# A MEDIATING PERSPECTIVE OF EYE MOVEMENT IN ATTRIBUTE FRAMING OF E-SHOPPING

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## ABSTRACT

Framing message often applies in business activities such as advertisement. Most of the previous framing effect research focused on moderator variables, yet this study is more interested in the mechanism than in the exogenous variable itself. This study found that framing could be treated as a trigger for different cognitive processing on information, which in turn guides a decision maker's actions. The results show exposing negative framing will activate more cognitive process than positive framing, and eye movement has prediction power on buying intention. The finding has potential implications for the design of information presentation in e-commerce.

**Keywords:** attribute framing effect, decision, eye movement, cognitive process, mediator variable.

## INTRODUCTION

Humans have judgmental biases because of limited information-processing capacity. Regarding attention, the amount of information that is transmitted through the optic nerve exceeds what the brain can process, so the brain has evolved attentional mechanisms that select a subset of relevant information for enhanced processing [14]. There are many characteristics of visual marketing stimuli that can influence attention, such as visual (e.g., color or sizes of objects) or information description. The latter information, if it is presented or framed, can affect judgments and decisions. This study focused on the latter, which often applies in advertisement; for example, "Prevent further hair loss for 4 out of 5 men."
Framing effects have demonstrated decision biases. The phenomenon of framing effect or framing bias is involved in the different evaluations and choices of objects such as consumer purchases when the same information is presented or framed in a positive or negative way. Most studies focus on framing as a biasing agent that predisposes decision makers to select one action over another, or explore the moderating effect on the relationship between framing and the final decision. However, little is known about whether framing might also influence cognitive processes thought to precede and guide a decision maker's actions.
An information frame affects both perception and the overall evaluation of a stimulus. The effects of stimuli on behavior are mediated by various transformation processes internal to the organism [1]. A self-reporting questionnaire is frequently used to measure perception of cognition, but it cannot reflect the cognitive process of the moment accurately when a decision maker is exposed to a stimulus. However, eye-movement measures were used not only to reflect cognitive processing but also to detect potentially more subtle information-salience effects than might obtain from the rather gross measure of overall perception. Therefore, this study used eye movement which has evidenced representation of cognitive processing instead of self-reporting questionnaires to explore framing effects on online

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shopping. The purpose of this study is to contribute to framing research by investigating the mediating role of eye movement in decision making.

## LITERATURE REVIEW

### Framing effect

Levin [10] developed a typology of framing effects: risk choice, attribute, and goal. Because attribute framing is the simplest case of framing, making it especially useful for gaining a basic understanding of how descriptive valence influences information processing [10], this present paper centers on attribute framing in which equivalent object/events attributes or characteristics are manipulated in a either positive or negative view. For instance, Zhang & Buda [15] presented new product as either positively framed information -- "85% of the users of this product were satisfied with its performance" -- or negatively framed information -- "15 % of the customers were dissatisfied with the product." Generally, the research results indicate a positive frame will yield a more positive rating of the event or object than a negative frame [3] [10] [15]. Thus, the following hypotheses were proposed:

**H1.** *Framing effect on decision*: Participants exposed to a positive framing message will reveal higher intention to buy the target product than those exposed to a negative framing message.

### Eye movement and cognitive processing

Any strategy for performing a cognitive task, such as consumer decision making, will exhibit a characteristic pattern of human cognitive processing [13]. To identify the consumer's strategy and infer the underlying cognitive strategy, eye tracking provides the means of monitoring aspects of user cognitive processes and of determining how specific visual features influence eye movement [13].

To direct the fovea toward the visual scene and to smoothly move our eyes, we continually make eye movements called *saccade*. Between the saccades, our eyes remain relatively still during *fixations* [12]. Saccades serve to project specific locations of the scene onto the fovea. During a fixation, a contiguous area of the scene is projected onto the fovea for detailed visual processing [14].

