

Human Search Patterns on Product Comparison Service

(제품 비교 웹서비스의 고객 검색 패턴에 대한 연구)

Hong-Hee Lee*, Choog Kwon Lee**, Sangjin Yoo***
(이홍희, 이충권, 유상진)

Abstract It is important for firms to help customers find the products or information they need in order to increase sales and promote return visits to their websites. Hence, the presentation of product information is very important in e-commerce websites. In this research, we study how disposition styles can influence browsing patterns. The test results show that people are inclined to use feature information paths in the vertical disposition style and product information paths in the horizontal disposition style. With vertical disposition, users are more likely to follow feature information paths which may help them focus on comparisons across products.

Key Words : Product Comparison Service, Information Search Patterns, Human-Computer Interaction

요약 기업이 매출을 신장하고 자신의 웹사이트에 접속하는 고객들의 재방문 횟수를 늘리기 위하여, 고객이 원하는 제품정보를 효과적으로 전달해야 하는 필요성이 대두되고 있다. 그러므로, 웹사이트상의 올바른 제품정보 배치에 대한 중요성은 강조되어야 한다. 이 논문에서는, 제품 비교 서비스에서 정보 배치의 형태에 따라 고객의 정보검색 패턴이 어떻게 바뀌는지를 연구하였다. 분석결과로 제품 비교 웹서비스의 수직적 배치 형태에서는 사람들은 특성 정보 경로를 따르는 경향을 보였으며, 수평적 배치 형태에서는 제품 정보 경로를 따르는 경향을 보였다.

핵심주제어 : 제품 비교 서비스, 정보 검색 패턴, 인간-컴퓨터 상호작용

1. Introduction

E-commerce has become an important business in the information era. The market share of e-commerce has increased in the last three years. Even though the market size of Business-to-Business (B2B) e-commerce is

bigger than Business-to-Customer (B2C) e-commerce, B2C is considered the most popular and the size of B2C e-commerce is growing fast. Major U.S. retail stores have established a bricks and clicks business strategy in order to enhance their competitive advantages. So-called bricks and clicks, also called "multichannel merchant", have a network of physical stores as their primary retail channel, but also have introduced online offerings. Wal-Mart, JCPenney, and Sears are all examples [1].

The Web provides consumers with an

* Full-Time Lecturer, Dept. of Management, Dankook University, honglee@dankook.ac.kr

** Assistant Professor, Dept. of MIS, Keimyung University, ckleee@kmu.ac.kr

*** Professor, Dept. of MIS, Keimyung University, yoosj@kmu.ac.kr

opportunity to compare a wide variety of alternatives at their convenience without being pressured by salespeople [2]. E-commerce firms have used various methods to present their products online so they can attract more customers. It is important for firms to help customers to find the proper information they want in order to increase sales as well as promote return visits to their Web sites [3]. To offer better quality of information to customers, firms have been trying to design their websites to attract potential customers. One strategy to accomplish this objective is to implement effective product presentation for comparing products on e-commerce Web sites.

E-commerce firms usually present their products online in two different styles: horizontal disposition and vertical disposition (see Figure 1 and Figure 2). In general, horizontal disposition is used to show a category product list, such as desktop computers or portable washing machines, and vertical disposition is used for product comparison. For example, the Best Buy e-commerce web site uses horizontal disposition to list their products, but when a customer selects several products and clicks the "Compare" button, the chosen products will be displayed vertically. Which disposition is more effective? How do firms use these dispositions to boost their e-commerce profits?

The objective of this research is to study the effects of horizontal and vertical dispositions on human information search patterns that may impact customer behavior. A lab experiment is designed to test the theoretical hypotheses related to the effects of the two disposition styles on customer attention.

2. Literature Review

Visual attention has been studied cognitively for several decades. In the last two decades, research on visual attention has been conducted in a computer mediated environment. Bundesen [4] used a theoretical model to examine the effects of a number of images on visual attention. He discovered that as the number of

images increased, the viewer's attention would decrease according to reaction time. Chang et al. [5] used eleven laws of Gestalt to study visual screen design. They found that the eleven laws of Gestalt are useful in designing a good screen to catch user's visual attention. For example, the law of focal point states "every visual presentation needs a focal point, however, it is widely believed that human attention is limited and allocated selectively to stimuli in the visual field" [6]. The law of proximity states that objects placed close to each other appear to be grouped. The viewer mentally organizes closer elements into a coherent group, since they assume that closely spaced elements are related.

