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Scientific Approach to Fashion Websites Using Eye Trackers

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eye tracking method,
visual attention,
internet shopping mall layout,
heat map, neuroscience

Abstract

This study analyze consumers' unconscious visual attention to color and images of internet shopping malls by using eye-tracking method. Twenty-nine participants, including 15 females and 14 males, participated. The average ages of the male and female participants were 27.3 years and 27.7 years, respectively. Ten images of five layouts (multi-composition images, single-model images, gender-composed images, videos, and moving banner images) of internet shopping malls were shown on an eye-tracker computer screen. Quantitative analyses of the eye-tracking responses were conducted. SPSS was used to analyze the descriptive characteristics and to conduct an independent-sample t-test, along with an ANOVA. The data analysis showed that the image area generally had the shortest time to first fixation (TFF), the longest duration of fixation (DOF), the highest number of fixations (NOF), and the highest numbers of revisits(NOR).Notably, visual attention towards female models was high among various images. The results can be used to improve credibility and design online shopping layout with a scientific evidence that helps consumers through their purchase decisions.

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1. Introduction

The value of Korea's online shopping transactions in 2018 amounted to 111.893 trillion won (KRW), up 22.6 percent from the previous year's 78.2273 trillion won (KRW) (Mo, 2019). This was the first time that the online market was able to continue to grow in the 100 trillion won range. Accordingly, the need for systematic research is recognized to identify the site characteristics of clothing internet shopping malls and to a provide scientific basis for interface design planning considering user convenience.

With the recent rise of the 4th industrial revolution, we are seeing increasing interest in sectors that were not previously the focus of public attention, including artificial intelligence (AI). In line with this trend, there has been a rise in the number of companies that use neuroscience methods to analyze consumers' unconscious emotions and behaviors and apply the results of such analysis to marketing activities.

Eye tracking used to help consumers identify symbols, trends, and consumption patterns through capture of their eye movements, which reflect their interest in a product. The visual attention identified by eye tracking can be a factor in measuring consumer's attention (Kim & Lee, 2020; Kanwisher & Wojciulik, 2000; Orquin & Loose, 2013). Hence, researchers have applied eye-tracking method in studies of print advertising and the visual attention processes of consumers (Rayner, Rotello, Stewart, Keir, & Duffy, 2001).

Customer journey maps are used to understand visualization techniques to represent the flow of unfolding customer experiences (Halvorsrud, Kvale., & Følstad, 2016; Moon, Han, Chun., & Hong, 2016). Folstad and Kvale (2018) found that the customer to gain insights into customers' shopping experiences.

Visual persuasion plays an essential role in advertising areas because the images presented used as cues to translate and convey messages that words cannot communicate as effectively (Kang, 1997; Messaris, 1997). Previous research on eye tracking has generally focused on industrial design, covering advertisements on magazines, banners, and outdoor billboards as well as mobile shopping applications related to store displays.

With the development of technology, eye tracking, which can be applied in the fashion sector, is a scientific approach that can directly measure consumers' attention. Thus, it can provide valuable data that can be used in designing website layouts, mobile shopping, advertising, and so forth. However, there has been little research on consumers' visual attention in relation to online layouts of fashion products.

Therefore, this study investigated internet-enabled clothing selection behavior using eye trackers to measure consumer vision and attention flow. We propose selecting the most effective image by using an eye tracker to determine a difference in visual attention between different types of stimuli (images, moving banner images, videos) and genders in various layouts. The results of this work are expected to help designers and marketers select the most effective image and arrange images when constructing and operating online fashion shopping malls based on scientific evidence.

2. Literature review/ theoretical framework:

2.1. Eye tracking method and terminology

Eye-tracking method monitors where a person is looking. It tracks the pupils and analyzes visual attention such as where and how long people gaze at a specific area (Kim & Lee, 2020; Maughan, Gutnikov & Stevens, 2007). A consumer's eye moves and many eye-tracking applications have been studied in various fields (Duchowski, 2007), such as neuroscience, marketing, advertising, and consumer science.

Generally, eye-tracking technology involves analyzing visual attention by setting up an area of interest (AOI). Every fixation was numbered based on the chronological order in specific points (Amatulli, Guido, Milletl, Tomacelli, Prete., & Longo, 2015). In addition, such studies have used a scan path representing the gaze trajectory and an attention map indicating the concentration distribution to gain insights into the gaze

of subjects (Seo, 2017).

The fixation frequency in the same areas of interest indicates the importance, whereas fixation time indicates the complexity and difficulty of visual display (Fitts, Jones, & Milton, 1950). Visual behavior data include the time to first fixation (TFF), duration of fixation (DOF), and number of fixations (NOF) (Ho, 2014; Kim & Lee, 2020; Orquin & Loose, 2013).

The TFF (time to first fixation) is more influenced by how visual stimulus is presented than by an individual's characteristics (Bang & Wojdynski, 2016; Kanwisher & Wojciulik, 2000; Kim & Lee, 2020; Rayner, Miller & Rotello, 2008). The TFF is the time it takes for a participant to look at a specific AOI from stimulus onset, and it indicates how quickly the AOI was viewed (Behe, Bae, Huddleston., & Sage, 2015).

