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Inside the Customer: Modeling Cognition during Online Shopping

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ABSTRACT

Online marketers want to present potential customers with the right information at the right time. Decisions about what information to present are typically made before the customer has visited a web site, using data such as purchase histories and logs of web pages visited (i.e., clickstream data). An alternative approach is to develop predictions about what information to present based on inferences made from cognitive models of the customer. This research presents one approach to collecting and analyzing data that could be used to construct such models. Two studies are presented on how differences in product type may impact customer cognition and browsing behavior. The results suggest that differences in product type may lead to differences in waiting time before making a purchase. Product type may also influence the types of information people consult before making a purchase.

Keywords

Cognitive modeling, online shopping, customer behavior, clickstream data

INTRODUCTION

Online marketers want to present the right information at the right time to potential customers. Decisions about what information to present to potential customers are typically made before the customer has visited a web site, using data such as purchase histories and logs of web pages visited (i.e., clickstream data). This research explores an alternative cognitive approach to investigate how differences in types of products customers are looking for may impact customer cognition and browsing behavior. To produce the data used in this study, shoppers followed given scenarios to make purchases and then thought-aloud retrospectively while watching recorded mouse movements. Analysis of the think-aloud and clickstream data suggests that variation in product type leads to variation in the time people wait before making a purchase and variation in their browsing behaviors.

A brief review of related prior research is followed by a series of pilot studies concerning how product types may impact online customers' shopping behaviors. The results of the studies are then presented, followed by analyses of clickstream data and statements in protocols. A discussion of directions for future work is then concluded in this paper.

RELATED WORK

To investigate customers' online shopping behaviors, researchers and online marketers mainly collect huge amount of clickstream data to find possible behavior patterns within. Clickstream is a record of the mouse clicks executed by the customer in the company's information space, typically the web (Chatterjee et al., 1998). Clickstreams of e-customers in virtual shopping malls are traces of behavior over time – much like footprints of shoppers in physical shopping malls – that may give evidence of browsing and buying behaviors. Clickstream shows information such as how long a customer spends with various products, what products the customer browsed through and the path that led to these products. Logs of clickstream data can be comprehensive, large and therefore unwieldy, making extraction of valuable information from them a difficult task (Davenport et al., 2001). All of those online marketers' efforts are based on the assumption that similar behaviors imply similar preferences or purchase occasions. However, customer's needs and goals, which are founded to be an important factor affecting customer's online shopping behavior (Chen et al., 1998; Cooley et al., 1999; Silberschatz and

Tuzhilin, 1996), are left out at most studies. Card especially states that clickstream is informative but fails to provide any moment-by-moment cognition occurred between customer clicks that is how people's goal evolved (Card et al., 2001).

Types of Products

In addition to customer's needs and goals, online marketers and researchers are also interested in finding factors that affect customer behaviors. Customers' involvement in products is believed to influence their information seeking behavior and decision-making process (Laurent and Kapferer, 1985; Quester and Smart, 1996). "People become avid seeker to obtain knowledge when they are highly involved with the product, but they do not actively seek information when they are less involved (Laurent and Kapferer, 1985)." Some researchers have typically analyzed the effects of product involvement on customers' risk perceptions. Risk perception is viewed as resulting from uncertain and unanticipated consequences of a product purchase (Dholakia, 2001). For examples, John purchasing a MP3 player from an unknown manufacturer may consider its possibility of breaking down in less than a year, while Jane buying a digital camera may be concerned about its memory capacity of not enough space for storing high-resolution pictures. In most of the cases, high involvement products represent higher risk for a customer than a low involvement product (Zaichkowsky, 1985). Customers are willing to spend more time learning product features and compare differences between products. Study also shows that risk perception is one of significant discriminators between those who purchased products online and those who did not (Jarvenpaa and Todd, 1997; Lowengart and Tractinsky, 2001; Pedersen and Nysveen, 2003).

Price is considered to be another important factor related to product class. Price is viewed as a perception construct that means one person's high-priced product could be another person's low-priced product. Price conscious consumers may not pay the lowest price available but tend to pay a lower price when more expensive alternatives do not provide distinguishing product features (Lichtenstein et al., 1988).

