privacy. A survey of online shoppers reported growing confidence in e-commerce (Saunders, 2004). One reason given by consumers for their increasing confidence is that despite their privacy concerns, consumers are becoming smarter about their online habits.

In addition to privacy concern, the security of consumer information has been recognized as one of the deterrents in the growth of e-commerce (Gray, 1999). Rose *et al.* (1999) identified six categories of technological impediments inhibiting the growth of e-commerce:

(1) download delays;
(2) interface limitations;
(3) search problems;
(4) inadequate measures of web application success, security; and
(5) the lack of internet standards.

Although security concerns have a close relationship with privacy concerns, it is a different construct (Belanger *et al.*, 2002; Vijayasarathy, 2004). Consistent with the distinction made by Hoffman *et al.* (1999), conceptualization of privacy and security concerns can be identified as different as "control over secondary use of information" and "environmental control" (Belanger *et al.*, 2002). Environmental control refers to the ability of consumers to control the actions of other people in the environment during a market transaction or commercial exchange (Hoffman *et al.*, 1999).

Risk has been viewed as the uncertainty associated with the outcome of a decision (Sitkin and Pablo, 1992). In e-commerce literature, two categories of risks are identified – product and transaction risks (Chang *et al.*, 2005). Product risk refers to the uncertainty that the purchase will match the acceptance levels in buying goals or objectives. Frugality of consumers seem to have influence over their risk-taking behavior, which may depend upon the context (Bansal and Zahedi, 2014). Perceived risk can be a significant predictor of attitude (Michaelidou and Christodoulides, 2011). Transaction risk is the uncertainty that something unfavorable and unforeseen may result during the transaction process. Transaction risks include authentication, privacy, security and non-repudiation of the transaction. Authentication risk refers to the uncertainty that the identity of the seller is not revealed. Privacy risk refers to the possibility of theft of private information (Pavlou, 2003). Security risk relates to the safety of the data transmitted over the Internet (Chang *et al.*, 2005). Nonrepudiation refers to ensuring that a transferred message has been sent and received by the parties claiming to have sent and received the message (Suh and Han, 2003).

To mitigate risk perception, creating trust has been recognized as an important antidote (McKnight *et al.*, 1998). Trust has generated a great deal of research in organizational studies. Internet consumers' trust and perceived risk have strong impacts on their purchasing decision (Kim *et al.*, 2008). Trust at the individual level is distinct from the trust at the group level (Zaheer *et al.*, 1998). For instance, trusting a sales person would be different from trusting the company where the sales person works. Trust can be viewed as personality traits that are relatively stable intrinsic characteristics shaped by developmental and social factors extraneous to a given context (Webster and Martocchio, 1992).

Theoretical background

TPB (Ajzen, 1991), an extension of the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980), examines the relationship between attitude, intention and behavior. According to the TRA, intentions are based on attitudes and subjective norms. The TPB adds the perceived behavior control held by an individual in the model and indicates that the intentions are predicted by attitudes, subjective norms and behavioral control. Attitude is defined as the individual's positive or negative feelings toward engaging in a specific behavior. Subjective norms represent an individual's perception of what other people important to them would think about a given behavior. Perceived behavior control describes the individual's beliefs regarding the efficacy and resources needed to perform a behavior. TPB is shown in Figure 1. When a consumer intends to participate in e-commerce, his/her intentions are shaped by the attitudes formed regarding the online company. Attitudes are shaped by salient beliefs. In addition to attitudes, the feeling of what others would feel about taking part in e-commerce and one's control over the process of taking part in e-commerce also determine the behavioral intention.

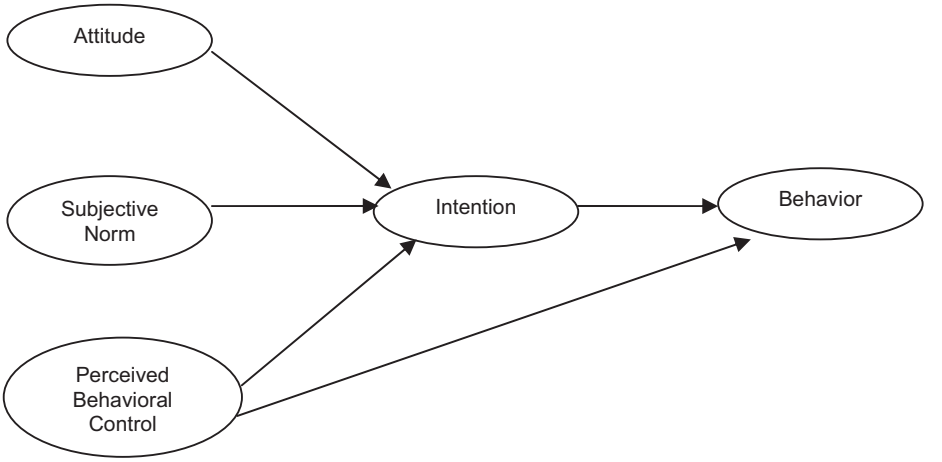

Figure 1.
The theory of planned behavior

Source: Ajzen (1991)

Mayer *et al.* (1995) proposed a trust model with its antecedents and outcomes. They define trust as the:

> […] willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (Mayer *et al.*, 1995).

In this study, trust is defined as the willingness of consumers to participate in e-commerce with belief that the companies will not misuse their personal information.

The technology acceptance model (TAM) which is an adaptation of the TRA has been popular with information systems (IS) researchers to determine the antecedents of system usage through beliefs about two factors:

(1) the perceived ease of use; and

(2) the perceived usefulness of an information system (Davis, 1989).

Earlier studies of adoption of e-commerce have widely used the TAM (Gefen *et al.*, 2003; Liu *et al.*, 2004; Vijayasarathy, 2004) and TRA (Jarvenpaa *et al.*, 1999; Malhotra *et al.*, 2004; McKnight *et al.*, 2002b; Pavlou, 2003).