Zhang and Massad [7] found that the side of the webpage that users view - "the left side has higher negative impact than on the right side". They confirmed an argument, supported consistently over the years, which states that the human habit of reading from left to right requires them to attend to the left side more than to the right side, making the left side more attention resource demanding [7]. They concluded that animation such as animals, airplanes, balls, and human faces on the left side is closer to the beginning of the line and this location proximity increases the interference effect, as evidenced by many visual search studies. By contrast, animation on the right side is "far away" from the visually demanding beginning of each line and thus has less impact. Zhang and Massad's findings confirm that the location of content on the Web will impact visual attention.

McConkie et al. [8] suggest that a page of text is viewed at a number of granularities, with a top-left bias in selecting where reading should begin. However, Arnheim [9] notes that in non text displays, the center will be dominant; and that if a number of images are shown, factors such as symmetry will displace the center.

Li and Zhang [10] point out that online shopping decision-making includes information seeking, comparison of alternatives, and choice making. According to Haubl and Trifts [11], "potential consumers appear to use a two-stage

process in reaching purchase decisions” [10]. First, consumers typically screen a large set of products in order to identify a subset of promising alternatives that meet their criteria of needs. Then, they evaluate each product in the subset in greater depth, making comparisons of each item based on some predefined attributes or features and then finally making a purchase decision.

3. Theoretical Background

The Web supplies a media rich environment for merchants to present their products online. The Web also provides a convenient way to search and compare information. From a customer perspective, the Web presents the customer with attractive and detailed information on products with media richness such as high-resolution 3-D images and animation. However, customers have to seek useful information on products that meet their needs. Sometimes too much media richness can distract the customer’s attention since human visual attention has limited capability. Thus, the web site should be designed for customers to easily and quickly gather relevant information about products.

Chang, et al. [5] identified the eleven laws of Gestalt Theory as having significant implications for computer screen design. We identify three laws of Gestalt that will play a critical role in a customer’s search path.

- **Law of focus point:** every visual presentation has a focal point, which is called the center of interest or point of emphasis. This focus point catches the viewer’s attention and makes the viewer follow the visual message further.
- **Law of proximity:** viewers will mentally organize closer elements into a coherent object group, because they assume that closely spaced elements are related and elements that are spaced further apart are not related.
- **Law of simplicity:** when a learner sees a

visual object, he/she will unconsciously simplify the perceived object into what the viewer can easily understand. This is a natural mental process.

With law of focus point, we argue that customers’ search paths will be different when they search for information on the Web. With law of proximity, we argue that when customers are searching for product information, they usually are intending to compare and group together closely spaced contents. Since human reading and writing habits are from left to right, customers are more likely to compare and relate the contents horizontally. With law of simplicity, customers prefer a short description of the products for comparing horizontally. However, when they are looking for further information for a specific product, they are more likely to focus on the full description of the product. In this case customers’ attention might be more affected by the product itself rather than by human reading habits.

In summary, all three laws play critical roles in the user’s search path. However, the law of focus point plays the most crucial role since human attention has limited capability. We believe that customer behaviors or decision making process on the Web will reflect customer’s search path or information path. Thus, we can trace the action path of customers on the Web to measure their decision processes.

4. The Two Disposition Styles

4.1 Vertical Disposition Style

A vertical disposition style in product comparison displays products by columns and features of the products by rows (see Figure 1). Most e-commerce Web sites that have functions for product comparison use this style. Product comparison in BestBuy.com and HomeDepot.com are examples. In this style, images of the products are usually shown in the second line below the titles of the products.





	Product 1	Product 2	Product 3	...	Product N
Image				...	
Feature 1 (Name)	P-202	B-220	V 2200	...	AB60
Feature 2 (Price)	\$ 439.99	\$ 899.99	\$ 459.99	...	\$ 999.99
...
Feature 3 (Weight)	120g	210g	180g	...	230g

Figure 1. Vertical Disposition Style in Product Comparison

The vertical disposition style may focus on helping customers to compare products in terms of a specific feature. People usually read text left to right and line-by-line. In this way, customers can pick out specific feature and compare the products in terms of their features. Therefore, this style seems to focus on product features. Figure 1 shows an example of the vertical disposition style in product comparison.

