

# THE EFFECTS OF CONTROLLING VISUAL ATTENTION TO HANDBAGS FOR WOMEN IN ONLINE SHOPS: EVIDENCE FROM EYE MOVEMENTS

Prof. Hong-Fa HO

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Department Of Electrical Engineering,  
National Taiwan Normal University

Email: [Jackho@ntnu.edu.tw](mailto:Jackho@ntnu.edu.tw)

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## The effects of controlling visual attention to handbags for women in online shops: Evidence from eye movements

Hong-Fa Ho\*

Department of Applied Electronics Technology, National Taiwan Normal University, Taiwan, ROC



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### ABSTRACT

This study investigates how e-consumers perceive online pictures of women's handbags, whether they are motivated to observe specific parts of the picture, and the sequence of their fixations on each handbag areas. The author conducted a task-free eye-tracking experiment in which 33 female participants look at 74 randomly displayed pictures of handbags. Seven types of attention-based regions of interests (ROIs) were coded for data analyses. Based on statistical analysis, the data yielded the following findings: (1) the main body ROI first attracts the attention of the participants; (2) the handle ROI receives the most attention; (3) the featured area ROI has the greatest capacity to hold attention; and (4) the handle and strap ROIs have a stronger visual attraction than any other ROI. This study provides eye-tracking evidence that may be applied to future empirical research and the theory construction of visual behavior in consumers.

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### 1. Introduction

With the rise of the Internet, electronic commerce (e-commerce) has become a major channel for shopping. Handbags for women are one of the most popular products in online shops, and fashion designers, product photographers, and web designers need to understand how women interpret pictures of handbags so that they can increase their online sales.

E-consumers shop online by browsing, selecting, and then buying a product of choice. Unlike in a conventional shop where buyers have direct contact with the physical products, e-consumers make shopping decisions based on the text and graphics that appear on the web pages of an e-retailer (Holbrook & Moore, 1981; Kim & Lennon, 2008). Although text provides more informative product descriptions, e-consumers usually focus on product pictures when deciding whether to buy the product (Rayner, Miller, & Rotello, 2008; Riegelsberger, Sasse, & McCarthy, 2002). This emphasis on pictorial information in online shopping demands answers to questions on how e-consumers view product pictures, or graphics, and how their visual behavior can be measured.

Women consider handbags as an everyday necessity. Handbags are available on the websites of major retailers around the world. E-retailers, handbag designers, product photographers, fashion

design instructors, and students need to know how to present the product online so that it attracts the attention of the buyer. Previous research has investigated the visual behavior of consumers toward fashion products (Park, DeLong, & Woods, 2012), but none of them have specifically discussed the visual behavior of e-consumers when browsing fashion products. Although the popularity of handbags has been explored, no research has specifically used eye-tracking technology to examine the visual behavior of consumers looking at handbags (Hooper, Huff, & MacDonald, 2009). This author selected handbags for women as the experimental material based on their online popularity and the identified gap in research.

In this experiment we collected data from an eye tracker, which was used to discuss the mechanism of attention selection between object-based and feature-based theories when e-consumers observe handbags online.

#### 1.1. Visual attention control

The mechanism of attention selection has been an important topic in human psychology and behavioral science. Researchers have proposed various theories on how this mechanism operates, each with their own scientific evidence and applicability. The four major visual attention theories are: space-based theory, object-based theory, feature-based theory, and surface-based theory. Scholars of space-based theory have argued that visual attention is based on a space array. Supporters of the object-based theory believe that objects are the basis of choice. The feature-based theory argues that information processing channels or characteristic analyzers

\* Address: Department of Applied Electronics Technology, National Taiwan Normal University, 162, He-ping East Road, Section 1, Taipei 10610, Taiwan, ROC. Tel.: +886 2 77343537, mobile: +886 918528461; fax: +886 2 23935711.

E-mail address: [jackho@ntnu.edu.tw](mailto:jackho@ntnu.edu.tw)

# Abstract

This study investigates how e-consumers perceive online pictures of women's handbags, whether they are motivated to observe specific parts of the picture, and the sequence of their fixations on each handbag areas. The author conducted a task-free eye-tracking experiment in which 33 female participants look at 74 randomly displayed pictures of handbags. Seven types of attention-based regions of interests (ROIs) were coded for data analyses. Based on statistical analysis, the data yielded the following findings:

- (1) the main body ROI first attracts the attention of the participants;
- (2) the handle ROI receives the most attention;
- (3) the featured area ROI has the greatest capacity to hold attention; and
- (4) the handle and strap ROIs have a stronger visual attraction than any other ROI.