The TPB is preferred over the TAM in this study because privacy and security concerns are the first hurdle that consumers have to cross to decide to take part in e-commerce before being influenced by the usability features of a website. As shown by Yang and Jun (2002), security was the key concern for a consumer who choose not to buy online. Another study found that perceived security was a much stronger determinant of intention to purchase online than the perceived ease of use and usefulness of the website (Salisbury *et al.*, 2001). Privacy and security concerns are the primary reason consumers are not purchasing over the web (Udo, 2001). The potential threats to consumers who use credit cards to purchase over the web have been well covered by the media. However, online companies also face a major threat of payment frauds. Therefore, security concerns perceived by both consumer and online company remain as barriers to

e-commerce. As for the scope of this study, the security concerns perceived by of consumers are considered, whereas security concerns of online companies are not considered.

Research model and hypotheses

In this paper, we develop a model to study how consumers' concerns regarding privacy, security and trust and risk beliefs affect their intention to engage in e-commerce transactions. Figure 2 shows the proposed model. The theoretical framework of trust and risk (Mayer *et al.*, 1995) and TPB (Ajzen, 1991) are used as the background for the proposed model.

Behavioral intention

Behavioral intention is an antecedent to actual behavior (Ajzen, 1991). The TPB model suggests that behavioral intention is the most influential predictor of behavior. Because of difficulties in measuring actual behavior in a field survey where the measures are self-reported, this study will measure behavioral intention. With self-reports it is difficult to determine whether the behavior actually took place even though the respondents reported their behavior. In the absence of an objective measure of behavior, measuring intention appears reasonable. In prior literature, behavioral intentions were measured instead of actual behavior (Malhotra *et al.*, 2004; McKnight *et al.*, 2002b; Smith *et al.*, 1996; Stewart and Segars, 2002). There is evidence in prior studies that show that behavioral intention correlates with actual behavior (Sheppard *et al.*, 1988; Venkatesh *et al.*, 2003). Therefore, measuring intention will give some indication of consumer behavior.

Trust beliefs

Trust in online contexts has been investigated by many researchers in Information Systems (Gefen *et al.*, 2003; McKnight *et al.*, 2002a; Pavlou, 2002). Trust has been studied extensively in organizational studies (Kim and Mauborgne, 1993; McAllister, 1995; Roberts and O'Reilly, 1974). Mayer *et al.* (1995) proposed an integrative definition of trust as:

> […] the willingness of a trustor party to be vulnerable to the actions of trustee party based on the expectation that the trustee party will perform a particular action important to the trustor party, irrespective of the ability to monitor or control the trustee party.

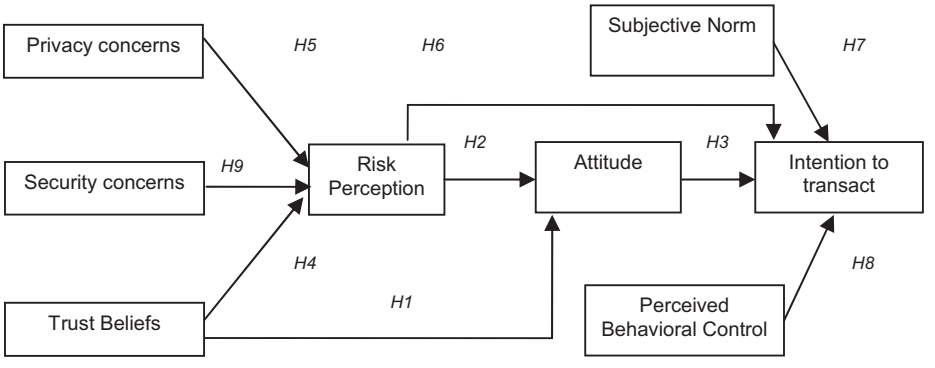

Figure 2. Research model

In e-commerce, consumers are the trustor party, whereas online companies are trustee parties. Consumers are vulnerable because they provide sensitive information such as credit card information, addresses and e-mails when they intend to participate in electronic transactions. Consumers have only limited ability to monitor the actions of the online companies regarding the unauthorized use of personal information; hence, there is an inherent hesitation on the part of consumers to share their personal information. Therefore, trust is needed to relieve the concerns of consumers (Luo, 2002).

In behavioral literature, trust has been conceptualized variously as a belief, attitude, intention and behavior (Mayer *et al.*, 1995; McKnight *et al.*, 1998). Because trust is a psychological state, trust is clearly distinct from behavior; rather, it is an antecedent to the behavior (Bhattacherjee, 2002). In this paper, trust is conceptualized as beliefs. The dimensions of trust beliefs described by Bhattacherjee (2002) are ability, integrity and benevolence. Ability refers to the consumer's perception of online company's competencies and knowledge salient to the expected behavior. These perceptions may result from prior experience or institutional endorsements from third parties in forms of trust seals. Integrity refers to the consumers' perception that the online company will adhere to a set of principles or rules of exchange acceptable to the consumer during and after the exchange. Benevolence is the extent to which an online company is perceived to be acting for the well-being of consumer. A subject may have either favorable/positive or unfavorable/negative attitude toward an object. Therefore, in e-commerce, consumers may have favorable/positive or unfavorable/negative attitude toward an online company. Prior studies have studied the relationship between attitude and trust. In a consumer to consumer electronic marketplace, favorable relationship has been found between consumer perceptions of trust and attitude in purchasing (Verhagen *et al.*, 2006). Online companies can build trust if they convince the consumer that online transactions will take place as expected by the consumer (Culnan and Armstrong, 1999). A higher level of trust results in positive attitude which helps in maintaining committed relationships (Euijin and Tadisina, 2007). Therefore, the first hypothesis to be tested is:

H1. Trust beliefs positively influence consumer attitudes toward online companies.

