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An Eye Tracking Analysis for Video Advertising: Relationship Between Advertisement Elements and Effectiveness

XUEBAI ZHANG AND SHYAN-MING YUAN
Department of Computer Science, National Chiao Tung University, Hsinchu 300, Taiwan
Corresponding author: Shyan-Ming Yuan (smyuan@cs.nctu.edu.tw)

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ABSTRACT This paper aims to assess which ad element-related eye movement behaviors could predict the traditional advertising effectiveness of high-order for video advertising. The data were obtained from 61 participants, each stimulated by six video ads, via an eye tracking method and questionnaires. A logistic regression was conducted to predict high and low ad effectiveness with regard to element-related eye indicators. Three core constructs of high-order advertising effectiveness commonly used in research address the memory (ad recall), affect (attitude toward ad and attitude toward brand) and desirability (purchase intention) of consumers. Three key advertising elements (product, brand, and endorser) were tracked, presented by three eye movement indicators (transformed fixation time (TFT), transformed fixation number (TFN), and average gaze duration (AGD)). The findings indicated that three items are related to attitude toward ad (product-related AGD, brand-related AGD and endorser-related TFT), attitude toward brand (brand-related TFN and AGD, endorser-related TFT), and purchase intention (product-related AGD, brand-related TFN and endorser-related TFN). However, only two items of them are related to recall (product-related AGD and brand-related TFN). Furthermore, for all ad outcomes, consistently, eye movements on product elements and endorser elements tend to positively related to ad effectiveness, while eye movements on brand elements tent to negatively.

INDEX TERMS Eye tracking, video advertising, dynamic AOI, ad elements, advertising effectiveness.

I. INTRODUCTION

Owing to advancements in technology in terms of performance capabilities and availability of video content across various screens and platforms [1], the Internet is increasingly being seen as an opportunity for video advertising. Video advertisements (ads) now appear before, during, or after streaming game or animation contents as in-webpage video advertising. According to Hsieh and Chen's study [2], video advertising type is the best one for drawing users' attention among various advertising information types, while having a stronger effect on consumers' memory and decision-making. However, the effectiveness of video ads on consumer cognitive processes and decision-making remains uncertain. Existing visual marketing literature focuses mainly on how salient factors such as ad location, format, size and presentation duration influence video marketing effectiveness [3]–[4], the relationship between eye tracking behaviors to visual key elements (i.e., products, brands and endorser elements) and higher-order ad effectiveness, especially for video ads, has not been investigated. Therefore, this paper explores the relationships between these key ad elements-related eye movements and higher-order ad effectiveness for video ads.

A. UNCONSCIOUS COGNITION

Tracking eye movements is as a proxy for visual overt attention [5]. While attention is a gate through which information enters to reach higher-order cognitive processes of increased interest [6], tracking eye movements for elements can be regarded as obtaining the most direct information to bring out consumers inner cognition to the video ad [7]. Moreover, as suggested by hierarchical processing models, psychological research reveals that visual attention not only is a gate but also reflects higher-order cognitive processes and is closer to actual behavior than intuition informs us [8]. Many literatures have shown that more attention leads to more opportunity

to encode and store messages, and a positive relationship between attention and cognition has been found by a number of eye-tracking studies [9]–[11]. However, some research suggest that high attention weakens the effect of emotional content, implicating that 'brand-building' might be more effective with lower levels of ad attention [12]. As attention is limited and selected, which means a lot of attention is invalid to have an impact on consumer decision [13], [14], the message may or may not remain in the consumers memory after cognitive processing. Thus, this study helps define meaningful eye movements to ad elements, which effective conversion into deeper cognitive level during consumers' exposure to video ads.

B. ADVERTISING EFFECTIVENESS

Nowadays, although attention effectiveness has caught enormous concern in marketing [15], considerable attention fails to have an impact on consumers' decisions. The message paid attention to may or may not remain in the consumer's memory after cognitive processing [14]. Consumers must therefore process what they have seen in order for an advertising message to achieve its goal of consumer persuasion. This study helps make clear the research position for attention in video advertising. Three measures that have been shown to reliably tap into higher-level constructs commonly used in advertising research are addressed: memory (ad recall), affect (attitude toward ad and attitude toward brand) and desirability (purchase intention) [16].

