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Examining the Impact of Web Advertising on Reading: An Eye Tracking Study

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This study measures visual attention to examine the impact of banner ads on reading and information processing on the Web. Using a 2 × 3 experimental design, 120 students were randomly assigned to read a series of either short or long articles on webpages presented with no banner ads, a static banner ad, or an animated banner ad. Visual attention was recorded by an eye-tracking device. Results from our study show that when there is too little information presented on a Webpage with no banner ads, the readers might become less attentive to the paper, while a long paper presented with too many visual stimuli may overload viewers' cognitive capacity. While these findings are generally consistent with past research that compared the impact of static ads against animated ads, the addition of a control condition and the varying of article length in our study extended previous research by revealing more complex visual processing and cognitive processes.

Keywords: reading, visual attention, web advertising, eye tracking

Introduction

With the rapid growth of the World Wide Web, the Internet is quickly becoming the primary medium for fulfilling individuals' informational needs. Reading news and informational articles on the Web is now one of the most common activities. Mirroring the Internet's growth, online advertising is also becoming increasingly pervasive. Since most informational websites do not require paid subscriptions, their principle source of revenue is from providing advertising space. Many commercial websites now also allocate a significant amount of space for online ads as well. According to recent statistics, Internet advertising revenues in the U.S. reached $26.0 billion in 2010, showing a 15% increase from the previous year (Internet Advertising Bureau, 2011). Visually displayed ads, such as banner ads, represent a significant portion of online advertising. With more than $6.2 billion in revenue in 2010, this form accounts for over one-third of total online advertising revenue.

Similar to ads found in newspapers, magazines and other print media, online ads could share the same visual space as the primary content on a webpage. However, unlike print ads, online ads have the unique advantage of having the ability of being dynamic and interactive. For example, many online ads contain animated features such as flashing videos, sounds, or interactive games. In this regard, online ads are comparable to television commercials and video games. In addition to sharing these characteristics with both print and other electronic media, internet advertising also adds a unique and new dimension for advertisers: The

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ability to immediately take viewers away from the primary media content and bring them directly to the advertisers. Regardless of how attractive or creative a print or television ad may be, very few media users would terminate or pause what they were viewing to immediately seek out the advertisers. However, this is not an uncommon scenario on the Web.

Despite the potential benefits it provides for advertisers, online advertising may be detrimental to media users. We likely do not need to conduct empirical research to realize that people do not like to be interrupted while reading or enjoying an entertainment program. Further, such interruptions may have an adverse effect on learning. But how much of a distraction are online ads to the online reading experience? Can readers overcome these distractions and continue to process information of their interest? In addition to its potential adverse effects on media users, online advertising can also present an interesting dilemma for content providers. The more visitors of a website pay attention to the ads, the more advertising revenue a site would likely bring in; however, if the visitors were too distracted by the ads and lost interest in the media content that initially brought them to the site, they may not visit the site again. This results in a loss of money in the long run for the website.

To address these different concerns and questions regarding both media users and content providers, we present results from a laboratory eye-tracking experiment to evaluate the impact of banner ads on reading and information processing on the Web.

Literature Review

Online Advertising Through Banner Ads

Online advertising is a form of promotion that uses the Internet as the medium to deliver marketing messages to consumers. There are assorted channels for online advertising, such as websites, social media, and e-mail. Additionally, a variety of ad types exist, such as banner ads, rich media ads, and contextual ads placed on search engine results pages. Among these types of ads, banner ads are one of the predominant configurations. Usually placed at the top or along the sides of web pages (Edwards, Li, & Lee, 2002), banner ads are designed to attract attention from a webpage and take viewers directly to the advertiser's website for further information by clicking on the banner (English and Pearce, 1999). Banner ads may appear in different styles, ranging from static with non-interactive graphics and texts to dynamic presentations of animations and sounds.

