

December 2006

A Cognitively-Grounded Approach: Customer Behavior Pattern Discovery in an Online Shopping Environment

Peishih Chang
New Jersey Institute of Technology

Follow this and additional works at: <http://aisel.aisnet.org/amcis2006>

Recommended Citation

Chang, Peishih, "A Cognitively-Grounded Approach: Customer Behavior Pattern Discovery in an Online Shopping Environment" (2006). *AMCIS 2006 Proceedings*. 12.
<http://aisel.aisnet.org/amcis2006/12>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISEL). It has been accepted for inclusion in AMCIS 2006 Proceedings by an authorized administrator of AIS Electronic Library (AISEL). For more information, please contact elibrary@aisnet.org.

A Cognitively-Grounded Approach: Customer Behavior Pattern Discovery in an Online Shopping Environment

Peishih Chang

New Jersey Institute of Technology
peishih.chang@njit.edu

ABSTRACT

While shopping online, customers' needs and goals may change dynamically based on the information they encounter. While these changes create emergent information needs, decisions about what information to present are typically made before customers have visited a website, using data such as purchase histories and logs of web page visited (i.e. clickstream data). The research lays the foundation for an alternative approach: developing predictions about what information to present based on inferences made from cognitively-grounded models of the customer. The research test hypotheses about how various factors (such as time pressure) may impact customers' cognition and behavior while shopping online. The main data sources are think-aloud protocols and clickstreams of the participants, as well as pre- and post-experiment questionnaires. This work is expected to improve understanding of how contextual, personal, and product-related factors help shape online shopping behavior, and to generate insights into the cognitive processes that inform this behavior.

Keywords

Clickstream data, time pressure, risk, product involvement, online shopping

INTRODUCTION

Online shopping allows people to browse for and purchase goods and services at the location of their choice. However, the advantages of online shopping do not eliminate the impacts of uncertainty and time pressure customers may encounter. There are both theoretical and practical reasons for investigating the behaviors of online customers. From a theoretical perspective, numerous factors affecting the actual purchasing behavior are left to be fully explored (Limayem et al., 2004). From a practical perspective, online marketers recognize the importance of designing a satisfactory shopping experience (Cho et al., 2003). Yet, studies of online shopping behaviors are relatively rare compared to those of traditional brick-and-mortar shopping behaviors (Bucklin et al., 2002).

While shopping online, customers' needs and goals may change dynamically (Cooley, Mobasher and Yu, 1999; Koufaris, 2002; Deflor, Sproule and Gupta, 2003; Chen, Park and Yu, 1998; Rabin, 2001), based on a variety of factors such as product information and characteristics, time pressure and riskiness of a choice. While these changes create emergent information needs, decisions about what information to present to customers are typically made before customers have visited a web site, using data such as purchase histories and logs of web pages visited (i.e. clickstream data). While historical clickstream data helps describe customer behavior (Van den Poel & Buckinx, 2005), it does not capture thinking processes behind the behavior (Card, Pirolli and Wege, 2001).

THE PROPOSED WORK

The proposed research explores an alternative cognitive approach to investigate how changes in levels of contextual, personal and product-related factors impact customers' cognition and behavior. Specifically, three factors are included. *Product involvement* is defined as a perceived relevance of the product based on a customer's interest, needs, or values (Zaichkowsky, 1985). *Time Pressure* is defined as feeling of anxiety and stress and a need to cope with the limited time (Ordonez and Benson III, 1997); (Fisher, Chengalur-Smith and Ballou, 2003). *Uncertainty and riskiness of choice* is defined as incompleteness, imprecision or missing product information resulting in a risky choice (Kivetz & Simonson, 2000).

Cognition and behavior will be investigated by examining three phenomenons. *Time on task* is calculated as the total time spent on a specific shopping task (Bucklin et al., 1993). *Perceived risk* is viewed as resulting from uncertain and unanticipated consequences of a product purchase while shopping online (Dholakia, 2001). *Search and decision strategies*

are conceptualized as navigation through a tree structure (Card et al., 2001; Zhong et al., 2004). Each node in a tree is an object containing attributes and methods. Customers may search information by depth-first or breadth-first search, with perhaps switching between these modes (Jenkins, Corritore and Wiedenbeck, 2003). *Depth-first (denoted as D-first)* search means that customers start to look for product- or issue-related information, then goes through the tree branch by branch till reaching the bottom. *Breadth-first (denoted as B-first)* search means that customers start from exploring as many product selections as possible and then read detailed information later on. A purchase is a decision (i.e. an allocation of resources), and the rules governing decision making are often characterized as either compensatory or non-compensatory (Chu and Spires, 2003). With *compensatory (denoted as C)* rules, a poor evaluation on one attribute may be compensated by a positive evaluation on another attribute; with *non-compensatory (denoted as NC)* rules, poor evaluation on one attribute makes that attribute an impossible choice.