Memory refers to the mechanisms by which past experiences influence behavior and is often associated with retrieval (which occurs at a future time) [17]. Retrieval success is often used as a proxy for the depth to which information was encoded [18]. Advertising research focuses on the retrieval aspects to evaluate the quality of ads. Literature has shown that people who recalled ads were more likely to have favorable outcomes than those who reported less exposure [19].

Affect refers to a relatively brief episode of coordinated brain, physiological, and behavioral changes that facilitate a response to an event of significance [20]. Attitude, consumers' affective reaction, is considered to be one of the key determinants of advertising efficiency. Attitude toward ad and brand are commonly measures for evaluating advertising effectiveness. A more positive ad attitude and brand attitude is related to a stronger purchase intention [21]. The way that the brand is perceived and evaluated is one of the most important predictors of purchases [22].

Desirability refers to the extent to which people desire the product featured in the ad. Marketing managers use purchase intent measures as a strong correlation of desirability and subsequent market behavior [16].

C. EYE-TRACKING METHODOLOGY

Owing to advancements in eye-tracking technology, modern eye-tracking equipment makes it easy to measure visual attention because it can record consumers' eye movement under natural exposure conditions, with large amounts of stimuli, high precision and at a low cost [23]. For example, Zhang *et al.* [24] provided a system to record eye movements for dynamic objects in video ads. With the system, users can track the viewer's visual attention for each area of interest (AOI). Traditional advertising research mainly uses self-report measurements to evaluate the video ad [25]. However, it is difficult to understand the effect of each advertising element on consumers' cognition and emotion using a self-report, because individuals typically assess the ad in its entirety. Using the eye-tracking method, this study enables researchers to learn the impact of each element on consumer persuasion.

In this study, we focus on tracking eye movement of three highly relevant visual elements as AOIs (products, branding and endorser elements), which are more likely to acquire [4] in video ads, to explore ad effectiveness. The key ad elements have unique effect on eye movement to ads [26], influenced by bottom-up factors (traits and states of the consumer) and top-down factors (characteristics of the visual marketing stimulus) [14]. According to biased competition theory [27], which argues that information in visual fields competes for cognitive processing, only a portion of ad element information attracts people's attention. In other words, when influenced by bottom-up factors, consumers' eye movements to each element in a video ad might have a different degree of distribution and result in a different display on eye indicators. In addition, since differences exist among individuals' objectives towards the internal goal, which affects an individual's processing of video information, the reaction of eye movements to each element is affected goal diversity with top-down factors [14], [28]. Therefore, we assume that individuals have different eye movement behaviors for different ad elements.

The way in which humans visually comprehend dynamic stimuli is largely unexplored; however, understanding this process is crucial to better inform existing eye movement research. While much has been learned about the relationship between eye movements and cognition, existing research has been limited mostly to the study of static image ads. However, the information processing of the video advertising likely differs from the processing of traditional ad images. Video-based contents not only contain graphic information but also have a longer viewing duration and storyline, giving the viewer more opportunity to discover an ad. Video advertising maintains higher attention intensity in the viewing flow [2]. This study thus provides a way to comprehend individuals' eye movement reactions to dynamic stimuli. In existing literature, the fixation time and fixation number are the most commonly used indexes measures of attention on AOIs [29]. The number of fixations and mean fixation time provide a measure of the depth to which information within an ad is processed. Longer fixation time and fewer fixations represent more detailed processing [30]. Recent research has shown that the number and duration of fixations can explain 45% of the variance in the actual in-market sales performance of television commercials [16]. Thus we adopted three

eye-tracking metrics related to observation time and observation count number, with the prediction possibility for video-based ads: transformed fixation time (TFT), transformed fixation number (TFN) and average gaze duration (AGD) on areas of interest. The details of these matrixes will be described in the following sections.

