Department of Information and Service Economy

Uncertainty in Consumer Decisions

Korhonen Pekka, Lauraéus Theresa, Saarinen Timo, Öörni Anssi

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Aalto University
School of Economics

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PEKKA KORHONEN

THERESA LAURAÉUS

TIMO SAARINEN

ANSSI ÖÖRNI

Uncertainty has been identified as a major force shaping behaviour. The ubiquity of uncertainty in everyday choices is reflected in its prevalence in economic theories. Despite the acknowledged importance of uncertainty, however, the actual content of the concept is far from clear, for uncertainty has rarely been the focus of research. Presence of uncertainty has been used as a justification for the relevance of the study, rather than the object of the study in and of itself.

In this paper, we have studied the presence of uncertainty in consumer decisions. Uncertainty has clearly a multidimensional nature and its dimensions have various effects on consumer behavior. To identify the central dimensions of uncertainty, we have adopted the idea from Herbert Simon who proposed a generalized approach to model a decision making as a process (Simon 1960). We propose that uncertainty has four dimensions in consumer decision context: *knowledge uncertainty, evaluation uncertainty, choice uncertainty, and implementation uncertainty*. Those dimensions can be clearly identified from our empirical data by using exploratory factor analysis. The questionnaire used in our empirical study can be used to measure uncertainty on each dimension. Against previous wisdom, evaluation and implementation uncertainties seem to exercise stronger impact on consumer decisions than the other varieties of uncertainty in electronic commerce context.

Introduction

Consumption involves decision making with what to buy, where to buy, and when to buy being the most obvious choices to be made. Often consumers face these decisions without being fully informed about the many aspects of the purchase. Indecision may exist over the best choice alternative. The needs and wants, the evaluation criteria, are often less than clear or they can't be directly matched with the characteristics of the available choice alternatives. The limits of one's knowledge about the products may be in doubt. In addition, one's ability to see the purchase through, to implement the purchase decision, is often indeterminate.

Gaps in one's knowledge lead to feelings of insecurity, a mental state that is often termed uncertainty. Alba and Hutchinson (2000) note that "the correspondence between self-assessed and actual validity of knowledge is an important issue for the study of consumer decision making for high levels of correspondence are achieved rarely and moderate levels that include some degree of systematic bias

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are the norm". Understanding the sources of uncertainty related to consumer decisions is a key to better serve the customer. Relevance of uncertainty in the context of electronic retailing has been demonstrated by e.g. Brynjoflsson and Smith (2000), who observed uncertainty reflected in customers' willingness to frequent sellers they had personal experience with (loyalty effect) and, in lieu of experience, to patronize well-known sellers (brand effect). As a research topic uncertainty is gaining on importance, for electronic retailing relies on human-to-computer interaction, which offers little on-the-spot adaptation to varying consumer needs. Flexibility has to be built in the systems and, therefore, the sources of uncertainty will have to be identified well before systems are implemented.

Uncertainty features in research traditions of individual decision making, ranging from decision science to economics and marketing. In the general decision making literature, from early on, uncertainty has been identified as the necessary precondition of choice (Dewey 1910, p. 112). In decision making context, uncertainty has often taken the form of subjective probability (see e.g., Einhorn and Hogarth 1981), which suggests that uncertainty could be quantified. Einhorn and Hogarth (1986), for example, have offered that uncertainty (ambiguity in their parlance) operates on individual judgment through personal adjustments to initial estimates of probabilities. One of the more prominent roles for uncertainty has been awarded in consumer search literature. It has been identified as the ultimate cause for search, for "the changing identity of sellers and buyers and also fluctuations in supply and demand result in uncertainty, since information becomes obsolete" (Stigler 1961). Since then, uncertainty has been part of the canon of consumer search literature. Yet, its composition has remained vague. Some efforts have been made to resolve the inner structure of uncertainty. Urbany et al. (1989) suggested that at least two dimensions of pre-purchase uncertainty exist and have quite opposite effects on consumer search behaviour. However, the authors themselves noted that their analyses suggested the existence of further dimensions in the uncertainty concept, which their data did not fully account for. Few efforts have been made to remodel pre-purchase uncertainty since. We are in need of identifying the causes of uncertainty and connecting them to their effects on consumer behaviour. As a foundation of consumer behaviour, the composition of consumer decision related uncertainty needs to be defined in a theoretically coherent frame of reference.

In this paper, we aim to model the structure of consumer decisions related uncertainty from the decision making perspective. We apply a theoretically coherent framework, the decision process model originally proposed by Herbert Simon (1957, p. 67) to identify the salient dimensions of uncertainty and to test for their relevance in consumer pre-purchase behaviour. Our tests suggest that four dimensions: *knowledge uncertainty, evaluation uncertainty, choice uncertainty, and implementation uncertainty* are major determinants of total uncertainty related to consumers' pre-purchase decision process. Our analyses further demonstrate that, opposite to earlier findings, evaluation uncertainty and implementation uncertainty may be the strains of uncertainties that affect consumer pre-purchase behaviour in electronic markets the most.

The paper is organized in five sections. In the next section, we provide an overview on the role of uncertainty in consumers' decision making literature and develop our approach. The survey is described in section 3 and results are given in section 4. We conclude the paper in section 5.

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Theory

To chart the contents of the uncertainty concept in relation to consumer decisions, we will address three interrelated topics. We will start by reviewing previous conceptualizations of consumer uncertainty and the identified uncertainty dimensions. We will next complement these dimensions by reviewing consumer behaviour literature on surrogates of uncertainty: consumer knowledge, experience, familiarity, and confidence. Lastly, we will discuss the competing decision making models for a theoretical framework to be used to define a coherent conceptualization of the uncertainty concept.

Dimensions of Uncertainty and Pre-Purchase Search

Stigler, in his seminal paper on economics of information, established that uncertainty is the driving force behind consumer search. Changing identity of sellers and buyers, and fluctuation in supply and demand result in uncertainty since information becomes obsolete (Stigler 1961). Consumers must therefore update their information, and there is often no better means to do that than search. Stigler's information search model builds on the premise that consumers have prior distribution for prices, yet they can't accurately predict any seller's price before getting a quotation (see e.g. Urbany 1986). While Stigler compressed product differences into a single dimension, price, he acknowledged that quality differences prevail in most consumer markets. Incorporating quality differences would have complicated the mathematical formulation of the problem, yet, did not affect the point Stigler made. In line with Stigler, Lanzetta (1963) posited that higher levels of uncertainty should lead to more extensive search (Lanzetta and Driscoll 1968). This position has received considerable empirical support: several constructs indicative of uncertainty (e.g. low prior knowledge, familiarity, experience) have been found positively associated with search (for an extensive review, see e.g. Fiske, Luebbehusen et al. 1994). This support has later proved equivocal, though. The relationship between uncertainty and search appears more intricate than originally hypothesized: negative, positive, and u-shaped relationships between surrogates of uncertainty and the search effort have been observed (*Ibid.*), and the conceptualization of uncertainty has been adapted accordingly.