Cognitive processing can be identified by tracking eye movements based on eye-mind hypotheses, a principle formulated by Just & Carpenter [9] which assumes that there is no appreciable lag between what is being fixated and what is being processed. In other words, the assumption posits that what a person is looking at indicates what they are currently thinking about or attending to. The main measurements in eye-tracking research are fixations and fixation duration. Table 1 is a summary of the measurement indices of eye movement and related cognitive processes [5] [6] [7] [11]:

Table 1. Summary of eye-movement indices and related cognitive processes

| Eye-movement indices | Cognitive process |
|---|---|
| Fixation duration | Fixation duration is linked to the processing-time. Longer fixations indicate spending more time interpreting or relating the component representations in the interface to internalized representations. In addition, longer fixation duration on each area of interest implies difficulty extracting or interpreting information from display element, or the object is more engaging or needs further investigation in some way. |
| Number of fixations | The number of fixations is related to the number of components that the user is required to process, but not the depth of required processing. More fixations indicate a less efficient search, requiring many components to be processed. In addition, more fixations on each area of interest imply the element/area is more noticeable or important, greater interest in, or more complex and more difficult to encode in the encoding task. |

## Framing effect and cognitive processing

Attribute framing can be useful for gaining a basic understanding of how descriptive valence influences information processing and, in turn, affects the evaluation of the stimulus object [10]. Dunegan [4] argued that framing may be a catalyst for different modes of cognitive processing based on two inferences: (1) negative framing would trigger more controlled decision processes, whereas characteristics of automatic modes would be more prevalent when positive framing was used, (2) in controlled modes, information is subjected to a more comprehensive, deliberate, and thorough analysis. Alternatively, in automatic modes, processing of information is limited, there is a reduced attention to detail, and it is not as thoroughly evaluated. More specifically, Just & Carpenter [8] eye-movement experimental results showed that because an implicitly negative sentence is represented as a negation, the stage of processing consumes extra time. In addition, because automatic modes are less easily recalled for conscious use than controlled modes, the relationships between cognitive processes and decision actions would be weak or nonsignificant [4].
Based on the above inferences and according to cognitive process relative to eye movement, the following hypotheses were proposed:
**H2.** *Mediating effect*: Eye movement measures are mediators of the effects of the framing message on buying intention.
**H3.** *Framing effect on cognitive processing*: Participants exposed to a positive framing message will reveal lower fixation duration and number of fixations than those exposed to a negative framing message.
**H4.** Positive framing will reveal weaker relationships between eye movement measures and intention than negative framing.

# METHOD

The research framework in Figure 1 illustrates that the attribute framing message influences the participants' eye movement, which in turn influences the participants' purchase intention.

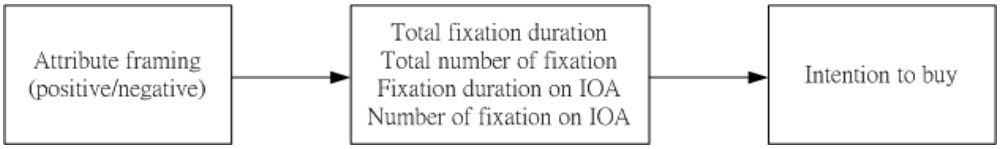

Figure 1. Research framework

## Participants

The participants were 31 students recruited from the College of Management at National Sun Yat-sen University in Taiwan. Five participants were omitted from the analyses; four participants' fixations were invalid due to incorrect calibration, and one failed to complete the questions. The effective participants included 12 males and 14 females. Seven participants were over the age of 25, while the remaining participants were between 19 and 25 years old. All participants had online shopping experience and digital camera experience, but only 11 participants had bought digital cameras.

## Measurement and apparatus

Participants rated their intention to buy the digital camera on a 9-point Likert scale. The EyeLink II eye-tracking system was used to track and record the participants' eye movements of saccades and fixations. This system has a sampling rate of 500Hz (about 2msec) head-mounted video-based eye tracker.

