

# The Impact of Video Quality and Image Size on the Effectiveness of Online Video Advertising on YouTube

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## ABSTRACT

Online video advertising is now an increasingly important tool for marketers to reach and connect with their consumers. The purpose of this study was to empirically investigate the impact of video format on online video advertising. More specifically, this study aimed to explore whether online video quality and image size influences viewer responses toward online video advertising. By conducting an experimental study on YouTube, the results suggested that enhanced video quality of online advertising may have an important impact on effectiveness of the advertising, and the concept of presence is a key to understanding the effects of enhanced video quality in online advertising.

**Key words:** High-definition (HD), Online video advertising, Presence, Video quality, Image size.

## 1. INTRODUCTION

Online video advertising is now an increasingly important tool for marketers to reach and connect with their consumers. According to Cisco's forecasts [1], global online video traffic will be 79% of worldwide consumer internet traffic in 2018, up from 66% in 2013. Accounting for the vast majority of consumers' online video viewing, YouTube has become a globally recognized online video platform. Online video site YouTube, which is part of the Google Sites family, has more than 1 billion unique users visit every month, which is equivalent to one out of every two people on the internet [2]. Driven primarily by video viewing at YouTube, Google ranked as the top online video content property in April 2014 with 155.7 million unique viewers. Facebook ranked #2 with 87 million viewers, followed by AOL, Inc. with 65.3 million, Yahoo Sites with 52.2 million and NDN with 45 million [3]. The dramatic growth of online video viewing will clearly influence the online video advertising industry. In fact, it is estimated that U.S. online video advertising spending is expected to reach \$5.96 billion by 2014 [4].

Currently many online video content sites, including YouTube provide high-quality video and full-screen viewing options. For example, most of recent online viral video advertising clips on YouTube are offered in various video qualities (e.g., 240p, 360p, 480p, 720p, 1080p) and sizes (e.g., default window, full-viewing window, adjustable window). Visitors can choose the quality of video from the lowest web-

cam video quality to the highest HD (high-definition) video quality with various size options.

Despite the growing popularity of online video advertising, relatively little empirical work had addressed the online video advertising format focused on the quality and size of the video. While previous studies have examined the importance of image quality [5] and screen size [6] in the context of television viewing experience, to the authors' best knowledge there exists no prior investigation focusing on the role of online video formats in advertising viewing context.

Therefore, the purpose of this study is to empirically investigate the impact of video quality and window size on online video advertising. Specifically, this study seeks to ascertain the role of video quality and window size in consumer response toward online video advertising on YouTube. As one of the first studies to explore the effects of video quality and video size on online advertising, findings of the current study make a relevant contribution to the advertising community by shedding theoretical light on the role of online video formats in determining consumers' response toward online video advertising.

## 2. THEORETICAL BACKGROUND

### 2.1 Technological Characteristics of High-Definition Video

High definition video is one format of digital television. It provides the highest resolution and picture quality among all digital broadcast formats. The FCC described HDTV as "the highest quality digital television, generally widescreen 16x9 with at least 720 progressive lines or 1080 interlaced lines and surround sound [7]". An HDTV picture can provide up to 1080 lines, allowing for sharp image details. The most common

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HDTV formats are 720p and 1080i. The letter “p” stands for progressive scan which is a way to scan vertical lines onto a TV picture by scanning all the lines consecutively or progressively. In contrast, the letter “i” stands for an interlace scan which scans a TV picture by scanning all the odd lines first, then filling in the even lines.

High-definition technology has recently been adopted by online video viewing sites such as YouTube. YouTube originally offered viewers one quality level, a resolution display of 320x240 pixels. In 2008, YouTube made a drastic change. It added a high quality mode, which increased the video resolution to 720p HD video. Also the video window was changed from a 4:3 aspect ratio to a widescreen 16:9. In 2009, 1080p HD video support was added and currently they offer a wide range of video quality levels including the highest 4096x3072 pixels of Ultra HD resolution.

## 2.2 Presence and High-Definition Video Viewing

Presence has been identified as a potentially important concept in video viewing experience in communication and media psychology research. Presence was first introduced by Minsky [8] as telepresence, referring to a physical sense of “being there.” Although the concept of presence was rooted in advanced virtual reality technology such as immersive virtual reality and augmented reality systems, a number of studies have reported that this “sensation of reality” is also generated through broadcast displays such as television [6], [9], [10]. Presence was initially conceptualized as a unidimensional construct, however after further investigation researchers proposed that the concept is a multi-level and multi-dimensional construct [7].