Urbany et al. (1989) suggested that uncertainty is a multidimensional construct, and its effect on consumer search may be conditional to the dominant form of uncertainty present in the purchase decision. The authors distinguished two types of uncertainty, labelled knowledge uncertainty (KU) and choice uncertainty (CU). Knowledge uncertainty captures doubts consumers have about their own ability to judge sellers and products well enough to execute reasonable product comparisons, whereas choice uncertainty arises from the conflict about which alternative to choose (Urbany 1986; Urbany, Dickson et al. 1989). While the former construct is likened to the original idea of uncertainty put forth by Stigler (1961), the latter is reminiscent of "response uncertainty" coined by Lanzetta (1963), who, referring to Berlyne (1960), stated that uncertainty occurs when the "choice of the best alternative is equivocal" in the context of resolving a conflict. Later, Moorthy et al. (1997) examined uncertainty as a central factor of consumers' problem framing and suggested that some degree of both knowledge and choice uncertainty are necessary antecedents of search as "in the common situation in which the consumer has brand-specific prior distributions, whether the consumer searches at all depends not only on involvement, search cost, and individual brand

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uncertainty but also on whether there is relative brand uncertainty." In their terminology individual brand uncertainty is close to knowledge uncertainty and relative brand uncertainty close to choice uncertainty.

Urbany et al. (1989) found knowledge and choice uncertainties having opposite effects on consumer search. While choice uncertainty increased the amount of search, knowledge uncertainty had a weaker negative effect. The finding that uncertainty may both induce and limit search is in conflict with the position the economics of information theory has taken on uncertainty, according to which higher levels of uncertainty signifies greater benefits of receiving new information and, thus, more extensive search (see e.g. Stigler 1961). The source of this seeming discrepancy lies, we believe, in the formulation of knowledge uncertainty concept used by Urbany et al. (1989). The original authors acknowledged that their uncertainty constructs were highly correlated, which they interpreted suggesting the presence of yet another dimension of uncertainty, labelled evaluation uncertainty. Theoretical support for such a proposition can be found in decision making literature in which uncertainty has been tagged as an antecedent of judgment (Dewey 1910, p. 9, 102).

It is well established in the decision making literature that judgment and choice may not be psychologically equivalent for choice implies greater commitment (Janis and Mann 1977; Beach and Mitchell 1978). This inequality is also reflected in common language as one can make a choice against one's better judgment (Einhorn and Hogarth 1981). Johnson and Russo (1984) suggest that incompatibility of judgment and choice may account for the observations of consumer choice processes being phased and combining decision strategies, such as elimination by aspects and additive utility, to make a choice. It appears that choice is characterized by elimination and "one-sided" search, while judgment implies more evaluation and a more balanced pattern of search (Johnson and Meyer 1984). Another practical expression of this disconnection is the regular failure of formal decision making models to reconstruct choice from its component judgements (i.e. evaluations) (Einhorn and Hogarth 1981). Hence, we feel that the choice uncertainty construct should be allotted to account for choice related doubts while evaluation uncertainty should be redefined to cover one's doubts over knowledge related judgements, which we will address shortly. Both of these uncertainties operate on the level of general purchase related knowledge rather than on brand related knowledge.

Punj and Staelin (1983, p. 368) distinguished between organization of product information and actual product attributes. They included in the concept of Prior Memory Structure "the consumer's knowledge of the buying process as well as knowledge associated with [the product category] in general". The concept has since been adopted under the labels of Product Class Knowledge (Brucks 1985) and Product Category Knowledge (PCK) (Fiske, Luebbehusen et al. 1994). Studies focusing on PCK have usually identified positive association between knowledge and the magnitude of search effort (Brucks 1985). Usable Prior Knowledge (Punj and Staelin 1983, p. 368), on the other hand, refers to the actual, detailed information accumulated. The concept has since received multiple labels, yet, the one that seems to enjoy the most widespread acceptance is Brand Knowledge (BK) (e.g. Brucks 1985; Fiske, Luebbehusen et al. 1994). Brand knowledge has often been found to limit search through a de-motivating effect: The more consumers have accumulated detailed product information, the less benefit they perceive in search.

Brand knowledge and product category knowledge show signs of being related as they tend to develop in tandem (Fiske, Luebbehusen et al. 1994). They do not, however,

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seem to share all of their antecedents: "Specific product-class information is gained by using the product in everyday activities, while directly relevant purchase-task information is obtained each time a person goes through the task of buying … ." (Punj and Staelin 1983) Hence, the two types of knowledge are usually seen conceptually distinct, the PCK capturing the evaluative dimension of purchase decision and BK the actual product details. This distinction can also be found in Urbany's (1986) characterization of abstract (i.e. product category related) and concrete product related knowledge. Fiske et al. (1994) suggest two reasons to distinguish between BK and PCK. "First, the two constructs may have different effects on search behaviour. Second, while BK and PCK likely develop in tandem over time, there are many situations in which existing PCK is relevant to a search problem, yet BK is not (e.g., when a consumer moves to a new market or several new brands have been introduced since the last purchase)." We feel that the conceptual division of knowledge should be reflected in the conceptualization of uncertainty as well. The definition of the knowledge uncertainty construct put forth by Urbany et al. (1989) suggests that KU captures the evaluation dimension of the purchase decision, while CU covers the doubts over which alternative to choose. Also, Fiske et al. (1994) related the knowledge uncertainty measures employed by Urbany et al. (1989) to product category knowledge. It appears that we are lacking an uncertainty dimension which covers the doubts related to detailed product information, brand knowledge. Further, the third dimension of uncertainty that Urbany et al. (Ibid.) proposed, evaluation uncertainty, seems to overlap the current KU dimension, which they defined in terms of evaluative doubts.

To resolve the conceptual dilemma with uncertainty, we propose that the original knowledge uncertainty dimension should be relabelled as evaluation uncertainty since its substance is really more related to ability to evaluate products rather than doubts over detailed product knowledge. The label of knowledge uncertainty, then again, should be redefined to cover doubts over brand knowledge, as the name suggests. As to the observed correlations between uncertainty constructs (Urbany, Dickson et al. 1989), we refer to the previous discussion about knowledge categories having common antecedents. Closer to the uncertainty concept, subjective evaluations on one's purchase related knowledge are found to be more based on product related experiences than on the more abstract product category related knowledge (Park, Mothersbaugh et al. 1994). This connectedness is also noted in decision making literature, which points to judgment and choice being related even if one often can't reconstruct choice from its component judgments. Therefore, it is only logical to expect that knowledge uncertainty is somewhat correlated with evaluation and choice uncertainties, while the dimensions are conceptually distinct. Hence, we take it that evaluation uncertainty and choice uncertainty share some of their antecedents and that the correlations observed by Urbany et al. (1989) reflect this.