Previous studies have found advertising banners to be reasonably successful in terms of their acceptance. A Web survey of German Internet users found that banners with an appealing design were successful in attracting users' attention; nearly half the respondents reported that they looked at advertising banners if they were well designed (Leest, 1996; Belz, 1997). Less than 25% of the respondents felt that banner ads were disruptive, and only a third said they ignored banners altogether. Wong (2001) surveyed Internet users and found that 80% had a favorable opinion towards banner ads on the Web. Moreover, a study by Hollis and Briggs (1997) showed that banner advertisements could impact the purchase intentions of customers and have a positive influence on assessment of the advertised products.

Despite these positive findings, other studies cast doubt on the effectiveness of banner ads. According to Nielsen (1997, 2000), click-through rates have decreased from 2% in 1995 to 0.5% in 1998, and they reached 0.2% in May 2000, suggesting that people were paying less attention to banner ads over time. Benway (1998) demonstrated that Internet users avoid looking at banners when surfing on non-search websites, a phenomenon that has been referred to as "banner blindness". In a more recent study, Lapa (2007) also found that Internet users evade banner viewing. When banners were inserted at the bottom of website pages, readers initially paid

visual attention to the banner area. However, Lapa observed that when the page structure was preserved, visual attention on the banner decreased as a function of page number. He suggested that Internet users had quickly learned the structure of the webpage and used this knowledge to avoid the banners.

Reading on the Web

A separate group of researchers have investigated reading behavior in the online setting, and many factors have been found to affect the online reading scenario. Josephson (2008) studied how different typefaces may affect reading on a computer screen by tracking the eye-gaze of readers. The results show that certain fonts may help people to read more quickly and with less backtracking in eye movements. Wise, Bolls, and Schaefer (2008) showed that readers devoted more cognitive resources to process articles if they were selected from a larger pool of hyperlinks as compared to articles chosen from a smaller set of hyperlinks. Researchers also examined how online reading might differ from reading on print (Bucher & Schumacher, 2006; d'Haenens, Jankowski, & Heuvelman, 2004; Eveland & Dunwoody, 2001). Their findings seem to suggest that there are factors other than the medium itself influencing people's reading pattern such as the use of visual cues (Bucher & Schumacher, 2006), content category, and gender (d'Haenens et al., 2004).

Influence of Banner Ads on Information Processing Online

Banner ads have been shown to be a factor influencing how people process information; however, previous studies have been mixed as to whether ads hinder or help. Day, Shyi, and WANG (2006) studied the effects of flashing banner ads on people's decision making. They found that banner ads decreased decision time but did not affect the decision accuracy. This finding suggests that while flashing banner ads may be visually distracting, but they may also be a source of arousal that would actually facilitate online decision-making. Burke, Hornof, Nilsen, and Gorman (2005) examined whether banner ads affected Web users' visual search speed, perceived workload, memory, and gaze patterns. However, their results revealed that visual search speeds were negatively affected by the presence of both animated and static banner ads. Generally speaking, empirical studies of the effects of banner ads on Web information processing are limited in numbers and inconclusive.

Banner Ads and Online Reading

Banner ads generally compete with the primary website content for attention, contributing to a paradoxical relationship between web content and banner ads. Web pages should be designed to allow visitors to easily read content in order to generate more traffic to the website. Yet on the other hand, banner ads should be designed and placed to attract more visual attention, as they provide a major source of income. For content providers, how viewers divide their attention between web content and banner ads is an important question. The answer to this question may help websites to be designed with an efficient amount of space for both the media content and the advertisements. To further the current literature, the present study is designed to empirically examine the impact of banner ads on visual attention paid to webpage content.

Theoretical Framework

Top-Down Versus Bottom-Up Perspectives of Visual Attention

Attention is a limited resource allocated to a limited number of concurrent mental activities (Kahneman, 1973). The allocation of visual attention, understood here as the focus of a person's vision, can be generally viewed from two perspectives: top-down or bottom-up (Egeth & Yantis, 1997; Ludwig & Gilchrist, 2002).