4.2 Horizontal Disposition Style

A horizontal disposition style in product comparison displays products by rows and features by columns. In this style, images are put in the second left column on the right side of the names of the products. The list for all products in a category in an e-commerce Web site usually has the horizontal disposition style. Product lists at eBay.com follow this style. Horizontal disposition is used less than vertical disposition for product comparison on e-commerce Web sites. An example of product comparison using the horizontal disposition style is the flight reservation system at Travelocity.com. The horizontal disposition style may focus on customers' comprehensive understanding of each product. As the old reading habit, customers might get information line by line. Before comparing with other products, they may focus on one product and bind features of the product. Therefore, this style seems to focus on the products. Figure 2 is an example of the horizontal disposition style

in product comparison.





	Image	Feature 1 (Name)	Feature 2 (Price)	...	Feature 3 (Weight)
Product 1		P-202	\$ 439.99	...	120g
Product 2		B-220	\$ 899.99	...	210g
Product 3		V 2200	\$ 459.99	...	180g
...
Product N		AB60	\$ 999.99	...	230g

Figure 2. Horizontal Disposition Style in Product Comparison

5. Theoretical Hypotheses on Visual Attention

We propose that the customer information path will be affected by the disposition styles when searching for information on the Web. Customer search behavior will indirectly represent the customer visual attentions. In other words, the customer's eye movement presents the visual attention on the target. We call this movement the information path. There are two kinds of information paths in our research: feature information paths and product information paths. If a customer moves his/her eyes from one target to another target within one feature, the customer follows the feature information paths. If a customer moves his/her eyes from one target to another target within one product, the customer follows the product information paths. Thus, by understanding customers' information search patterns regarding information path, we will be able to test whether the horizontal or vertical disposition will impact the visual attention of the next target.

We argue that the two dispositions styles affect customers' information search patterns. In other words, we will test the relationship between disposition style and information search patterns.

Human usually read from left to right and

from top to bottom. We argue that the information search pattern in the vertical disposition is more feature-focused since the features of several products are listed side by side on the same line and hence they are very easy for customers to make a comparison of specific features. In the horizontal disposition style, the information search pattern is more-product focused since customers would rather move their eyes within a row where there are features of a product than within a column where there is product information in terms of one feature. Therefore, we create two hypotheses.

- H1: Respondents looking at a vertical disposition style follow the feature information paths more than respondents looking at a horizontal disposition style.*
- H2: Respondents looking at a horizontal disposition style follow the product information paths more than respondents looking at a vertical disposition style.*

6. Experimental Design

A within-subject experimental design is proposed to test the two hypotheses. Each subject will experience both vertical and horizontal disposition styles, thus serving as their own control. The order of the disposition styles will be randomized among the subjects. The subjects will be asked to search for a product that he/she would like to purchase on a simulated e-commerce website. In order to motivate the subjects to search for their most highly preferred product in each of the two rounds/conditions (i.e., vertical and horizontal disposition styles), we will provide incentives to them by drawing one grand prize where the winner will be given one of the two products he/she has selected in the experiment.

To control for the (randomized) positioning of products, a randomization procedure is used. For each experimental session, the total set of products (i.e., 10 products) is randomly divided into two disposition styles (i.e., 5 products are randomly selected out of 10 for each disposition

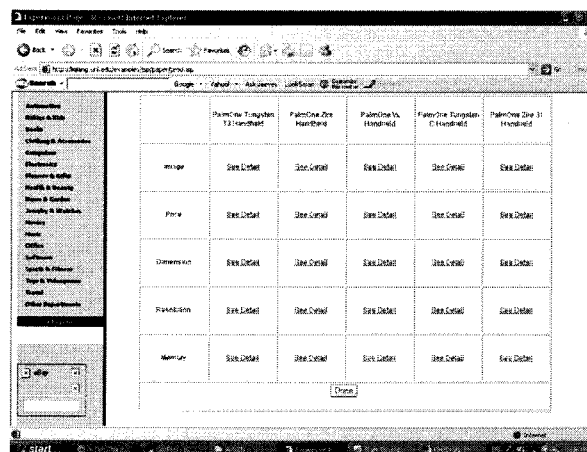


Figure 3. Screen Shot of the Experiment

style) and displayed in a completely randomized order in the product comparison tables (see Figure 3) of the two disposition styles. In this way, the placement of products is completely randomized for each subject.

