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Dimensions of Perceived Ecommerce Risks: An Empirical Study using the Psychometric Paradigm

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Abstract

The ecommerce environment is relatively new, and several risks associated with ecommerce are novel to consumers. While there is some published work which tries to relate how risk perceptions affect purchase behavior, virtually no research addresses *risk per se* – that is, how do consumers judge perceived risk in online environments.

In this research, we use the well-known psychometric paradigm to study perceived risk of consumers in ecommerce. We develop a taxonomy of ecommerce risks relevant to business to consumer domain, an instrument for data collection and identify multivariate statistical techniques for data analysis. The research design allows us to uncover the basis of consumer's perceived risk judgments. We report results from a pilot study and provide details on work-in-progress.

Keywords: Business-to-Consumer (B2C) ecommerce, perceived risk, ecommerce risk dimensions, MDS, Psychometric Paradigm, Procrustes Rotation

Introduction

Consumers participating in ecommerce face several risks related to possible loss of financial and personal information, which may have significant consequences (Chua et al., 2005, Rose et. al., 1999). While there is considerable research in the IS field on ecommerce risks and their impact on consumer behavior, the focus of most of these studies is not on risk perception per se.

The purpose of this research is to focus on how consumers perceive risk in ecommerce contexts – that is on *risk per se*. Since many risks that arise in ecommerce environments are novel or unknown to consumers, the question of how consumers form risk judgments is unclear. The research question is: what dimensions do consumers use to judge risks in ecommerce?

We use the well-known psychometric paradigm of Slovic et. al. (1982) and study risk characteristics which affect online risk perception. Following the psychometric paradigm, we develop a taxonomy of risks, a simple instrument and identify statistical techniques for data analysis. We report the results of a pilot study and details on future work.

Perceived Risk in IS/Ecommerce Research

Numerous articles have been published in various conferences and journals in the last few years on ecommerce related risks. Using the AIS elibrary and snowballing from published papers, we collected a sample of about 20 articles dealing with the topic from IS journals, conferences and unpublished work spanning the 2000-2006 period. Since our research questions deal with individual subject level perceived risk, we chose articles with such a focus (i.e. typically a Business-to-consumer, B2C ecommerce orientation). Many of these articles are work-in-progress documents; however, in

most cases they provide enough details on goals of the study and approach to facilitate this review. We organized these studies using a) the purpose of the study and b) the conceptualization and operationalization of the risk construct in Table – I below.

Table I: Studies Dealing with Ecommerce Risks

Author	Purpose of study	Conceptualization and Operationalization of Perceived risk construct
1. Andrade (2000)	Differences between online versus offline buyers.	Risk is operationalized using context factors (performance risk, financial risk, convenience)
2. Bhatnagar (2000)	Impact of risk on likelihood of online purchase	Risk is operationalized using context factors (product category risk and financial risk)
3. Ahn (2001)	Impact of a) perceived product risk and b) perceived online risks on adoption	Risk with online transactions is operationalized as technological factors (security, privacy, non-repudiation and overall risk).
4. Kim (2001)	Impact of online risks on purchasing decision	Perceived risk (context)
5. Miley (2001)	Impact of demographics on online purchase	Demographics and perceived risk
6. Miyazaki and Fernandez (2001)	Impact of perceived risk on shopping behavior	Risk perceptions as function of internet experience
7. Featherman and Pavlou (2003)	Impact of perceived risk on adoption	Perceived risk operationalized as technological and social factors (performance, financial, time, social, psychological etc.)
8. Ha (2002)	Relationship between perceived risk on pre-purchase decision processes	Perceived risk operationalized as a context variable (financial, psychological, performance, and time)
9. Kehoe (2002)	Impact of trust and risk on purchase behavior	Risk operationalized as a context variable
10. Chang (2003)	Impact of trust and risk (mediating) on purchase intentions	Risk operationalized as context variable
11. Salam et al. (2003)	Impact of perceived risk on purchase behavior	Perceived risk operationalized as a probability & value
12. Su (2003)	Differences in risk perceptions, attitudes and purchase intentions for online v/s offline behavior for search v/s experience goods	Perceived risk operationalized using context variables
14. Kanungo and Jain (2004)	Impact of perceived risk, gender on purchase intentions (TAM)	Perceived risk conceptualized based on context
15. Park et al. (2004)	Impact of perceived risk on adoption (TAM)	Perceived risk is a context variable
16. Pires et al. (2004)	Impact of a variety of factors on Perceived risk	Perceived Risk is a context variable
17. Lim (2002)	Determinants of perceived risk	Perceived risk is affected by technology risks, vendor risks and product risks