Risk perceptions

Risk perception was first conceptualized by Bauer (1967) in marketing literature as consumer behavior in the theoretical framework of risk-taking. According to the risk-taking framework, consumers decide to buy a product under some degree of uncertainty about a given brand. Assuming risk is perceived, consumers take steps to reduce it, mostly by relying upon a person or idea (Sheth and Venkatesan, 1968). For instance, a consumer may rely on the brand image of a product or on the opinion of an expert. Risk perception is used as a surrogate of risk because it is difficult to capture risk as an objective reality. Risk perception is described as the subjective probability of suffering a loss in pursuit of a desired outcome. Previous research in consumer behavior have reported a significant impact between risk perceptions and attitude when it comes to purchasing (Bian and Moutinho, 2009; Michaelidou and Christodoulides, 2011). It is posited that consumers who perceive higher levels of risk will have a negative attitude toward online companies. The second hypothesis to be tested is:

H2. Risk perception negatively influences consumer attitudes toward online companies.

In an e-commerce scenario, a user's beliefs about an online company may be captured by trust and risk perception. Attitude may be either favorable or unfavorable. A favorable attitude will form the intention to engage in an e-commerce transaction. Then intention is followed by the actual behavior of buying from the online company. Consumers form their trust beliefs based on the information available on the companies and on the appearance of the website of those companies. Trust in an online company can generate a favorable attitude to a consumer and may also improve the attitude indirectly by lowering the risk perception of the consumer (Jarvenpaa *et al.*, 1999). The third hypothesis to be tested is:

H3. Favorable attitudes toward online companies will increase the consumer's intention to purchase.

Relationship between trust beliefs and risk perceptions

As pointed out by Malhotra *et al.* (2004), it has been established in the trust-risk literature that personal traits influence trust and risk beliefs (Mayer *et al.*, 1995; McKnight *et al.*, 1998). Sitkin and Pablo (1992) suggested that perceived risk may mediate the effect of trust on intention and behavior. Few studies have investigated the effect of trust on perceived risk. A significant adverse effect between trust and perceived risk was found (Jarvenpaa *et al.*, 1999, 2000; Kimery and McCord, 2002; Van der Heijden, 2003). In an online auction marketplace, buyers' trust in sellers was a factor in reducing perceived risk (Pavlou and Gefen, 2004). The fourth hypothesis to be tested is:

H4. A consumer's trust beliefs will negatively affect the consumer's perception of risk.

Privacy concerns and risk perceptions

Privacy concerns refer to an individual's views of fairness within the context of information privacy (Campbell, 1997). Consumers may have different opinions about what is fair and what is not when it comes to a company's collection and use of their personal information (Malhotra *et al.*, 2004). Smith *et al.* (1996) developed concern for information privacy (CFIP) scale to capture individuals' concern about organizational information privacy practices, which had four dimensions, namely, collection, unauthorized secondary use, improper access and errors. Hong and Thong (2013) developed a third-order general information privacy concerns that has two second-order factors of interaction management and information management and six first-order factors (i.e. collection, secondary usage, errors, improper access, control and awareness). Drawing on social contract theory, privacy concerns of online consumers have been proposed to center on three major dimensions – collection, control and awareness of privacy practices (Malhotra *et al.*, 2004). If a consumer is too concerned about privacy, it will influence how he/she will perceive risk in purchasing from the vendor. Liu *et al.* (2004) proposed that the less riskiness of an online company may depend on the beliefs of consumers that their privacy is maintained. In the context of e-commerce, a positive relationship between privacy concerns and risk is shown (Malhotra *et al.*, 2004). Internet users with a high degree of privacy concerns are likely to be high on risk perceptions. Consistent with the above studies, the fifth hypothesis to be tested is:

H5. A consumer's privacy concerns will positively affect the consumer's perception of risk.

Although a favorable attitude may influence consumers to take part in e-commerce, the level of risk perception plays a strong deterrent. The risk perception associated with online shopping may reduce the consumer's perception of control and, thus, may negatively influence the willingness to buy online (Jarvenpaa *et al.*, 2000). Risk perception was found to be significant with consumer's willingness to buy books from websites (Jarvenpaa *et al.*, 2000). Chiu *et al.* (2014) found that risk perception influenced repeat purchase intention for online buyers. Therefore, the relationship between risk perception and e-commerce transaction intention is stated in the following hypothesis:

H6. A consumer's perception of risk will negatively affect the intention to transact in e-commerce.

Subjective norm

In the TPB model, one's subjective norm toward a behavior is defined as one's assessment of whether or not people important to him/her feel the behavior should be performed (Ajzen, 1991). This assessment is conducted for a number of relevant referents such as friends, family and co-workers. The belief-based measurement of subject norm consists of normative beliefs and motivation to comply. Normative beliefs refer to an assessment of how likely or unlikely the referent groups support the behavior. Motivation to comply refers to personal assessment of how motivated one is to comply with referent groups. For this study, subjective norm refers to the degree that a consumer's referent group approves the e-commerce adoption. Only normative beliefs are examined in this study because motivation to comply is more suited for organizational studies, where individual's referent groups will be co-workers. The TPB model suggests a definite relationship between subjective norm and behavioral intention. This has been demonstrated in the empirical work of intention to use on-line shopping (Vijayasarathy, 2004). Therefore, we expect that:

H7. Subjective norms of consumer have a positive relationship with intention to purchase from online companies.

Perceived behavioral control

According to Ajzen (1991), perceived behavioral control (PBC) relates to how easy or difficult it would be to carry out a certain behavior. PBC denotes a subjective degree of control over the performance of a behavior rather than the perceived likelihood that a behavior will result in a certain outcome (Ajzen, 2002). For this study, PBC is defined as a consumer's perceived ease or difficulty in buying from the online company. PBC is found to have a positive relationship between intention and actual behavior (Pavlou and Fygenson, 2006). Therefore, we can expect that:

H8. Perceived behavioral control positively influences the intention to purchase from online companies.