For example, the shorter the TFF, the shorter the response time in looking at the specific AOI (area of Interest). Bottom-up factors have a greater influence on the TFF than top-down factors; hence, this fact has affected how stimuli are presented (Kim & Lee, 2020). Fixation count is the number of fixations, indicating what content attracts viewers' attention and how interesting it is (Park, Bae, & Cho, 2016). In one study, consumers who showed long gaze durations or frequent eye fixations tended to recall more products in the advertisements than those who showed short gaze durations (Rosbergen, Pieters., & Wedel, 1997).

2.2. Eye tracking and fashion and clothing research

Several studies have researched the use of eye-tracking tools to assess participants behaviors. Pazhoohi, Macedo, and Arantes (2017) used eye tracking to study the effects of the various types of religious clothing on visual behavior. One of the results showed that participants spent more time looking at the midriff and thighs of official and liberal clothing than conservative clothing. The participants also looked at and fixated more at the head of a model wearing a chador than models wearing other clothing styles. Pazhoohi et al. (2017)'s study used eye tracking as well as quantified dwell times and fixations on stimuli.

Park, DeLong, and Woods (2012) studied twenty fashion images of models. The fashion images, posted by a male and female model were shown on an eye-tracker screen. The trained viewers tended to show longer gaze and higher densities of fixations, to be more sensitive to design changes, and to have less random scanning time, than the untrained viewers.

In a study by Ju and Johnson (2010), subjects viewed several fashion advertisements (Elle, Cosmopolitan, Vogue, Harper's Bazaar, and Lucky) while their visual attention was recorded based on the gaze duration and eye fixations. The participants looked at models longer and more often compared to other advertisement elements.

Hwang & Kim (2014) conducted an eye-tracking study related to non-online advertising and studied college and graduate students aged 20 to 35 to analyze visual information processing of fashion magazine advertisements. They utilized eye trackers to measure the effects of advertisement based on the types of advertisement layout. Thus, they identified the visual attention to different layouts, and presented effective layout types for the development of advertising strategies. Fashion websites and advertisements have also been analyzed using static eye trackers, static pictures, and the manipulation of the internet website elements (Chae, 2016; Ho, 2014; Huang & Kuo, 2011; Wang, Yang, Liu, Cao., & Ma, 2014). Cortinas, Cabeza, Chocarro, and Villanueva (2019) used the stimulus -organism-response (SOR) model (Eroglu, Machleit, & Davis, 2001). The study used eye-tracking method to observe attention in a stimuli design with eye-tracking technology. The experiment was designed to consider four purchasing tasks in different product categories. It measured the visual attention participants paid to the website and time spent on the website. The findings of the study showed that shoppers paid more attention to other areas of the website than for performing purchase tasks.

Ho (2014) analyzed female consumers' visual processing of handbag images in online shopping malls,

gaining insights into consumers' visual attention. Visual attention was considered in relation to four types of web pages (text-based, text-and picture-based, picture-based, and video-based).

2.3. Research on internet shopping mall interfaces

Eroglu et al. (2001) set a stimulus (online environmental cues)-organism (internal states; affect and cognition)-response (shopping outcomes) relationship. A high task-relevant environment is defined as one in which all the site descriptors (verbal or pictorial) that appear on the screen facilitate and enable the consumer's shopping goal. A picture of merchandise is a stimulus, given that it conveys product attributes and characteristics, in the case of clothing or other items purchase. The ability of shoppers to sample merchandise can be considered as highly task-relevant.

Eroglu, Machleit, and Davis (2003)'s study developed two web sites for a fictitious shirts retailer, a maker of high-quality shirts (including t-shirts and sweatshirts, among others). One site contained high task-relevant cues, while the other contained both high and low task-relevant information. The content, which was same across both sites, began with an introduction page that included links to *About Us* and *Design Options*. The study found that the online store atmosphere did make a difference. It was seen that increasing the atmosphere of the online store website increased the pleasure felt by the shopper.

Lohse and Spiller (1998) quantified the UI design components that influence the volume of communication and transactions in large-scale online stores, presenting directions for effective UI design to improve communication and transaction volumes by improving the exploration and search functions of website product lists. Dukes and Liu (2015) studied consumers' search behavior by focusing on online brokerage services. They analyzed the product search environment's influence on consumers' product evaluations and presented an interface methodology for optimal search environments.

3. Research method

3.1. Research questions

Eye-tracking method was used in this study to record fashion consumers' visual behavior on a desktop computer while browsing or shopping on fashion retailers' websites. The eye-tracker method was used to analyze five internet shopping mall layouts. We considered the unconscious visual attention of consumers to stimuli changes (multi-composition images, single-model images, gender-composed images, videos, and moving banner images) and their sight movements to determine the view share, view attractiveness, area of interest, visual attention, and the main areas of interest (AOI) of the experiment.

The results can be used to improve website credibility and provide a basis for designing a scientific evidence-backed layout that is easy to view and use to help consumers with their purchase decisions. The research questions of the study are the following.