D. SUMMARY

Because of a lack of research concerning eye movements to key ad elements for video ads, the present study attempts to fill the existing research gaps by exploring the relationship between ad element-related eye movement behaviors and higher-order effectiveness of video ads. Demographic characteristics including gender and age [31], as well as variables including product involvement [32], brand familiarity and endorser familiarity [33], [34] are used as control variables to explore video ad effectiveness because previous research has found that the effect of these variables is significant in relation to ad effectiveness.

As Anderson and Pichert [35] reported, the information processing might be biased by the goal. Thus high-order ad outcomes might be mainly influenced by product elements because the product is the goal of the video advertising. Therefore, this paper posits consumers who pay more attention to core goal product element will have higher evaluation to the video ad in various outcomes. Zajonc [36] has announced a mere exposure effect of the brand. The mere repeated exposure of an individual to a stimulus is a sufficient condition to enhance their attitude toward it. Mere effects tend to be more pronounced when individuals have low attention to the stimulus. During their exposure to the video ads, the participants focused mainly on the core product of the ad, but not the brand. Thus we posit consumer paying more attention to the brand is associated with lower evaluating of ad outcomes. According to a general 'attractiveness effect' [37], we posit a positive relationship between eye movement to endorser elements and various ad outcomes.

This study examine the extent to which ad element-related eye movements behaviors related to various ad effectiveness:

- Question 1: Is there a relationship among eye movements on product, brand and endorser and consumers' recall for ad (REA)?
- Question 2: Is there a relationship among eye movements on product, brand and endorser and consumers' attitude toward ad (ATA)?
- Question 3: Is there a relationship among eye movements on product, brand and endorser and consumers' attitude toward brand (ATB)?
- Question 4: Is there a relationship among eye movements on product, brand and endorser and consumers' purchase intention (PI)?

II. RESEARCH METHODOLOGY

A. PARTICIPANTS & VIDEO ADS

Seventy-three participants originally participated in our experiment, of which 61 participants had sufficient eye tracking data and questionnaire data for analysis. The participants (28 men and 33 women) are all Taiwanese with an average of 25 years (range = 17–46 years), including students and staff members. All participants viewed all of our 6 video commercials in random order, each being 30 seconds. The video commercials were actual video ads chosen for a range of products to improve the validity of the results, including shoes, liquor, mobile phones, clothes, humidifiers and razors (as shown in Fig.1). All of the six videos contained product element, brand element and endorser element, which are the focused objects in the study. To acquire valid data on effective visual execution factors in video ads, it was necessary to expose the participants to novel, unfamiliar commercials. Thus, these six ads are from different regions; we expected the participants to be unfamiliar with the ads. Although the sample size is small, it is adequate for this study, because six repeated measures were gathered from each participant, allowing the power to detect large-sized effects (Cohen's $f = 0.4$) at $p < .05$ with 100% power [38].

FIGURE 1. The screenshots of the six experimental video ads.

B. PROCESS

The participants were required to answer the product involvement measures for the six product categories in advance, corresponding to the ads used in this study. Our lab assistant briefed the participants and obtained their signed informed consent before sitting them in front of a computer connected to an Eye Tribe Tracker [39], which was placed below the screen displaying the stimuli and pointed toward the user. The participants were instructed of a free viewing task. During the experiment, the participants were exposed to six video ads while their eye movements were tracked and recorded. A series of self-report questions were asked to capture the participants' perceptions after each ad was played. Before watching each video, the participants' eye condition was checked

using a nine-point calibration and validation exercise. Finally, eye movement data on key objects were exported from the system and used for analysis. The experiment lasted approximately 25 minutes for each participant, which included the calibration process, exposure to the six ads and the process of completing the questionnaire for each ad.

C. EYE-TRACKING

This study used an Eye Tribe Tracker [40] to track participants eye movements. The Eye Tribe Tracker has a sampling rate of 60 Hz and a tracking accuracy of about 0.5 to 1 degrees of visual angle. This study used Zhang *et al.*'s Advertisement Video Analysis System [24] to collect and analyze the participants' eye movement of the key elements in video ads. With the system, users can track the viewer's eye movement for each dynamic object in video ads.