This study provides eye-tracking evidence that may be applied to future empirical research and the theory construction of visual behavior in consumers.

Keywords: Eye tracker, Visual attention, Visual behavior, Women's handbag, Fashion product picture

# Introduction

- E-consumers usually focus on product pictures when deciding whether to buy the product (Rayner, Miller, & Rotello, 2008; Riegelsberger, Sasse, & McCarthy, 2002).
- Web atmospherics could affect the intention to shop online by adopting a framework for atmospheric cues (Koo & Ju, 2010).
- No research has specifically used eye-tracking technology to examine the visual behavior of consumers looking at handbags (Hooper, Huff, & Macdonald, 2009).

# Visual Attention Control

- The four major visual attention theories are:
  - space-based theory
  - object-based theory
  - feature-based theory, and
  - surface-based theory.
- Certain endogenous and exogenous attention-controls affect the way e-consumers perceive pictures of handbags in online shops.

# Eye-tracking Technology

- Eye tracker is an instrument designed to record eye movement data to be used to analyze process of reading a written text or behavior of gazing at an object
- Eye-tracking technology has been applied to various fields such as Language, Neurosciences, Psychology, Engineering, Marketing, Computer sciences, and etc.
- To examine visual behavior of consumers, such as visual behavior on advertisements (Ju & Johnson, 2010; Lohse, 1997; Pieters, Rosbergen, & Wedel, 1999; Wedel & Pieters, 2000)
- The four common eye movement variables: duration of first fixation (DFF), latency of first fixation (LFF), number of fixations (NOF), and total contact time (TCT); are common models for processing eye movement data (Calvo & Lang, 2004; Hewig, Trippe, Hecht, Straube, & Miltner, 2008).

# Visual Behavior of E-consumers

- Some studies have investigated the effects of online advertisements on the browsing behavior of Internet users. Hsieh and Chen (2011) tested the effects of four types of web pages, text-based, text- and picture-based, picture-based, and video-based, on the attention of Internet users.
- Another study researched how Internet users react to pop-ups and found that users quickly dismissed pop-ups visually and cognitively (Bahr & Ford, 2011).
- Other studies explored how Web atmospherics could affect the intention to shop online by adopting a framework for atmospheric cues (Koo & Ju, 2010).
- Information search on the Internet is a widely researched topic. Roth, Tuch, Mekler, Bargas-Avila, and Opwis (2012) asserted that the time required for users to find target objects can be reduced by placing Web objects according to user expectations.
- In a study exploring the relationship between banner blindness and user-goal orientation, Heinz, Hug, Nugaeva, and Opwis (2013) found that users with explorative orientation remember banners better than those with goal orientation.

# Visual Behavior of E-consumers

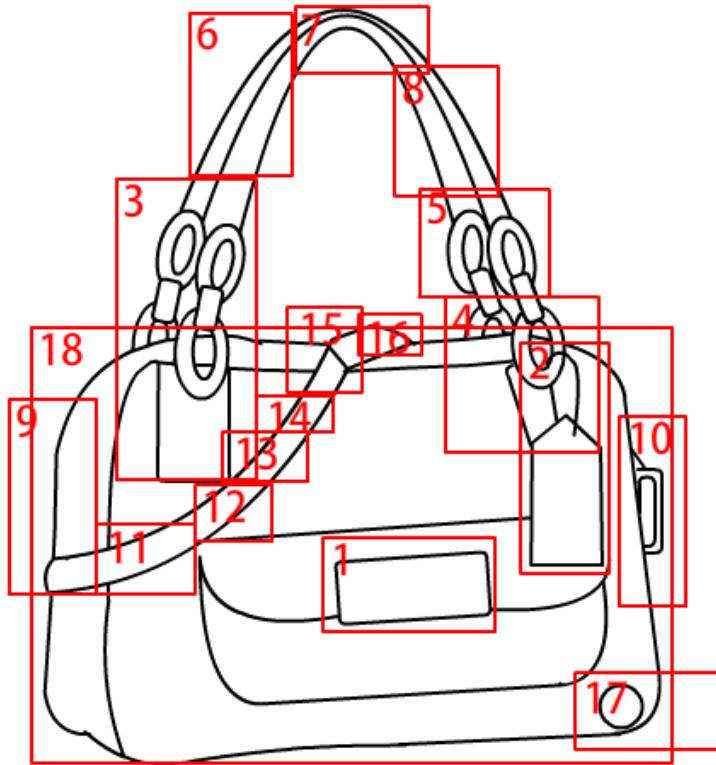
- How individuals observe target images online is another popular topic of study. A study on how Internet users observed menus of various page orientations and complexity showed that uncomplicated, vertical menus are more suited to the perception and cognition of users than dynamic menus (Leuthold, Schmutz, BargasAvila, Tuch, & Opwis, 2011).
- An extensive body of literature exists on the visual behavior of an individual to the structure and layout of web pages. However, more research needs to be performed on the visual behavior in response to a specific product, because the ultimate goal of e-consumers is to buy the products, not to appreciate the web design.
- Analyzing point-to-point scan paths and fixations of each participant provides detailed gaze patterns. This methodology is highly useful in textual reading research (Hyönä, Lorch, & Rinck, 2003; Karnath & Huber, 1992; Liversedge & Findlay, 2000).
- In this study, the author extended the point-to-point concept in ROI methodology to a region to-region concept for the purpose of measuring visual behavior on several regions of an image more effectively (Buscher, Cutrell, & Morris, 2009; Light & Isaacowitz, 2006; Underwood, 2009; Xing & Isaacowitz, 2006). Liu, Jiang, Huang, Xu, and Gao (2007) also reported that segmenting an image into multiple regions is an effective method of analyzing and ranking visual attention on each ROI.