Research Question 1. The visual attention related to time to first fixation (TFF), the number of fixations (NOF), duration of fixation (DOF), and the number of revisits (NOR) differ depending on the type of stimuli changes (multi-composition images, single-model images, videos) on the internet shopping mall layout.

Research Question 2. The visual attention for images of each gender differs according to participants' genders on the internet shopping mall layout.

Research Question 3. There are differences in visual attention related to images and moving banner images depending on the type of internet shopping mall layout.

3.2. Data analysis methods

This study's measurement tool was the GP3 eye tracker (60 Hz) developed by Gazepoint, a Canadian firm. Gazepoint Analysis Professional Edition, an analytics software, was used for quantitative analysis, and SPSS was used to data analysis.

As the analysis method of eye tracking can derive the

attention and concentration by setting the AOI sequence, this study set the AOIs as the logo area, navigation area, category area, image area, and information area of the layout. Other analysis tools used included a scan path, which can confirm the gaze flow path and stop of the subject in real-time, and a heat map.

The TFF used as a visual attention variable is the first time the experimental participant's gaze reaches the area for 15 seconds. The DOF is the total time that the gaze is fixed in the area for 15 seconds. The NOF is the number of times that a participant's gaze rests on an AOI for 0.33 seconds or more, indicating which area attracted the experiment participants' attention. The NOR indicates areas in which participants have repeatedly taken interest. This study was conducted after approval by the International Review Board (IRB).

3.3 Selection of research participants

A Google questionnaire survey was conducted for three months, between November 2018 to February 2019, to identify participants. The pre-experiment questionnaire included seven questions to identify demographic characteristics, five questions on online purchase experiences (including the percentage of total shopping conducted online, the degree of interest in online shopping, and the use of fashion-related social network services) and three questions on the appropriateness of eye-tracking experiments.

Table 1. Frequency Analysis Results of Demographic Characteristics of Subjects

Subjects		Frequency	Percentage (%)
Gender	Male	14	48.3
	Female	15	51.7
Age	20-24 years	6	20.7
	25-29 years	11	37.9
	30-34 years	10	34.5
	35-39 years	2	6.9
Gender by age group	Male, 20s	8	27.6
	Male, 30s	6	20.7
	Female, 20s	7	24.1
	Female, 30s	8	27.6
Occupation	Students	14	48.3
	Professionals	13	44.8
	Freelancers	2	6.9
Average monthly online spending on fashion products (KRW)	200,000~300,000	15	51.8
	300,000~400,000	5	17.2
	400,000~500,000	5	17.2
	500,000 and above	4	13.8
Proportion of online shopping in general shopping behavior	20-40%	6	20.7
	40-60%	6	20.7
	60-80%	5	17.2
	80% or more	12	41.4

Of the 89 respondents, a total of 32 participants suitable for the experiment were selected, with KRW 200,000 or more in average monthly online purchases. Among the 32 participants, those who were able to look at the screen without glasses were selected to prevent reflections from computer screens, and participants with errors in data measurements (two participants) were excluded. Ultimately, 29 participants (15 female, 14 male) were selected. A KRW 20,000 research incentive was provided to the participants after completion of the experiment session.

The frequency analysis results of the final 29 research subjects' demographic characteristics are shown in Table 1. The average ages of the male and female participants were 27.3 years and 27.7 years, respectively, and 52% of the participants spent KRW200,000~ 300,000 on online fashion purchases per month.

The experiment was conducted in a quiet computer room set up with eye trackers based on the participants' individual schedules. The instructions and the questionnaire took approximately 10 min to complete. After the questionnaire was completed, the participants moved in front of the monitor, attached eye trackers, and participated in the eye-tracking experiment session. They were instructed to look at the experimental stimuli while imagining that they were engaged in online shopping. During the experiment, they looked at approximately 10 experimental stimuli presented on the monitor.

3.4. Development of fashion internet site as stimuli

Rankey.com is a service channel that mainly provides website analysis and evaluation services. Using the Rankey toolbar from Rankey.com, this study analyzed 30 popular shopping malls in weeks 3 and 4, in July and August 2018. Thirty shopping malls were examined, including ranks 1 to 5 for branded female clothing shopping malls, female clothing shopping malls, as well as sports clothing shopping malls, outlet shopping malls, male clothing shopping malls, and SPA shopping malls.

The layout of each internet shopping mall was essentially divided into a logo, navigation, category, and image areas (Table 2). The 30 shopping malls were classified by type according to the layout of each area. They were classified into five types of main layouts, and the layout to be used in the experiment was directly produced.

