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How Do Consumers' Cognitive Styles Affect Their Visual Attention Patterns? – Emphasis on Field-Independent and Field-Dependent Styles

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Abstract

It is widely known that consumers' cognitive styles lead to making online shopping behavior react quite differently to various types of information on the online shopping websites. However, empirical results proving such premise from the perspective of eye-tracking are rare in literature. In this sense, this paper deals with two types of consumers' cognitive styles- field-dependent and field-independent. Field-dependent users tend to follow other people's opinion, while field-independent users show maverick style of making decisions, trying not to be influenced by others. To add rigor to our empirical results, we analyzed users' eye-movements in response to information on the online shopping websites. Empirical results obtained from eye-tracking analysis revealed very robust and promising results. For a utilitarian product like notebook computer, the field-independent users showed higher TFD (Total Fixation Duration) and FC (Fixation Count) to product description information and product image information than the field-dependent users. For a hedonic product like perfume, field-independent users showed higher TFD and FC to product description and product image information than field-dependent users. As expected, field-dependent users showed higher TFD and FC to consumer review information than field-independent users. In this way, it is quite clear that the physiological information obtained from analysis of the eye-tracking data reveals more reliable and unique description of possible influences that consumers' cognitive styles may have on their online shopping behavior.

Keywords: *Field-dependent/Independent Cognitive Style, Online Shopping Behavior, Eye-Tracking Approach*

1. Introduction

With the proliferation of the Internet, electronic commerce market is rapidly growing [1]. As world economy declines into recess, the e-commerce market faces fierce competition to attract online consumer to their web site. One of the limits of the e-commerce is that online shopping consumer is not able to feel and touch products displayed on the online shopping malls. Consumers can only observe the product information on the websites to make a purchase decision [2]. Therefore, how they feel about the product information and image displayed on the websites tends to have a great influence on customers' online shopping behavior. Therefore, how to organize product information in limited screen on the online shopping mall will play a significant role in effectively delivering the value of product to consumers [3].

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However, even though the display of product information is an important determinant of successful online shopping mall, it still remains unclear how much consumer's cognitive styles may make them react differently to the product information on the shopping mall websites. In an online shopping environment, consumer's purchasing decision tends to depend on a small set of particular information [4]. Even though many types of information are available for consumers during their online shopping, it is true that only some of them are considered. Consumers are known to observe and perceive such information to which they feel interested depending on their cognitive style [5]. However, in previous studies, consumer's cognitive styles and their way of interpreting product information in the online shopping environments have received very few attentions from both practitioners and scholars.

Therefore, this study aims to investigate whether consumer's online shopping behavior may change significantly depending on their cognitive styles towards product information displayed. The two types of consumer's cognitive styles we consider in this study include field-independent style and field-dependent style. Since our main focus lies in interpreting consumers' way of observing product information displayed on the online shopping mall, we adopt an eye-tracking approach as a main research method. We will rely on eyeball fixation counts and time, and eye-movement paths to answer our research questions.

2. Research Background

Usually, cognitive styles represent an individual's way of recognizing, organizing and processing information [6]. An individual has his/her own unique mechanism and internal preference about cognition [7]. Among various constructs of cognitive style, field-independent and dependent styles were widely discussed in the perspective of information processing. Those persons with field-dependent cognitive styles seem to be externally directed to and easily influenced by salient cues. They tend to have concern in global experience with being more likely to accept ideas presented to them from external interface [8].

Contrary to the field-dependent cognitive style, field-independent cognitive persons are internally directed to their own cognitive structure. In other words, they process information based on their own cognitive style, independent of others' opinion. Therefore, they tend to have concern on analytical experience with being more likely to accept information through their own analysis. In a nutshell, the field-dependent persons tend to globally perceive stimuli, whereas the field-independent persons are likely to differentiate and analyze stimuli until they make a final decision about the target information [8].

This study proposes research questions- (1) consumers with field-independent cognitive styles may be more internally directed towards their own way of interpreting information by analyzing product information with their own cognitive structure, and (2) consumers with field-dependent cognitive styles may be more concerned with salient cues, paying more attention to global experience information like other consumer's product review comments.

3. Experiments

In order to answer the research questions, we conducted experiments using eye-tracking method. Experiments participants were invited with $10. Their demographic information is addressed in Table 1, where 47 college students of a major private university in South Korea agreed to participate in the experiments in May of 2015.