This research draws upon the results of prior research, as well as two pilot studies, to motivate the design of a study involving human participants making purchasing decisions in an online shopping environment.

Method

A 2 x 2 x 2 factorial designed experiment will be used to investigate the relationships between the independent variables (Product Involvement, Time Pressure, and Uncertainty and Riskiness of Choice) and dependent variables (Time on task, Perceived Risk, Search and Decision Strategies), operationalized as perceived risk, percentage of time in breadth-first search mode, and percentage of time using non-compensatory (NC) strategy. The time pressure condition is simulated by reducing the available product choices over time (Sutter, Kocher and Straub, 2003), while uncertainty and riskiness of a product choice is calculated using an expected utility model based on the availability and weight of product attributes (Kivetz, 1999). The research hypotheses and the relationships between them are illustrated in Figure 1. They state that product involvement, time pressure, and riskiness of choice all increase customers’ perceived risk. While time pressure and riskiness of choice increase the percentage of time customers will use non-compensatory (NC) strategy, product involvement shows an opposite effect. In addition, while time pressure increase the percentage of time customers in using breadth-first search mode, riskiness of choice and product involvement increase the percentage of time customers use depth-first search.

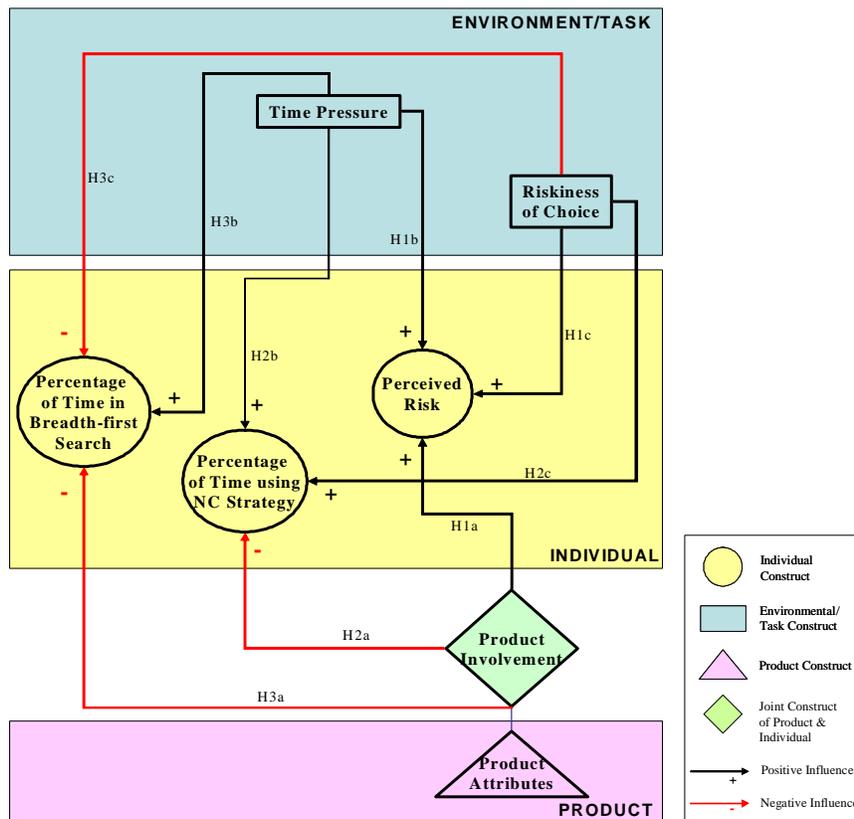


Figure 1. Research Hypotheses

Subjects

Approximately 50 students will be recruited from various courses in Information Systems and Computer Science at a northeast research university. They represent a homogenous group with similar level of computer skills. Prior studies show that university students are active online shoppers, specifically those who not only have more experience using web tools but also spend a fair amount of time online (Han & Ocker, 2002). To motivate realistic choices, participants choosing the product with best value will enter a draw for a winning prize. Twelve subjects will be assigned to each experimental condition with repeat measure as shown in Table 1.

		Riskiness of Choice			
		Low		High	
		Product Involvement		Product Involvement	
		Low	High	Low	High
Time Pressure	No	12	12	12	12
	Yes	12	12	12	12

Table 1. Subjects Assignment Table

Experimental Tasks and Procedure

Before the experiment, subjects are asked to complete a task-relevant background questionnaire. During each of the individual experimental sessions, subjects work on an identically-equipped laptop in the presence of an investigator. Next, subjects complete a tutorial designed to familiarize them with the think-aloud method and the experimental website. After the tutorial, subjects are informed that their objective is to shop for two products following the given task scenarios under assigned conditions. Subjects are also informed that their shopping experiences and verbal protocols will be audio- and video-recorded along with mouse movements on the computer screen. Following the completion of each task, subjects are asked to complete another questionnaire about their experiences in the experiment. Finally, they will be debriefed.