The study incorporated an analysis of two eye-tracking metrics, total fixation duration and total number of fixations, in order to explore the determinants of ocular behavior on a product information page.

### Design and procedure

A digital camera is the target product of this experiment. There were three key attributes for three digital cameras respectively. Each digital camera had a positive and a negative frame. In the positive frame (negative frame), for example, the digital camera was described as: "9 out of 10 (1 out of 10) professional photographers agree (disagree) this DSLRC meets high-level standards." For each camera, four blocks of product information were provided on one screen page, including a product picture, non-product functions (e.g., price, shipping and payment), product functions, and attribute framing message. The four blocks were also the Areas of Interest (AOI) for further analysis. Furthermore, product brands were removed to avoid participants' subjective preferences or stereotypes.
The experiment is an incomplete within-subject design. Each participant viewed three different types of digital camera in a fixed order. The attribute framing appearing for a digital camera was completely counter-balanced. There were a total of $2^3$ combinations. Each participant was randomly assigned to one of the eight groups. Eye movements were recorded while participants viewed digital camera webpages after drift correct of eye movements. All webpages were presented unlimited. After any key was entered, the participants rated intention to buy the digital camera by paper-and-pencil while the eye tracker stopped recording. The whole experiment took about 15 min.

## DATA ANALYSIS AND RESULTS

### Framing effect

A *t*-test was conducted to examine whether or not individuals had different buying intentions and eye movements due to the difference in framing. The results showed a significant effect for message framing. Participants receiving positive framing revealed higher buying intention than those receiving negative framing ($M_{pos.intention}$=5.31 vs $M_{neg.intention}$=4.66, t=1.76, p<0.1). However, participants receiving negative framing revealed higher total numbers of fixations and total fixation duration for the whole page and all blocks of product information except AOI of picture than those receiving positive framing (see Table 2). These results support Hypotheses 1 and 2.

Table 2. Results from the *t*-test. Buying intention and eye movement in positive and negative frame

| | | Total Number of Fixation | | | Total Fixation Duration | | |
|---|---|---|---|---|---|---|---|
| | | Positive framing Means(S.D) | Negative framing Means(S.D) | t Value | Positive framing Means(S.D) | Negative framing Means(S.D) | t Value |
| Whole Page | | 105.59(36.524) | 141.39(44.680) | 3.855*** | 24.7016(8.1189) | 33.2928(11.0438) | 3.896*** |
| AOI of | Picture | 5.21(5.192) | 5.61(5.022) | 0.344 | 1.2170(1.3664) | 1.4263(1.3712) | 0.671 |
| | non-product function | 26.54(14.469) | 35.58(15.137) | 2.679*** | 6.3288(3.2663) | 8.5725(3.4723) | 2.921*** |
| | Product Function | 40.59(16.852) | 54.39(28.630) | 2.57*** | 10.2445(4.7690) | 13.5623(7.1608) | 2.387** |
| | Framing Message | 15.97(11.412) | 28.66(15.764) | 4.035*** | 3.1097(1.9492) | 6.1051(3.6540) | 4.471*** |

*p<0.1; **p<0.05; ***p<0.01; N=39 for positive framing; N =38 for negative framing

### The mediating effects of eye movement

To test the Hypothesis 3 that a eye movement mediates the framing effects on buying intention, a mediation analysis (see table 3) was performed using the procedure proposed by Baron & Kenny [1]. First, a dummy variable of attribute framing message was created, and buying intention was regressed

on this dummy variable. Second, participants' total number of fixations and total fixation duration were regressed on attribute framing separately. Third, buying intention was regressed on eye movement indices simultaneously. Fourth, when both the dummy variable of attribute framing and eye movement indices were included to predict buying intention, eye movement indices remained a significant factor, but the coefficient for attribute framing became not significant. These results support Hypothesis 3.