Table 1. Demographic Information of Participants

Characteristics	Frequency	%
(Gender) Male	15	32
Female	32	68
(Age)Under 20	9	19
21 and 22	17	36
23 and 24	12	26
25 and 26	6	13
27	3	6

Experiments procedures, shown in Figure 1, worked as follows. Firstly, participants were introduced to a whole picture of the experiments. Then, they were asked to fill in two questionnaire surveys to collect their demographic information and discover their cognitive styles. Especially, each participant was asked to answer a group embedded figures test (GEFT) in order for us to identify their cognitive styles such as field-dependent or field-independent [9]. Secondly, a calibration test was conducted in order to correctly trace a participant's eye movement before starting the eye-tracking experiments. Finally, the online shopping screens designed for our experiments were displayed to the participants, and their eye-movements as well as their eye-fixation patterns were analyzed by using an eye-tracker.

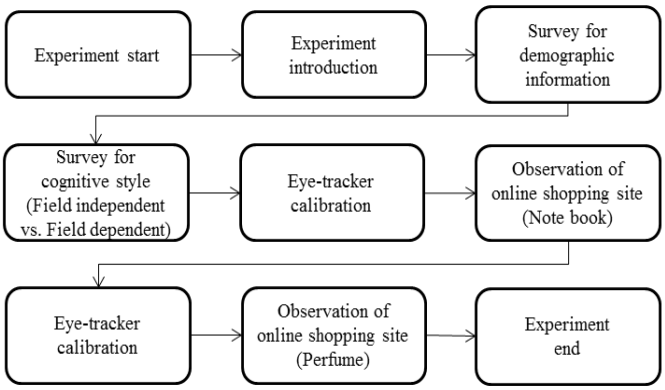


Figure 1. Experiments Procedure

Online shopping screen for the experiments was prepared as in Figure 2. We made the online shopping screen following typical characteristics of Amazon and other typical shopping malls in South Korea. Expecting that participants will show different reactions depending on the product types, we used two types of products such as notebooks and perfumes to acquire more reliable results. Notebook computer represents a utilitarian product, and perfume a hedonic product [10]. In case of purchasing a utilitarian product like a notebook, it is already known in literature that consumers primarily make a purchase decision using analytical information processing. However, in case of a hedonic product like a perfume, consumer's purchase motivation tends to be more influenced by experiential affect with the hedonic product [11]. In this respect, participants in the experiment were exposed to two types of online shopping screen - notebook shopping screen, and perfume shopping screen.

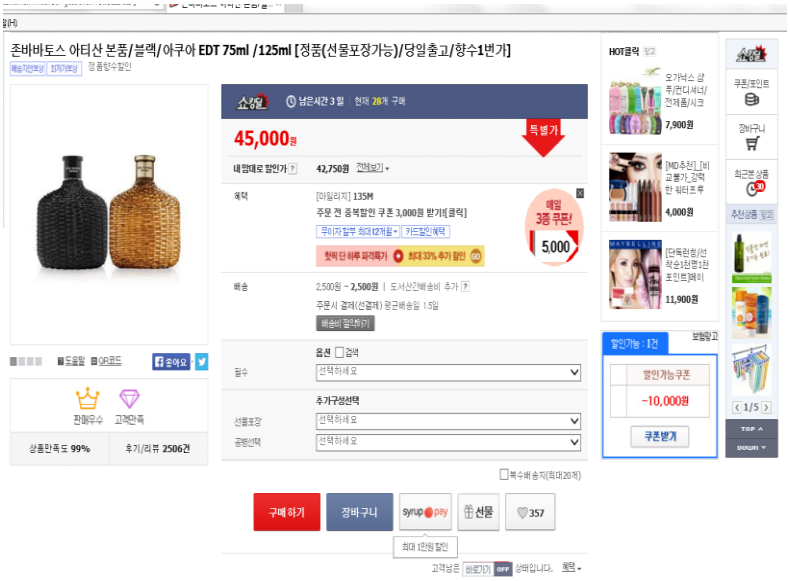


Figure 2. An Example of Online Shopping Screen for Experiments

In the experiments setting, participants were asked to observe the screen and related product information for 100 seconds. During that, an eye-tracker recorded participants' eye-movements and fixation patterns. The eye-tracking method is one of typical physiological techniques to measure individual's visual attention [12]. Eyeball fixation presents how long a participant's eyes stay focused on a particular area on the target screen. Meanwhile, eyeball movements represent which kinds of patterns participants' eyeball movements show on the target screen. In this study, participants' visual attention includes the fixation length on certain product information displayed on the screen. Figure 3 depicts the experiments setting used for this study.

