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The Influence of the Food Images on Consumers' Attention by Using the Eye-Tracking Technology*

WANG Hui-ya
Minghsin University of Science and Technology, Shinchu County; National Taiwan Normal University, Taipei, Taiwan

This study used an eye-tracking methodology to investigate consumers' gazing behavior by focusing on how assessment design influences gazing behavior and decision time. Only one factor of test design was investigated and each test contained three images. Eight participants were recruited. This study answered three questions: (1) Does the color of food influence gazing behavior? (2) Does the color of food influence decision-making? (3) Is gazing behavior related to decision-making behavior? The results demonstrated that gazing behavior and decision time have a positive relationship with the image selected. Future research should consider the relationships between eye movements, cognitive goals, and tasks.

Keywords: eye tracking, gazing behavior, decision time, food image

Introduction

Eye Tracking in Sensing and Consumer Science Applications

Analyzing eye movement can help determine the behavior of and influences on an individual and the relationships between behaviors, such as eye movement and choice-making. Therefore, eye-tracking technology has objective research potential in sensing and consumer science.

Designing an Eye Tracking Test

The variables in the eye-tracking tests in this study included the number of images per test picture (from one to four); the content of the question (preference, health, willingness to try, willingness to buy, or taste expectation); and the type of assessment (mandatory selection, rating, ranking, or projection mapping).

Eye Movement and the Relationship Between Cognitive Goals and Tasks

Eye movement and cognition have been shown to coextend; that is, eye movement and cognitive treatment complement each other (Liversedge, Gilchrist, & Everling, 2011). Eye movement was reported as highly dependent on tasks associated with cognitive goals (Castelhano, Mack, & Henderson, 2009).

Eye movement is largely dependent on the content being viewed and how the viewer has been asked to assess the content. Tatler (2010) determined that the task of the viewer may affect eye movement patterns.

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WANG Hui-ya, M.A. in TESOL and Early Childhood Education, New York University; Lecturer, Minghsin University of Science and Technology, Shinchu County; Doctoral Student, National Taiwan Normal University, Taipei, Taiwan.

Daily, people are exposed to different food stimuli at home as well as outside. High energy dense foods that are presented and easily accessible in the environment, e.g. via advertising on television or fast food stores, rther than food considered healthy. Reasearchers have warned about the dangers of food advertisement to children(Harris, Brownell, & Bargh, 2009) or in general, about the exposure to food related stimuli in the absence of hunger in our consumption promoting society. Similar results have also been obtained in other studies (Glaholt et al., 2010; Glöckner et al., 2012; Kim et al., 2012).

The cognitive processes involved during the focused attention to food images, stimuli and cues have been the interest of researchers in the field of eating disorders, reatrained eating and obesity (Hendrikse et al., 2015; Hume, Howells, Rauch, Kroff, & Lambert, 2015; Werthmann, Jansen, & Roefs, 2016; Werthmann, Roefs, Nederkoorn, & Jansen, 2013; Wolz, Faqundo, Treasure, & Fernandez-Aranda, 2015). A few studies have taken the potential influence of the type of food stimuli presented into account and compared different subtypes of food stimuli, e.g. by means of flavor. For example, Graham et al. (2011) examined differences in eye movements between high calorie savory and high calorie sweet food cues in a female population.

In short, a clear general relationship exists between tasks, cognitive processes, and eye movements. The task set affects the cognitive process, which in turn affects eye movement, and this movement reveals changes in the cognitive process.

Research Questions

Understanding the effects of test design will lead to more organized and effective testing of consumer behavior (Figure 1). Therefore, the present study investigated what factors in test design affect consumer behavior.

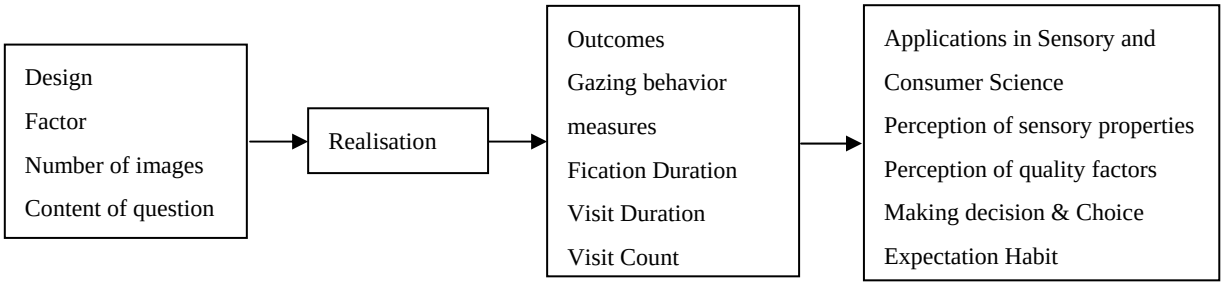

Figure 1. Eye-tracking test from design to application.

Research Design

Test Design Factors

In the study of consumer behavior, eye-tracking tasks are usually constructed around making a choice; therefore, eye movement is controlled by top-down and bottom-up processes (Orquin & Loose, 2013). In this study, we employed the design as the tested factor in terms of both the content of the tested problem and the type of assessment. The number of images per picture is also a factor in stimulus-driven attention; therefore, we also examined its influence.

(1) We limited the total number of pictures to four.

(2) We adjusted the problem content (five aspects of food: taste, health, price, convenience, and familiarity).

(3) We adjusted the assessment type (five assessments: ranking, rating, and grouping). These reflected the tasks with different difficulty levels commonly used in consumer research.