# Aim

- This study investigates how e-consumers perceive online pictures of women's handbags, whether they are motivated to observe specific parts of the picture, and the sequence of their fixations on each handbag areas.

# An example of a women's handbag with different ROIs



- $R_1$ : handle
- $R_2$ : main body
- $R_3$ : hanging ornament
- $R_4$ : strap
- $R_5$ : featured area
- $R_6$ : textual information

# Region of Interests (ROI) area

- According to object-based and feature-based theories of visual attention control, the author coded six types of attention-based ROIs on handbags: handle, main body, hanging ornaments, strap, featured areas (e.g., a metal part with larger size), textual information (e.g., brand name or logo), and other features, such as the background of the image.
- All types of attention-based ROIs are listed in Table 1. An ROI may consist of several ROIs of the same type (Fig. 1). For example, R 1 consists of number 3, 4, 5, 6, 7, 8 ROIs that compose the handle, and number 18 ROI of R 2 overlaps with other smaller ROIs.
- The size of the ROIs corresponds to the structural shape of a handbag. For instance, the handle and strap ROIs are smaller because of their curved shapes. ROIs with smaller areas can cover these two curved parts to increase the precision of eye movement data. Fixations inside the hollow space between the handle and the bag are thus eliminated.

# Research Questions

- $Q_1$ : What is the sequence in which participants look at the six types of ROI on the handbag pictures?
- $Q_2$ : What is the relative order of the capacity of the six types of ROI to hold the attention of the participants?
- $Q_3$ : What is the relative order of the amount of attention paid to the six types of ROI?

# Pilot study

- **No literature related to visual attention on handbags for women could be found. Therefore, the author implemented a small-scale pilot study to explore the three research questions.**
- **The participants were 10 female undergraduate volunteers studying at the National Taiwan Normal University in Taipei, with an average age of 20.8 years (SD = 3.3 years, range 19–22 years). The author collected 50 pictures of handbags for women.**
- **The background of each picture was blank and each picture displayed only one handbag. Some handbags were branded, some were not. Of the 50 pictures, 10 pictures were selected on the basis of image quality, and their similarities in orientation, angle, and image size. Of the selected pictures, five contained brand or other text information.**
- **The formal experiment used the same experimental design as the pilot study and based its hypotheses on the results. The pilot study was identical to the formal experiment, except for the pictures and the number of participants. The results of the pilot study confirmed some of the subjective expectations of the author, and disproved others.**
  - For example, the main body ROI ( $R_2$ ) attracted the most attention, which was consistent with the expectations of the author because of its large area size. However, the result of the visual attention on the strap ROI ( $R_4$ ) was inconsistent with the expectations of the author who did not predict the strap ROI to have aesthetic and functional attractions. Thus, the author proposed the following hypotheses based on the object-based theory, the feature-based theory, and the results of the pilot study:

# Hypotheses

- $H_1$ : The gaze sequence of participants was  $R_2$ ,  $R_6$ ,  $R_3$ ,  $R_5$ ,  $R_1$ , and  $R_4$ .
- $H_2$ : The relative order of the capacity of the six types of ROI to hold the attention of the participants was  $R_1$ ,  $R_5$ ,  $R_4$ ,  $R_3$ ,  $R_2$ , and  $R_6$ .
- $H_3$ : The relative order of the amount of attention paid to the six types of ROI was  $R_5$ ,  $R_2$ ,  $R_3$ ,  $R_1$ ,  $R_6$ , and  $R_4$ .