According to the top-down perspective, viewing patterns are primarily driven by goals. It posits that people voluntarily control where to assign their visual attention. In a classic eye-tracking experiment conducted by Yarbus (1967), participants were asked different questions when they were shown the same painting. For example, some participants were asked to evaluate the ages of subjects in the painting while other participants were asked to estimate the social status of the family portrayed. Yarbus observed that the ways in which the viewers' eyes scanned the painting (i.e., scan-paths) significantly differed from one condition to another when different questions were asked. This study was recently replicated by DeAngelus and Pelz (2009) with less intrusive an eye gaze tracking device, and it showed similar results. These studies suggest that visual attention can be goal-driven and is influenced by the viewers' tasks and goals. On the other hand, the bottom-up perspective regards visual attention as being driven, involuntarily, by the visual stimuli in the environment (Egeth & Yantis, 1997). Despite an individual's intention or goal, other things in the visual field can distract visual focus from the task at hand. For example, attention would be unconsciously given to the sudden movement of an object in the environment.

In the natural environment these two processes often co-occur. For example, Web-based banner ads are often placed next to the primary media content, such as a news article. Because people usually visit websites for a specific reason, they actively direct their visual attention to the content of interest. However, banner ads placed next to the content may attract visual attention via the bottom-up visual process, as readers would involuntarily look away from the article to determine whether there is something worth paying attention to. Thus, this reading environment would be more cognitively demanding than one that has only an article or an ad. The limited capacity theory of information processing (Lang, 2000) can be applied to further understand the cognitive process involved in this scenario.

Limited Capacity Theory

The limited capacity theory (Lang, 2000) is an information-processing model concerning how people cognitively process mediated messages. The model is based on two assumptions. First, individuals process information by mentally representing and organizing external stimuli in the surrounding environment that they turn into mental representations. Second, information processing requires mental resources, and people have a limited (and perhaps fixed) pool of such cognitive capacity.

The theory further posits that the limited cognitive resources are independently allocated to three simultaneously occurring sub-processes of information processing: encoding, storage, and retrieval. For information to be completely processed, all three of these sub-processes must be given enough cognitive resources. The more information contained in a message, the more cognitive resources it requires. If fewer resources are allocated to the task than the message requires, then it will not be thoroughly processed (Lang, 2000). Information thus may not be fully processed for two main reasons. First, the message recipient may choose to allocate fewer resources to the task than it requires. Second, message processing may require more resources than the recipient is able to give. Both would lead to a deficit in information processing.

Within the encoding sub-process, which involves the transfer of a message from the environment into a person's brain, different factors would affect what information is encoded and what is not. Two of these factors include the relevance of the message content to the viewer's goals and needs as well as the novelty of the information. The theory suggests that novel stimuli (i.e., things that are unexpected or represent a change in the environment) are more likely to engage the sensory receptor and invoke involuntary attention (Lang, 2000).

Although much of the empirical evidence supporting aspects of the limited capacity model has been confined to the television medium, some studies have applied the model to the Internet. For example, Heo and Sundar (2001) found that a website with animated ads imposed a higher cognitive load on the user than a website with static ads. The study suggested that the site containing animated ads elicited stronger orienting responses, thereby triggering a greater demand of mental resources for encoding messages. In another study, Diao and Sundar (2004) reported that the sudden appearance of pop-up windows prompted a change in the visual domain and was regarded as a novel and unexpected stimulus that elicited automatic orientation.

Hypotheses

In the context of online reading, banner ads, especially animated ads, can be unexpected and can thus serve as a novel stimulus. As suggested by the limited capacity theory, this would induce involuntary attention, likely distracting readers' visual attention from the primary content. Further, animated ads represent a greater change in the visual environment than static ads and accordingly should provide a greater distraction. Therefore, we propose the following hypotheses:

H1a: The presence of a banner ad will distract a reader's visual attention away from the main online article.