The various stimuli to be applied to the layout were investigated to determine the flow of the consumer's perspective and interest through observation of visual attention. Photographs and videos to be used as experimental stimuli were approved for use by the ZARA website in August 2018 and produced using images posted on online shopping malls for ZARA's 18 F/W season and 19 S/S season products. Zara is a Spanish SPA brand that had over 2,000 stores worldwide; it has now grown into the world-renowned retailer Inditex with eight brands based on its success in

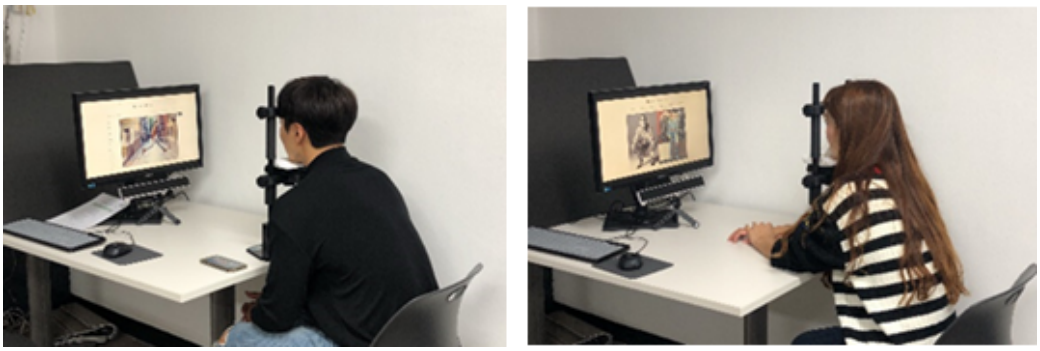


Figure 1. Male (L) and Female (R) Participants in the Experiment
(taken by authors)

the 1980s (Seo & Suh, 2019).

Based on the results of analyzing the stimuli by type, five types of experimental stimuli were selected, namely, multi-composition images, single-model images, gender-composed images, videos, and moving banner images. Eventually, ten stimuli to be applied to the layout were selected, and in this study, layout numbers were assigned to stimuli applied randomly for each layout.

A multi-composition image, a male image, and a video among the stimuli were selected to be applied to Layout 1 to identify differences in visual attention by applying various stimuli to the same layout. In Layout 2, male and female model images with low and high chromaticity were used to find out whether there are changes according to gender and color saturation.

Layout 3 included a moving banner composed of two female model images to investigate the visual attention paid to a still image and a moving image. The stimuli applied Layout 4 included male and female model images to determine whether there was any difference in the visual attention toward models based on gender. Unlike Layout 3, which included only female model images in moving banners, Layout 5 contained both male and female model images in moving banners (Table 2).

Table 2. Five Types of Internet Shopping Mall Layouts as Stimuli

Layout area (logo, navigation, category, image)
Type 1. (1-1.multi-image, 1-2.solo image, 1-3.video)

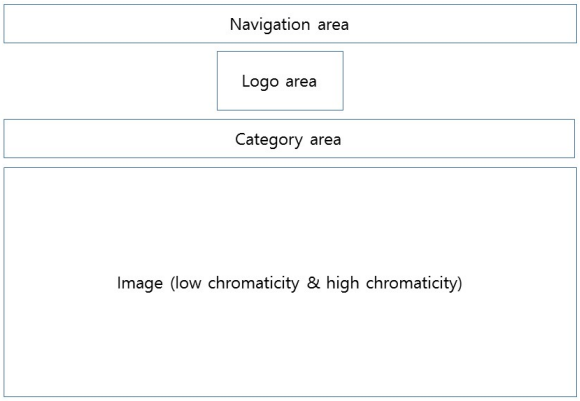
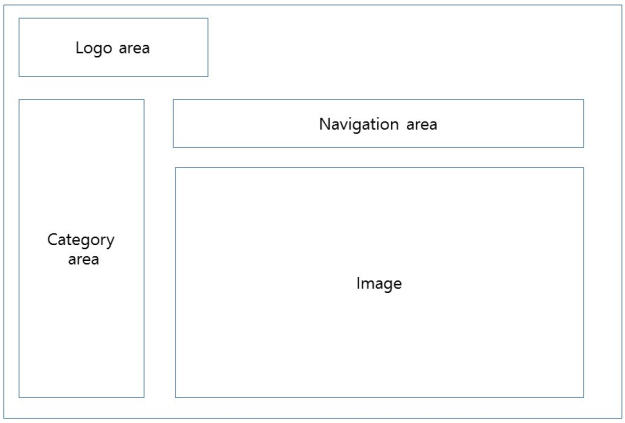
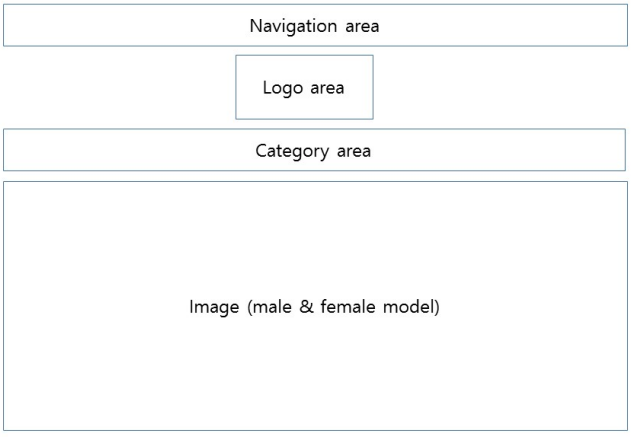
Type 2. (2-1.low chromaticity, 2-2.high chromaticity)


Table 2. Continued

Layout area (logo, navigation, category, image)
Type 3. Moving banner images (two female models)

Type 4. (4-1. female solo image, 4-2. Male solo image)

Type 5. Moving banner images (male & female models)


4. Research results and discussion

Research question 1. Does the visual attention related to TFF, DOF, NOF, NOR differ depending on the type of stimuli changes (multi-composition image, single-model image, video) in the internet shopping mall layout?