# Method

- **Participants**

- Thirty-three female undergraduate volunteers who were studying at the National Taiwan Normal University in Taipei, with an average age of 21.6 years ( $SD = 3.7$  years, range 19–22 years)
- They were informed that the aim of this experiment was to measure pupil expansion in response to visual stimuli
  - This was done to prevent participants from consciously or subconsciously conforming to the experimental goal
- A self-developed eye-tracking instrument named EyeNTNU-180 was used to collect the participants' eye movement data from their left eyes

# Method

- **Design**

- To study the effects of the control of visual attention on handbags for women in online shops, a six-factorial design was used, with the factors being the six types of ROI on a handbag (handle, main body, hanging ornament, strap, featured area, and textual information).
- We recorded data for four kinds of dependent variables, DFF, LFF, NOF, and TCT, to evaluate the attention participants paid to the handbag pictures.
- These data were related to endogenous and exogenous attention controls.
  - The longer the DFF rests on a particular ROI, the stronger the attraction of the ROI.
  - The value of LFF is related to the attention controls on an ROI: the shorter the LFF of an ROI, the more attractive it is to the participant.
  - The larger the NOF, the more attractive the ROI is.
  - The longer the TCT, the more attractive the ROI is to the participant.



# Method

- **Stimulus Material**

- Four hundred collected pictures of women's handbags from webpage without background or patterns
- Carefully selected 74 pictures with good quality
- The pictures were placed in the same orientation and image sizes of the pictures were very similar
- Pictures were randomly displayed centered on the center of computer screen
- The distance from the participants' eyes to the screen was 60 cm
- Six types of ROIs were assigned for each picture

# Method

- **Instruments**

- Hardware

- EyeNTNU-180 eye-tracking system
- Sampling rate = 180 Hz
- Angle error  $< 0.3^\circ$
- Two infrared light-emitting diodes (LEDs) provided lighting that reflected on the cornea of the left eye to detect eye movement. The output energy of the LEDs was  $3.5 \text{ mW/cm}^2$  at a working distance of 4 cm.
- A nine-point calibration was performed at the start of each procedure. The participants were instructed to track nine white, moving points on a black screen.
- The eye movement data was collected at a 180 Hz sampling rate while the participant looked at the working area.

# Method

- **Eye Tracking: Recording and Quantification**

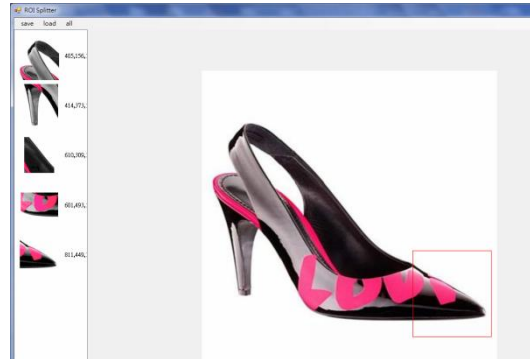
- Five EyeNTNU-180s were used to record five participants' eye movement data concurrently
- The participants rested their chins on a chin-rest to secure the distance between the eyes and the screen, and to lower the need for recalibration.
- The distance between the computer screen and the eyes of the participants was 50 cm.
- Nine-point calibration before the experiment
- The data was collected every 5.56ms as participants gazed at the working area on the screen
- No data would be recorded when the participants blinked

# Method

## • Instruments

### • Software (Analyzing Tools)

- ROI Tool: define ROIs of the 20 pictures
  - The ROI Tool was used to define ROIs on the handbag pictures. Because the areas of the ROIs were not exactly the same size, the picture sizes were adjusted to 80–100% in ratio to the height of the screen.
- Fixation Calculator: process the eye movement data
  - The Fixation Calculator was used to prioritize overlapped ROIs according to the ascending order of the ROI number. It was used to analyze eye movement data based on the following parameters:
    - (a) dwell time: the TCT of each ROI,
    - (b) NOF of each ROI,
    - (c) LFF of each ROI, and
    - (d) DFF of each ROI.