Lombard and his colleagues [10] defined presence as a sense of the “perceptual illusion of nonmediation (p. 77)”. They argued that “illusion of nonmediation” occurs when a person fails to perceive or acknowledge the existence of a medium in his or her communication environment and responds as he or she would if the medium were not there (p. 77)”. Further, they identified six dimensions of presence including presence as social richness (the warmth of intimacy via a medium), realism (perceptual and/or social), transportation (the sensations of “you are there,” “it is here,” and/or “we are together”), and immersion (in a mediated environment) [10].

Presence researchers who focus specifically on television as a mediating technology have largely adopted Lombard and Ditton’s [6], [10] definition and measurement of presence. In the context of online video advertising viewing experience, presence could be extrapolated to signify a viewer’s feeling of “being there” which is created by the auditory and visual information from the online video advertising.

Previous studies have shown that presence affects viewer attitudes. More specifically, presence generated by television viewing can evoke viewers’ attitude confidence such as confidence in brand preference [9]. By virtually “being there” and “experiencing the information directly,” viewers can become more confident in their attitudes toward the mediated information. Kim and Biocca [9] argued that the virtual experience created by presence can simulate a real sense of “seeing” the product, which leads to a stronger sense of “believing” in the information embedded in the mediated

communication. They also suggested that presence appears to be part of the mental state in which persuasion via mediated environments such as the television can be significantly improved. More recently, it was reported that high-definition television (HDTV) viewers experience higher involvement with the television content while they perceive the greater amount of presence [5].

## 2.3 The Influence of Image Size

Previous studies report that large image size has a positive relationship with TV viewing experience by generating presence [10-13]. For example, Hatada et al. [11] suggested that the increasing visual angle through larger image sizes and nearer viewing distances should lead to a greater subjective evaluation of the sensation of reality. In addition, Lombard et al. [10] found that people who watched a large screen television reported greater sense of physical movement, enjoyment, and involvement than people who watched a small screen television. Neuman [12] also suggested that a wall-sized (180 inches) display dramatically increased the “sense of realism” over a 35-inch display. In the same manner, viewers who watched action films on a 70-inch screen reported significantly greater agreement with the statement “I felt like I was a part of action” than viewers who watched a 35-inch screen [13]. The influence of image size on consumers’ evaluation and emotion has been founded by previous studies [14-16]. For example, Lombard et al. [15] suggested that viewers evaluated people on a large screen more positively than those seen on the smaller screen. Also, viewers tended to pay more attention to large screen [16]. Their emotional and cognitive responses were influenced by the size of the picture regardless of its content [14]. More specifically, it has been reported that screen size can increase attention and arousal for media message regardless of its content [17]. Research on media and persuasion has reported that the level of psychological involvement may be a key factor that determines how persuasive information is processed [18].

Taken together, the size of an image can impact on viewers’ perception of content by increasing their arousal, involvement, and attention. When consumers are exposed to advertising content in a specific manner, the first communication effect from the advertising processing response is the consumer’s overall evaluation of the advertising itself, that is, the consumers’ attitude toward the advertisement [19]. Therefore, it is likely that watching a persuasive message within a large image format would positively influence both viewers’ sense of presence and their responses toward the content. Based on the preceding discussion, the following hypotheses are developed:

*H1a. Subjects who watch the online video advertisement within large image size will experience greater presence than those who watch the same within small image.*

*H1b. Subjects who watch the online video advertisement within large image will have more positive attitude toward the ad (Aad) than those who watch the same ad within small image.*