To complete our search for candidate dimensions for consumer decisions related uncertainty, we next consider the possibility of uncertainties related to implementation of the purchase decision affecting pre-decision considerations (see Table 1 for a summary of supporting literature). It is possible that uncertainties related to the later stages of the purchase process are projected to the decision. This notion is already embraced by the original definition of product category knowledge (Punj and Staelin 1983) according to which the prior memory structure captures "the *consumer's knowledge of the buying process* as well as the knowledge associated with [the product category] in general". Such nonfunctional motives of shopping as *company responsiveness* and *reputation* have been con-

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nected to retail channel selection (Eastlick and Feinberg 1999) suggesting that implementation of the purchase decisions is of concern to consumers. Closer to electronic markets environment Brynjolfsson and Smith (2000) found *trust* an important source of perceived heterogeneity in Internet retailers. In general, trust, is found an antecedent of consumer loyalty, the propensity of consumers to switch their purchase allegiances. Finally, an entirely different vein of literature, namely cognitive psychology, also points to implementation being conceptually separate from evaluation and choice phases of action. Ajzen (2002) suggests that positive attitude towards action, and the related intention to act, may not consistently predict future behavior unless they are complemented with an implementation plan, an implementation intention in Ajzen's parlance. Planning to implement an act primes environmental cues for action. Entering the planned space of action may, thus, be the needed impulse to realize the plans, which might remain good intentions in absence of these primed environmental cues.

TABLE 1: SOME INFORMATION PROCESSING DEPICTIONS OF CONSUMER CHOICE

Author(s)	Year	Sequence
Starch	1925	Seeing → Reading → Believing → Remembering→ Acting
Strong	1925	Awareness → Interest → Desire → Action
Lionberger, Rogers	1960 1962	Awareness → Interest → Evaluation → Trial → Adoption
Colley	1961	Unawareness → Awareness → Comprehension → Conviction → Action
Lavidge and Steiner	1961	Awareness → Knowledge → Liking → Preference → Conviction → Purchase (i.e. cognition → affect → conation)
McGuire	1969	Exposure → Attention → Comprehension → Yielding → Retention → behaviour
Howard and Sheth	1969	Attention → Brand Comprehension → Attitude → Intention → Purchase
Rogers and Shoemaker	1971	Knowledge → Persuasion → Decision → Confirmation
McGuire	1976	Exposure → Perception → Comprehension → Agreement → Retention → Retrieval → Decision making → Action
Engel, Blackwell and Kollat	1978	Perceived information → Problem recognition → Search [→] Evaluation of Alternatives → Beliefs → Attitudes → Intentions → Choice
Britt	1978	Exposing → Attending → Perceiving → Learning and Remembering → Motivating → Persuading → Desired Action
Foxall and Goldsmith	1994	Environment → Attentional and perceptual filter → Interpretation (involving experiences, beliefs, attitudes and goals held in short and long term memory) → Brand beliefs → Brand attitudes → Brand purchase intentions → Response
Rossiter and Percy	1997	Need arousal → Information and evaluation → Purchase → Usage

Source: (Foxall 2005, p. 27)

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Taken together, our re-formulation of the uncertainty concept and the preceding discussion about the relationship of uncertainty and consumer search allow us to make the following propositions, which will serve as the basis for developing our research hypotheses and operationalizing the key concepts: Four conceptually distinct dimensions of uncertainty appear to influence consumer search behaviour. Knowledge uncertainty captures the brand knowledge related doubts while evaluation uncertainty captures the product category related (i.e. evaluative) doubts. Choice uncertainty encapsulates the doubts over committing to the alternative judged best. And, finally, implementation uncertainty captures the doubts related to seeing through the transaction. The first three uncertainties fit nicely with Newman's (1977) keen observation: search activity increases when the consumer believes that the purchase is important, there is a need to learn more, and s/he can easily obtain and utilize information. Thus, they show some promise towards accounting for the motivational, encoding, and selective search effects. Higher levels of KU motivate consumers to increase pre-purchase search, higher levels of EU discourages search through making learning new product information more difficult, and, finally, higher levels of CU encourages more extensive search as consumers have difficulties identifying diagnostic product attributes, especially when choice alternatives are near equally attractive (for a discussion of consumer underconfidence, see Alba and Hutchinson 2000, p. 133). Implementation uncertainty (IU) connects our uncertainty concept to consumer loyalty and its antecedent, trust. How IU operates on search depends on the decision strategy applied. When conjunctive decision models are applied, IU operates through constricting the consideration set as untrustworthy sellers are weeded out. In disjunctive, lexicographic, and compensatory strategies IU merely adds an item to the preferences structure.

To sum, existing literature on uncertainty has identified and tested two dimensions of uncertainty: knowledge uncertainty and choice uncertainty. Further, existence of a third dimension, evaluation uncertainty, has been suggested but not tested. Evaluation uncertainty promises to resolve the problem of less than perfect discriminant validity of the original uncertainty constructs, and is a promising candidate for a third dimension of uncertainty. Finally, implementation uncertainty promises to provide the means of accounting for purchase process related doubts that are projected prior to purchase decision. We will next discuss how these four dimensions fit with theoretical decision making frames.

The Decision Making Framework for Studying Uncertainty

Decision making and uncertainty have been linked since, at least, the early 20th century, when John Dewey (1910, p. 9, 112) recognized uncertainty as the necessary precondition – and sometimes a constraint of choice: "*Unless there is something doubtful ... there is merely apprehension, perception, recognition, not judgment. If the matter is wholly doubtful, if it is dark and obscure throughout, there is a blind mystery and again no judgment occurs.*" Dewey's formulation of the problem solving process, the complete act of thought, was among the first frameworks for investigating the individual decision making. He recognized five logically distinct steps, common elements found in all thinking: 1) a felt difficulty, 2) its location and definition, 3) suggestion of possible solution, 4) development by reasoning of the bearings of the suggestion, and 5) further observation and experiment leading to its acceptance or rejection; that is the conclusion of belief or disbelief. He also noted that the first

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two steps "*frequently fuse into one*." (1910, p. 72)

John Dewey has heavily influenced consumer behaviour researchers, who have elaborated his basic scheme and suggested that the consumer as a decision maker undergoes several cognitive stages (see Table 1) during the purchase process. These information processing models often mix stages of decision making (e.g. problem recognition, and evaluation) with functions of the cognitive mechanism (e.g. awareness, perception, and retention) and acts of the purchase process (e.g. search, usage). Also, the consumer information processing models have been regularly criticized for not being testable. The sheer size of many of the models indeed complicates both their verification and application. As the consumer information processing models tend to incorporate much more information than is necessary for our analyses, we elect to turn to more parsimonious models of decision making.While John Dewey (1910) introduced the notion of decision making as a sequence of decomposed stages that converge on a solution, Herbert Simon (see e.g. 1960, p. 2) established the dominant model of the decision-making process as a three phase "intelligence-design-choice" sequence (Langley, Mintzberg et al. 1995), which was later supplemented with a fourth stage of "implementation" as many authors felt it significant enough to be shown separately (see e.g. Sprague Jr. and Carlson 1982, pp. 26-27). In the intelligence phase the decision maker identifies the available alternate strategies. He obtains, processes, and examines raw data for clues that may identify problems with the strategies.