# Method

- **Eye Tracking: Recording and Quantification**
  - ROIs that were looked at for longer than 80 ms were counted as one fixation.
  - To remove invalid eye movement data, no fixation was recorded when participants blinked. The average time for one blink was 50 ms.
  - While the participants looked at one point, they could not look at other points.

# Method

## • Procedure



- After the calibration, the eye trackers monitored the eye movements of the participants as they looked at 74 random handbag pictures.
- To avoid capturing invalid eye-movement data from staring at the blank background of the picture.
- The participants were instructed to view the pictures without a time limit, but not to skip a picture.
- A picture of a centered cross was shown between each handbag picture to determine whether the eye movement data was still synchronized with the eyes of the participant. To ensure the accuracy of eye movement data, participants were required to re-calibrate their eye movement after each observation of a handbag picture.
- An eye tracker collected and recorded data of each eye movement during the experiment.
- Finally, a questionnaire survey was conducted to collect the age of each participant.

# Results (1/5)

- **The ANOVA analysis of LFF, DFF, NOF, and TCT was conducted to find the correlation of all types of ROI in the four variables.**
  - TCT, dwell time: the degree of attention
  - LFF, latency of first fixation: the attractive regions which participants can quickly position
  - DFF, duration of first fixation: the participants' adhere attention to the ROI
  - NOF, number of fixation: the participants' adhere attention to the ROI

## Results (2/5)

- **Eye movement data of each ROI**

**Table 2**

Eye-tracking data for each ROI.

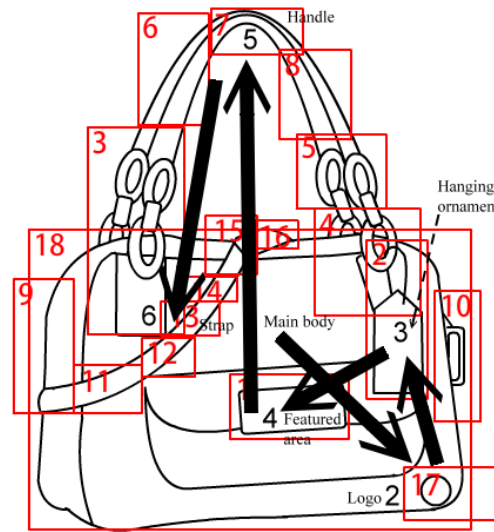
ROI	NOF		TCT (ms)		LFF (ms)		DFF (ms)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
$R_1$	2.92	.38	382.47	65.40	3211.25	530.60	195.66	14.68
$R_2$	4.07	.41	534.87	67.12	1418.63	115.01	133.84	4.36
$R_3$	3.23	.43	406.33	66.13	1989.64	213.77	135.43	6.34
$R_4$	2.47	.23	312.17	38.06	4327.12	727.24	185.37	14.80
$R_5$	3.99	.52	564.26	94.82	2913.63	391.98	189.42	11.47
$R_6$	3.20	.49	427.40	82.24	1771.07	186.99	126.12	5.92
$R_7$	0.34	.06	86.53	14.71	6483.55	525.77	58.86	3.65

*Note:* Mean and standard error (SE).



# Results (3/5)

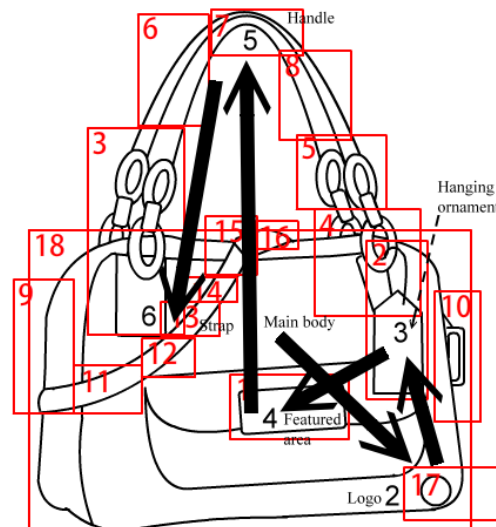
- Latency of First Fixation (LFF)
  - The gaze sequence is  $R_2$ ,  $R_6$ ,  $R_3$ ,  $R_5$ ,  $R_1$ ,  $R_4$
  - ROIs with lower FFL can quickly attract the participants' attention
  - $H_1$  is confirmed



- $R_1$ : handle
- $R_2$ : main body
- $R_3$ : hanging ornament
- $R_4$ : strap
- $R_5$ : featured area
- $R_6$ : textual information