D. MEASURES

1) CONTROL VARIABLES

To obtain a better understanding of the relation between eye movements to elements with the effectiveness of video ads, consumers' demographic characteristics (e.g. gender and age) and measures (e.g. product involvement, brand familiarity and endorser familiarity) were collected as control variables. The product involvement scale ($\alpha = 0.927$), derived from Wu *et al.* [41], included 10 seven-point semantic differential question items such as 'Important/unimportant', 'Means nothing/means a lot to me' and 'Not needed/needed'. The participants were asked to rate their familiarity with the brand and endorser on a five-point scale ranging from 1 (very unfamiliar) to 5 (very familiar). The participants were familiar with three of the six brands and endorsers. Thus, we expect a variable combination of video ads to be measured in this study.

2) SUBJECTIVE DEPENDENT VARIABLES

Ad efficiency measures were mainly adapted from related prior studies to suit the study context. All effect items in our study were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire comprised three constructs: (1) memory, including REA (2) affect, including ATA and ATB, and (3) PI. A more detailed description of the measurements are given as follows:

REA: Memory efficiency was used to investigate the recall memory of the ad video. The items were mainly derived from Wu *et al.* [41] with some necessary modifications. The participants were asked to indicate their REA ($\alpha = 0.826$) using the following items: 'I can remember most of the ad content', 'This ad enhanced my impression toward the product', 'I can describe the ad content' and 'When I see similar ads, I can recall this ad'.

ATA: We assessed ATA ($\alpha = 0.907$) using the following items [42], [43]: 'Overall, this ad is...' (1) 'attractive', (2) 'useful', (3) 'entertaining' and (4) 'good'.

TABLE 1. The detailed information of product, brand and endorser AOIs for each video advertisement.

AOIs		Product	Brand	Endorser
Ad1	Average available time(s)	1.74	1.31	1.00
	Frequency of occurrence	9	3	7
Ad2	Average available time(s)	1.32	2.09	1.37
	Frequency of occurrence	9	4	12
Ad3	Average available time(s)	2.89	1.27	2.97
	Frequency of occurrence	9	4	9
Ad4	Average available time(s)	1.74	3.08	1.78
	Frequency of occurrence	12	2	13
Ad5	Average available time(s)	1.63	1.99	1.48
	Frequency of occurrence	12	4	21
Ad6	Average available time(s)	2.07	1.13	1.20
	Frequency of occurrence	4	7	15

ATB: ATB ($\alpha = 0.845$) was measured with three items [43]: 'Overall, this brand is...' (1) 'good', (2) 'favorable' and (3) 'pleasant'.

PI: PI ($\alpha = 0.908$) scale was measured using items adapted from Shaouf *et al.* [44] to fit the context of video advertising: 'After viewing the advertisement…' (1) 'I became interested in making a purchase', (2) 'I am willing to purchase the product being advertised' or (3) 'I will probably purchase the product being advertised'.

3) OBJECTIVE EYE MOVEMENT VARIABLES

a: AOI DEFINITION

Three AOI categories, corresponding to the key ads elements, were created to video ad analysis, including product, brand and endorser categories. The product typology contained any AOIs related to the product being advertised, such as the product packaging; the brand typology contained any AOIs related to the brand name (could be graphical or textual in nature) or the brand's logo; and the endorser typology contained any AOIs that advertised the endorser, whether human or animated. These three categories were chosen because they include all types of AOIs present in a scene during the video ads. Two people and one advertiser decided whether to adopt the objects as AOIs for analysis. For example, objects that appear less than 0.25s are not defined as AOI, because the used video analysis system defined a meaningful fixation duration, which should not less than 0.25s. The AOIs were combined to create a complete human being. For example, the face and body part AOIs of the endorser were combined as one AOI in the typology endorser. The detailed information of final AOIs for each element for the six advertisements are presented in Table 1.