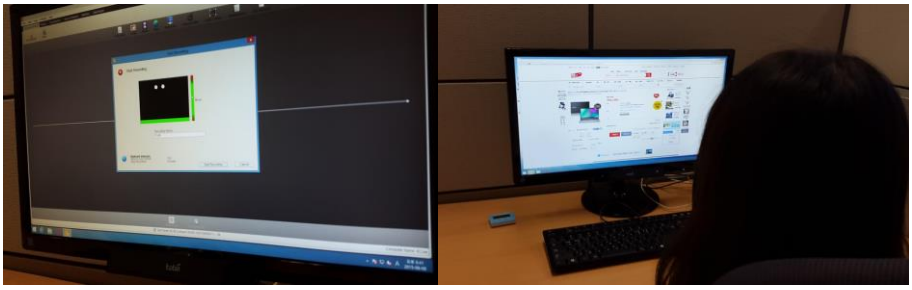


Figure 3. Experiments Setting for Eye-Tracking Analysis

4. Data Analysis

As one of eye-tracking analyses, we used a heat map, which is a visualization tool provided by an eye-tracker. The denser heat map area becomes, the more consumers pay visual attention. Figure 4 depicts an example of heat map which we obtained during experiments with perfume product.

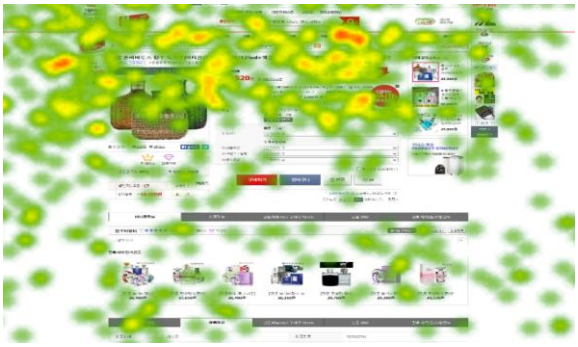
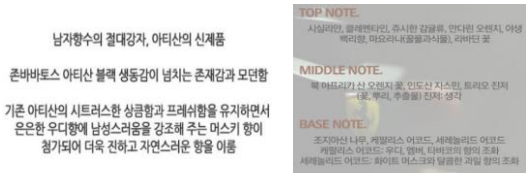
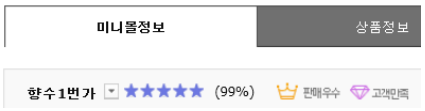
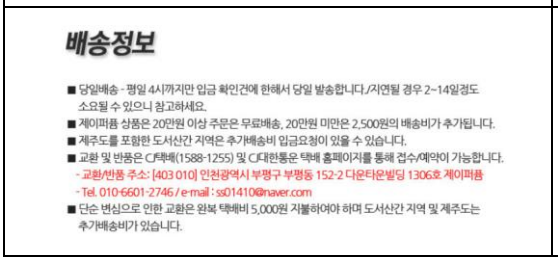
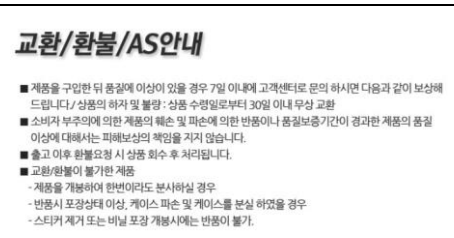


Figure 4. Example of Heat-Map

In the experiments online shopping screen, various information areas are included, which is to know how consumers react depending on their cognitive styles. To measure and calculate consumer's visual attention to the displayed information, we categorized nine types of areas of interest (AOIs) - product image, product description, price, consumer's review, consumer's Q&A, seller information, shipping information, exchange/return information, and event information. Table 2 summarizes nine types of AOIs.