H1b: The presence of an animated banner ad will distract a reader's visual attention away from the main online article more so than the presence of a static ad.

In addition, if an individual gets distracted by an ad while reading an article, the reader must then find where they left off to continue reading the article. Based on the principles of the limited capacity theory and visual processing, the reader must devote more cognitive resources to deal with (or even to just ignore) the additional information. As such, we predict that:

H2a: It will take a person longer to read an online article when a banner ad is present then when one is absent.

H2b: It will take a person longer to read the main online article when an animated banner ad is present than when a static banner ad or no banner ad is present.

Since the total amount of information to be processed is another factor in the limited capacity theory, a less demanding task, such as reading a shorter and/or simpler article, would demand less cognitive resources. As such, the distractions provided by the banner ad many not affect reading behavior of a shorter article to a large degree. Conversely, a demanding task, such as reading a long and/or complex article, would require much more cognitive resources. Therefore, the visual distraction of the banner ad may have a stronger impact. We thus expect there to be an interaction effect between the length of an article and the influence of banner ads on reading. Specifically, we predict the followings:

H3a: The distraction of banner ads on reading will be stronger when reading longer articles than when reading shorter articles.

H3b: The distraction of banner ads will be strongest when reading longer articles with animated banner ads.

Method

Design

In this study, the effects of banner ads and the length of articles on reading were examined in a 2 × 3 ("short" vs. "long article" by "no ad" vs. "static ad" vs. "animated ad") factorial experiment. Participants read news articles presented on a series webpages on informational website. The site was created by researchers to

mimic the layout and design of a commercial informational website, such as Web MD. An eye-gaze tracker was used to record participants' visual attention and scan paths.

Stimulus Materials and Manipulation

Web articles. A set of 24 webpages was developed containing different news articles with varying length and topical themes. Designed to look like content pages from a typical informational website, the webpages included a site logo on the top, a navigation bar on the left, the main article in the middle column, and a vertical banner ad area on the right. To increase external validity and control for topical interest, we included four news articles on different topics (science, health, entertainment, and information technology) in each condition. The articles were edited to maintain consistency in writing style, sentence length, and overall length.

Article length. Shorter versions of the original articles were created to manipulate the length of the article content. A manipulation check showed a significant difference between the word count of the short articles (M = 261.8, SD = 25.9) and the long articles (M = 475.9, SD = 45.4) with $t(11) = 2.2$ and $p < 0.001$.When presented on a computer screen set to 1280 × 1024 (a typical resolution of desktop PCs), the short articles took up approximately two thirds of the space in the article area, whereas the long articles covered the entire space and required users to scroll down in order to view the entire article.

Banner ads. The page layout and design were kept consistent across all conditions with the exception of the banner ad area to the right of the article. In this vertical column, the presence and format of the banner ad was manipulated. In the "no ad" control condition, the area was left empty. The "static ad" condition fitted a motionless image in the banner ad area featuring a promotional message. Lastly, the "animated ad" condition contained a dynamic banner with flashing images of the same promotional message. The promotional image in the banner ads was kept consistent in all conditions, and it was not directly related to any article content used in this study.

The Eye-Tracking Apparatus

Eye-tracking techniques have frequently been used by researchers to study eye movement and reading behavior (Rayner, 1998). Our study employed a Tobii T120 eye-tracker to capture the position of participants' eye-fixations and their viewing patterns. Comparable to reading on a typical desktop computer, the eye-tracker was disguised and integrated with a typical 17" LCD monitor configured to the resolution of 1280 × 1024. Tobii Studio, a software package provided by the manufacturer of the eye-tracker, was used to control the presentation sequence of the stimuli and record eye-tracking data. The webpages were presented via Internet Explorer 8 in a maximized window.

Participants

Participants were recruited through a mass email sent to undergraduate students at a large public university in Hong Kong. With a mean age of 22.8 (SD = 2.50), 120 undergraduate students total were used. 37.5% of the students were male and 62.5% were female. Participants were awarded a supermarket coupon of HK$50 (about US$6.50) for their participation.