b: EYE MOVEMENT INDICATORS

Three eye movement representations are addressed in this study, including TFT, TFN and AGD. Because fixation duration time and count number are the two most important aspects of gaze behavior, we adopted them as the measurement variables. Fixation time refers to the duration of the gazes on each AOI. A higher number indicates that the tally

of the gaze durations is longer. Fixation count refers to the total number of gazes. A higher number indicates more gazes on AOI. As for ad video, each dynamic AOI appeared for varying lengths of time, it was important to standardize the fixation time and fixation number to minimize the influence of the AOI showing time. Therefore, the fixation time and fixation number on the AOIs were converted into a standardized percentage. Divided by the AOI showing lengths, fixation time and fixation number were converted to TFT and TFN variables, respectively. TFT is the ratio between fixation time on AOIs and the AOIs display time. TFN is the ratio between fixation number on AOIs and the AOIs display time. Because AGD indicate the intensity of cognitive processing, the AGD index, one of the most commonly used eye movement measures in existing literature [29], was adopted in this study for analyzing eye movement for the video. AGD was calculated by dividing the participants' fixation time by their fixation number on the AOI (the fixation time per fixation on the AOIs). The unit of measurement used was the second (s).

III. RESULTS

A. LOGISTIC REGRESSION

Logistic regressions (LRs) are appropriate for exploratory analyses, for they are more robust over discriminant analysis with fewer violations of assumptions, such as small and unequal sample sizes [45]. Specifically, the authors ran six separate forward stepwise logistic regressions to identify which eye movement variables (TFT, TFN and AGD) to product, brand, and endorser were significant predictors of specific ad outcomes (REA, ATA, ATB and PI). All regression analyses controlled for the effect of gender, age, product involvement, brand familiarity and endorser familiarity.

Prior to conducting the binary logistic regressions, dichotomous variables were created for ad effectiveness, following the categorization procedure explained below. A set of dependent variables was formed, each corresponding to specific ad effectiveness. For our purposes, only those respondents who agreed or strongly agreed with all the statements were included in high-evaluating (coded as 1), with the remainder being classified as low-evaluating consumers (coded as 0). The mean and standard deviation of element-related eye indicators are shown in Table 2. To simplify the exposition, for all six ads outcomes, the significant results of logistic regression can be found in Table 3. The odds ratios with a 95% confidence interval were also presented to establish which of the described various better associated with each ad outcomes.

B. RECALL FOR AD (REA)

The regression predicting ad recall using product eye data (AGD) ($\chi 2(4) = 77.262$, $p < .001$, $R2 = .261$) was significant. In this model, brand familiarity, endorser familiarity, AGD for product objects were positive associated with consumers' recall for ad, while TFN for brand objects were negative associated with consumers' ad recall.

TABLE 2. Descriptive statistics for each eye indicator among the key elements.

Elements	Mean	SD
Product_TFT	.3174	.2090
Product_TFN	.3612	.1738
Product_AGD	.8654	.5125
Brand_TFT	.4604	.2949
Brand_TFN	.4121	.2514
Brand_AGD	1.0705	.6365
Endorser_TFT	.4776	.1541
Endorser_TFN	.6025	.1778
Endorser_AGD	.7997	.1801

C. ATTITUDE TOWARD AD (ATA)

The regression predicting ATA using product eye data (AGD) ($\chi 2(5) = 140.266$, $p < .001$, $R2 = .426$) was significant. In this model, brand familiarity, endorser familiarity, AGD for product objects, and TFT for endorser objects were positive associated with consumers' attitude toward ad, while AGD for brand objects were negative associated with consumers' ad attitude.

D. ATTITUDE TOWARD BRAND (ATB)

The regression predicting ATB using product eye data (AGD), brand eye data (TFT), and endorser eye data (TFT) ($\chi 2(5) = 120.315$, $p < .001$, $R2 = .377$) were significant. In this model, participants' age, brand familiarity, and TFT for endorser objects were positive associated with consumers' attitude toward brand, while TFN and AGD for brand objects were negative associated with consumers' attitude toward brand.