Gazing Behavior Procedures

The fixed time (i.e., the time at which the eye is fixed in the region of interest (ROI)), is a sensitive measure of cognitive processing load (Russo & Dosher, 1983). A fixed structure can reflect how a participant perceives information from the image (as the ROI). Conversely, access (i.e., the time the eye visits the ROI) may reflect how a participant compares information between images. Before making a decision, a participant can enter an ROI multiple times after viewing other ROIs. Therefore, in the present study, the duration and number of fixations and accesses was paramount.

Research Questions

On the basis of the literature, we aimed to answer the following questions:

Q1. Does assessment type affect consumer gazing behavior?

Q2. Does assessment type affect the time it takes to make a decision?

Q3. If the answers to Q1 and Q2 are affirmative, does that affect consumer behavior and time taken to make a decision?

Methods

Two experiments were conducted. The first examined the independent effects of individual factors on consumer behavior and time taken to make a decision. The second investigated the impact of the factors on staring behavior and time taken to make a decision.

Stimuli

The position of each test image was the same to ensure identical stimulus for all participants.

Presented stimuli were selected from four standardized and evaluated food pic data bases to investigate differences between diverse food stimuli. Further, within the group of high calorie food pictures, we distinguished between 4 pictures of sweet foods e.g. cake. Finally, we distinguished within both subtypes of food (HC and LC) based on the salient characteristic of each type of food, taste for HC food and type of arrangement for low calorie food. To control for different image characteristics. There were no differences in image characteristics (brightness and contrast) between the high calorie and low calorie food stimuli, the size of the shown stimuli, their complexity or their arousing qualities (see Figure 2). The valence and craving qualities for the two stimuli types, however, were significantly different.

Procedures

Each test began with a red cross in the middle of the screen for three seconds to fix a participant's eyes at a predefined point before viewing the test picture. Then, the test picture appeared on the screen until the participant had an answer and clicked the mouse. No time limit was given to the participants to make a decision. The participants were reminded to click the mouse before entering the response page. Depending on the type of assessment, the response page appeared as follows:

"For maximum and minimum selection tasks, display all images. Please click on the products you choose."

"For rating tasks, the images are displayed one by one on an 11-point scale (from 0 to 10). Please click on your rating for each product."

"For ranking tasks, all images are shown. Please click on your choices separately—the most, second-most, third-most, and least healthy products."

Data Analysis

To examine the impact of the number of images per test picture, in the first experiment and the second experiment, the ROI was considered to be the entire test picture.

As described above, for each ROI there were four measures of consumer gazing behavior: fixed duration, fixed frequency, duration of access, and number of visits. In addition, the time required to first click the mouse to the next page was used to characterize the task difficulty.

In section 1 of the first experiment, for each measurement parameter, the following model for one-way ANOVA was used:

Gaze parameter = group + mean value of error + main effect

In section 2 of the first experiment, the first of three for each measurement parameter, the following model for two-way ANOVA was used:

Gaze parameter = average + main effect ROI + main influence group + interaction ROI × group + error

In the second experiment, for each measurement parameter the following model for two-way ANOVA was used:

Gaze parameter = average (total number of images) + main effect + main effect of group (assessment type) + interactive part × group + error

For decision time, the following model for one-way ANOVA was used:

Decision time = group + error average + main effect

When the effect was significant, the Tukey test at a 5% significance level was employed to identify significant differences.

Statistical analysis was conducted using SPSS 21 and Microsoft Excel 2010.

Results

Gazing Procedures

Because the ROI was the entire test chart, the effect of the ROI was not determined. Each participant generally only viewed the entire screen once or twice; therefore, the entire ROI was not considered.

ANOVA analysis revealed that height significantly affected the number of images for a fixed number and access duration at p □ 0.01. For a p level of 0.05, but only at a 0.1-grade p level, the effect on the fixed duration was not significant. Therefore, at least two test gazing behavior parameters were affected by the number of images per test image.

Figure 2. The hot spot.

Decision Time

One-way ANOVA analysis revealed no significant effect between the number of images and decision time at $p < 0.05$. The p value was 0.092; therefore, a slight trend was observed toward longer decision times as the number of images increased.

Problems

ANOVA analysis discovered no significant effect of the ROI. Because the ROI was the test image for each food image, no image was of more concern than any other.

In addition, no significant effect was found between the problem content and the measured gazing behavior. Therefore, gazing behavior was not affected by problem content.

Gazing Program

ANOVA results revealed that the ROI had no significant effect, again demonstrating that no image was given more attention than any other.

The type of assessment was found to have a significant effect on all gaze behavior parameters. Compared with other tasks, consumers in the ranking task tested the images for longer.

Gazing Program

ANOVA results revealed that the ROI had no significant effect, again demonstrating that no image was given more attention than any other.

The type of assessment was found to have a significant effect on all gaze behavior parameters. Compared with other tasks, consumers in the ranking task tested the images for longer.

Gazing Procedures

Based on the first experiment's results, the impact of the number of images and type of assessment was found. For data analysis, because the ROI was defined as the entire test picture, the number of visits was typically 1.

Decision Time

No significant effect between number of images and type of assessment during the decision-making process was identified. Each factor may have independently affected decision-making.

Conclusion

In this study, the type of assessment, rather than product problems, was found to influence consumer gazing behavior. The effect of assessment type on decision time reflected the difficulty of the task. Furthermore, design factor had a negative effect on gazing behavior and decision time. No combined effect between the number of images per test image and assessment type was revealed in behavior and decision-making time. This research examined the relationship between eye movement, cognitive goals, and tasks. The findings highlight the importance of understanding the factors that affect gazing behavior in eye-tracking tests.

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