## 2.4 The Influence of Video Quality

The impact of image quality on consumers' perceived sense of presence has been conceptualized and suggested by previous researchers [6], [10]. Due to the limited access to high definition technology, however, only a few empirical studies have supported the speculations. With the recent wide availability of HDTV, several studies have been conducted to test the effect of image quality. For example, Bracken [5], [20] reported that enhanced image quality in television can generate a strong sense of presence. Bracken [5], in her experiment investigating the level of presence on HDTV, found that the improved image quality on HDTV increased the higher level of presence than that on SDTV over the same content. More specifically, image quality was found to influence various dimensions of presence such as the level of immersion and social presence-passive (i.e., the ability to observe social cues) [5]. Another experimental study conducted by Bracken [20] reported that TV viewers who watched the local news in high-definition rated the newscast as more credible. These studies demonstrate that audience can distinguish between enhanced and standard quality video, and that varying image quality leads individuals to perceive different levels of presence. Bracken [20] suggests that improved image quality may impact television audiences' perceptions such as a character's physical attractiveness, reality judgments, and the impact of message on oneself. Recently, she also found that people who viewed television advertising in higher image quality reported more positive attitudes towards the brands and higher levels of telepresence [21].

Taken together, the previous research findings suggest that higher quality of video should enhance consumers' video advertising viewing experience by providing a higher level of presence than low quality of video. Consequently, high definition video advertising would influence consumers' perceived level of presence and attitude toward the ad in a more positive way than advertising in lower definition. Thus, the following hypotheses are proposed:

*H2a. Subjects who watch the online video advertisement in high video quality will report greater presence than those who watch the same ad in low quality.*

*H2b. Subjects who watch the advertisement in high video quality will have more positive attitude toward the ad (Aad) than those who watch the same ad in low quality.*

Finally, the combined impact of image size and image quality should be assessed. Based on the review of the literature, the following hypothesis is proposed.

*H3. The effect of video quality on subjects in terms of presence and Aad will vary according to window size (image size).*

## 3. METHODOLOGY

### 3.1 Experimental Design

The research goal is to understand if and how the size and quality of video would impact consumer attitude toward online

video advertising. In order to accomplish this goal, an experimental study was conducted. A between-subject 2 (large vs. small window size) X 2 (high vs. low image quality) experimental study was carried out to test the hypotheses derived from theories.

A total of 104 college students (39 males and 65 females) were recruited to participate in the study. Their informed consent was obtained in compliance with the protocol of using human subjects in research. In return, each subject received a small gift card for his/her participation. Subjects were randomly assigned to the four experimental conditions (2 screens for image size: small vs. large; 2 image quality: high vs. low).

### 3.2 Procedure

Upon arrival, each subject was greeted and escorted into a 120 square feet room that was equipped with a laptop and a comfortable chair. Subjects were informed that they would be participating in a study about online video advertising and were exposed to stimuli for 40 seconds. Later, subjects were asked to fill out a questionnaire that measured presence and attitude toward the ad, and basic demographic information. Upon completion of the study, subjects were debriefed and dismissed.

### 3.3 Independent Variables

**3.3.1 Video Quality:** Given the various formats of online video advertising, advertising in high video quality in the current study is defined as online video advertising provided in the resolution of 720p within the 16x9 screen ratio. 720p video quality is categorized as HD (high-definition) in the US television market and it is one of the highest available online video qualities on YouTube. In contrast, advertising in low definition is defined as online video advertising provided in the resolution of 240p within the 16x9 screen ratio. 240p video quality is one of the lowest online video qualities on YouTube.

A total of 16 television advertising clips for eight existing brands were found in two formats (high and low) via YouTube. In order to avoid confounding effects of prior exposure, all of the test advertisements were selected from non-US English-speaking counties. Two European subjects who knew the brand name or had prior exposure to the stimuli were excluded from the analysis. Eight high-definition and eight standard definition online video advertisements were downloaded by video downloading software (YouTube Downloader version 2.6.2.) and uploaded to a laptop. In order to avoid problems of possible ceiling or floor effect, a pretest with 21 subjects was conducted to assess the attitude toward the advertisements. The ad for a Swedish travel agency (i.e. Ving) was selected as a sample stimulus for this study since subjects held a relatively neutral attitude toward the advertisement ( $M=4.72$ ).

The video codec information software (The KMPlayer version 2.9.4.1435) was used to assess the image quality of each stimulus. The software indicated the frame information of high video quality (1920 x 1080) and low video quality (320 x 240).

**3.3.2 Image Size:** To test the effect of image size on dependent variables (H1), small window size (YouTube default window

viewing) and large screen size (full screen viewing) on a 13.3-inch LCD display on a laptop (Sony VGN-SZ645) was selected. 13.3-inch LCD display is selected since 13.3-inch laptops (e.g., Apple MacBook, MacBook Pro) were one of the best-selling models in the U.S. market at the time the study was conducted.