In the design phase the decision maker determines and evaluates the consequences of following the alternative strategies and evaluates these sets of consequences. The word all is used advisedly as it is often impossible for the decision maker to identify all of the alternatives, or their consequences. This second phase of decision making is about inventing, developing, and analyzing the possible consequences. In the choice phase decision maker chooses his strategy and in the implementation phase he puts the chosen strategy to use.

Simon's depiction of the decision-making process is one model in the growing company of information processing and consumer choice models (see Table 2) most of which show some promise as a framework for consumer choice related uncertainty. We base our selection of the framework primarily on completeness and parsimony: consumer behaviour literature suggests the presence of four dimensions of uncertainty, which limits our choice alternatives to a handful of models, those with four identified stages. To choose among these models, we next turn to examine their content. Simon's model is a description of general decision making process as opposed to consumer purchase or information processing models, which mostly attempt to capture the sequence of acts in purchase process rather than focus on the distinctive stages of decision making as such. The model implicitly embraces the concept of uncertainty as ambiguity is the precondition for boundedly rational decision behaviour, and the stages of the model also closely match the dimensions of uncertainty we have identified through the review of consumer behaviour literature.

As it is our aim to identify the general dimensions of uncertainty facing consumers in any purchase, we deem that the model of decision-making process put forth by Simon best fits with this goal. The model suggests that four logically distinct dimensions can be identified in any decision. A measurement instrument for testing this is next developed and tested for assessing the reliability and validity of the model with a sample of 604 consumers.

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TABLE 2: UNCERTAINTY CATEGORIES IDENTIFIED IN CONSUMER BEHAVIOUR LITERATURE

Decision Stage	***Uncertainty***		
	Dimension	*Observation*	*Reference*
Intelligence	Knowledge uncertainty (KU)	The authors coin the term *Usable Prior Knowledge* to account for relevant brand information held in memory.	(Punj and Staelin 1983)
		The authors coin the term *individual brand uncertainty* to account for brand information related doubts.	(Moorthy, Ratchford et al. 1997)
		search experience	(Park and Lessig 1981)
Design	Evaluation uncertainty (EU)	While the authors coin the term *knowledge uncertainty*, they actually define the concept in terms of doubts over one's capacity to evaluate information	(Urbany, Dickson et al. 1989)
		usage experience	(Park and Lessig 1981)
Choice	Choice uncertainty (CU)	The authors coin the term *choice uncertainty* to account for doubts over identifying the best choice alternative.	(Urbany, Dickson et al. 1989)
		The authors coin the term *relative brand uncertainty* to account for doubts of choice.	(Moorthy, Ratchford et al. 1997)
		response uncertainty (choice of the best alternative is equivocal) produces conflict and, subsequently, the motivation to resolve that conflict	(Lanzetta 1963, p. 262)
		ownership status	(Park and Lessig 1981)
Implementation	Implementation uncertainty (IU)	Prior memory structure captures "the *consumer's knowledge of the buying process* as well as the knowledge associated with [the product category] in general"	(Punj and Staelin 1983)
		Functional motives, including perceived value, order services, and convenience were the strongest motives in influencing catalog shopping for 2 different product classes. Several motives identified as important for catalog patronage by previous research were not as strong as these motives. In addition, 2 nonfunctional motives related to *company responsiveness* and *reputation* were comparable in strength to several functional motives.	(Eastlick and Feinberg 1999)
		Salient motives of males for catalog patronage consisted mainly of merchandise- and service-related. In contrast, females indicated that their *salient motives were convenience-oriented*	(Eastlick and Feinberg 1994)
		… branding, awareness, and *trust* remain important sources of heterogeneity among Internet retailers	(Brynjolfsson and Smith 2000)

Methodology

The paradigms for measurement development (Churchill 1979, Nunnally 1978) suggest an iterative process. Widely used instruments have several characteristics that promote their use: they are theory based, they are developed using established psychometric methods and they are confirmed for reliability and validity (Churchill 1979, Peter 1979, Nunnally 1978). Furthermore, they propose constructs that are intuitively appealing (Churchill 1979, Peter 1979, Nunnally 1978).

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The measurement development process and item generation

Firstly, we studied in the pilot study the validity and the structural relationship of the uncertainty constructs and their effect on consumer search processes and pre-purchase search behaviour. The effect of individual differences and purchase situations on search behaviour is complex, often interactive and difficult to interpret and generalize about. Therefore, we chose as similar and consistent a group as possible for our observation research. Our response group consisted 56 of 12-15 year old teenagers from the same demographic area. The method we used in this pilot study was empirical observation. We choose this method in order to find out what people really do in a search, purchase and decision making situation, instead of just asking what they think they would do. We conducted observations during May 2004 on the school's premises. In the pilot study, we treated the knowledge and choice uncertainty as the constructs of uncertainty, but the first empirical analyses showed that there was a considerable need to separate the uncertainty constructs for more phases.

We conducted seven iterations together when creating the items of each uncertainty dimensions. After all the iterations, we attempt at an empirical assessment of the validity of the measurements instrument was made by using 17 experts (e.g. professors, ICT directors and ICT consultants) as a control group. With control group, we used a questionnaire consisting of questions concerning how respondents think that our proposals really measure different uncertainty in different phases of decision process by Simon (1957). This information was interpreted and used for assessing whether our main constructs and detailed items are valid and representative. Then, the control group commented on the detailed items included in the questionnaires and tried to improve them. After refining some details of the instrument on the basis of feedback, the advisory group approved the questionnaires.