Security concerns

There has been a limited research that has studied the relationship among security, risk perception and purchase intention. In most cases, security has been incorporated as a part of privacy concerns. This practice is also apparent in the CFIP instrument developed by Smith *et al.* (1996). The four dimensions in CFIP were collection, errors, unauthorized secondary use and improper access. Of the four dimensions, improper

access appears similar to what Hoffman *et al.* (1999) referred to as environmental control, which is closely linked to security concerns.

Among the very limited empirical studies on security, Miyazaki and Fernandez (2001) found that system security concerns of the consumers were related to the rate of online product purchasing. However, no negative correlation between the presence of privacy and security statements and the perceived risk was found (Miyazaki and Fernandez, 2000). In the same study, privacy and security statements were positively related to online purchase likelihood. Testing the role of risk perception in the relationship between privacy and security concerns and the purchasing intention, Miyazaki and Fernandez (2001) found some support for its mediating role. This empirical evidence is at odds with the results of another study by Harris Interactive (2001). They found that only 25 per cent of consumers seem to recognize privacy and security seal features on web sites. Bansal and Zahedi (2014) reported in their study on frugal customers that when security concerns were high, the customers preferred to transact sensitive information to only trustworthy websites, thus suggesting the higher risk perceptions. In light of mixed empirical evidence of the limited research on security, the next hypothesis to be tested is:

H9. A consumer's security concerns will positively affect the consumer's perception of risk.

Method and measures

This study used a survey methodology to collect data to perform an empirical test of the relationships proposed by the research model. Instrument development followed the procedure as suggested by Churchill (1979) which included item generation, item refinement and confirmatory analysis. In the following section, we discuss the process of instrument development and validation and survey administration.

Instrument validation

It has been suggested that using validated and tested questions improve the reliability of results (Straub, 1989). To minimize potential problems with the reliability and validity of the questionnaire, whenever possible, the items were adopted from previous validated studies. Item measures are included in Appendix 1. Item map is shown in Appendix 2. All items used a seven-point Likert-type scale, where 1 = strongly disagree to 7 = strongly agree. A ten-item Likert-type scale was adapted to measure privacy concerns from Malhotra *et al.* (2004). The privacy concern measure is used as a second-order construct with three underlying dimensions of collection, control and awareness. A three-item Likert-type scale is adapted from Salisbury *et al.* (2001) to measure security concerns. Two items were newly developed. The scale measuring trust beliefs is adapted from Bhattacherjee (2002). The dimensions of trust were ability, benevolence and integrity. An eight-item Likert-type scale, including one that measured the overall trust was adopted. Risk perception measures were based on Jarvenpaa *et al.* (1999) and Malhotra *et al.* (2004). Three-item Likert scale was adapted. Measures for attitude, PBC and subjective norm were adapted from Pavlou and Fygenson (2006).

A pilot study was conducted to validate the instrument developed for this study. The pilot study served several purposes:

- to determine the time taken for filling out the survey to ensure that the length of the instrument was reasonable;
- to test the reliability and validity of the context and the instrument; and
- refinement of the instrument. The confidentiality of respondents for the pilot test was ensured.

After the pilot test, some modifications were made to the instrument to improve the clarity. For example, on one of the items regarding security concern, the original wording of "I am hesitating to make purchases from the Web because I am concerned about security issues of sensitive information" was changed to "I hesitate to make purchases from the Web because of security issues of sensitive information". The pilot study was conducted with a group of 34 undergraduate business students. The respondents were 52.9 per cent male and 47.1 per cent female. The age distribution was as follows: 26.5 per cent were from 17 to 20 years old; 50 per cent were 21-29; 11.8 per cent were 30-39; 8.8 per cent were 40-49; and 2.9 per cent were above 49 years. Time taken for completing the survey was determined to be approximately 20 min. This being a reasonable length of time, no action was taken to shorten the instrument.

Although the measures were adopted from the literature, it was necessary to conduct the validity and reliability tests because they are used in a different context in this study. Content validity refers to whether the questionnaire items or measures are representative of the way that could be used to measure the content of a given construct (Kerlinger, 1964). As suggested in Straub (1989), content validity is established through literature reviews and expert judges or panels. A literature survey was made to find all possible relevant measures. A pretest study was done with three IS faculty members and two doctoral students. The participants were requested to review and evaluate the instrument. Based on the suggestions, minor revisions were made to the instrument to clarify questions. For example, the use of words such as "Internet" and "Web" to mention the World Wide Web was revised and changed to "Web" across the instrument. The "web vendor" was also changed to "online company" to bring consistency throughout the instrument.

Construct validity was established by demonstrating that the reasonable operationalization of the construct is done. The constructs being validated are related to other constructs as suggested by the theory. Further, the constructs do not correlate with other theoretically unrelated constructs and variables. Principal component analysis with varimax rotation was used to determine if all the items hang together and load onto related factors. Factors with eigen values greater than 1.0 were retained. All the scales except for the privacy concerns scale loaded onto one factor. Privacy concerns loaded onto three factors as expected because this instrument was adapted from Malhotra *et al.* (2004), which had three factors of control, awareness of privacy practices and collection.

Data were collected for the actual survey from 273 undergraduate business students. The respondents were asked to select a specific product that they plan to purchase in the next six months. After selecting a product, the respondents were required to report an online company that they have recently visited which offers the selected product. The respondents were requested to fill out the survey with regard to their selected online company. Time given was approximately 20 min.