Table 2. Nine Types of Areas of Interest (AOIs)

<table>
<tr><td>Product image</td><td>Product description (text)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Price</td><td>Event</td><td>Seller information</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Consumer's review</td><td colspan="2">Consumer's Q&A</td></tr>
<tr><td>  </td><td colspan="2">  </td></tr>
<tr><td>Shipping information</td><td colspan="2">Product exchange/return information</td></tr>
<tr><td>  </td><td colspan="2">  </td></tr>
</table>

We used three measures to identify unique eye-tracking outcomes explaining participants' cognitive styles- (1) time to first fixation (TFF) addressing the time in seconds from the moment when stimulus was suggested to the moment when the first fixation starts within a specific AOI, (2) fixation count (FC) explaining the number of fixations within a specific AOI, and (3) total fixation duration (TFD) describing the length of the fixation in seconds within a particular AOI. Generally speaking, TFF indicates where the participants' eyes stop first on the specific AOI, while TFD and FC represent how long and how many times the participant take a look at the AOI.

4.1. Results with Notebook

24 participants were identified as the field-independent consumers, and the remaining 23 participants were recognized as field-dependent consumers. Figures 5-7 are the eye-tracking results from the experiments with notebook. From the TFF results in Figure 5, both field-dependent and independent consumers began to observe the price information at first. Also, from the TFD and FC results, both field-dependent and independent consumers paid most frequent and longest attention to consumer review area. In addition, field-independent consumers gave more visual attention to product directly related information such as product description, image, and Q&A than other areas. This was the same with field-dependent consumers.