Furthermore, we pre-tested our paper questionnaire by the consumers from different age and demographics to get feedback to refine the questionnaire. On our pre-test we got together 27 answers. We conducted our pre-test at half a year before sending the questionnaire. We conducted a survey for the period from May through June 2006. The respondents were obtained by drawing a random sample of 2000 Finnish people. The sample frame was restricted to people over 18 years of age. We used seven point scales where only the extreme points of each scale were labelled. Increments of the scales can thus be regarded as equal. The technique makes the scales more like interval scales and provides more justification for the use of parametric statistical analyses. In the final phase of measure developing process, we tested our uncertainty measures for reliability, content validity, predictive validity and construct validity.

Survey

To collect data, we conducted a survey and the respondents responded fairly actively, and we tallied 639 questionnaires of which 604 included all of the response to questionnaire. Thus, the response rate was 32 %. To check that our sample represented the Finnish population, we identified the demographic variables having a prominent role in relation to consumer search and compared our data on these with the latest census figures for the Finnish population.

Our respondents were from 15 to 80 years old Finnish people. The age profile in our sample corresponds well enough to Finnish population (see, Appendix A). Our respondents are 58.1 % males and 41.9 % females. The corresponding statistics of population in Finland were 49 % males and 51 % females. Because males are known to use more Internet than females, so our data obviously correspond to the current population of active Finnish Internet users quite well. The number of people with low education was also smaller in the sample than in the population in Finland. Furthermore, the people in our sample earned clearly more wealth than people in the Finnish population in average. Location of residence may effect on search behaviour in the Internet. Our respondents represent well Finnish population in average in location of residence. We think that our data corresponds to the current population of active Finnish Internet

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users accurately and there are not problems to generalize the results of the study.

Results

Reliability

The reliability of a measure reflects high internal consistency: the detailed items (questions) measure the same thing. In this study the reliability of the constructs was assessed by using Cronbach´s Alpha reliability coefficient (Cronbach 1951).

Cronbach´s Alpha for the knowledge uncertainty variables was .89, for the evaluation uncertainty .89, for the choice uncertainty .86 and for the implementation uncertainty .80. All these coefficients are at least .80 regarded as sufficient for the basic research according to Nunnally 1978. The reliability of the developed scales is thus not a problem, at least not in this sample.

TABLE 3: RELIABILITY MEASURES

Construct name	*N*	*Number of indicators*	*Reliability*
Knowledge Uncertainty	604	4	0.89
Choice Uncertainty	604	6	0.89
Evaluation Uncertainty	604	4	0.86
Implementation Uncertainty	604	7	0.80

Content validity

Content validity means that we measure what we are supposed to measure. In other words, if we aim at a good measure of uncertainty constructs of different decision phases, we should be convinced that the measurement instrument includes the essential features of uncertainty (Churchill 1979). According to Nunnally (1978), content validity can be best assured by the procedures used to develop measures. 1) We achieved high content validity by a two phased research strategy which helped us in understanding the phenomena of uncertainty. 2) We also connected uncertainty measurement to the traditional decision making theory by Simon (1957) widely accepted by academic society. 3) In addition, we used a control group of 17 experts to provide feedback and develop our ideas. 4) Furthermore, addition to uncertainty measure tests, we pre-tested our paper questionnaire by 27 different age and demographics of consumers. After that we repair our questionnaire to be better understood by consumers. The above means clearly increased content validity, but were still adequate. Therefore, 5) Content validity was studied in the survey phase by analyzing correlations between the detailed items and the total uncertainty. 6) Further, we identified items that had low loadings and were not measuring what they were supposed to measure and drop them out. Correlations between total uncertainty and the detailed items are shown in table 4.

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TABLE 4: CORRELATIONS BETWEEN THE ITEMS OF FOUR MAIN UNCERTAINTY DIMENSIONS AND THE UNCERTAINTY CONTROL VARIABLE.

	UNCERTAINTY ITEMS	*Mean*	*Std.dev.*	*Item to total uncertainty correlation*	*Significance*
	KNOWLEDGE UNCERTAINTY				
KU1	Uncertainty about the alternatives	2.919	1.734	0.29	*****
KU2	Uncertainty about the prices	3.254	1.810	0.26	*****
KU3	Uncertainty about different products	3.092	1.780	0.28	*****
KU4	uncertainty about where is the lowest prices	3.121	1.901	0.26	*****
	EVALUATION UNCERTAINTY				
EU1	Uncertainty of the main criteria on my choice	2.268	1.480	0.26	*****
EU2	Uncertainty of which attributes are the criteria	2.234	1.404	0.26	*****
EU3	Uncertainty of the most important criteria	2.298	1.424	0.29	*****
EU4	Uncertainty of ability to compare information	2.623	1.589	0.33	*****
EU5	Uncertainty of comparability of the information	2.533	1.474	0.32	*****
EU6	Uncertainty of availability of comparable information	2.570	1.482	0.30	*****
	CHOICE UNCERTAINTY				
CU1	Uncertainty to choose a product	2.032	1.412	0.33	*****
CU2	Uncertainty to choose a brand	2.200	1.500	0.31	*****
CU3	Uncertainty to choose an alternative	2.066	1.437	0.28	*****
CU4	Uncertainty to choose where to shop	2.189	1.296	0.28	*****
	IMPLEMENTATION UNCERTAINTY				
IU1	Uncertainty of having problems in purchasing	2.084	1.418	0.21	*****
IU2	Uncertainty to go to the store	1.976	1.402	0.10	**
IU3	Uncertainty of product availability at purchase time	2.880	1.762	0.08	**
IU4	Uncertainty of fulfilment of delivery	3.482	1.978	0.15	****
IU5	Uncertainty of having problems in purchasing the product	2.706	1.758	0.31	*****
IU6	Uncertainty of fulfilment on delivery price	2.574	1.790	0.14	****
IU7	Uncertainty of fulfilment of adds promised delivery	2.847	1.876	0.20	****

(Significance levels ***** =<.0001,**** =0.001, *** =0.01, ** =0.1)

On the basis of detailed item to total uncertainty correlations, the questionnaire could be improved by dropping out some items. Therefore, to improve our measurement instrument, we drop out the detailed item below correlation value of 0.1. In this study, Content validity is good and we are convinced that the measurement instrument includes the essential features of uncertainty.

Predictive validity

Predictive (or Nomological) validity assesses whether an item measured is associated with the main construct. Predictive validity in our case means that the measurement instrument distinguishes different uncertainties and converges with alternative measures of uncertainty. There are two cases in which correlating one test with another will provide definite information. If correlation between the two tests is nearly perfect, close to .90, then the two tests are almost identical and should approximately equal in predictive effectiveness

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for any assessment. On the other extreme, if the correlation between two tests is very low, approaching zero correlation, it is certain that the two tests are measuring different things. High correlations reflect high predictive validity. However, if correlations are very high it also may mean that new scales provide the same information as existing measures and may therefore be redundant. Correlations between the developed scales and control variables were used to study the predictive power of each construct. Item to control variables correlations are shown in figure 1 for each of the four constructs of uncertainty.