The age distribution was as follows: 29.4 per cent were from 17 to 20 years old; 44.5 per cent were 21-29; 13.5 per cent were 30-39; 9.2 per cent were 40-49; and 3.4 per cent were above 49 years. Out of 273 respondents, 138 were male and 131 were female; 4 respondents did not mark the gender item; 57.5 per cent were full-time students, whereas 42.5 per cent were part-time students.

Data analysis

Partial least squares (PLS) graph was used for data analysis and testing the research hypotheses. In PLS, estimation is based on ordinary least squares fixed point iterations on subsets of model parameters, thus requiring few distributional assumptions (Chin, 1998; Fornell and Larcker, 1981). PLS is used for both predictive applications and theory building (Chin, 1998). PLS was selected for this study because the emphasis was on theory building by extending on TPB and because of the sample size requirements. The sample size requirements for the PLS regression approach are much less than that required for covariance-based structural equation modeling. According to Chin (1998), sample size requirements for PLS can be determined in the following ways:

- the construct with the largest number of formative indicators; or
- the dependent latent variable with the largest number of relationships.

The required sample size will be 5 to 10 times of either of the points mentioned above, whichever is higher. Because there were no formative indicators in this study, the latent variable with the most number of relationships was "intention" with four predictors. Following Chin (1998) the sample size required would be around 40. However, Goodhue *et al.* (2006) forewarns that "10 times" rule for sample size should not be used as a guideline while using either PLS or regression for anything except for a strong effect size with high reliability. Therefore, it was determined that adequate sample size over 200 would be enough to ensure sufficient power for the data analysis.

Measurement validation

PLS estimates parameters for both the links between measures and constructs (i.e. loadings) and links between different constructs (i.e. path coefficients) simultaneously. However, the PLS model is usually analyzed and interpreted sequentially in two stages (Hulland, 1999):

(1) the assessment of the reliability and validity of the measurement model; and

(2) the assessment of the structural model.

Following this sequence ensures that the instrument has adequate reliability and validity before trying to draw conclusions about the nature of the construct relationships. The measurement model is evaluated by examining in three ways as suggested by (Barclay *et al.*, 1995):

(1) individual item reliability;

(2) internal consistency; and

(3) validity between constructs.

All the measures reached the required criteria of 0.7 as suggested by Fornell and Larcker (1981). Convergent and discriminant validity were assessed by two criteria:

(1) the square root of the average variance extracted from the indicators should be at least 0.707 and be greater than inter-construct correlation; and

(2) item loadings should be at least 0.707 and load more highly on theoretically linked construct than on other constructs.

The results showed that the items have adequate reliability and validity, as shown in Tables I and II.

Testing of structural model

Figure 3 presents the results of the hypothesis testing. As recommended by Chin (1998), bootstrapping with 200 subsamples was performed to test the significance of path coefficients. Except for one, all hypotheses were supported. The structural model showed R^2 of 0.53 for intention to transact in e-commerce, R^2 of 0.43 for attitude and R^2 of 0.33 for risk perception. The estimation provides support for most of the hypotheses except for *H6*, which examined the relationship between risk perception and intention:

- *Attitude*: As expected in *H1*, trust beliefs had significant effect on attitude ($b = 0.437$, $t = 8.39$, $p < 0.01$). The more one trusts an online company, the more favorable the attitude toward it. Consistent with *H2*, risk perception had a significant negative effect on the attitude ($b = -0.325$, $t = 5.92$, $p < 0.01$). The higher risk perceived in an online company will negatively affect the consumer attitudes toward that company.
- *Intention*: *H3*, stating the relationship between the attitude and the intention was significant ($b = 0.455$, $t = 5.64$, $p < 0.01$). A favorable attitude toward an online company will increase the likelihood of being involved in e-commerce with that company. As predicted in *H7*, subjective norm had a positive impact on intention ($b = 0.178$, $t = 2.77$, $p < 0.05$). A consumer's intention is positively related to the normative beliefs of his/her peer groups and family. *H8* was also found significant ($b = 0.408$, $t = 5.59$, $p < 0.01$). The more control a consumer feels he/she has over e-commerce transaction, the stronger is his/her intention to engage in an e-commerce transaction.

Variables	Com rel	CON	AWA	COL	SEC	RSK	TRU	SN	PBC	ATT	INT
Control (CON)	0.82	0.61									
Aware (AWA)	0.86	0.48	0.67								
Collect (COL)	0.91	0.35	0.50	0.71							
Sec con (SEC)	0.89	0.31	0.25	0.42	0.63						
Risk (RSK)	0.90	0.09	0.13	0.25	0.29	0.70					
Trust (TRU)	0.87	0.15	0.24	0.12	−0.09	−0.46	0.51				
Sub nom (SN)	0.85	0.20	0.20	0.10	−0.10	−0.25	0.63	0.74			
Per B con (PBC)	1	0.00	0.01	0.02	−0.18	−0.19	0.35	0.39	1		
Attitude (ATT)	0.94	−0.03	0.03	−0.03	−0.05	−0.53	0.59	0.37	0.22	0.89	
Intention (INT)	0.95	0.04	0.01	−0.07	−0.26	−0.18	0.49	0.47	0.60	0.40	0.91

Table I.
Internal consistencies and correlation of constructs

Notes: Average variance extracted is shown on diagonal. Com Rel = composite reliability; Sec Con = security concern; Per B Con = perceived behavioral control; Sub Norm = subjective norm