Brand is one of the important product attributes that impacts customer shopping behaviors (Keller, 1993). It can be defined as "a name, term, sign, symbol, or design, or combination of them which is intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of competitors" (Kotler, 1991). Researchers are typically interested in the relationships between brand loyalty and product involvement. Reports show that brand loyalty could be identified when customer make a repeat purchase for a high-involvement product, whereas a simply habitual purchase could be indicated when customer make a repeat purchase for a low-involvement product (Quester et al., 2003). Study also shows that if brand choice dominates other product attributes, customers will spend much less time to make product choice than if the customer has near equal preferences (Tyebejee, 1979).

The interest of this research is using product involvement and price to construct a product matrix for investigating types of products may lead to variation in the time people search product-related information before making a purchase and variation in information search behavior.

Customer Search Behaviors

Another way for analyzing customer online shopping behavior is to find unique information-seeking strategies related to product class. Several studies visualize online customer's behavior as a tree structure (Card et al., 2001). Each node in a tree is an object containing attributes and methods, which could represent different types of web pages or different product attributes (See Figure 1). Customer may search information by depth-first, by breadth-first, or by switching between these two modes (Jenkins et al., 2003). Depth-first search means that customer starts to look for product- or issue-related information; then goes through the tree branch by branch till reaching the bottom, whilst breadth-first search means that customer starts from exploring as many product selections as possible and then read detailed information later on.

By investigating customer's navigation style, online marketers can also observe number of pages a customer viewed, time duration for per-page visit, the decision point to stay or exit the site, and choices of which links to follow or which page to view (Bucklin et al., 2002). Moreover, the decision aids, such as search engine and sorting capability provided by each site, may also affect customer's navigation style (Tan, 2003). We need to carefully control our experiment in which kind of information aid we provide to test subjects because that may result in different navigation results.

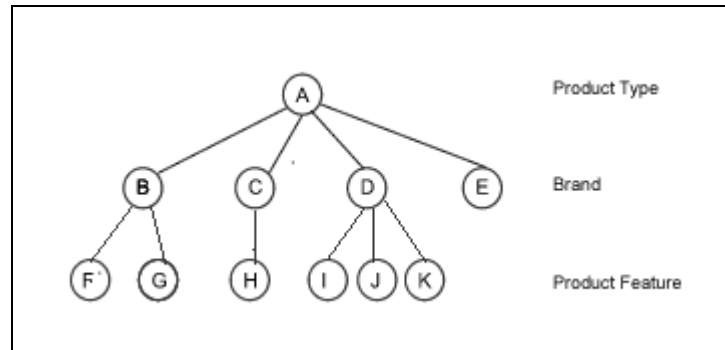


Figure 1. Information-Seeking Structure

Customer Cognition

While discussing about the navigation modes of online customers, many of those researchers also emphasize on the importance of understanding human's limitation of memory load and information load. Human have limited short-term memory (Miller, 1956). To overcome this limitation and to reduce customers' information searching time, researchers grow interests in measuring time that customers spend on each page and investigating the effectiveness of decision aids (i.e. sorting function) (Tan, 2003). One interesting finding shows that online customers tend to search for small number of the best alternatives because of the short-term memory limitation (Montgomery et al., 2003).

TWO STUDIES OF COGNITION IN ONLINE SHOPPING

Few studies (Moe, 2003; Pedersen and Nysveen, 2003) investigate variation in cognition and behavior during online shopping. Yet there are practical and theoretical needs for this type of research, particularly in developing and validating methods for the discovery and comparison of online shopping behavior patterns under different needs and goals. This study is motivated by a belief that modeling customers' thinking patterns is likely to lead to knowledge about customers that is both accurate and generalizable. Two rounds of pilot experiments have been completed in order to identify salient features of cognition in online shopping. The constructs of two studies aim to measure time spent before making a purchase, customers' search strategies, and information source (i.e. third-party opinions such as customer reviews) by controlling the variation in product involvement and price.

Pilot Study 1: Self-Protocol

In Pilot Study 1, a single subject (one of the authors) shopped online for four different types of products under different time pressure conditions.