When created the questions of control variables we conducted a large literature review. Total uncertainty is measured by question of "Purchasing consist a lot of uncertainty". We used literature of Stigler 1961 and Urbany et al. 1989 to create the control variable to measure the "Total Knowledge uncertainty" by question of "I had uncertainty of my own knowledge about the alternatives". Total Evaluation uncertainty is measured by question of "I had Uncertainty about my decision criteria to conduct my choice" (Urbany et al. 1989). Total Choice uncertainty is measured by question of " I was uncertain of which product to choose" (Lanzetta 1963, Lanzetta and Driscoll 1968, Sieber and Lanzetta 1964, Urbany et al. 1989). Total Implementation uncertainty is measured by question of " I was uncertain of being able to purchase the product I have chosen already in my mind".

Correlations between knowledge uncertainty scale and its control variable are between .27 and .36, and the values are significant at $p<.0001$ level. Correlations between evaluation uncertainty scale and its control variable are between .24 and .35, and the values are significant at $p<.0001$ level. Correlations between choice uncertainty scale and its control variable are .28 and .35, and the values are significant at $p<.0001$ level. There is larger scale of correlation values between implementation uncertainty scale and its control variable, the range of values vary between .03 and .26. Four values are above .15 and two of them are below .10. All correlations, except IU3 and IU4, are quite high thus accessible. Implementation uncertainty scale is significant at $p<.001$ level. We drop out the item of IU3, because of low content validity, and also, low predictive validity. We will drop out also the item of IU4, because the lowest predictive value of .03.

Correlations between the developed scales and control variables were used to study the predictive power of detailed measures of each uncertainty dimensions. In this study, the predictive power of detailed measures of KU, EU and CU are excellent. The values for KU, EU and CU are significant at $p<.0001$ level. The predictive validity of Implementation Uncertainty is sufficient, when we dropped out IU3 and IU4.

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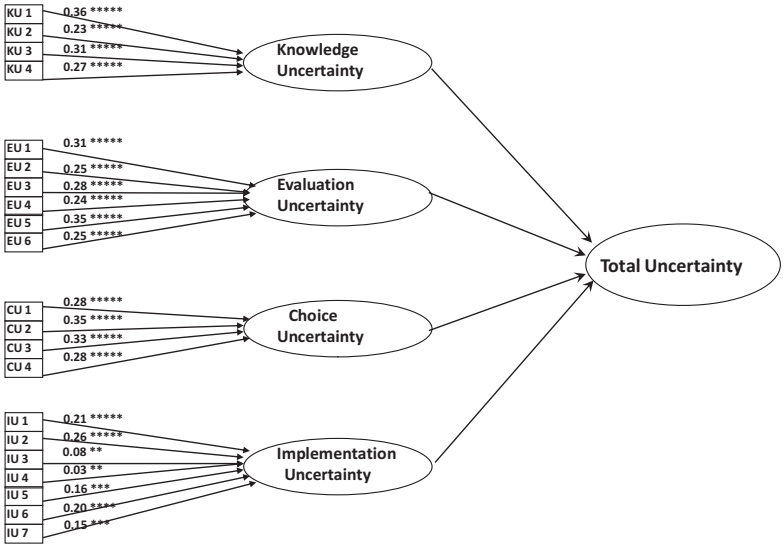
FIGURE 1: PREDICTIVE VALIDITY



Construct validity

Construct validity, in this case, means that the underlying structure of the developed construct is found also in reality. A most powerful method for analyzing construct validity is factor analysis. We have 21 variables describing uncertainty found by large literature review. Then we did the factor analysis with principal component method for those 21 uncertainty variables and created a general uncertainty point for consumer pre-purchase uncertainty with program of SAS Enterprise Quide 4.

We used seven point scales where only the extreme points of each scale were labeled. The technique makes the scales more like interval scales and provides more justification for the use of parametric statistical analyses. First we carried out a factor analysis. The results are: the Eigenvalue for the first Factor is 9.833 and it explains 46,8% of all uncertainty. The Eigenvalue for the second factor is 1.879 and these two factors explains 55,8 % of all uncertainty. The four first eigenvalues explains 68,7 % of all uncertainty.

TABLE 5: EIGENVALUES OF THE CORRELATION MATRIX

Eigenvalues of the Correlation Matrix			
	Eigenvalue	*Proportion*	*Cumulative*
1	9.833	0.468	0.468
2	1.879	0.090	0.558
3	1.659	0.079	0.637
4	1.051	0.050	0.687

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TABLE 6: FACTOR ANALYSIS LOADINGS OF UNCERTAINTY VARIABLES (NO ROTATION)

UNCERTAINTY ITEMS	Factor 1	Factor 2	Factor 3	Factor 4	*Communality Estimates*
KU1 Different alternatives	***0.691***	0.473	-0.231	-0.142	***0.774***
KU2 The different prices of products	***0.664***	0.562	-0.107	-0.204	***0.810***
KU3 The different products	***0.689***	0.522	-0.213	-0.160	***0.818***
KU4 Where to shop	***0.653***	0.441	-0.150	-0.263	***0.713***
EU1 The main criteria on my choice	***0.688***	-0.137	-0.218	0.018	***0.539***
EU2 Which attributes are the criteria	***0.708***	-0.147	-0.337	0.132	***0.654***
EU3 The most important criteria	***0.716***	-0.147	-0.404	0.201	***0.738***
EU4 Own ability to compare information	***0.764***	-0.059	-0.263	0.191	***0.692***
EU5 The information comparability	***0.759***	-0.145	-0.277	0.300	***0.764***
EU6 Availability of comparable information	***0.755***	-0.085	-0.228	0.199	***0.669***
CU1 Difficult to choose product	***0.685***	-0.357	0.010	-0.170	***0.625***
CU2 Difficult t to choose brand	***0.689***	-0.306	0.213	-0.396	***0.770***
CU3 Difficult to choose an alternative	***0.716***	-0.296	0.144	-0.349	***0.742***
CU4 Difficult to choose where to shop	***0.756***	-0.275	0.077	-0.295	***0.740***
IU1 Problems in purchasing	***0.719***	-0.259	0.221	-0.010	***0.633***
IU2 Problems to go to the store	***0.685***	-0.292	0.223	-0.061	***0.607***
IU3 Product availability at purchase time	***0.548***	0.270	***0.508***	0.120	***0.646***
IU4 Fulfilment of delivery of the product	***0.458***	0.394	***0.526***	0.110	***0.654***
IU5 Problems in purchasing the chosen product	***0.692***	0.083	0.372	0.183	***0.658***
IU6 Fulfilment on delivery price	***0.649***	-0.004	0.371	0.318	***0.660***
IU7 Fulfilment of adds promised delivery	***0.613***	0.086	0.151	0.332	***0.516***
Variance explained by each Factor	***9.833***	***1.879***	***1.659***	***1.051***	

In table 6 we are able to see that all uncertainty variables load to the first Factor. The variance explained by the first factor is 9.833, which is very high indeed. All values above .50 are acceptable and thus, all of our loaded factor solution values in Factor 1 are acceptable except IU4. Thus, we dropped out the variable of IU4. All of the communalities are more than .60, except two and they still is acceptable and over .50. Thus, all communalities are very good in value. Next, we carried out a Factor analysis with orthogonal varimax rotation to get visible the different uncertainty dimensions loadings.