Variables	Con	Aware	Col	Sec	SN	Trust	Risk	PBC	Attitude	Int
CON1	*0.819*	0.510	0.380	0.280	0.177	0.152	0.113	−0.024	0.073	−0.031
CON2	*0.837*	0.421	0.272	0.129	0.169	0.192	0.021	0.025	0.039	0.064
CON3	*0.689*	0.380	0.299	0.237	0.176	0.110	0.052	−0.014	−0.020	0.026
PAW1	0.456	*0.820*	0.340	0.079	0.232	0.200	0.025	0.048	0.035	0.061
PAW2	0.431	*0.833*	0.455	0.229	0.166	0.243	0.143	0.025	0.077	0.085
PAW3	0.481	*0.799*	0.504	0.343	0.141	0.208	0.168	−0.046	0.046	−0.006
COL1	0.252	0.363	*0.820*	0.363	0.038	0.073	0.200	0.047	0.024	−0.024
COL2	0.386	0.412	*0.856*	0.337	0.101	0.216	0.097	−0.021	−0.020	−0.057
COL3	0.412	0.525	*0.909*	0.443	0.085	0.181	0.207	−0.009	0.027	−0.068
COL4	0.305	0.493	*0.810*	0.486	−0.005	0.076	0.225	−0.085	−0.045	−0.117
SEC1	0.198	0.261	0.389	*0.802*	−0.108	−0.075	0.279	−0.170	−0.113	−0.244
SEC2	0.198	0.141	0.343	*0.829*	−0.032	−0.008	0.169	−0.137	−0.011	−0.153
SEC5	0.218	0.216	0.349	*0.780*	−0.195	−0.222	0.427	−0.258	−0.194	−0.316
SEC4	0.228	0.215	0.462	*0.777*	−0.104	−0.004	0.348	−0.044	−0.087	-0.161
SEC3	0.248	0.233	0.394	*0.854*	−0.167	−0.087	0.321	−0.180	−0.109	−0.246
SN1	0.137	0.178	0.006	−0.196	*0.917*	0.512	−0.340	0.381	0.459	0.502
SN2	0.240	0.225	0.096	−0.147	*0.894*	0.612	−0.331	0.401	0.402	0.435
TRA1	0.207	0.281	0.119	−0.173	0.643	*0.779*	−0.409	0.367	0.493	0.515
TRA2	0.297	0.340	0.155	−0.120	0.593	*0.785*	−0.377	0.337	0.457	0.491
TRI1	0.208	0.269	0.140	−0.045	0.498	*0.878*	−0.381	0.256	0.442	0.414
TRI2	0.287	0.298	0.147	−0.078	0.476	*0.854*	−0.342	0.283	0.437	0.407
TRB1	0.060	0.137	0.118	−0.110	0.432	*0.794*	−0.317	0.277	0.419	0.362
TRB2	0.017	0.096	0.138	−0.017	0.473	*0.787*	−0.361	0.269	0.422	0.329
TRB3	0.129	0.175	0.141	−0.075	0.501	*0.849*	−0.343	0.280	0.430	0.387
RSB1	0.094	0.103	0.212	0.458	−0.353	−0.342	*0.747*	−0.196	−0.183	−0.204
RSB2	0.043	0.090	0.170	0.377	−0.276	−0.386	*0.797*	−0.262	−0.172	−0.186
RSB3	−0.036	0.056	0.105	0.284	−0.345	−0.416	*0.780*	−0.272	−0.195	−0.264
RSB4	0.001	0.046	0.134	0.364	−0.332	−0.448	*0.789*	−0.267	−0.193	−0.284
PBC	−0.008	0.012	−0.025	−0.160	0.385	0.305	−0.236	*0.950*	0.324	0.522
ATT1	−0.033	0.063	−0.048	−0.268	0.498	0.600	−0.343	0.481	*0.753*	0.623
ATT2	0.083	0.067	−0.007	−0.214	0.471	0.498	−0.282	0.396	*0.762*	0.585
INT1	−0.017	0.028	−0.104	−0.296	0.444	0.440	−0.220	0.517	0.583	*0.962*
INT2	0.057	0.069	−0.062	−0.239	0.492	0.485	−0.283	0.505	0.584	*0.955*

Table II.
Loadings and cross-loadings

- *Risk perception*: The influence of trust beliefs on risk perception of consumers was significant ($b = -0.499$, $t = 9.58$, $p < 0.01$). The direction of the relationship was negative as expected in *H4*. The higher level of trust on an online company will lead to lesser risk perception. *H5* was found significant ($b = 0.260$, $t = 3.93$, $p < 0.01$). The more concerned a consumer is regarding his/her privacy, the higher level of risk he/she is going to perceive in taking part in e-commerce. *H6* indicating the relationship between risk perception and intention was not supported ($b = 0.073$, $t = 1.35$, $p > 0.05$). There was not any support for the argument that more risk perception leads to lower intention to transact in e-commerce. It seems that there is a full mediation of attitude in the relationship between risk perception and intention. In other words, there is not any direct effect of risk perception on intention. Risk perception influences the attitude and the attitude affects the intention.

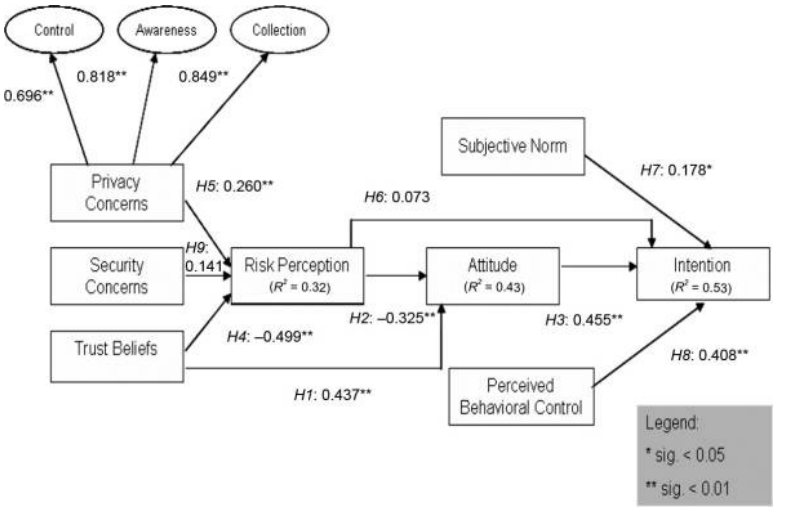

Figure 3.
Results of the PLS analysis

Attitude is shaped by both risk and trust beliefs. However, *H9* was supported ($b = 0.141, t = 2.28, p < 0.05$). Similar to privacy concern, security concern also had a positive impact on risk perception. The more concerned a consumer is about his/her security, the more risk he/she perceives in taking part in an e-commerce transaction.