18. Ueltschy et al. (2004)	Determinants of perceived risk, with focus on culture	financial, performance, physical, psychological, social, and time/convenience
19. Nyshadham (2001)	Origins of risk perception related to Prospect Theory	Perception of risk probability, perception of loss as in Prospect Theory
20. Corbitt and Van Canh (2005)	Determinants of perceived risk (in the context of low-cost airlines in Thailand)	10 factors identified

We summarize the list of articles above using 2-dimensions. The first dimension refers to the *purpose of the study*. Many studies usually place perceived risk in the larger context of ecommerce or in a broader theoretical setting. Several studies try to assess the perceived risk of various facets of online environment (e.g., technological, purchase context, product-related, vendor-related aspects etc.) For example, a study might try to test the relationship between a technological feature of ecommerce (e.g., non-repudiation) and a purchase variable (e.g., purchase intention). Typically, in these studies, there is no intermediate construct between the facets of the online environment and the outcome. Therefore, such studies focus on the context variables in ecommerce rather than perception of risk. Some studies introduce perceived risks as a variable in a social psychology models which are variations of the belief→ attitude →intention → behavior model. Others view risk in the "probability of loss" tradition. A subset of studies relate risk, trust and behavior where trust (mechanisms to alleviate risk) receives focus.

A second dimension across which the studies can be distinguished is the *conceptualization/operationalization of the perceived risk construct*. Several studies used in perceived risk research borrow from reference areas in conceptualizing and operationalizing the perceived risk construct. For example, studies which view risk as a "probability of a loss" typically use utility theory and its variants and operationalize risk as a function of perception of probability and negative consequence (potential loss) of risk. Studies which conceptualize perceived risk as a belief draw upon the rich research in social psychology and operationalize perceived risk as a belief using a Likert scale. Context of ecommerce enters strongly into most studies and many studies use aspects related to ecommerce environment in operationalization (e.g., product risk, financial risk, vendor risk etc.) Few studies focus on emotional, attitudinal and cognitive aspects of risk perception and ask questions related to origins or determinants of perceptions of such risks (e.g., Nyshadham, 2001).

Our literature review suggests that most studies in IS-ecommerce area operationalize risk construct in terms of the context of ecommerce, typically the purchase environment, product or vendor characteristics. This is understandable because the focus in early work on risk in ecommerce was in terms of its impact on purchase behavior – therefore, risk enters typically as a mediating or a moderating variable in a more general model of choice. It appears that a deeper conceptualization of risk itself is not attempted within the existing research.

Theoretical Notions of Risk

The standard notion of risk, commonly used in decision theory, economics and many applied business areas including IS, is modeled using utility theory. Utility theory states that, under some reasonable assumptions about human behavior, a rational consumer ought to choose the alternative which maximizes the expected utility, which is defined as the product of probability and payoff. Attitudes towards risk (risk aversion, risk seeking, and risk neutrality) are represented using assumptions on the curvature of the utility function. Utility theory is the normative theory of choice under uncertainty. Winterfeldt and Edwards (1986) provides an excellent treatment of utility theory when probabilities and values are treated as subjective.

In recent years, several objections have been raised about the descriptive validity of utility theory and several authors argue that utility theory cannot explain the behavior of realistic decision makers. An excellent example of such work is Prospect Theory by Kahneman and Tversky (1979). Two interesting assumptions of this theory relevant to this research are a) perception of probabilities, and b) perception of values. In Prospect Theory, decision makers are assumed to overweight small probabilities and underweight large probabilities. These weights, called decision weights in Prospect Theory, imply that subjects use distorted perceptions of probability in making decisions. With respect to values (i.e., payoff functions), subjects are assumed to use an S-shaped payoff function which makes perceived losses seem larger than similarly placed perceived gains. Such distorted weighting of probability and value lead to violations of rational choice behavior, even though these models fit real life data better than normative models.

Another notion of risk is related to the notion of "risk as feelings" (Lowenstein et. al, 2001) and "risk as affect" (Slovic, 2001). Recent advances in understanding human decision processes suggest that humans employ two different decision processes – an analytical process and an intuitive process. As the brief review above indicates, most current research assumes an analytical view of decision making and therefore, cognitive aspects of risk are emphasized. Under the analytical view, people are assumed to estimate the likelihood of probabilities and payoffs (probably, imperfectly) and combine them into a value judgment using an expectation type of operator. The "risk as feelings" literature suggests that, a) people use emotions in reacting to risk and therefore their behavior diverges from cognitive reactions, and, b) when they diverge, it is emotions rather than deliberation (cognition) that drives behavior.