Procedure

Participants were randomly assigned to one of the six conditions, with 20 students total per each condition. Research assistants proctored the experiment in an eye-tracking lab, giving instructions and obtaining consent from participants. Instructed to view the webpages as if from the comfort of home, participants were asked to evaluate the design and content of a series of pages captures from an informational website. Participants were

allowed to spend as much time as they wished on each webpage. To become familiarized with the interface, participants were presented with five dummy pages before the stimulus pages were displayed in a random order.

Dependent Measures

The following dependent variables were used to measure how much visual attention a participant devoted to a given area of interest (AOI).

Total fixation count (FC). FC measures the total number of fixations (visual attention focused on a specific point in the visual field). Generally speaking, the more fixations that are in a given area, the more visual attention devoted to process information.

Total observation count (OC). Observation count is the number of times a participant's eye gaze enters and stays in an AOI. This may also be conceived as the number of times the eye gaze was distracted by objects outside of an AOI.

Total observation length (OL). OL measures the total time in seconds that a participant's visual attention was focused in a given AOI, regardless of how many times the eye gaze was distracted from that area.

Distraction (OL/OC). Total observation length over total observation count is a means of measuring distraction of visual attention. An OC of 1 would suggest that the person focused visual attention in a given area exclusively without distraction, but it could also mean that this person was distracted from the area and never returned. As such, we derived the degree of distraction by the ratio of OL over OC. A large ratio (i.e., fewer OC and/or longer OL) would indicate devoted visual attention; a smaller ratio (i.e., more OC and/or shorter OL) would indicate distraction.

Data Standardization and Transformation

In the present study, all dependent measures were standardized by the size of an AOI in terms of per million pixels (an area of 3.33in $\times$ 3.33in). This was to ensure that the difference in size of AOIs did not contribute to variations of results found between experimental conditions.

This method of standardization to control the size of AOI potentially reduces the main effects of article length, as a long article occupies a larger AOI compared with a short article. However, this mathematical transformation does not necessarily affect the article readers' overall perception. According to the principle of top-down visual processing, a reader first makes an overall evaluation of a piece of information and then decides how much visual attention to devote to processing it. Furthermore, the primary focus of this study is not on the main affects of article length, but rather on an intersection effect between article length and banner ads. We believe that the benefits outweigh the potential downside of this standardization.

Additionally, summed measures of all four within-subject conditions were used throughout the data analyses. This was employed because the four articles were presented in a random order for each participant in each experimental condition (i.e., no order effect) and because topical differences were not a primary focus.

Results

To test the hypotheses, a series of 2 $\times$ 3 between subject univariate analysis of variance (ANOVA) was performed on each of the four visual attention dependent measures. The results are presented in Table 1. The distribution of eye-tracking data can be very sensitive to extreme scores as the maximum scores of fixation and observation, in terms of counts and length, are theoretically infinite. As such, we removed outliers with scores of two standard deviations above the mean for each dependent variable in the respective analyses.

Our first set of hypotheses (H1a-b) predicted a main effect of banner ads. Specifically, we expected that the presence of a banner ad, particularly an animated one, would distract reader's visual attention away from reading the article. As can be seen from Table 1, there was not a main effect from the ad type on the distraction score, and neither was there a main effect from the length of the article. However, the interaction effect of ad type by article length was significant ($F = 2.516$, $p < 0.05$). As can be seen in Figure 1, the length of an article significantly affected the impact of banner ads on distraction. A series of planned pairwise comparisons were thus conducted to examine the interaction effect (see Table 2). We found that participants were more distracted when reading the shorter articles ($M = 8.41$, $SD = 4.62$) than when reading the longer articles ($M = 12.96$, $SD = 7.21$), but only in the no banner ad condition. We also found that, when reading shorter articles, participants were actually less distracted by the presence of banner ads compared to when a banner ad was absent. This is the opposite of what we had predicted.