The mediation test was carried out to test whether attitude (MV) mediates the relationship between risk (IV) and intention (DV). Without the mediator (attitude), the correlation coefficient (r) between IV and DV is -0.22, which decreases to 0.082 when the mediator is present.

After bootstrapping, the beta coefficients for IV and MV is -0.557, for MV and DV is 0.448. Standard errors are 0.0439 and 0.0829, respectively. Sobel test shows that there is mediation ($t = -4.97, p < 0.05$) effect between IV and DV. To test for partial or full mediation, we looked at direct and indirect effects of the IV on DV. Although the correlation coefficient decreases when the mediator is present, t-test shows that the relationship between IV and DV is not significant. Therefore, there is full mediation effect or the results support that attitude fully mediates the relationship between risk and intention.

Discussion and future research

Consistent with the proposed research model, the results suggest that privacy and security concerns and trust beliefs had effects on risk perception. Among these effects, trust had the largest effect followed by privacy and security concerns. Furthermore, risk perception and trust beliefs had effects on attitude. The effect of trust beliefs on attitude was larger than the effect of risk perception on attitude. Similarly, subjective norm, PBC and attitude had a positive and direct effect on intention to be involved in e-commerce. Among the predictors of intention, attitude was the most influential followed by PBC and subjective norm. However, the effect of risk perception on intention was not significant. The reason for this could be that risk perception only helps in forming

attitude of consumers rather than their intentions. Even though the risk perception is high, consumers may not outright decide not to take part in e-commerce. Consumers would also consider the trust beliefs that they may have toward online companies and make their purchasing decision. In addition to risk perception, trust beliefs play a significant role in shaping the attitude of consumers. The finding of the insignificant relationship between risk perception and intention supports the fact that attitude fully mediates the relationship between risk perception and intention.

The effect of privacy concerns on risk perception was larger than that of security concerns. When consumers gain more experience in using the Web, the security concerns they may have had at the beginning may not show in their risk perceptions. It is likely that they may have adopted protective measures on their own to defend their privacy online. An example of such a measure would be, providing false information to online companies when asked to submit personal information.

In contrast to privacy concerns, security concerns are evolutionary beliefs. These beliefs could transform over time with more awareness and internet experience. As consumers become familiar with ongoing threats of privacy intrusion, such as the uses of information gathering technologies such as spyware, malware and adware, they are more likely to adopt protective measures. Such protective measures may be installing and updating firewall, virus definition files, anti-spyware tools, etc. With the adoption of protective measures, consumers become more confident in taking part in e-commerce because they are able to mitigate their security concerns to some extent.

The effect of trust was the largest among the predictors of risk perception. Online companies develop trust beliefs in consumers by assuring them of their expertise in performing electronic transactions, by being fair in its conduct of customer transactions and by keeping the customer's best interests in mind. Besides these actions, online companies can also encourage consumers to do business with them by assuring the protection of their personal information. Such measures include the use of trust and security seals on their websites. By developing trust in consumers, online companies are able to compromise the effects of privacy and security concerns largely and thereby encourage the consumers to take part in e-commerce. Developing trust beliefs is a necessary condition for consumers to participate in e-commerce because the online companies have no opportunities of creating personal relationships as in an offline environment.

The first limitation of this study is the use of student subjects. Because this study took place in an educational setting, its generalizability to the general population of consumers lacks to some degree. Most of the criticism toward using student subjects relates to the argument that they differ significantly from the population in their perception regarding the phenomenon of interest. Therefore, the limitations to extend the results to the general population by using student subjects in this study must be viewed in this light. Furthermore, student population, with resources and skills to use the internet, form a significant pool of the online consumers.

The second limitation of this study is mono-method bias. For one of the constructs, i.e. PBC, there was just one measure. We had collected PBC using two items, however item loading on one of the items was very low in the measurement model and was removed from the structural model. While using a single measure, there is always the potential threat to construct validity, i.e. not measuring the construct one is trying to measure. Because this construct is not a fundamental construct central to this research,

the limitation should be viewed in this light. Future studies should incorporate multiple measures for all the constructs. The data for both independent and dependent variables were gathered using self-reports. Common method variance is a common problem related to self-report (Podsakoff and Organ, 1986) because such variance is one of the main sources of measurement error. One-factor test, recommended by Podsakoff and Organ (1986), is the most popular method to test for the presence of common method variance, despite the fact it has been criticized for its drawbacks (Podsakoff *et al.*, 2003). The basic assumption of one-factor test is that one single factor will emerge from factor analysis or one single factor will account for the most variance. Conducting one-factor test gave some support that the common method variance might not be a serious problem. However, the results should be taken with caution with regard to the drawbacks of this test. Another limitation of this study is that respondents had to choose their own online company. This may have biased their responses because they are most likely to choose the companies that they are already more familiar with. Future studies should overcome this shortcoming by asking respondents to answer about a specific online company so that all the responses relate to the same online company.

This study addresses the social issues targeted at the initial adoption of e-commerce. Future studies could incorporate technological measures as suggested by TAM. After consumers cross the initial hurdle of privacy and security concerns, their decision to buy products from a specific online company may depend on usability features of their website. In a field study, most of the factors cannot be controlled, thus providing limited information for causality. Future studies should also validate the model by conducting experiments in a controlled manner. In this study, the respondents were asked to choose an online company and select the product of their own choice. Because of self-selection, the effect of risk perception may have been less pronounced, because the subjects would more likely choose an online company that they are more familiar with, or whom they trust. Future studies can improve the study by designing a laboratory experiment that would ask subjects to provide response with regard to a specific online company.