To prevent possible effect of field-of-view (FOV), which is how far the viewers are sitting away from the screen and the shape of the projected image, the actual distance between the subjects and the screen is controlled. Subjects were asked to keep 25 inches of eye-to-screen distance, which is recommended as an optimal viewing distance [22].

### 3.4 Dependent Variables

**3.4.1 Presence:** The amount of presence experienced by the subjects was measured by using a 15-item seven-point Likert-type multi-dimensional presence scale developed and modified by prior studies for high-definition television research [5], [6], [20]. Among the six dimensions of presence measure (e.g., immersion; spatial presence; social presence-passive interpersonal; social realism; perceptual realism; physiological presence responses), the social realism and the physiological presence responses were excluded from the current study since having social realism (e.g., the events I saw/heard would occur in the real world) and physiological presence responses (e.g., stomach awareness; nausea; dizziness; adrenaline rush) were not expected from the online video advertising watching experience. The descriptions of the questionnaire items of the four presence dimensions are presented in Table 1. Items of each of the four dimensions were averaged and formed a reliable scale as assessed by Cronbach's alpha (immersion,  $\alpha = .85$ ; spatial presence,  $\alpha = .86$ ; social presence-passive interpersonal,  $\alpha = .82$ ; perceptual realism,  $\alpha = .81$ ).

Table. 1 Dimensions of Presence and Questionnaires

Dimension	Questionnaires
Immersion	How involving was the advertising?
	How completely were you senses engaged in the advertising?
	I was so involved in the advertising that I lost track of time
	To what extent did you experience a sensation of reality in the advertising?
Spatial presence	How much did it seem as if the objects and the people in the advertising had come to the place you were?
	How much did it seem as if you could reach out and touch the objects or people in the advertising?
	How often when an object seemed to be headed toward you did you want to move out if its ways?
Social presence-passive interpersonal	How well were you able to observe the facial expressions of the people in the advertising?
	How well were you able to observe the body language of the people in the advertising
Perceptual realism	How much did the things/people in the advertising SOUND like they would if you experienced them directly?
	How much did the things/people in the advertising LOOK like they would if you experienced them directly?
	How much did the things/people in the advertising SMELL

like they would if you experienced them directly?

How much did the things/people in the advertising FEEL like they would if you experienced them directly?

**3.4.2 Attitude toward the ad (Aad):** This study adopted the three-item measure of attitude toward the ad from past research [23]. The three items were measured on a seven-point semantic differential scale (e.g., good vs. bad; pleasant vs. unpleasant; favorable vs. unfavorable). They formed a reliable scale as assessed by Cronbach's alpha ( $\alpha = .84$ ) and were averaged.

**3.4.3 Manipulation Check:** Although the video quality manipulation was assessed by a software, a manipulation check questionnaire was used to ensure the video quality manipulation worked as expected. The two items were selected from previous work [24] and measured on a seven-point semantic differential scale (i.e., the quality of video you just watched is: vague vs. vivid; unclear vs. clear). They formed a reliable scale as assessed by Cronbach's alpha ( $\alpha = .95$ ) and were averaged.

## 4. RESULTS

### 4.1 Manipulation Check

To check the video quality of the advertising, a t-test was performed on the check measure. Results show that the manipulation of video quality was successful, as significant differences were found between low quality condition ( $M = 5.93$ ) and high quality condition ( $M = 6.40$ ;  $t = 2.47$ ,  $p < .05$ ). Participants in the high video quality condition reported that the quality of online video was more vivid and clear than participants in the low video quality condition.

### 4.2 Hypotheses Testing

The hypotheses were tested via a 2 (video size: small vs. large) X 2 (video quality: high vs. low) between-subjects analysis of variance (ANOVA) on dependable variables (four dimensions of presence and Aad). Results are shown in Table 2. Hypotheses 1a addressed how image size affects viewers' perceived presence. Main effect of size was not detected for any of the four presence dimensions: immersion ( $F(1, 100) = .093$ , ns), spatial presence ( $F(1, 100) = 1.386$ , ns), social presence-passive interpersonal ( $F(1, 100) = 1.464$ , ns), perceptual realism ( $F(1, 100) = .053$ , ns). Main effect of size was not detected for attitude toward the ad ( $F(1, 100) = .331$ , ns). Thus hypotheses 1a and 1b were not supported.