E. PURCHASE INTENTION (PI)

The regression predicting PI using product eye data (TFN), brand eye data (TFT), and endorser eye data (TFT) ($\chi 2(5) = 71.020$, $p < .001$, $R2 = .240$) was significant. In this model, participants' gender, brand familiarity, AGD for product objects and TFN for endorser objects were positive associated with PI, while TFN for brand objects were negative associated with consumers' purchase.

IV. DISCUSSIONS

A. RESEARCH QUESTIONS

- *Question 1: Is there a relationship among eye movements on product, brand and endorser and consumers' recall for ad (REA)?*

This study revealed that users' AGD on product elements was positively predictive of subjective recall of video ad, while TFN was negatively predictive. Product-related AGD indicator was the strongest predictor of Ad recall effectiveness, with an odds ratio of 2.97. This indicated that consumers who gazed for long time at the product element per fixation count

TABLE 3. Logistic regression results included in the final model from regressing participant demographic (gender, age), product involvement, familiarity with brand and endorser, and eye movement attention to product, brand and endorsers on REA, ATA, ATB and PI.

Independent variables	Ad recall		Attitude toward ad		Attitude toward brand		Purchase intention	
	B(SE)	OR	B(SE)	OR	B(SE)	OR	B(SE)	OR
Gender	/	/	/	/	/	/	.587(.244)	1.799*
Age	/	/	/	/	.098(.027)	1.103***	/	/
INV	/	/	/	/	/	/	/	/
BF	.299(.093)	1.348**	.231(.091)	1.260*	.409(.082)	1.505***	.244(.077)	1.276**
EF	.218(.103)	1.244*	.372(.107)	1.450***	/	/	/	/
Product_TFT	/	/	/	/	/	/	/	/
Product_TFN	/	/	/	/	/	/	/	/
Product_AGD	1.092(.368)	2.979**	1.581(.420)	4.860***	/	/	.605(.243)	1.832*
Brand_TFT	/	/	/	/	/	/	/	/
Brand_TFN	-1.140(.513)	.320*	/	/	-1.277(.548)	.279*	-1.362(.508)	.256**
Brand_AGD	/	/	-.487(.212)	.615*	-.420(.209)	.657*	/	/
Endorser_TFT	/	/	2.119(1.016)	8.323*	4.464(1.018)	86.794***	/	/
Endorser_TFN	/	/	/	/	/	/	2.406(.772)	11.091**
Endorser_AGD	/	/	/	/	/	/	/	/

Note. INV= product involvement, BF=Brand familiarity, EF=Endorser familiarity, TFT = Transformed fixation time, TFN = Transformed fixation number, AGD = Average gaze duration.
*p < .05. **p < .01. ***p < .001.

were 2.97 times more likely to recall ad information than those who gazed for short time at the product element per fixation count, controlling for all other factors in the model. The odds ratio of 0.32 for brand-related TFN was less than 1, indicating that for every additional TFN on brand elements, the consumers were 0.32 times less likely to have high ad recall.

The longer user's AGD on the product objects, the better their recall performance. This finding is likely because consumers' memory of the video ad is goal oriented. That is, memory depends mainly on the product elements, which are the core of product-focused video advertising. When being exposed to product-focused video advertising, consumers automatically transform the attention of product into memory, while attention to the brand and the endorser might not be processed into memory. As Anderson and Pichert [35] reported, the recall of information might be biased by the goal at retrieval. Thus, the recall of ad information might be mainly influenced by product elements because the product is the goal of the video advertising.

A higher fixation number on brand is expected to produce less recall of ad information. Lange and Dahlén [46] reported that consumers had a harder time remembering the ad for the familiar brand when it was not congruent with the brand, because it does not fit in the brand schema in their heads. This may explain the low ad recall. In our study, band familiar is positively related to ad recall effect (odds-rate = 1.508, $p<0.001$). However, if people are familiarity with brand, they are more likely not paying much attention to the brand elements. Therefore, an increase of fixation number on brand decreased overall ad recall.