Instrumentation

The main data sources are clickstreams and the think-aloud protocols of the participants, as well as pre- and post-experiment questionnaires. To better control factors manipulated in this proposed work while sustaining the complexity of a shopping task, this research adopts an information display board (IDB) method (Payne, 1976; Weenig & Maarleveld, 2002) to automatically collect behavioral data as Figure 2. When the cursor moves away from the cell, the information is hidden. An advantage of using a computerized version of IDB is that data collection and analysis are much easier (Cook & Swain, 1993). On the other hand, this approach demands higher time and effort to examine an information item. Subjects need to move the mouse to the information they desire to know and then click on the circle button to actually view the information. Methods of data collections and measures for each variable introduced in this study are summarized as Table 2.

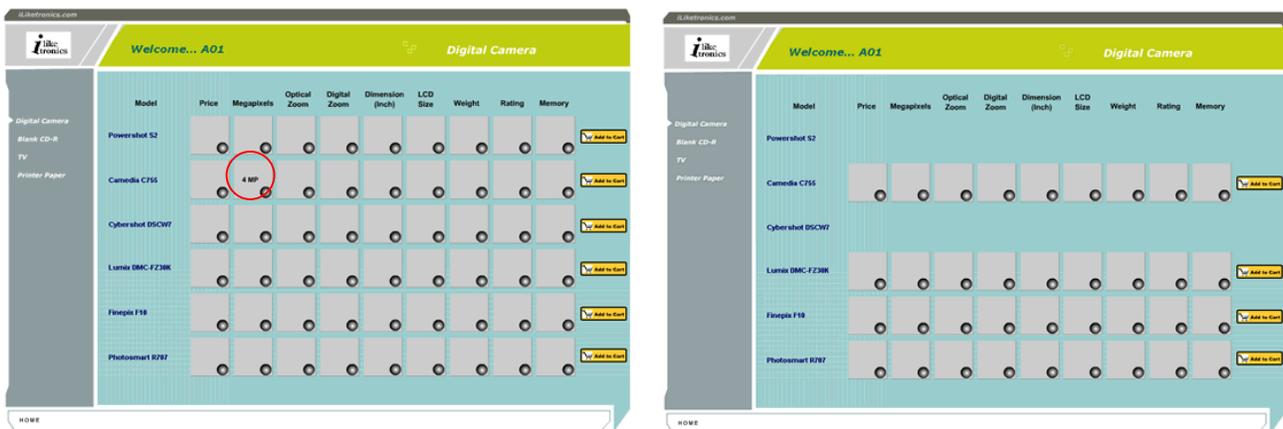


Figure 2. Sample of IDB

Variables	How Measured	Scales
Product Involvement	Background questionnaire	Range: 10-70 (7-point scale) (McQuarrie and Munson, 1992)
Time Pressure	System manipulation with Post-experiment questionnaires	Range: 2-14 (7-point scale) (Fisher, Chengalur-Smith and Ballou, 2003)
Uncertainty and Riskiness of Choice	System manipulation using expected utility model	$U(L) = \sum_i^k u_i P_i \quad (k=9)$ L: Product; u_i : Assignment of probability; P_i : Attribute of a product;
Perceived Risk	Difference between data collected from background and post-experiment questionnaires	Range: 5-35 (7-point scale) (Spiekermann, 2004; Murray and Schlacter, 1990)
Percentage of Time in Breadth-first Search	Time stamp in clickstream data	$\frac{\text{Time of B-first Search}}{\text{Time of B-first Search} + \text{Time-D-first Search}}$ Range: 0-100%
Percentage of Time in NC Strategy	Time stamp extracted from clickstream data and keywords in protocols	$\frac{\text{Time of NC Strategy}}{\text{Time of C Strategy} + \text{Time of NC Strategy}}$ Range: 0-100%
	Post-experiment questionnaire	Range: 5-35 (7-point scale) (Fisher, Chengalur-Smith and Ballou, 2003)

Table 2. Summary of Data Collections and Measures for Each Variable

EXPECTED CONTRIBUTIONS

This research not only consolidates literatures across multiple disciplines but also takes one step further to incorporate time pressure and uncertainty of product choices, which are identified as important factor but seldom being investigated in online shopping literatures, into the research framework. The experimental tools and task procedure designed for this study can also be further modified and extended for research in choice and judgment decision making. This work is expected to improve understanding of how contextual, personal and product-related factors help shape online shopping behavior. Models resulting from this work should therefore lead to improved information display and then to improved shopping experiences. It will also generate insights into the cognitive processes that inform this behavior. Future work beyond this research is likely to involve more formal modeling of human cognition in online shopping environments.