Hypotheses 2a addressed the influence of video quality on viewers' perceived presence. As predicted, the results yield a significant main effect of video quality on two dimensions of presence: Spatial presence ( $F(1, 100) = 4.737$ ,  $p < .05$ ) and social presence-passive interpersonal ( $F(1, 100) = 4.938$ ,  $p < .05$ ). The main effect of image quality on the other two dimensions of presence was not founded: Immersion ( $F(1, 100) = .223$ , ns), perceptual realism ( $F(1, 100) = .029$ , ns). As shown in Table 3, the results indicate that subjects who watched the ad in high quality video perceived greater amount of spatial presence ( $M_{\text{High}} = 3.97$ ) and social presence-passive

interpersonal ( $M_{High} = 6.29$ ) than those who watched the same ad in low quality video ( $M_{Low} = 3.27$  and 5.88). Thus, hypothesis 2a was supported.

As predicted, the significant main effect of image quality on attitude toward the ad ( $F(1, 100) = .035, p < .05$ ) was detected. As shown in Table 3 and Figure 1, participants who watched the ad in high quality video indicated more positive attitude toward the ad ( $M_{High} = 6.53$ ) than subjects who watched the same ad in low quality video ( $M_{Low} = 6.22$ ). Therefore, hypothesis 2b was supported.

Hypothesis 3 addressed the combined effect of image size and quality on four dimensions of presence and attitude toward the ad. Interaction effect was not detected on four presence dimensions and attitude toward the ad.

Consistent with prediction, a positive influence of image quality on presence and attitude toward the ad was detected in this study. Subjects who watched the online video advertising in high video quality perceived greater amount of presence and had more positive attitude toward the ad than those who watched the same ad in low video quality.

However, contrary to the predictions, the results of current study suggest that the window size of online video advertising do not influence viewers' sense of presence. In addition, there was no difference in terms of attitude toward the ad between viewers who watched the ad on the small window (YouTube default viewing) and those who watched it on the large window (full viewing) within 13-inch LCD monitor.

Table 2 . ANOVA Result (DVs: Presence and Aad)

Variable	ordering	Sources of variation	Df	MS	F	Sig
Presence	Immersion	Size	1	.17	.093	.761
		Quality	1	2.79	1.506	.223
		Size x Quality	1	1.89	1.020	.315
	Spatial presence	Size	1	3.70	1.386	.242
		Quality	1	12.66	<b>4.737*</b>	.032
		Size x Quality	1	5.41	2.024	.158
	Social presence-passive interpersonal	Size	1	1.276	1.464	.229
		Quality	1	4.305	<b>4.938*</b>	.029
		Size x Quality	1	1.157	1.328	.252
	Perceptual realism	Size	1	.084	.053	.818
		Quality	1	.046	.029	.865
		Size x Quality	1	.705	.444	.507
Attitude toward the advertising (Aad)	Size	1	.189	.331	.566	
	Quality	1	2.609	<b>4.565*</b>	.035	
	Size x Quality	1	.045	.079	.779	

\* $p < .05$

Table 3 Means and Standard Deviations

Image Size	Video Quality	Presence				Aad	N
		Immer-sion	Spatial presence	S.P.-passive interpersonal	Perceptual realism		
Large	High	5.03 (1.18)	4.38 (1.67)	6.30 (.99)	4.88 (1.25)	6.56 (.70)	27
	Low	4.43 (1.20)	3.23 (1.20)	6.10 (.94)	4.76 (1.34)	6.28 (.77)	25
	Total	4.74 (1.22)	3.83 (1.60)	6.20 (.96)	4.82 (1.28)	6.42 (.74)	52
Small	High	4.84 (1.59)	3.55 (1.76)	6.29 (.80)	4.66 (1.33)	6.51 (.68)	28
	Low	4.78 (1.41)	3.31 (1.74)	5.67 (1.01)	4.87 (1.08)	6.15 (.87)	24
	Total	4.82 (1.50)	3.44 (1.74)	6.00 (.94)	4.76 (1.22)	6.35 (.79)	52
Total	High	4.93 (1.39)	3.96 (1.76)	6.29 (.89)	4.77 (1.29)	6.53 (.67)	55
	Low	4.60 (1.31)	3.27 (1.52)	5.89 (.99)	4.81 (1.21)	6.22 (.82)	49
	Total	4.78 (1.36)	3.63 (1.68)	6.10 (.95)	4.79 (1.25)	6.38 (.76)	104