Data analysis indicated that the image area had the shortest TFF, the longest DOF, and the highest NOF; NOR was the highest in the category area in layout type 1. In particular, visual attention towards female models had a high score. The differences in visual attention according to layout type indicated that for Layout 1 (which was divided into Layout 1-1, with the main screen layout but a high number of images for key image areas; Layout 1-2, with one image; and Layout 1-3, with videos in Table 2), all types had high visual attention for image and video areas. Fixation mostly occurred on the faces of the models (Figure 2). Red in the heat map means a lot of stares followed by yellow and green.

ANOVA was conducted to analyze the differences in visual attention for each area and indicated significant differences for all values: TFF ($F = 19.39$, $p = 0.00$), DOF ($F = 70.77$, $p = 0.00$), NOF ($F = 16.73$, $p = 0.00$), and NOR ($F = 5.80$, $p = 0.00$). The results are shown in Table 3. A post hoc test was conducted to analyze the differences in visual attention between areas in detail, and *Dunnett T3* was used after testing for homogeneity (Leven's test). In the case of TFF, fixation was faster, in the order of Image > Logo, Category, Navigation > Information areas ($p < 0.032$). In the case of DOF, fixation was longer, in the order of Image >

Table 3. Variance Analysis of Visual Attention by Domain (Layout 1-1, 1-2, 1-3)

Visual attention	N	AOI	Mean sec (SD)	F(*p*)	Post-hoc
TFF	25	Logo	3.45 (3.31)	19.39 (0.00)	Image > Logo, Category, Navigation > Information *
	16	Navigation	6.53 (3.42)		
	29	Category	4.66 (3.28)		
	29	Image	1.23 (1.09)		
	19	Information	7.95 (2.79)		
DOF	24	Logo	0.45 (0.49)	70.77 (0.00)	Image > Category > Information, Navigation, Logo ***
	16	Navigation	0.55 (0.44)		
	28	Category	2.26 (1.31)		
	29	Image	5.05 (1.87)		
	19	Information	0.74 (0.35)		
NOF	24	Logo	2.29 (1.71)	16.73 (0.00)	Image, Category > Navigation, Information, Logo ***
	19	Navigation	3.08 (1.80)		
	27	Category	7.22 (3.76)		
	28	Image	7.36 (4.07)		
	19	Information	3.00 (2.13)		
NOR	15	Logo	1.80 (1.01)	5.80 (0.00)	Category, Logo > Image, Information, Navigation *
	12	Navigation	1.13 (0.77)		
	23	Category	3.30 (2.79)		
	24	Image	1.33 (0.85)		
	7	Information	1.19 (0.38)		

* $p < 0.05$; *** $p < 0.001$; N= participants

Category 〉 Information, Navigation, Logo (p = 0.00). NOF was in the order of Image, Category 〉 Navigation, Information, Logo (p = 0.00). In the case of NOR, re-fixation was higher, in the order of Category, Logo 〉 Image, Information, Navigation (p 〈 0.030).

By summing the above results, this study concluded that consumers look at the image area fastest and longest when exploring an online fashion shopping mall's main screen but turn their attention to the category and logo areas most often.

Research question 2. Does the visual attention for images of each gender differ according to participants' genders in the internet shopping mall layout?

The data analysis showed that the image area had the shortest TFF, longest DOF, and highest NOF for both men and women, and the category area had the highest NOR in layout type 2. However, there were apparent differences between male and female participants depending on the gender of the image model; men looked at the male model's images longer and often, as did women for female models.

Table 4 shows the independent-sample t-test used to analyze the differences in visual attention for each area according to gender. Regarding TFF, women had quicker TFF than men for image areas containing female models (= −2.13, t = −3.27, p = 0.006), whereas gender-based differences in visual attention for other areas were not significant. Regarding DOF, women looked at images of female models longer than men did (= 1.85, t = 2.96, p = 0.006), and men looked at images of male models longer than women did (= −1.88, t = −3.35, p = 0.002); however, gender-based differences in visual