Design and Procedure

Pilot Study 1 was used to discover factors that might impact online shopping behavior and to provide a preliminary evaluation of the feasibility of the experiment method. Experimental factors of product involvement and price were used, each at a low and high level, thereby yielding the four classifications of product type shown in Table 1. Note that a high involvement product is not necessary a high price product. One product or class of products was chosen for each of the four classifications. Two different types of web sites were used because customer behavior may vary depending on the type of web site he or she is visiting. Clickstream data were collected as the subject thought out loud while accomplishing the following four tasks:

You can't wait to get "Harry Potter V: the Order of the Phoenix." However, it is out of stock from most of the bookstore. You decide to purchase it online now.

Your mother's birthday is at the end of next month. You think a digital camera will be a great gift for her. She is an amateur in photography. Therefore, a high-resolution (maybe 5 megapixel) camera would be good enough for her. Also, it will be ideal if the camera has better zooming capability. You expect to spend \$700-\$1,000 for this gift. Some memory expansion and accessories are considerable.

You decide to buy a photo editing software to edit your personal/ family photos. You know Adobe is quite a brand name in this industry. You know you can get a better price online.

You want to find an earring or a necklace to match your black evening dress. Products pricing around \$50 or less are considerable.

		Product Involvement	
		Low	High
Price	Low	Harry Potter V	Fashion Accessories
	High	Photo Editing Software	Digital Camera

Table 1. Product Types

Results

The subject used various price comparison sites either to begin searches or evaluate search results. The subject spent much more time in finding information (such as reviews) and looking for alternatives for the high involvement and high price product than for the low involvement and low price product. If the subject had insufficient knowledge of a product, both expert and objective opinions were sought. The results suggest that a higher product price leads to more price comparisons.

For both high price products, product brand was used to narrow down the number of alternatives. For example, in the digital camera task, the subject visited the sites of three prominent vendors to obtain more detailed technical information. Finally, when time pressure was high (task 1) or moderate (task 3), the subject requested third-party opinions to enable the decision to be made sooner. Finally, more time was spent shopping for high involvement than for low involvement products.

Discussion

One effect of time pressure may be seeking help from third-party opinions. The results begin to suggest a further investigation of how customers under same time pressure will react while purchasing different types of products. It may also be advantageous to apply prior research in online information-seeking modes and users' expertise to investigate customers' online shopping (Jenkins et al., 2003). Finally, it should be noted that some refinements were made to the experimental protocol. Allowing the subject to use different sites introduced an unnecessary factor into the design, which was then incorporated into the design of a second pilot study.

Limitation

In this study, only one subject who is one of the authors has been recruited. However, for an exploratory study like this, our goal is to find possible factors that would impact customer shopping behaviors and to find possible results for the study as well. We recognize the advantages of using one subject, who is always available and can go deeply through all four tasks, without worrying about how to motivate the subject sustaining his/her energy throughout a long experiment. Another limitation of the study is that time pressure has not been clearly controlled. Future experimental design needs to address this issue.

Pilot Study 2: 4 Subjects

In Pilot Study 2, four subjects were given two online shopping tasks to complete.

Design and Procedure

This study was used to gather information on cognition during a high time-pressure purchase. Only one site (amazon.com) could be used for browsing and purchasing. Four subjects, of approximately the same level of computer skill and frequency of online shopping, took part in the study (see Table 2 for subjects' characteristics).

Subjects were first instructed in how to give a retrospective verbal protocol then were each given two tasks, described to them as follows:

All the tasks should be completed within the provided web site (amazon.com). The tasks are considered completed once you place the order.

You can't wait to get "Harry Potter V: the Order of the Phoenix." However, it is out of stock from most of the bookstore. You decide to purchase it online now.

Your mother’s birthday is approaching. You need to make a purchase now to make sure your gift can be delivered in-time. You think a digital camera will be a great gift for her. She is an amateur in photography. Therefore, a high-resolution (maybe 5 megapixel) camera would be good enough for her. Also, it will be ideal if the camera has better zooming capability. You expect to spend \$700-\$1,000 for this gift. Some memory expansion and accessories are considerable.