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TABLE 7: FACTOR ANALYSIS LOADINGS OF FOUR DIFFERENT UNCERTAINTY VARIABLES WITH VARIMAX ROTATION

UNCERTAINTY items		*Factor 1* *EU*	*Factor 2* *CU*	*Factor 3* *KU*	*Factor 4* *IU*
KU2	Different alternatives	0.336	0.138	***0.778***	0.189
KU3	The different prices of products	0.196	0.142	***0.825***	0.266
KU4	The different products	0.303	0.124	***0.817***	0.207
KU5	Where to shop	0.212	0.226	***0.767***	0.170
EU1	The main criteria on my choice	***0.567***	0.380	0.252	0.100
EU2	Which attributes are the criteria	***0.709***	0.299	0.239	0.069
EU3	The most important criteria	***0.788***	0.246	0.232	0.054
EU4	Own ability to compare information	***0.709***	0.265	0.284	0.198
EU5	The information comparability	***0.794***	0.242	0.176	0.211
EU6	Availability of comparable information	***0.695***	0.278	0.247	0.216
CU1	Difficult to choose product	0.394	***0.667***	0.101	0.122
CU2	Difficult t to choose brand	0.150	***0.825***	0.178	0.187
CU3	Difficult to choose an alternative	0.227	***0.789***	0.197	0.171
CU4	Difficult to choose where to shop	0.310	***0.751***	0.227	0.168
IU1	Problems in purchasing	0.356	***0.591***	0.064	0.391
IU2	Problems to go to the store	0.316	***0.621***	0.045	0.346
IU3	Product availability at purchase time	0.030	0.205	0.250	***0.735***
IU4	Fulfilment of delivery of the product	-0.070	0.099	0.303	***0.740***
IU5	Problems in purchasing the chosen product	0.271	0.314	0.185	***0.672***
IU6	Fulfilment on delivery price	0.341	0.258	0.045	***0.689***
IU7	Fulfilment of adds promised delivery	0.427	0.126	0.152	***0.543***
	Variance explained by each Factor	***4.280***	***3.886***	***3.241***	***3.015***

The rotated solution revealed the four dimensional structure of uncertainty as we expected. Each factor has clearly one dominant variable and on the other hand, the variances of all variables the four factor solution explain, vary from 0.516 to 0.818. Thus more than 50% of the variance of each variable is explained by the four factor solution. Moreover, it means that there is no reason to drop any variable from the analysis. The factors can be easily named according to the variables with the highest loadings. The factors are called "Evaluation Uncertainty (FEU)", "Choice Uncertainty (FCU)", Knowledge Uncertainty (FKU)", and "Implementation Uncertainty (FIU)". The-classification of some variables is clearly needed. The loadings IU1 and IU2 are highest loaded on factor FCU, even if they originally grouped to contribute to Implementation Uncertainty" Thus those variables are associated to that factor ("Choice Uncertainty").

The factor solutions illustrate good construct validity for all of the four uncertainty scales because all values are acceptable and above .50. Most of the values are higher than .70, which is a very good result.

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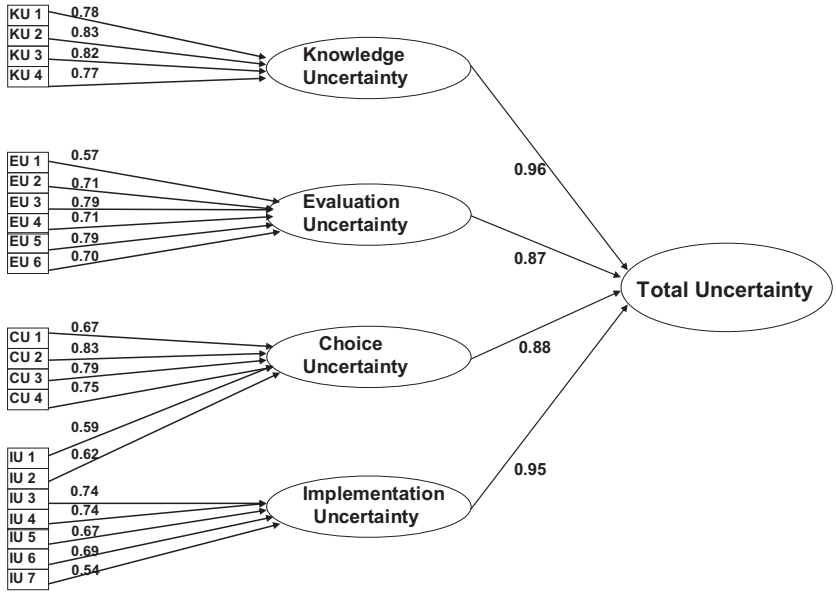
FIGURE 2. A SECOND ORDER FACTOR MODEL WITH FOUR FIRST ORDER FACTORS (Factors order is changed to follow the consumer decision making process.)



Conclusion of results

In the final phase of measure developing process, we tested our uncertainty measures for reliability, content validity, predictive validity and construct validity.

The reliability of a measure reflects high internal consistency. All these coefficients are between.80 and .89. Thus, the detailed items measure the same thing (Cronbach 1979).

According to Nunnally 1979, content validity can be best assured by the procedures used to develop measures. We achieved high content validity by a two phased research strategy which helped us in understanding the phenomena of uncertainty and we used the procedures used to develop measures widely accepted by academic society (Churchill 1979, Peter 1979, Nunnally 1978). We also connected uncertainty measures to the traditional decision making theory by Herbert Simon (1957). In addition, we used a control group to provide feedback and develop our ideas. Furthermore, addition to uncertainty measure tests, we pre-tested our paper questionnaire by a different age and demographics of consumers. We repair our questionnaire to be better understood by consumers and to be a lot of shorter. In addition, content validity was studied in the survey phase by analyzing correlations between total uncertainty and the dimensions of uncertainty, and also total uncertainty and the detailed items measuring different uncertainties. In this study Content validity is good for all main constructs and for most of

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the items, and we are convinced that the measurement instrument includes the essential features of uncertainty.