For this experiment, the visual attention of each subject will be tracked using computer logs of click patterns [12]. Every cell in the product comparison table specifies information about a feature of a product. At the beginning of the experiment, the information in all the cells will be hidden. To view the information in a cell, the subject will have to click on the cell to have the information displayed. When the subject clicks on another cell, the information on previously clicked cells will be closed or hidden again. This is done to track which information is being attended to by the subject throughout the search process in order to derive the complete information search paths.

For example, if a subject clicks on the cell for the price of product A, and then clicks on the cell for the price of product B, and then clicks on the cell for the image of product B, the first movement is a feature information path (i.e., comparing or looking up a feature of two products) and the second movement is a product information path (i.e., looking up features of a product). A subject can click on any cell as many times as he/she needs until he/she decides on the product to purchase.

Upon completion of the task, (i.e., the product

to purchase has been determined), the subject will be asked to click on the "Done" button at the bottom of the screen (see Figure 3) and to specify the product chosen. Right after taking each test, the respondents were asked to answer what product they had chosen. We used Java Server Pages (JSP) to build our experimental Web pages. JSPs were connected to Apache Web server to put the pages on the Web and to MySQL which recorded all data generated by subjects during the experiment.

For the experiment, twelve graduate students majoring Management Information Systems or Operations Management and ten other subjects who are proficient at using the Internet were selected. Ten products of PDA were chosen for the test. Each respondent was asked to take two tests: one test for product comparison using the vertical disposition style and another using the horizontal disposition style. In order to control product positions, the ten products were randomly divided into two disposition styles for each respondent, and the five products in each style were also randomly displayed in the product comparison table.

7. Experiment and Results

Twenty two subjects took part in the experiment and ten PDA products were chosen for the study. Table 1 shows the descriptive statistics of the data. For H1, the mean of the number of feature information path in the vertical disposition style (18.23) is about 5 more than the means of the number of feature information paths in the horizontal disposition style (13.18). For H2, the mean of the number

Table 1. Descriptive Statistics of the Test

Information Path	Disposition Style	# of Subj.	Mean of Paths	Std. Dev.
Product	Vertical	22	5.55	5.74
	Horizontal	22	8.14	7.53
Feature	Vertical	22	18.23	13.52
	Horizontal	22	13.18	8.45

of product information path in the horizontal disposition style (8.14) is about 2.5 more than the mean of the number of product information paths in the vertical disposition style (5.55).

A paired-samples T test was first conducted with an assumption that the population is normally distributed. For H1, the number of feature information paths in the vertical disposition style was compared to the same number in the horizontal disposition style. As shown in Table 2, the t value is 2.633, and H1 is supported ($p < .01$). For H2, the number of product information paths in the horizontal disposition style was compared to the same number in the vertical disposition style. The t value is 1.694, and H2 is marginally supported ($p < .1$).

Table 2. Paired-Samples T Test for H1 and H2

	(Feature Paths in Horizontal) - (Feature Paths in Vertical)	(Product Paths in Horizontal) - (Product Paths in Vertical)
T	-2.633	1.694
Sig.	.008	.053

Even though the sample size ($N=22$) is large enough to conduct an experimental study, the Wilcoxon signed-rank test, which is a non-parametric statistical test, was also conducted in case the population is not normally distributed (Siegel and Castellan, 1988). Table 3 shows the analysis and the results of the Wilcoxon test. The results indicate that both H1 and H2 are supported ($p < .05$), which are more significant results than those in the T test.

Table 3. Wilcoxon Signed Ranks Test for H1 and H2

	(Feature Paths in Horizontal) - (Feature Paths in Vertical)	(Product Paths in Horizontal) - (Product Paths in Vertical)
Z	-2.080	1.683
Sig.	.019	.046

8. Conclusions and Future Research

The experiment results show that the feature information path in the vertical disposition is 10

points more than in that horizontal disposition. Therefore, we assume that H1 is supported. The product information path in the horizontal disposition style is 5 points more than that in that vertical disposition. Therefore, we assume that H2 is supported.