Subject	Sex	Age	Frequency of Online Shopping Experiences	Level of Computer Skills	Knowledge level of Digital Camera	Products purchased online before
S1	Female	26-35	2-6 times a year	Expert	Serious Amateur	Book, Clothes/Shoes/ Accessories, Electronics, and Toy
S2	Female	26-35	2-6 times a year	Expert	Advanced Amateur	Book & Computer
S3	Female	26-35	2-6 times a year	Expert	Beginner Amateur	Book, CD/VCD/DVD, and Computer peripherals
S4	Male	36-45	2-6 times a year	Expert	Novice	Book

Table 2. Subjects’ Characteristics

As subjects searched for a product, the contents of the computer screen were recorded to a file. Once they completed a task, they watched the video while recalling, out loud, what they had been thinking. They were then asked to explain how they came up with their product selections and how they made their final decision. These responses were audio- and video-taped. Subjects were then debriefed. All protocols were transcribed. Finally, an annotated file that summarized the clickstream and protocol data was then created, as shown in Figure 2.

	<p>4. (5:11:30) [Scroll down & up] “S2: But it only gives me three choices at the first shot. It seems that there are not many choices for me. Ex: It’s very weird that it didn’t give you choices of digital camera. S2: yeah...it only gives me PDA and video software...”</p> <p>5. (5:12:17) [Click on the picture of Canon EOS 6.3MP...] “S2: I click on Canon to see the details if it matches my expectation.”</p> <p>6. (5:12:21) [Scroll down to read the product descriptions.] “S2: I need to buy camera with very large zoom, but this camera only has 18-55 mm. So I think the zoom range is not so big. What did I do now?”</p> <p>7. (5:12:48) [Click on “Digital Camera” from the menu at the top] “S2: I want to see more product selections.”</p> <p>8. (5:12:57) [Click on Browse digital camera by 5 megapixel & up.] “S2: Actually, I try to find if it has feature which can rank all the digital cameras by their zoom, but there is no such feature. So I have to browse through all the cameras.”</p>
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Figure 2. Screen Shot

Figure 3. Sample of Protocol

Results

For Task 1, purchasing the book *Harry Potter V* (low price and low involvement product), all four subjects directly typed in either “harry potter” or “Harry Potter: the order of the phoenix” to search within the book category. They all expressed that they were familiar with the book and had an acceptable price in mind. They did not read the product description and customer reviews. Two of them checked the price of used & new books, then bought the least expensive one in either new or like-new condition. According to the recordings of their mouse movements and their protocols, they all started to search this product in depth-first search mode. They went directly to the book they were looking for, checked the price, read shipping and discount information, and then make a purchase. Two of them checked alternative vendors for cheaper price; therefore, they switched from a depth-first search to a breadth-first search mode. The average number of search-mode switching for Task 1 is 0.5 times and the average completion time of Task 1 was 1.7 minutes (see Table 3 for results).

For Task 2, purchasing a 5MP digital camera as a gift for mother (high price and high involvement product), all subjects except subject 1 looked up for three or four alternatives. The result is quite matched to Montgomery’s finding that people tend to search among a small number of the best alternatives—usually less than four—in order to reduce short-term memory loads (Montgomery et al., 2003). The subjects then read and re-read related information several times. Two of them used the “Back” button to retrieve the best alternatives; the other subject opened each alternative in a new window, thereby using a sort of external memory aid. The average completion time of Task 2 is 9.72 minutes – considerably higher than Task 1 (see Table 3).

The results suggest that repeatedly switching between depth-first and breadth-first search may indicate that the shopper has searched for a high-involvement and high price product. They began to explore product selections in breadth-first search until finding one product for which they looked up detailed information. They then switched to depth-first search to read through the product descriptions, product features, editor reviews, customer reviews, and technical specification. After they gained more knowledge about digital camera, they began to search for alternatives, bringing them back to breadth-first search. Repeating this process several times, they decided to compare major features and price for the best two products. Results of Task 2 show that shopper switching between two search-modes around 5 times (See Table 3).

Measures	Low Price/Low Involvement	High Price/High Involvement
Product	Harry Potter V (Decided Goal)	Digital Camera (Partially-Decided Goal)
Average Task time	1.7 minutes	9.72 minutes (excluding subject S1)
Average alternatives lookup	1	3 (excluding subject S1)
Search Mode	Depth-first Search	Breadth-first Search
Average Search-mode Switching	0.5 times	5 times (excluding subject S1)

Table 3: Results by Product Type

Price and brand also seem very important for electronics purchasing. They used their perceived best digital camera brands to narrow down their search. For example, Subject 1 expressed her preference for Sony brand early on. Moreover, she said that she owned and was pleased with a Sony digital camera. Thus she chose not to look for other (brand) alternatives, and went straight to a Sony model. Subject 2 stated that “15. I use one Fujifilm digital camera before. Actually I like this brand, brand is very important, at least for me. I have one camera which is made by Nikon, Nikon is good too.” This result confirms a previous study’s finding that choice time would be reduced if customer has strong preference in brand (Tyebjee, 1979).