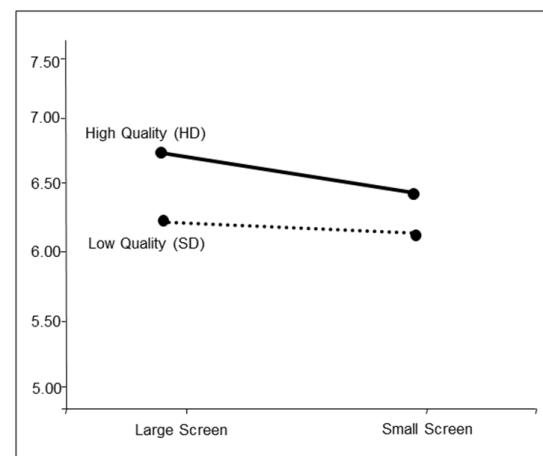


Fig. 1. Attitude toward the Advertising

## 5. DISCUSSIONS

The purpose of this investigation is to explore the effect of enhanced video quality on online video advertising. More specifically, this study aims to explore whether video quality and image size will influence viewers' response toward online video advertising. Overall, results from this study suggest that enhanced video quality of online advertising may have an important impact on advertising effectiveness and the concept of presence is central to understand the effect of enhanced video quality in online advertising.

The findings of this study provide evidence that video quality of online video influences the amount of presence experienced by viewers. These findings confirm the previous study, which suggested enhanced image quality on television

plays a role in generating a sense of presence [5], [20]. There were significant differences for two dimensions of presence, which are spatial presence and social presence-passive interpersonal, thus this study provides a new case that enhanced video quality does increase the amount of presence sensations in an online video viewing context. The finding related to the social presence-passive interpersonal dimension is particularly valuable, since this dimension examined the nature of the characters or people in the mediated environment [5]. The results of the current study indicate that enhanced quality of online video advertising allow the viewers to identify individuals and their nonverbal expressions in the advertising. The high quality video viewers reported that they were able to observe the people's facial expression and body movement in the advertising significantly better than the viewers who watched the same advertising in low quality video.

The most remarkable finding of this research is the significant role of presence in advertising effectiveness. The findings provide evidence that sensations of presence were found to lead positive attitude toward the online video advertising. The participants who watched the advertising in high video quality held significantly more favorable attitudes toward the online video than those who watched the same advertising in low quality video.

From a managerial perspective, these findings underscore the importance of video format in popular online video advertising campaigns. Our findings suggest that practitioners should consider higher video quality when launching online video advertising. Since high quality video generates more positive attitudes toward the advertising regardless of image size, online advertisers should focus their attention on video quality rather than image size. While the video quality is important, marketing professionals should be aware of that a typical type of enhanced video quality such as 3D may generate cybersickness for consumers, resulting in possible negative ad experience.

Limitations exist and should be considered. One major limitation that needs to be considered is the selection of stimuli. The current study employed only one product category and the effect of presence may differ depending upon other variables such as the nature of product categories and the advertising creativity strategies. Further research with a larger set of advertisements is needed to identify the degree of generalizability of these results. In addition, the use of a 13.3-inch laptop as a mediating device is another major limitation. Online video advertisings are accessible via many other devices such as desktop connected monitors, which are usually bigger than laptop displays. Thus, the failure of finding a significant impact for image size may be the result of adopting only one display size. Moreover, current online video advertisements are also accessible via mobile devices. Thus, future research should consider incorporating various devices equipped with different screen sizes. Besides, today's online video advertising is provided by various video quality and image size options. For example, when consumers watch video advertising on Youtube, they can select one of the video quality options from 240p, 360p, 480p, 720p, and 1080p. They can also choose one of the image size options from Theater mode, Full Screen, and Default view. Therefore, further investigation with more

various video quality and image size conditions will be necessary. Lastly, the sample consisted of students, which are not representative of the target population of online video advertising. The current study needs to be replicated with different demographics whose media consumption behavior is different from college students.

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