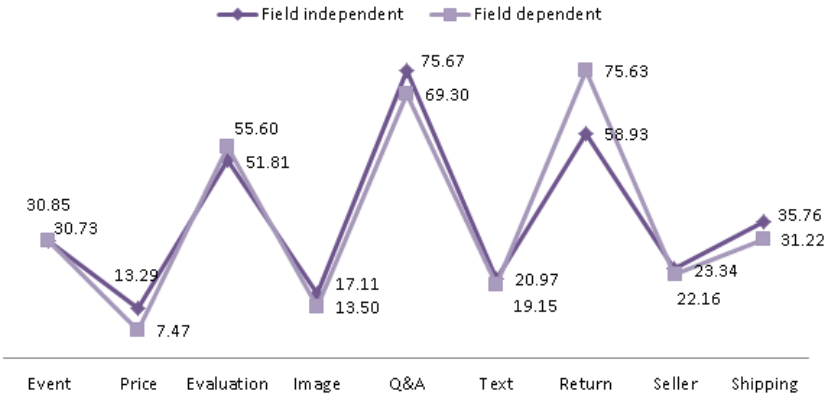


Figure TFF (Time to First Fixation) of Notebook

Figure 5. TFF (Time to First Fixation) Results with Notebook

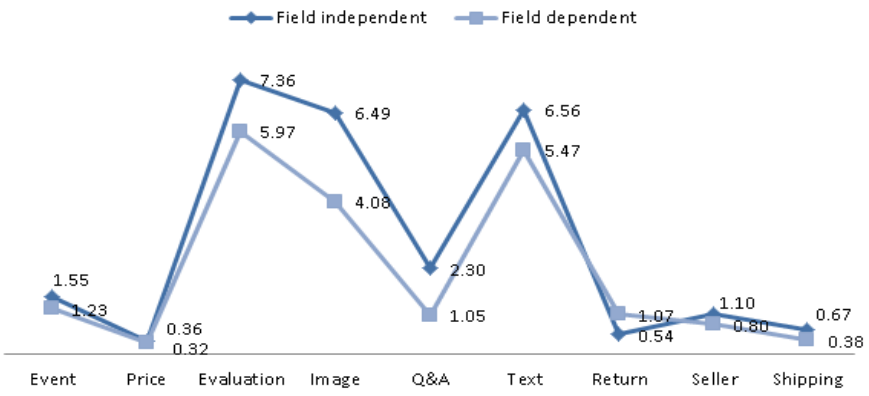


Figure 6. TFD (Total Fixation Duration) Results with Notebook

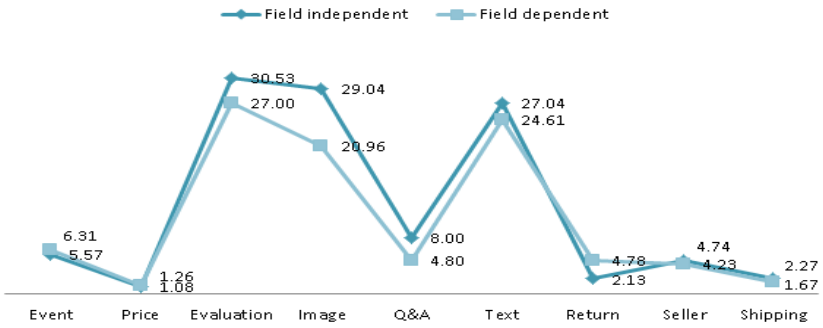


Figure 7. FC (Fixation Count) Results with Notebook

4.2. Results with Perfume

In case of a hedonic product like perfume, the TFF, TFD, and FC results were quite different from notebook. Figures 8,9,10 are the eye-tracking results from the experiments with perfume. From the TFF results, we knew that both field-dependent and field-independent took a first look at the price information. Then the field-independent consumers observed the product's Q&A area and product return information more quickly. From the TFD and FC results, field-dependent consumers paid most frequent and longest attention to the consumer's evaluation area. However, the field-independent consumers' visual attention was more concentrated to the product image and text information present than the characteristics of the product. As expected, the field-dependent consumer's visual attention was highly targeted to the consumer review because it represents salient cues and global experience about the product. Their TFD and FC were higher than the field-independent consumers in the consumer review (evaluation) AOI. In the contrary, field-independent consumers paid more visual attention to internally directed and analytical product information. Through the TFD and FC measures, we identified that the field-independent consumers paid longer and more frequent visual visits to the product description and product image information than the field-dependent consumer.