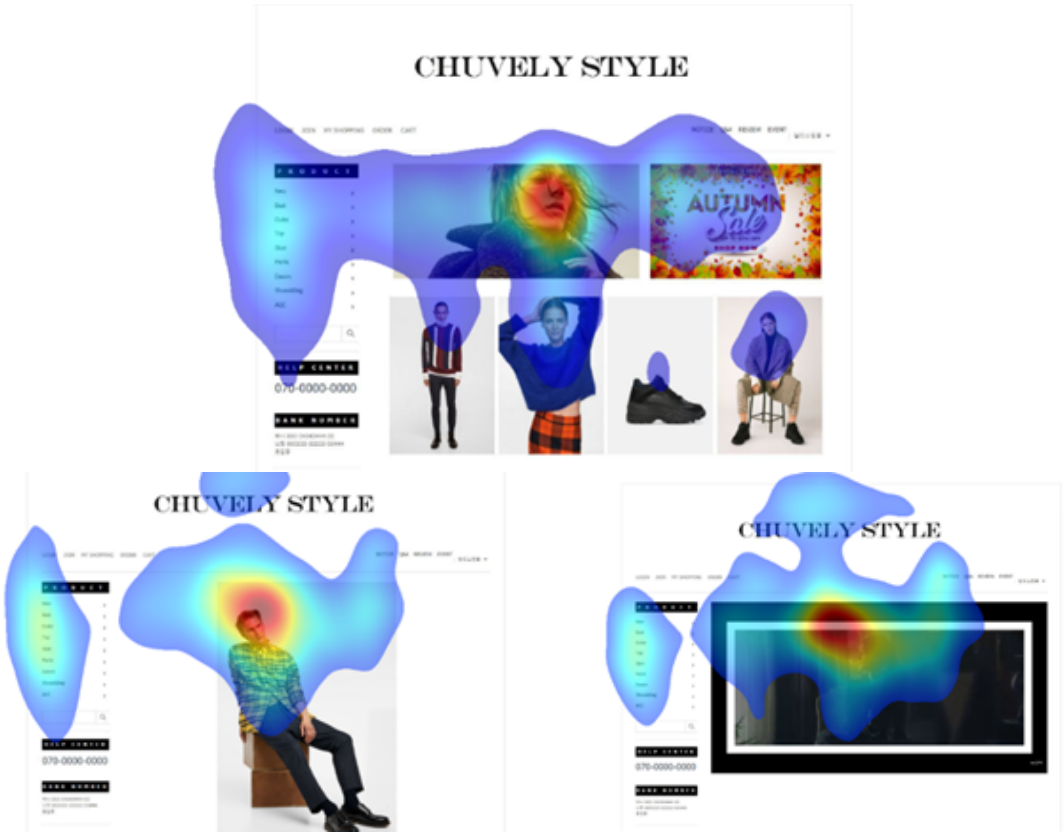


Figure 2. Heat Map of All Participants' Visual Attention on Layouts 1-1, 1-2, and 1-3
(captured by authors)

Table 4. Independent-Sample *t*-Test Results for Male and Female -Specific Visual Attention (Layouts 2-1 and 2-2)

Visual attention	Information	gender	N	Mean sec (SD)	F (df)	*t*	*p*
TFF	Logo	Female	13	3.57 (3.64)	0.620 (20)	−1.11	.282
		Male	9	5.27 (3.37)			
	Navigation	Female	7	6.29 (5.30)	4.194 (10)	−0.61	.554
		Male	5	7.97 (3.56)			
	Category	Female	14	4.28 (3.18)	0.235 (24)	−0.75	.462
		Male	12	5.32 (3.92)			
	Image (Female)	Female	14	0.68 (0.62)	35.298 (24)	−3.27**	.006
		Male	12	2.81 (2.19)			
	Image (Male)	Female	13	1.17 (1.59)	12.938 (25)	0.39	.699
		Male	12	0.94 (1.35)			
DOF	Logo	Female	15	0.63 (0.71)	1.633 (27)	0.40	.695
		Male	14	0.54 (0.57)			
	Navigation	Female	15	0.05 (0.08)	0.001 (27)	0.01	.996
		Male	14	0.05 (0.08)			
	Category	Female	15	0.69 (0.73)	1.786 (27)	0.78	.443
		Male	14	0.50 (0.55)			
	Image (Female)	Female	15	4.40 (1.90)	1.315 (27)	2.96**	.006
		Male	14	2.55 (1.39)			
	Image (Male)	Female	15	2.34 (1.38)	1.702 (27)	−3.35**	.002
		Male	14	4.22 (1.65)			
NOF	Logo	Female	14	3.29 (3.50)	0.000 (26)	0.00	1.00
		Male	14	3.29 (3.85)			
	Navigation	Female	14	0.93 (1.64)	0.718 (26)	0.68	.503
		Male	14	0.57 (1.09)			
	Category	Female	14	4.21 (4.39)	1.386 (26)	0.44	.661
		Male	14	3.57 (3.18)			
	Image (Female)	Female	14	12.36 (5.34)	0.112 (26)	1.93	.065
		Male	14	8.79 (4.41)			
	Image (Male)	Female	14	7.57 (4.74)	0.479 (26)	−3.39**	.002
		Male	14	13.71 (4.84)			

** $p < 0.01$; N= participants

attention for other areas were not significant. Regarding NOF, men looked at male models' images more frequently than women did (= −6.14, t = −3.39, p = 0.002), while gender (male and female)-based differences in visual attention for other areas were not significant. In the case of NOR, gender-based differences in visual attention for all areas were not significant.