Predictive validity in our case means that the measurement instrument distinguishes different uncertainties and converges with alternative measures of uncertainty. In this study, predictive validity is analyzed by correlations to control variable in each dimensions of uncertainty. All items and control variables correlations, except IU3 and IU4, are acceptable and most are significant $p<.0001$ level. Thus, we will drop them out.

Construct validity, in this case, means that the underlying structure of the developed construct will be found also in reality. This can be analyzed with factor analysis.

Most of the values are higher than .70, which is a very good result. However, we shift now the values of IU1 and IU2 to Choice Uncertainty. Although, considering the content of variables IU1 "Problems in purchasing" and IU2 "Problems to go to the store", they are more related to choice than implementation uncertainty. All values above .50 are acceptable and thus, all of our loaded factor values are good, when we shift the the values of IU1 and IU2 to Choice Uncertainty.

TABLE 8. THE FINAL MEASURES OF UNCERTAINTY

	UNCERTAINTY	**Included to the scale**	**Explanation, if not**
	KNOWLEDGE UNCERTAINTY		
KU1	Uncertainty about the alternatives	Included	
KU2	Uncertainty about the prices	Included	
KU3	Uncertainty about different products	Included	
KU4	uncertainty about where is the lowest prices	Included	
	EVALUATION UNCERTAINTY		
EU1	Uncertainty of the main criteria on my choice	Included	
EU2	Uncertainty of which attributes are the criteria	Included	
EU3	Uncertainty of the most important criteria	Included	
EU4	Uncertainty of own ability to compare information	Included	
EU5	Uncertainty of comparability of the information	Included	
EU6	Uncertainty of availability of comparable information	Included	
	CHOICE UNCERTAINTY		
CU1	Uncertainty of having difficulties to choose product	Included	
CU2	Uncertainty of having difficulties t to choose brand	Included	
CU3	Uncertainty of having difficulties to choose an alternative	Included	
CU4	Uncertainty of having difficulties to choose where to shop	Included	
IU1	Uncertainty of having problems in purchasing	Included	Sifted to CU
IU2	Uncertainty of having problems to go to the store	Included	Sifted to CU
	IMPLEMENTATION UNCERTAINTY		
IU3	Uncertainty of product availability at purchase time	Deleted	Low content and predictive validity
IU4	Uncertainty of fulfilment of delivery of the product	Deleted	Low construct and predictive validity.
IU5	Uncertainty of having problems in purchasing the product	Included	
IU6	Uncertainty of fulfilment on delivery price	Included	
IU7	Uncertainty of fulfilment of adds promised delivery	Included	

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Discussion

In this paper, we studied the presence of uncertainty in consumer decisions. Our purpose was to show that uncertainty has a multidimensional nature and to identify those dimensions. Our initial idea was to associate those dimensions to a classical decision making process originally proposed by Herbert Simon (Simon 1960) completed with the Implementation phase proposed by Sprague and Carlson (1982). We carried out an empirical survey in which we used 21 questions to describe various features of uncertainty. The questions were based on literature review. Each question was subjectively associated to one of the uncertainty dimension, we expected to reveal. Our empirical findings confirmed our initial idea. Using the rotated solution of factor analysis, we were able to recognize the uncertainty dimensions: *knowledge uncertainty, evaluation uncertainty, choice uncertainty, and implementation uncertainty* as we expected. However, some of the variables required to reclassification.

Our results provide a pattern of questions which all can be used to characterize a certain dimension of uncertainty. The use of all variables can be used to find "Total Uncertainty", if one dimensional measure is needed. However, we recommend to use four dimensional solution, because "fine tuning" will be lost if only one dimensional measure is used.

To summarize our contribution, we have introduced the decision making process (Simon 1957) as the basis to study uncertainty in relation to consumer behaviour in electronic markets. We have also complemented the previously tested uncertainty dimensions (KU, CU) with two additional constructs: (1) Evaluation uncertainty has its origin in previous empirical studies of uncertainty in consumer behavioural context (Urbany et al. 1989), while (2) implementation uncertainty is derived from the generic model of the decision making process (Simon 1957).

In this paper, measurement scales have been tested for reliability and validity with a sample of 639 consumers. The resulting measurement instrument can be used in future studies using decision making theory and bounded rationality, in particular, as their theoretical foundation.

Limitations

Data was collected in a specific context. Our sample consists of Finnish citizen, who are used to advanced technology, well education, well-being. Limitations of data collection method: We used two times pre-tested questionnaires, but still it is possible that questions may have been understood inadequately. We conducted a survey in a context of travel information and travel purchase. General decision making approach is useful to understand consumer buying behaviour when the purchase is a real decision making situation. However, when a purchase is small or otherwise unimportant to the buyer, it does not apply. In many cases earlier experience and habits may dominate decisions. Similarly, if the purchase is relatively big and important for the buyer it may have some limitations. For example, if consumer is buying a house, the process may have many characteristics that link it merely to a learning process. In some cases when the buying decision is dependent on many decision makers, negotiation processes might be suitable. This may occur, for example, in a case when a family wants to buy a holiday trip, but part of the family members would like to go for skiing, part of them would prefer sunny beaches.

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APPENDIX A: The Profile of Respondents

		Frequency	Sample Percentage	Population Percentage*
Gender				
Valid	Male	351	58.1	48.8
	Female	253	41.9	51.2
Total **		604	100	
Missing Values		35	5.5	
Education				
Valid	Comprehensive school education	127	21.3	41.5
	Upper secondary general education	50	8.4	22.9
	Vocational and professional education	159	26.7	12.7
	Polytechnic education	163	27.4	12.6
	University education	96	16.1	10.3
Total		595	99.9	
Missing Values		44	6.9	
Income	Euro /Year			
	– 9999	71	12.9	28.4
	10000 – 24999	147	26.7	39.1
	25000 – 49999	191	34.7	24.7
	50000 –	141	25.6	5.1
Total		550	99.9	
Missing Values		89	13.9	
Community Size				
	The Metropolitan area	130	22.5	18.3
	Town, > 45,000 inhabitants	123	21.2	21
	Town, < 45,000 inhabitants	160	27.6	21.1
	Urban or semi-urban municipality	39	6.7	16.5
	Rural Municipality	127	21.9	23.1
Total		579	99.9	
	Can´t choose of those	8	1.4	
# of Non-Missing Values		587		
Missing Values		52	8.1	
Sample Size		639		

* Statistics Finland (2004)

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Aalto-BE 11/2011

ISBN 978-952-60-4365-4 (pdf)
ISSN-L 1799-4810
ISSN 1799-4829 (pdf)

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