- *Question 2: Is there a relationship among eye movements on product, brand and endorser and consumers' attitude toward ad (ATA)?*

Users' ATA is positively associated with AGD on product elements and TFT on endorser elements, while negatively associated with AGD on brand elements. Attitude toward video ad's strongest predictor was endorser-related TFT indicators, with an odds ratio of 8.32. This indicated that consumers who gazed at endorsers for a long time were 8.32 times more likely to have a positive attitude toward ad than those who gazed at the endorser elements for a short time, controlling for all other factors in the model. The second-strongest predictor of ad attitude was the product-related AGD indicator. In this case, consumers gazed for long time at the product per fixation count were 4.86 times more likely to have good attitude toward ad than those who gazed for short time at the product per count. The odds ratio of 0.62 for brand-related AGD was less than 1, indicating that for every additional AGD on brand elements, the consumers were 0.62 times less likely to have positive attitude toward ad.

A higher product-related AGD is expected to produce a better attitude toward ad, which might be biased by the goal. This finding is consistent with Keller's [47] report that consumers' processing goals during ad exposure also affects their evaluations. High intensity of cognitive processing for product elements on video ad might produce a good attitude toward ad. A lower brand-related AGD is expected to produce a better attitude toward ad. In other word, low intensity of cognitive processing for brand elements on video ad might produce a good attitude toward ad. It is likely that the low level of intensity reflects their high trust position [48], which will have a good attitude towards. A higher fixation number on endorser is expected to produce a better attitude toward ad. This is congruent with Meles' suggestion [49] that a trend effect of fixation number in predicting implicit attitudes.

- *Question 3: Is there a relationship among eye movements on product, brand and endorser and consumers' attitude toward brand (ATB)?*

Users' ATB is negatively associated with the product-related TFN indicators and AGD indicators, while positively related to TFT on endorser elements. For video ads, ATB's strongest predictor was endorser-related TFT indicator, with an odds ratio of 86.79. This indicated that consumers who gazed on endorsers for a long time were 86.79 times more likely to have a positive attitude toward brand than those who gazed on the endorser elements for a short time, controlling for all other factors in the model. The odds ratio of 0.28 for brand-related TFN was less than 1, indicating that for every additional TFN on brand elements, the consumers were 0.28 times less likely to have positive attitude toward brand. The odds ratio of 0.66 for brand-related AGD was less than 1, indicating that for every additional AGD on brand elements, the consumers were 0.66 times less likely to have positive attitude toward brand.

A lower TFT on the brand is expected to produce a greater positive ATB, which is consistent with prior attention-related research for other ad types [11]. It is likely because of the mere exposure effects of the brand [36]. Mere repeated exposure of an individual to a stimulus is a sufficient condition to enhance their attitude toward it. Effects tend to be more pronounced when individuals are unaware of the exposure [50] or have low attention to the stimulus. A higher TFT on the endorser is expected to produce a greater positive ATB. This finding is consistent with the report by Till and Busler [37], which indicated a general 'attractiveness effect' on brand attitude. No significant eye movement indicators were found for product elements to influence the attitude toward brand. This could be that consumers have an inherent ranking model of the important of elements. When assessing the brand attitude, consumers might re-examine the central position of the product object in the ad and they are more likely to focus on the brand and endorser, rather than the product.

- *Question 4: Is there a relationship among eye movements on product, brand and endorser and consumers' purchase intention (PI)?*

Users' product-related AGD and endorser-related TFN was positively predictive of PI for video ads, while brand-related TFN was negatively predictive. PI's strongest predictor was endorser-related TFN indicator, with an odds ratio of 11.09. This indicated that consumers who gazed at endorsers frequently were 11.09 times more likely to have a purchase intention to the exposure products than those who gazed at the endorser elements not frequently, controlling for all other factors in the model. Consumers who gazed at the product objects for long time per fixation count were 1.83 times more likely to purchase the products than those who gazed at the product objects for short time per fixation count. The odds ratio of 0.26 for brand-related TFN was less than 1, indicating that for every additional TFN on brand elements, the consumers were 0.26 times less likely to purchase the products.