Table 3. Mediation analysis

| | Stage 1: Intention | | Stage 2: fixations, duration | | Stage 3 : Intention | | Stage 4 : Intention | |
|---|---|---|---|---|---|---|---|---|
| Independent variables | β | *t* | β | *t* | β | *t* | β | *t* |
| framing | 0.199 | 1.76* | -0.407, -0.410 | -3.855***, -3.896*** | | | 0.2 | 1.636 |
| Total number of fixations | | | | | -0.780 | -2.188** | -0.746 | -2.11** |
| Total fixation duration | | | | | 0.692 | 1.940** | 0.741 | 2.093** |
| Adjusted $R^2$ | 0.027 | | 0.157, 0.154 | | 0.038 | | 0.059 | |

*p<0.1; **p<0.05; ***p<0.01. The betas reported are standardized beta coefficient, N=77

To repeat the fourth procedure, a further breakdown of the eye movement data on AOI shows some interesting results. For duration (adjusted $R^2$=0.08), especially, the AOI of non-product function was a significant negative predictor of buying intention (β= -0.249, t= -1.977, p<0.05), but the AOI of product functions significantly predicted buying intention, which was a positive relationship (β=0.231, t=2.002, p<0.05). These relationships show longer fixations on product function of information will increase buying intention. Conversely, longer fixations on non-product function will lessen buying intention.

To test Hypothesis 4 that positive framing will reveal weaker relationships between eye movement and intention than negative framing will, any shared variance among the predictors would be controlled by putting all variables of eye movement on AOI in the multivariate model simultaneously. Results from the negative-frame group were significant and accounted for 21.2% of the variance in buying intention, F(6,31)=2.644, p<0.05, whereas results for the positive-frame group were not significant, F(6,32)=1.281, *ns*. The two multivariate models indicated that eye movement possessed prediction power on buying intention when negative framing was used. These results support Hypothesis 4.

## DISCUSSION AND CONCLUSION

This study investigates the framing effect and the role of eye movement in online shopping contexts. The results revealed a phenomenon: attribute framing significantly affects individual intention to buy. But when eye movement was put together with framing and to predict buying intention, the framing became insignificant. That is, there is a mediating mechanism that the framing indirectly influenced buying intention through the cognitive process, which was represented by eye movement.

It may not seem surprising that the results support Hypothesis 1: positive framing induces more buying intention than negative framing. However, exposing negative framing revealed more fixations and longer duration than positive framing on the product information. Meanwhile, eye movement possessed predictive power on buying intention when negative framing was used. The eye-tracking experimental results provided an explanation of how framing affects judgment: it is because the framing leads to difference in attention and cognitive modes. When incoming information is positive, cognitive processing tends to be less thorough and systematic because it promotes a more automatic cognitive mode. Conversely, when information is not favorable, a more controlled cognitive mode was promoted by affecting perceptions of discrepant or threatening conditions: thus, there is a greater tendency to engage in a more deliberate and careful analysis [4].

The results of this study also showed that an extended look at product function results in higher intention to buy; on the contrary, an extended look at non-product function will lessen buying intention. In the former situation, to deliberate or evaluate information about product functions, participants would

understand the target product and then form ideas about perceived quality. In the latter, participants encode the actual price and cost, and then generate a price perception. Eventually, perceived price negatively influenced perceived value, in turn influencing purchase intention [2].

In summary, although most advertisements promoting products focus on positive framing messages in order to attract customers' choice decision, negative framing messages are also an alternative way to attract customers' attention and thought. The negative framing message could not generate more buying intention than the positive frame, but it could induce consumers take much time on product information, especially on product functions, which in turn have increase and predictability on buying intention.

This paper provides a better understanding of the framing effect and cognitive processing. However, there are a few limitations to this study. First, it is a question of generalization because all participants were college students. Second, this study addresses only the attribute framing effect. Further research may apply this research model in other types of framing effects. Finally, this study analyzes fixations and duration. Because eye movement is a subtle behavior, and the metrics of eye movement are relevant to their inherent cognitive activities, future research is encouraged to refer to various metrics in analysis.

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