REFERENCES

1. Bucklin, R. E., Latin, J. M., Ansari, A., Bell, D., Coupey, E., Gupta, S., Little, et al. (2002) Choice and the internet: From clickstream to research stream. Paper presented at the *U.C. Berkeley 5th Invitational Choice Symposium*, February 10.
2. Card, S. K., Pirolli, P., and Wege, M. V. D. (2001) Information scent as a driver of web behavior graphs: Results of a protocol analysis method for web usability. *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI 2001)*.
3. Cho, Y., Im, I., Fjermestad, J., and Hiltz, S. R. (2003) The impact of product category on customer dissatisfaction in cyberspace, *Business Process Management Journal*, 9, 5, 635-651.
4. Chu, P. C., & Spires, E. E. (2003) Perceptions of accuracy and effort of decision strategies, *Organizational Behavior and Human Decision Processes*, 91, 203-214.
5. Cook, G. J., & Swain, M. R. (1993). A Computerized Approach to Decision Process Tracing for Decision Support System Design. *Decision Sciences*, 24, 5, 931-952.
6. Detlor, B., Sproule, S., and Gupta, C. (2003) Pre-purchase online information seeking: Search versus browse, *Journal of Electronic Commerce Research*, 4, 2, 72-84.

7. Dholakia, U. M. (2001) A motivational process model of product involvement and consumer risk perception, *European Journal of Marketing*, 35, 11/12, 1340-1360.
8. Fisher, C. W., Chengalur-Smith, I., and Ballou, D. P. (2003) The impact of experience and time on the use of data quality information in decision making, *Information Systems Research*, 14, 2, 170-188.
9. Han, H. J., & Ocker, R. (2002) Is it worthwhile to target university students? *Decision Line*, 33, 5, 18-20.
10. Jenkins, C., Corritore, C. L., and Wiedenbeck, S. (2003) Patterns of information seeking on the web: A qualitative study of domain expertise and web expertise, *Information Technology and Society*, 1, 3, 62-80
11. Johnson, E. J., Payne, J. W., and Bettman, J. R. (1993) Adapting to time constraint. In O. Severson & A. J. Maule (Eds.), *Time pressure and stress in human judgment and decision making*. New York/London: Plenum Press.
12. Kivetz, R. (1999) Advances in research on mental accounting and reason-based choice, *Marketing Letters*, 10, 3, 249-266.
13. Kivetz, R., and Simonson, I. (2000) The effects of incomplete information on consumer choice, *Journal of Marketing Research*, 37, 4, 427-448.
14. Koufaris, M. (2002) Applying the technology acceptance model and flow theory to online consumer behavior, *Information Systems Research*, 13, 2, 205-224.
15. Laurent, G., and Kapferer, J. N. (1985) Measuring consumer involvement profiles, *Journal of Marketing Research*, 22, 41-53.
16. Limayem, M., C. Cheung, et al. (2004) Online consumer behavior: What we know and what we need to know, *European & Mediterranean Conference on Information Systems*, Tunis Tunisia.
17. McQuarrie, E.F., and Munson, J.M. (1992) A revised product involvement inventory: Improved usability and Validity, In *Advances in Consumer Research*, J. F. Sherry and B. Sternthal (eds.), 19, Association for Consumer Research, Provo, UT, 108-115.
18. Murray, K. B. and Schlacter, J. L. (1990) The impact of services versus goods on consumers' assessment of perceived risk and variability, *Journal of the Academy of Marketing Science*, 18, 1, 51-65.
19. Payne, J. W. (1976) Task complexity and contingent processing in decision making: An information search and protocol analysis, *Organizational Behavior and Human Performance*, 16, 366-387.
20. Spiekermann, S. (2004) Product context in EC website: How consumer uncertainty and purchase risk drive navigational needs, *Proceedings of the 5th ACM conference on electronic commerce*, New York, NY.
21. Sutter, M., Kocher, M., and Straub, S. (2003) Bargaining under time pressure in an experimental ultimatum game, *Economics Letters*, 81, 341-347.
22. Van den Poel, D., and Buckinx, W. (2005) Predicting online-purchasing behavior, *European Journal of Operational Research*, 166, 2, 557-575.
23. Wennig, M. W. H. and Maarleveld, M. (2002) The impact of time constraint on information search strategies in complex choice tasks, *Journal of Economic Psychology*, 23, 6, 689-702.
24. Zaichkowsky, J. L. (1985) Measuring the involvement construct, *Journal of Consumer Research*, 12, 341-352.
25. Zhong, N., Godoy, D., Shiaffino, S., & Amandi, A. (2004) Interface agents personalizing web-based tasks, *Cognitive Systems Research*, 5, 207-222.