The above results indicate that consumers look at the image area fastest and most frequently when browsing the main screen of online fashion malls. Within the image area, women tend to fixate longer on female models, and men tend to fixate longer on male models. In Layout type 2-1, the main image areas consist of images of female and male models.

The respondents' fixations are marked with various colored circles as below. Different colors are eye-catching for different respondents, and the size of the circle means the amount of fixation. Both men and women paid the most visual attention to the image area. In particular, men paid the most visual attention to images of male models, and women paid the most visual attention to images of female models, irrespective of image saturation (Figure 3).

Research question 3. Are there differences in visual attention related to images and moving banner images depending on the type of internet shopping mall layout? The data analysis for all participants indicated that TFF was shorter for the image area for all layout types in type 3 and 4. NOR was the highest for the image area for both images and moving banner images. However, there were differences in visual attention for images and moving banner images in terms of DOF and NOF. In the case of images, the category area had the longest DOF and the highest NOF, whereas in the moving banner images, the image area had the longest DOF and highest NOF.

The results of a responsive-sample t-test used to analyze the differences in visual attention between image and moving banner image areas for the layout types are shown in Table 5. In contrast to TFF, there were significant differences in visual attention for DOF, NOF, and NOR regarding moving banner images and images in the image area. Moving banner images received longer fixation (= −1.16, t = −3.064, p = 0.005), more frequent fixation (= −4.00, t = −4.229, p = 0.000), and more frequent re-fixation (= −0.98, t = −2.191, p = 0.039) in the image area compared with images.

Layouts 3 and 5, both of which had moving banner image in their main image areas, had higher levels of all visual attention types in comparison to banner areas

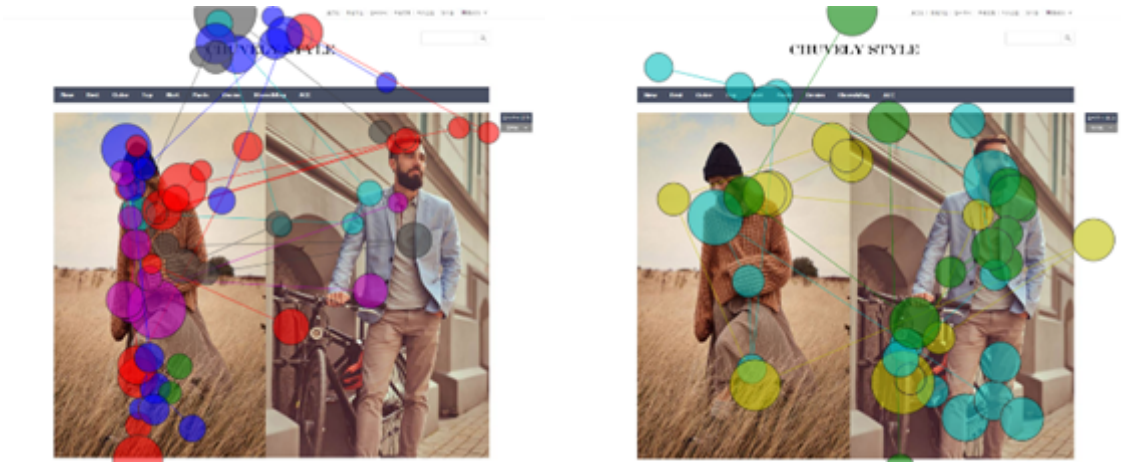


Figure 3. Gaze Fixation Map of Male (Left) and Female (Right) Participants' Visual Attention to Layout 2-1
(captured by authors)

(Figure 4, 5). For Layouts 2-2 and 4-1, which had fixed images in their image areas, Layout 4-1 had the shortest TFF and highest NOR for the image area; however, the category area had the longest DOF and highest NOF. Therefore, despite the differences in layout types, visual attention increased for the image area when it contained a moving banner image; when it contained images, visual attention increased for non-image areas.

Table 5. Sample *t*-Test Results for Visual Attention Responses Depending on Image/Moving Banner Image (Layout 3 (Moving Banner Image), 4-1 (Image))