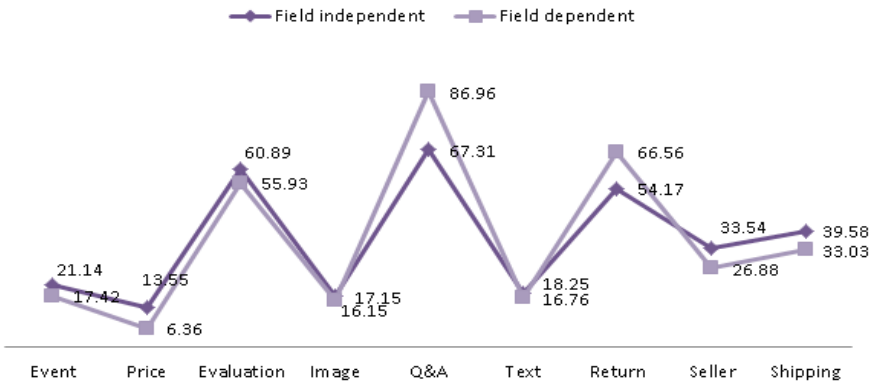


Figure 8. TFF (Time to First Fixation) Results with Perfume

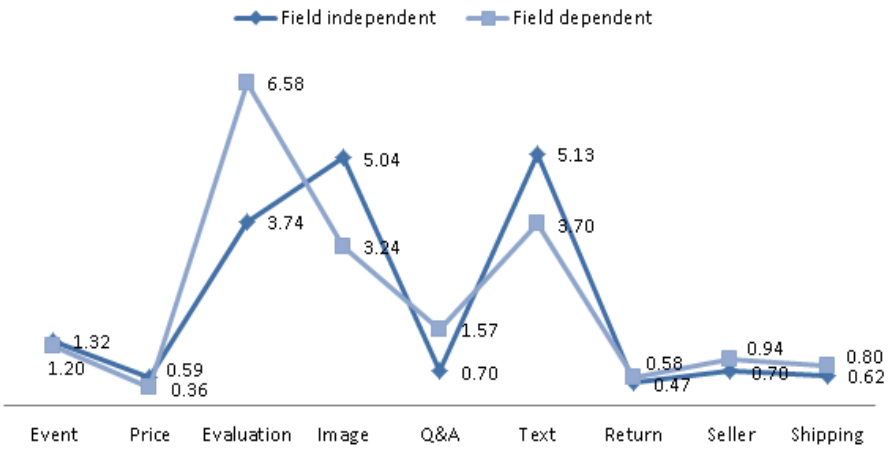


Figure 9. TFD (Total Fixation Duration) Results with Perfume

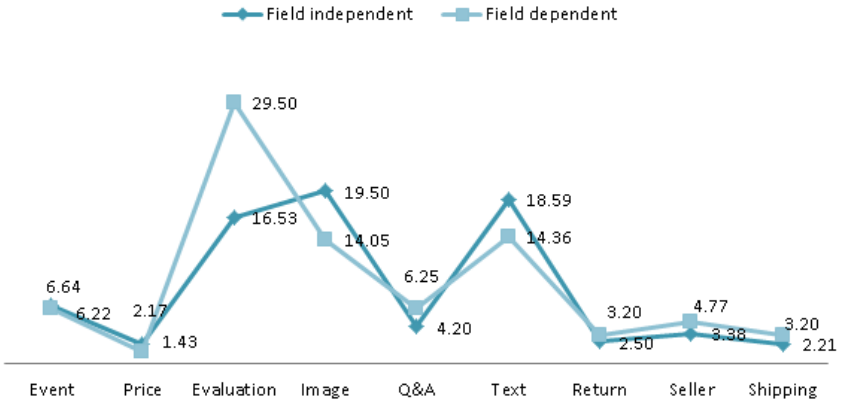


Figure 10. FC (Fixation Count) Results with Perfume

5. Discussion and Conclusion

According to the cognitive processing theory [13], each user has their own self-schema which contains information about oneself such as perceptions, attributes, and experiences related to the self. Based on the theory, this study investigated eye-tracking results to know how consumer's cognitive styles will have different influence on consumers' visual attention patterns. We pursued two different types of cognition such as field-dependent and field-independent styles to find how much those two styles will affect consumers' visual attention outcomes. Descriptive statistics obtained from the eye-tracking experiments with 47 participants proved that the research questions are sufficiently worthy of being answered by the eye-tracking experiments. Practical values of this study need to be more sought in further studies. Therefore, future studies are currently under way to answer such remaining research issues.

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References

[1] W. Hong, J. Y. Thong and K. Y. Tam, "The effects of information format and shopping task on consumers' online shopping behavior: A cognitive fit perspective", Journal of Management Information Systems, vol. 21, no. 3, **(2004)**, pp. 149-184.
[2] D. H. Park, J. Lee and I. Han, "The effect of on-line consumer reviews on consumer purchasing intention: The moderating role of involvement", International Journal of Electronic Commerce, vol. 11, no. 4, **(2007)**, pp. 125-148.
[3] W. Hong, J. Y. Thong and K. Y. Tam, "The effects of information format and shopping task on consumers' online shopping behavior: A cognitive fit perspective. Journal of Management Information Systems, vol. 21, no. 3, **(2004)**, pp. 149-184.
[4] R. Hastie and R. M. Dawes, "Rational choice in an uncertain world", SAGE Publications, Thousand Oaks, **(2001)**.
[5] J. C. White, P. R. Varadarajan and P. A. Dacin, "Market situation interpretation and response: the role of cognitive style, organizational culture, and information use", Journal of Marketing, vol. 67, no. 3, **(2003)**, pp. 63-79.
[6] M. A. Cronin and L. R. Weingart, "Representational gaps, information processing, and conflict in functionally diverse teams", Academy of Management Review, vol. 32, no. 3, **(2007)**, pp. 761-773.
[7] J. Decety and J. A. Sommerville, "Shared representations between self and other: a social cognitive neuroscience view", Trends in Cognitive Sciences, vol. 7, no. 12, **(2003)**, pp. 527-533.
[8] R. T. Pithers, "Cognitive learning style: A review of the field dependent-field independent approach", Journal of Vocational Education & Training, vol. 54, no. 1, **(2002)**, pp. 117-132.
[9] S. Y. Chen and R. D. Macredie, "Cognitive styles and hypermedia navigation: Development of a learning model", Journal of the American Society for Information Science and Technology, vol. 53, no. 1, **(2002)**, pp. 3-15.
[10] R. Dhar and K. Wertenbroch, "Consumer choice between hedonic and utilitarian goods", Journal of Marketing Research, vol. 37, no. 1, **(2000)**, pp. 60-71.
[11] G. S. Mort and T. Rose, "The effect of product type on value linkages in the means-end chain: implications for theory and method", Journal of Consumer Behavior, vol. 3, no. 3, **(2004)**, pp. 221-234.
[12] D. Y. Choi, M. H. Hahn and K. C. Lee, "A comparison of buying decision patterns by product involvement: an eye-tracking approach", In Intelligent Information and Database Systems, Springer, vol. 7, **(2012)**, pp. 37-46.
[13] K. Y. Tam and S. Y. Ho, "Understanding the impact of web personalization on user information processing and decision outcomes", MIS Quarterly, vol. 30, no. 4, **(2006)**, pp. 865-890.

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