In this research, we study how disposition styles can influence browsing patterns. The experiment results show that people use feature information paths more than product information paths in the vertical disposition style whereas product information paths are used more frequently than feature information paths in the horizontal disposition style. With vertical disposition, users are more likely to follow feature information paths which may help them focus on comparing features across products - a primary purpose of product comparison services.

Humans usually read from left to right. These habits imply the information path will be more feature-focused in the vertical disposition than in the horizontal disposition. Zhang and Massad [7] stated that animation on the left side has more impact than animation on the right side, even though the impact is negative. Therefore, we can see the search path would start at the left and go on to the right on the same horizontal level. If H1 is supported, then it further confirms the subject information path is more feature-focused in the vertical disposition.

For H2, there is a difference of means. If H2 is supported, then it will state subjects may be more focused on the full information or feature for individual products. If it is not supported in the future test, it will explain that subjects may not be able to make a decision without a feature by feature comparison of different products. There may be some confounding factors mediating the results.

There are several directions for future research. Attention bias is the degree to which attention to one subject differs from attention to another subject. In the product comparison table on an e-commerce Web site, there are two dimensions and these generate two kinds of biases: attention bias on features and attention bias on products. Attention bias on features is a difference between attention on one feature and attention on another

feature. Attention bias on products is a difference between attention on one product and attention on another product. For this study, we will focus on the product bias because it is important to help customers to get a fair chance to examine each product and to give the suppliers of the products the same opportunities to show their products to customers.

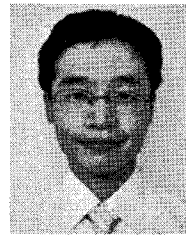
In our future research, we will use a large enough sample size to investigate these hypotheses. We will also examine users' decision making processes. People undergo several steps to make a decision. Tybout et al. [13] used information processing theory to describe how people make decisions, and they maintain that there are three stages in a decision-making process. Payne et al. [14] argued that decision makers have a tendency to ignore items or conditions they are not interested in (i.e., elimination), and after identifying a small number of possible options or favorites they would carry out a tradeoff analysis among a small number of products. Future research will examine the different decision making stages and how they may affect horizontal and vertical disposition styles.

Tarasewich and Fillion [3] outlined the strengths and weaknesses of existing eye-tracking and process-tracing methods. In this research, we adopted the clicking method highlighted by Todd and Benbasat [12]. In future research, we will use multiple process-tracing methods, including the Restricted Focus Viewer (RFV) recommended by Tarasewich and Fillion [3].

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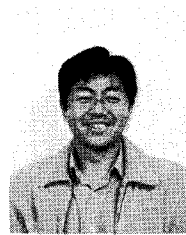
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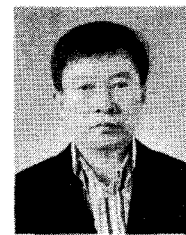
이 홍 희 (Hong-Hee Lee)

- 정회원
- 경희대학교 경제학과를 졸업
- 2006년 : 미국 네브라스카대학교 경영학과 (경영학박사)
- 대구디지털산업진흥원 책임연구원으로 근무
- 2008년 ~ 현재 : 단국대학교 상경대학 경영학부 경영학전공 전임강사
- 관심분야 : 아웃소싱, HCI, ERP, SCM



이 충 권 (Choong Kwon Lee)

- 정회원
- 계명대학교 경영정보학과를 졸업
- 2003년 : 미국 네브라스카대학교 경영학과 (경영학박사)
- 미국 Georgia Southern University에서 조교수로 근무
- 2006년 ~ 현재 : 계명대학교 경영대학 경영정보학과 조교수
- 관심분야 : IT인력의 업무수행능력 측정, IS/IT의 전략적 활용



유 상 진 (Sangjin Yoo)

- 정회원
- 서강대학교 물리학과와 경영학과를 졸업
- 1986년 : 미국 네브라스카대학교 경영학과 (경영학박사)
- 미국 Bowling Green State University에서 조교수로 근무
- 1989년 ~ 현재 : 계명대학교 경영대학 경영정보학과 교수
- 관심분야 : IS/IT의 전략적 활용, 경영혁신, e-Business

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