Consistently with REA and ATA, a higher product-related AGD is expected to produce a higher PI, implying a goal- oriented effect. A lower TFN on the brand is expected to produce a greater positive PI, while a higher TFT on the endorser is expected to produce a greater positive PI, which is likely because of the mere exposure effects of brand [37] and the 'attractiveness effect' of the endorser on PI [37]. Thus, less attention on the brand and more attention on the endorser are expected to predict better purchase persuasion.

B. EYE METRICS

The eye movement indicators of all ad effectiveness show consistency in a particular element in this study. For all ad outcomes, consistently, eye movement on product element and endorser element are positively related to ad effectiveness, while eye movement on brand elements are negatively related to ad effectiveness. We infer a goal-oriented effect on product elements in the video, a mere exposure effect on brand elements, and an attractiveness effect on endorser elements [36], [37], [47].

Fixation duration on endorser element positively predicts the ATA and ATB. That is individuals who gaze longer at the endorser are more likely to exhibit good attitude toward ad and brand. Fixation count on brand element negatively predicts REA, ATB and PI, while count on endorser element positively predict PI. It implies that individuals who gaze frequently at the brand were less likely to recall the ad information and have a good ATB. Furthermore, individuals who gaze frequently at the brand were less likely to produce persuasion effect. Conversely, individuals who gaze frequently at the endorser tend to be persuaded to purchase the products. AGD on product element is positively related to REA, ATA and PI, while AGD on brand element is negatively related to ATA and ATB. The results indicate that one eye fixation with a long gaze duration, instead of a number of short fixations, can increase or decrease positive ATA depending on the type of elements. The remainder variables show no influence on the ad effectiveness in our study.

V. CONCLUSIONS

This paper examined the effectiveness of video ads in terms of how eye movement behaviors to specific ad elements (product, brand and endorser) were associated with various high-order ad outcomes. Results from this study show that different advertising effectiveness each have a specific association with the eye movement behavior of three key ad elements. REA is associated with product-related AGD (positively) and brand-related TFN (negatively). ATA is associated with product-related AGD and endorser-related TFT positively, while ATA is associated with brand-related TFN negatively. ATB is associated with brand-related TFN and AGD (positively) and endorser-related TFT (negatively) for video advertising. PI is associated with product-related AGD and endorser-related TFN positively, while PI is associated with brand-related TFN negatively. The results not only enrich our understanding of the relationship between eye movement behaviors to elements and video ad effectiveness but also extend our knowledge of eye matrixes for tracking dynamic objects. In addition to the

contribution to visual marketing by evaluating ad outcomes based on eye movement when exposing individuals to video ads, this study extends the existing metrics, helps enrich the marketing theory and improves the marketing success model.

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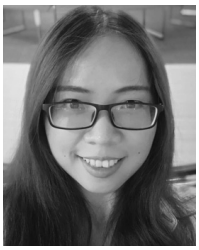

XUEBAI ZHANG received the B.S. degree from Xiamen University, China, in 2011, the M.S. degree in computer science and information management from Providence University, Taiwan, in 2013. She is currently pursuing the Ph.D. degree with the Department of Computer Science, National Chiao Tung University, Taiwan. She is an author of more than ten peer-reviewed international journals and conferences. Her research interests include Internet technologies, digital learning, human–computer interaction.

SHYAN-MING YUAN received the Ph.D. degree in computer science from the University of Maryland at College Park, College Park, MD, USA, in 1989. In 1990, he was an Associate Professor with the Department of Computer and Information Science, National Chiao Tung University, Hsinchu, Taiwan.

Since 1995, he has been a Professor with the Department of Computer Science, National Chiao Tung University. He is also the Director of Library at National Chiao Tung University. His current research interests include distance learning, Internet technologies, and distributed computing.