Implications and conclusion

The major contributions of this study are developing and validating an integrative framework of e-commerce adoption at the individual level. The model includes privacy and security concerns, risk perception and trust beliefs. This study also highlighted the distinction of constructs of privacy and security concerns and showed their differential effects on other related constructs in the research model.

Implications of this study follow for both theory development and practice. By integrating concerns for privacy and security in the theoretical framework of TPB, this study made a key contribution for theory development. Consumers' concerns influence their different set of beliefs that ultimately decide on the intention and behavior. Besides concerns, this study also introduced the risk perception into the framework of TPB. Because a consumer makes the decision to participate in e-commerce in a social confluence of trust beliefs and risk perception, which in turn is affected by concerns for privacy and security, it is necessary that a framework of e-commerce adoption includes all these factors. To trust literature, this study contributes by emphasizing the role of risk perception as a consequence of trust beliefs. Further, this study also proposes a direct and indirect effect of trust on attitude through risk perception.

E-commerce adoption studies have been mostly centered on usability features of websites. The major barriers that need to be overcome before consumers reach the level of adoption are the concerns for privacy and security. This study is one of the first attempts to develop an integrative framework of e-commerce adoption with the constructs of privacy and security concerns.

The managerial implication of this study is that usability features of the website can be enhanced not only aesthetically but also by adding security features. Having security features would help gain the confidence of consumers. Besides, adding other technical features, such as recommendation agents and personalization schemes can help to create a favorable attitude in consumers toward their websites. Clear and readable privacy and security policies should be posted on the websites. As consumers become more experienced with their online habits, a simple compromise on privacy and security features may cost a business. Further, shortcomings on securing personal information may even result in serious consequences.

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Appendix 1

Construct	Items
Privacy concerns control	Con1: Consumer online privacy is really a matter of consumers' right to exercise control and autonomy over decisions about how their information is collected, used and shared
	Con2: Consumer control of personal information lies at the heart of consumer privacy My personal information could be misused when transacting with online companies
	Con3: I believe that online privacy is invaded when control is lost or unwillingly reduced as a result of a marketing transaction
Awareness of privacy practices	Paw1: Companies seeking information online should disclose the way the data are collected, processed and used
	Paw2: A good consumer online privacy policy should have a clear and conspicuous disclosure
	Paw3: It is very important to me that I am aware and knowledgeable about how my personal information will be used
Collection	Col1: It usually bothers me when companies ask me for personal information
	Col2: When companies ask me for personal information, I sometimes think twice before providing it
	Col3: It bothers me to give personal information to so many people
	Col4: I am concerned that companies are collecting too much personal information about me
Trust beliefs	Tru1: This online company has the skills and expertise to perform transactions in an expected manner
	Tru2: This online company has access to the information needed to handle transactions appropriately
	Tru3: This online company is fair in its conduct of customer transactions
	Tru4: This online company is fair in its customer service policies following a transaction
	Tru5: This online company is open and receptive to customer needs
	Tru6: This online company keeps its customers' best interests in mind during most transactions
	Tru7: This online company makes good-faith efforts to address most customer concerns
	Tru8: Overall, this online company is trustworthy
Risk perception	Rsb1: There would be high potential for loss associated with giving information to this online company
	Rsb2: It would be risky to give information to this online company
	Rsb3: Providing this online company with information would involve many unexpected problems
	Rsb4: There would be too much uncertainty associated with providing information to this online company

Table AI.
Questionnaire items

(*continued*)

Construct	Items
Security concerns	Sec1: I would not feel secure sending sensitive information across the Web Sec2: The Web is not a secure means through which to send sensitive information Sec3: I would not feel totally safe providing sensitive information about myself over the Web Sec4: I think my sensitive information sent to online companies will be accessed by unauthorized parties Sec5: I hesitate to make purchase from the Web because of security issues of sensitive information
Attitude	I think buying from the online company in near future would be: very bad idea/very good idea very desirable/very undesirable
Subjective norm	SN1: Most people who are important to me would purchase a product from the online company SN2: Most people who are important to me think that it is fine to purchase a product from the online company
Perceived behavioral control	PCB: Please rate the difficulty while purchasing this product from the online company: extremely difficult/extremely easy
Intention	Int1: What is the extent to which you will buy from this online company? unlikely/likely Int2: I predict that I would consider buying a product from this online company

Table AI.

Appendix 2

Constructs	Variables	No. of items	Related literature
Privacy concern	Collection	4	Smith *et al.* (1996)
	Awareness of privacy practices	3	Malhotra *et al.* (2004)
	Control	3	
Security concern	Perceived web security concern	3	Salisbury et al (2001)
		2	Newly developed
Risk perception	Riskiness, potential for loss and safety	3	Malhotra *et al.* (2004)
Attitude	Attitude of individual	2	Pavlou and Fygenson (2006)
Perceived behavioral control	The level of difficulty	1	Pavlou and Fygenson (2006)
Subjective norm	Normative beliefs	2	Pavlou and Fygenson (2006)
Trust	Trust beliefs	8	Bhattacherjee (2002)
Gender	Gender	1	Smith *et al.* (1996)
Age	Age	1	Smith *et al.* (1996)
Internet experience	Internet experience	1	Smith *et al.* (1996)
Falsify ID	Provide misinformation	1	Smith *et al.* (1996)
Privacy victim	Invasion of privacy in past	1	Smith *et al.* (1996)
Media exposure	Media exposure	1	Smith *et al.* (1996)
Education	Education	1	Smith *et al.* (1996)

Table AII.
Item map