Visual attention	Information	Layout	N	Mean sec (SD)	*t* (df)	*p*
TFF	Logo	Image	13	6.13 (4.58)	1.424 (12)	.180
		Banner	13	3.92 (4.25)		
	Navigation	Image	12	5.73 (3.92)	−0.729 (11)	.481
		Banner	12	6.42 (2.68)		
	Category	Image	27	3.32 (3.13)	−0.020 (26)	.985
		Banner	27	3.33 (2.92)		
	Image	Image	26	1.19 (2.14)	1.427 (25)	.166
		Banner	26	0.54 (0.62)		
DOF	Logo	Image	12	0.66 (1.11)	−0.526 (11)	.609
		Banner	12	0.48 (0.65)		
	Navigation	Image	11	0.88 (1.48)	−0.938 (10)	.371
		Banner	11	0.41 (0.37)		
	Category	Image	28	3.56 (1.93)	−0.068 (27)	.946
		Banner	28	3.59 (2.33)		
	Image	Image	28	3.10 (2.14)	−3.064** (27)	.005
		Banner	28	4.26 (2.19)		
NOF	Logo	Image	13	2.00 (1.00)	−0.379 (12)	.711
		Banner	13	2.15 (1.28)		
	Navigation	Image	13	2.62 (1.71)	0.349 (12)	.733
		Banner	13	2.38 (1.45)		
	Category	Image	27	12.22 (5.20)	−0.239 (26)	.813
		Banner	27	12.48 (5.38)		
	Image	Image	27	11.19 (6.01)	−4.229*** (26)	.000
		Banner	27	15.19 (6.39)		
NOR	Logo	Image	3	1.33 (0.58)	−1.732 (2)	.225
		Banner	3	2.33 (0.58)		
	Navigation	Image	4	1.25 (0.50)	0.225 (3)	.836
		Banner	4	1.13 (0.95)		
	Category	Image	25	2.70 (2.01)	−1.372 (24)	.183
		Banner	25	3.56 (2.72)		
	Image	Image	24	3.75 (2.07)	−2.191* (23)	.039
		Banner	24	4.73 (2.48)		

* p <0.05; ** p <0.01; *** p <0.001; N = participants

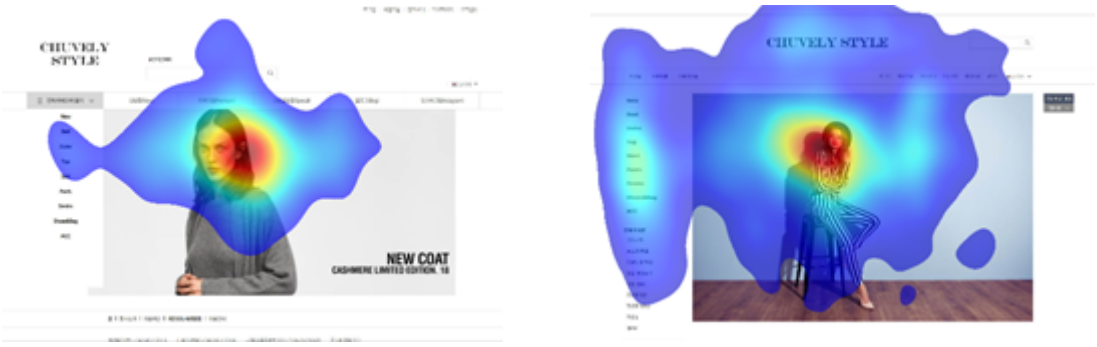


Figure 4. Heat Map of All Participants' Visual Attention on Layouts 3 and 4-1
(captured by authors)

Figure 5. Heat Map of All Participants' Visual Attention on Layouts 2-2 and 5
(captured by authors)

5. Conclusion and recommendations

This study used eye tracking, a method that studies consumer's visual attention, and the results of information acquired by an experiment that considered several types of fashion website layouts. The data analysis showed that the image area generally had the shortest TFF, longest DOF, and highest NOF; the numbers of re-fixations and NOR were the highest for the category area for all layout types. In particular, visual attention towards female models was high among various images.

Analysis of all participant data indicated that in all layout types, moving banner image areas received the most visual attention. TFF was the shortest for the image area with the highest NOR, while the category area had the longest DOF and highest NOF.

NOR was the highest for the category area, and all other visual attention was the highest for the image area. Therefore, this study indicates that even if the layout type is the same, the visual attention on websites increases for moving banner images.

The results of the study are expected to help those who want to operate or start an internet fashion shopping mall. The results will provide basic data on layouts (multi-composition images, single-model images,

gender-composed images, videos, and moving banner images) that can increase convenience for users of internet shopping malls and attract customers' attention when producing efficient online shopping mall pages.

For higher education, classes should be developed that converge traditional fashion classes with high technology to develop new fashion business models for the students. For future research, dynamic follow-up studies would be possible through monocular eye-tracking glasses worn by consumers, allowing view processing to simulate a physical store.

Furthermore, while this study researched unisex internet shopping malls, it could be meaningful to use eye trackers to study internet shopping mall layouts and image colors for big-size clothing shopping malls, which are increasingly regarded as a new territory with the increase in the overweight population.

Further eye-tracker-enabled research could be conducted on internet shopping mall layouts in various environments and devices (smartphones and tablets), given the explosive growth of the online shopping market due to the expansion of mobile services.

The sexuality of the advertisement component was not a focus of investigation in this study. However, it is meaningful to discuss gender differences in processing the gender roles of models differently. Regarding the gender-specific differences in visual attention for layouts 3 and 5, Layout 3, which consisted of two images of female models, men had the shortest TFF and highest NOR for the image area and the longest DOF and highest NOF for the category area.

However, for women, all types of visual attention were the highest for the image area. On the other hand, for Layout type 5, which was composed of one image of a female model and one image of a male model in the banner, men had the highest NOR for the category area, and all other visual attention types were the highest for the image area for both men and women.

There are limitations to generalizing the findings of this study to other groups. Also, the study included a small number of participants.

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