Weber (2001) describes three approaches commonly used in literature on risk perception: axiomatic approach, socio-cultural paradigm and psychometric paradigm. Studies under the axiomatic measurement paradigm focus on the way in which people subjectively transform objective information. A good example of measurement under the axiomatic approach is by Holtgrave and Weber (1993) who use conjoint measurement methods. Studies within the socio-cultural paradigm examine the effect of group and culture level variables on risk perception. An extensive review of such work is provided by Rohrman (2001).

The seminal work in the area of risk perception comes from Slovic and colleagues (e.g., Slovic et. al., 1982), who popularized what came to be known as the *psychometric paradigm*. The psychometric paradigm, which will be used in this study, identifies "people's emotional reactions to risky situations that affect judgments of riskiness of physical, environmental, and material risks in ways that go beyond their objective consequences (Slovic & Weber 2001)." These judgments may be related to judgments about other properties such as risk attitudes, benefit of regulation etc. Slovic and Weber (2001) suggest that under the psychometric paradigm, perceived risk is quantifiable and predictable as well as suited for identifying similarities and differences among groups. It also appears possible to study the newer conceptions of risk (such as risk as feelings or risk as affect) under the psychometric paradigm. Under the psychometric paradigm, the strategy used for study of risk is to develop a taxonomy of hazards (risk sources), develop a set of risk characteristics, collect data from subjects and use methods such as psychophysical scaling and multivariate statistics are used to produce quantitative representations of risk perception.

Contrasting the results available under psychometric theory with current work in IS on risk perception is instructive. Current work in IS, as briefly summarized above, uses different concepts of risk and measurement approaches. Typically, risk is measured in a study using a generalized "belief" of the likelihood and severity of a risk (using a Likert scale), a context variable (e.g., financial risk, product risk etc.) or as a subjective probability of a loss. In contrast, the common risk characteristics used under the psychometric paradigm are: voluntary/involuntary, chronic/catastrophic, common/dreaded risk, known to exposes / unknown, immediate/delayed impact, known to science/unknown to science, controllable/uncontrollable, new risk / old risk etc.

We summarize this section by suggesting that a deeper conceptualization of risk as in the psychometric paradigm can help understand risk perceptions in ecommerce context. Current research in IS, as our review in Tables – I indicates, does not focus on *risk per se*. Therefore, we propose using the psychometric paradigm for study of risk perception.

Research Design

Under the psychometric paradigm, researchers first create a taxonomy of risks. Slovic et. al. (1987), for example, ask subjects to rate several known naturally occurring risks (e.g., radiation, nuclear power etc.) across several risk characteristics/attributes (e.g., voluntary/involuntary, known/unknown etc.). They reduce the dimensionality of data by using Factor Analysis and provide a 3-factor and 2-factor solutions. For example, their 2-factor solution suggests that people judge risks using two dimensions: Known/Unknown risk and Dread/Not dread risk.

In the proposed research, we assume that while risk objects may be known to consumers in an ecommerce context, the *risk characteristics are unknown to a consumer*. For example, a consumer might know that identity theft is a possible source of risk in ecommerce, but he may not know whether (and to what extent) it is a dreaded risk, a controllable risk etc. Indeed, it appears that even experts might have a difficulty answering such questions. Therefore, we use a slightly modified version of instrument and analysis method. The instrument we use requires subjects to compare two risks on a scale of "how similar/dissimilar" they are. The dissimilarity matrix is analyzed using a data reduction method called non-metric Multidimensional Scaling. The advantage of this method is that it requires subjects to compare risks against one another rather than make judgments across attributes of risk. A weakness is that interpretation of risk dimensions is subjective and left to the researcher.

Pilot test

A taxonomy of risk objects relevant to ecommerce (business-to-consumer) domain was developed based on a literature review. This yielded about a list of 15 potential risk sources in the ecommerce context. Next we added 5 off-line risk sources from Slovic's classic study – these were picked from the four different quadrants in the 2-factor solution (Slovic, 1987). The addition of offline risk sources is expected to be helpful in interpreting dimensions of MDS solution, and allowing a comparison with Slovic's work. Research subjects were recruited from the well-educated, 30-40 age group because it was expected that these subjects would have prior experience with judging and responding to risk (e.g., purchase insurance, invest in financial markets etc.)

Each subject was asked to rate *how similar/dissimilar one risk is compared to another risk* on a 9 point Likert scale which was anchored using 1= very dissimilar and 9= very similar. For example, a subject would be asked to rate how similar identity theft is to another risk such as fake website. Given N=20 risk sources used in the instrument, each subjects produces N(N-1)/2 = 190 dissimilarity ratings. The dissimilarity ratings were fitted to a smaller set of dimensions using a data reduction technique called non-metric Multi Dimensional Scaling (MDS). Since the appropriate number of dimensions is not known a priori, we fitted 2 thru 6 dimensional solutions to the data and recorded the measure of (mis)fit in a scree plot. A "kink" in the scree plot was used to identify the number of dimensions to be used for further interpretation.