# Results (4/5)

- Duration of the First Fixation (FFD)
  - The sequence of the duration of the first fixation is  $R_1$ ,  $R_5$ ,  $R_4$ ,  $R_3$ ,  $R_2$ ,  $R_6$
  - Longer duration shows that the capacity of attention of the ROI is stronger than the others
  - $H_2$  is confirmed



- $R_1$ : handle
- $R_2$ : main body
- $R_3$ : hanging ornament
- $R_4$ : strap
- $R_5$ : featured area
- $R_6$ : textual information

- # Results (5/5)

# ANOVA Analysis

- Further analysis was conducted to understand the correlation of all types of ROI among the four variables. The results of the ANOVA analysis are presented in Table 3.
  - NOF is not significantly different [ $F(5,192) = 2.18, p = .058$ ].
  - TCT is not significantly different [ $F(5,192) = 1.79, p = .116$ ].
  - LFF is significantly different [ $F(5,192) = 6.70, p = .000$ ].
  - DFF is significantly different [ $F(5,192) = 9.47, p = .000$ ].
- The post hoc analysis and Scheffe multi-comparison yielded the following results.
  - In DFF,  $R_1 > R_2$ ,  $R_1 > R_3$ ,  $R_1 > R_6$ ,  $R_4 > R_2$ ,  $R_4 > R_3$ ,  $R_4 > R_6$ ,  $R_5 > R_2$ ,  $R_5 > R_3$ , and  $R_5 > R_6$ . The results show that the participants paid more attention to the handle ROI ( $R_1$ ) than to the other three types of ROI. The strap ROI ( $R_4$ ) received more attention than the other three types of ROI. The featured area ROI ( $R_5$ ) received more attention than the other three types of ROI.
  - The analysis result of LFF showed that  $R_4 > R_2$ ,  $R_4 > R_3$ , and  $R_4 > R_6$ . The participants first gazed at the strap ROI ( $R_4$ ).
  - Comparisons of NOF and TCT showed no significant differences.

**Table 3**  
Results of ANOVA analysis.

NOF	TCT (ms)	LFF (ms)	DFF (ms)
$F(5,192) = 2.18, p = .058$	$F(5,192) = 1.79, p = .116$	$F(5,192) = 6.70, p = .000$	$F(5,192) = 9.47, p = .000$

# Discussion

- The visual attention of the participants conforms to the object-based theory (Table 2). The NOF and TCT of R 1 –R 6 are higher than R 7 (others ROI), illustrating that participants fixated on objects more frequently than on spaces.
- From the perspective of the spotlight effect described in the space-based theory, the main body ROI is easily “illuminated” because of its comparatively large size. Another explanation of this finding is that the blank background of the picture highlights a particular part of the object (Underwood & Foulsham, 2006).
- An endogenous attention-control perspective in which female consumers attach importance to the function of handbag handles. This phenomenon is consistent with the object-based theory.

# Discussion

- The results of this experiment support the results of the experiment by Pieters and Warlop (1999), in which consumers paid more attention to the feature and brand of the product.
- Saccade and information processing occur in parallel. In the second stage, participants placed their attention on one type of ROI, namely R 5 , which held their interest. we deduced that R 5 receives the greatest amount of attention because it stands out from the rest of the handbag. This phenomenon conforms to the feature-based theory in which the feature controls visual attention.
- The ANOVA analysis of the six types of ROI in LFF and DFF yielded unexpected results. The ROIs R 1 (handle ROI) and R 4 (strap ROI) are more attractive than any other ROI. These ROIs are considered functional parts of handbags, so the participants appear to care more about the usability of a handbag than its esthetics. This phenomenon may illustrate the endogenous control of visual selectivity.

# Conclusion

- The concrete eye movement evidence demonstrates that eye-tracking approach is an effective and efficient approach of predicting potential female consumers' gazing behaviors and visual attention as they look at images of fashion products
- With the knowledge of how consumers observe handbags, fashion designers now know how to design and attract the attention of consumers.
- The insufficient participants and the number of handbag pictures, and few variety handbags' styles are the limitations of this pilot study
- Researchers may conduct similar research or construct theories about the visual behavior of e-consumers based on the results of this task-free eye-tracking experiment.
- Color, material, and other elements are also factors that influence visual behavior, but this original study did not include these elements because of the complexity of the experimental design. This study also did not discuss the cognitive process of e-consumers. Issues listed above may be further explored in the future by using methodologies that are suitable to the respective issues.

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# Q & A