Four questions were asked of each subject once the study was completed:

What are the main features of the web site (amazon.com) that you use most?

What kind of feature(s) do you think should be added to the web site to improve your online shopping experience?

Do you think the setup of this experiment close to your true online shopping experiences? If not, please specify the reasons.

What are the major concerns when you are making a purchase online?

The questionnaire responses, summarized in Table 4, suggest some insights into shopper behavior and cognition. Subjects all wanted to consult more sites while performing the second task than the first task. They indicated that they wanted more product-related information. Most importantly, they also wanted to compare price and then chose a vendor with great reputation and relatively good return policy. Memory aids were used to keep the information about alternatives that had been looked up.

All four subjects said that they wanted the search engine to provide only the information they were looking for. For example, while searching product selections for digital camera, Subject 2 said that "...it only gives me PDA and video software?" and Subject 4 stated that "a lot of phone come out, not what I want." They spent a considerable time to reach certain amount of product selections they were looking for. That suggests a measure for the number of alternatives and information length of each page could help explain variation in choice time between high-involvement-high-price product and low-involvement-low-price product.

Questions	Subject 1	Subject 2	Subject 3	Subject 4
Q1	Search price and product. Similar product comparison and used product information.	Search function, Sort, and product details	Search function, and customer reviews	Search function, product category, and sort by price.
Q2	N/A	Sort by product features (e.g. Camera with zoom)	Clear product category	Price and product comparison.
Q3	"Yes, especially for books. However, for camera, I would like to search from other sites instead of only one site. (e.g. I like Sony camera, so I would like to search it from Sony web site.)"	"Yes. But I would like to compare products and see product reviews from different web site for digital camera."	"Yes, very close. But I want to switch site and look for more information for digital camera."	"It's a working web site, so it's pretty close to true online shopping experiences. But you need to remind me that I have to pretend that I will shop for myself as I usually do."
Q4	Price, Brand, and my own budget.	Product features, services (return policy), and price.	Price, return policy, detailed description of the product, customer reviews/rates about the vendor	Price, condition (e.g. New or used product), vendor.

Table 4. Summary of Answers to Interview Questions

DISCUSSIONS AND CONCLUSIONS

The results of both studies suggest that variation in product type leads to variation in shopping behavior and cognition. Additionally, customer information-seeking behavior may also switch between breadth- and depth-first search depending on product involvement. The findings may enable variation in clickstream data regarding (i) time spent on one product and its alternatives and (ii) in information-seeking behavior to lead to predictions about the types of product a customer is seeking.

Further study should address additional factors. For instance, based on the findings from the previous two studies, subjects' knowledge and as well as their attitudes about brand could be confounding factors. Since brand is important to customers, especially in buying electronic products, a refined experiment needs to either address brand directly or eliminate it as a factor (e.g., by using fictitious brands). It may be possible to assess subject knowledge about products, or to train subjects so that their product knowledge is roughly equivalent. Extra attentions are needed for constructing task scenarios because different description of a scenario may result in different perception of a product's involvement. Buying a kids book for your nephew's birthday may require more search time than buying a Harry Potter book in the study. The uncertainty risk associated with a purchase (Dholakia, 2001) may be also worth investigating. In keeping with some prior research (Moe and Fader, 2002;

Montgomery et al., 2003), it may also be appropriate to assess the correctness of the customer's purchase given the information shown to them.

Finally, the results suggest that the efficacy of predictions about customer needs and goals may be improved by analyzing cognitive-level data, as well as behavioral data such as clickstreams. Models resulting from this work should have both theoretical and practical significance. The chief benefits to theory may be in the development of models which may be tuned in real-time through the use of clickstream data analysis, then compared for their similarity to the behavior and thinking processes of actual online shoppers. A benefit to online merchants should be that improved customer models lead to improved information displays, and then to improvements in the shopping experience. The integration of protocol and clickstream data is anticipated to provide a powerful source of information to predict customer behaviors and enable greater efficiency in online shopping.

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