Results of analysis for a specific subject (S1) are summarized in Appendix I. The scree plot is presented in the top left corner and for S1 would suggest either a 3 or a 4-dimensional solution. That is, S1 is probably using 3-4 dimensions in judging risks. The three dimensional plot is displayed in the top right corner. The loading of objects on selected dimensions is presented in the table below the three dimensional plot. Objects were assigned to dimensions using the sign and value of loadings, making sure that no object is assigned to more than one dimension. The table below the scree plot presents the assignment of objects to dimensions. The data presented for S1 has some weaknesses (as discussed below), so we use the Appendix to illustrate the research procedures and not interpret data literally.

The pilot test revealed some weaknesses in instrument design. Specifically, given 20 objects, each subject had to provide about 190 evaluations across objects apart from answering a few questions on demographics and signing Institutional Review Board forms. The rating task can indeed be tedious and many volunteer subjects were not sufficiently motivated to complete the task. Some subjects abandoned the task in the middle while some others just went thru the routine with a complete lack of interest (e.g., choose the same number on a Likert scale for the last 100 comparisons). We are revising the instrument to decrease the number of objects to something close to 15, including online and offline risks. Also, we plan to ease the task by providing a break during the task and providing some refreshments. Finally, we are also considering remunerating the subjects or contribute to a charity on their behalf.

Summary and Conclusions

The purpose of this research is to understand what dimensions consumers use in judging risks in ecommerce. The study is based on the psychometric paradigm with a difference. While studies under the psychometric paradigm assume a set of dimensions (e.g., voluntary/involuntary, chronic/catastrophic) as characterizing risk perception, we assume that ecommerce risks are very new to consumers. Hence, consumers may not be able to judge a new risk (e.g., identity theft) on a characteristic (e.g., known to science/ unknown to science). Therefore, we ask subjects to rate risk objects *against one another* based on how similar/dissimilar they are on overall risk. We think most consumers can answer these questions.

An analysis of the dissimilarity matrix provided by a subject using a non-metric MDS can help answer the research question (i.e., what dimensions do people use in judging risks) after subjective interpretation of dimensions. This could serve as a starting point for future work on developing scales for perceived risk with god psychometric properties.

We plan to collect data using a revised instrument shortly. We are confident of completing data collection and analysis in time for the conference.

Appendix I: Instrument key and sample analysis for a specific subject (S1) – pilot test

Scree Plot

Derived Stimulus Configuration

Euclidean distance model

Dim	Positively loading on objects	Negatively loading on objects	Tentative Interpretation
D1	Online False Information Online Purchase Motorcycle	Online Credit Card Fraud Online Login Bad Product Received	
D2	Online Hacker Online Auction Smoking Nuclear Power	Online Delivery No Product Received	
D3	Identity Theft Fake Website Online Return Online Bargain Wrong Product Received	Terrorism	

Key to Abbreviations: idt - IdentityTheft, od - OnlineDelivery, occf - OnlineCreditCardFraud, nt - No Tactile, oh - OnlineHacker, Bpr - Bad ProductReceived, fw - FakeWebSite, Wpr - Wrong ProductReceived, Ofi - OnlineFalseInformation, Npr- NoProductReceived, ore- OnlineReturn, S- Smoking, ol - OnlineLogin, se- SpaceExploration, Oa- OnlineAuction, T- Terrorism, Ob- Online Bargain, np- NuclearPower, op- OnlinePurchase, m- Motorcycles

Loading of objects on dimensions (3D solution for S1)

Dimension

Risk #	RiskCode	1	2	3
1	idt	1.0971	-.2926	1.4006
2	occf	-2.1927	-.0752	.5398
3	oh	1.1359	1.3548	-.4519
4	fw	-.9574	.4396	1.6283
5	ofi	1.7696	-.5869	.4767
6	ore	.6125	-1.0601	1.2050
7	ol	-1.8903	-.0253	-.1988
8	oa	.6887	1.6424	-.4155
9	ob	-1.0517	.0583	1.1240
10	op	1.3130	-1.2896	-.1434
11	od	-.9309	-1.0057	-.6785
12	nt	-.7098	-1.1073	-1.1348
13	bpr	-.8287	.5167	-1.5268
14	wpr	-.2264	-1.0835	1.0449
15	npr	.0912	-1.6218	-1.1805
16	s	-.2073	1.1341	.6312
17	se	.8768	.9127	.4897
18	t	.3132	.7264	-1.2702
19	np	.0688	1.3654	-.4162
20	m	1.0284	-.0024	-1.1236

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