Our second set of hypotheses (H2a-b) concerns the influence of banner ads on the amount of time people take to read the article of interest. As can be seen from Table 1, neither the type of ad nor the length of an article had a main effect on total observation length. However, the interaction of the two factors was significant ($F = 5.638$, $p < 0.01$). An examination of the estimated mean plot (see Figure 2) shows that the article length did indeed have an influence on the effect of banner ads on reading time. As Table 3 shows, a planned pairwise comparison reveals that the presence of a static banner ad increased the time for reading short articles, but decreased the time for reading longer articles. If we were to only compare the animated ad condition with the static ad condition, participants took longer to read the shorter articles but spent less time reading the longer articles. H2a and H2b were thus partially supported.

H3a-b predicted that distraction of banner ads on reading would be stronger when reading longer articles, and that this distraction would be most pronounced when reading longer articles with animated banner ads. These predictions were not supported.

To better understand our results, additional analyses for total fixation count and total observation count were conducted. A main effect for observation count was found ($F = 9.793$, $p < 0.001$). Regardless of the ad type, participants seemed to have more observation counts (i.e., more interrupted reading) when reading short articles. However, a planned pairwise comparison reveals that this main effect of article length was primarily caused by a significant difference in observation count between longer and shorter articles in the control condition (see Table 4). This pattern confirms an earlier finding on distraction: participants seemed to be distracted from the reading the short articles when there were no banner ads.

Finally, as can be seen in Table 5, we found a marginally significant interaction effect of banner ads by article length on total fixation counts ($F = 2.509$, $p < 0.06$). A pairwise comparison shows that the static banner ad increased total numbers of fixation in shorter articles but reduced total fixation counts in the longer articles (see Figure 3).

Discussion

Although we failed to clearly support our hypotheses, the present study yielded many interesting and unexpected findings. For example, the interaction of banner ads and article length significantly influenced fixation count, observation length, and distraction. However, the interpretation of these interaction effects was difficult because the banner type impacted visual attention during reading quite differently when article length was taken into account. Compared to the static banner, the animated banner was indeed more distracting.

However, participants seemed to have paid more visual attention to the short articles when a static banner ad was present, as compared to the control and the animated ad conditions.

While this finding was unexpected, it was not surprising. Consistent with the limited capacity theory (Lang, 2000) and the top-down visual processing perspective (DeAngelus & Pelz, 200), participants who read shorter articles in the control condition might have had spare cognitive resources to visually process other areas on the webpage. When a moderately distracting static banner ad was presented, participants became more focused on the article area because they devoted more cognitive resources to compensate for the additional objects in the visual field. When a highly distracting ad or an intimidatingly long article was presented, however, participants were overwhelmed; as such, they would devote attention to process the information. These findings suggest that a modest amount of distraction might be beneficial to information processing.

When evaluated as a whole, findings from out study were consistent with previous studies that only compared the impact of static ads with that of the animated ads (Heo & Sundar, 2001). The addition of a control condition and the article length factor revealed a complexity that was not found by the previous studies. Overall, results from our study point to a possibility that the influence of banner ads might be curvilinear. When there is not enough information presented on the webpage, visitors might not devote much attention to the content. However, if there is too much distraction or content, viewers might be overwhelmed and become less attentive.

Table 1

Summary of ANOVA

	Fixation Count		Observation Count		Observation length		Attention/Distraction (OL/OC)	
	F	η^2	F	η^2	F	η^2	F	η^2
Ad Type	0.063	0.001	1.333	0.024	2.669	0.024	0.573	0.005
Article length	0.496	0.009	9.793***	0.083	0.022	0.000	1.177	0.021
Ad * Article length	2.509[a]	0.044	0.629	0.012	5.638**	0.095	2.516*	0.044

Note. The lower the distraction score the more a reader was distracted. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, [a] $p < 0.10$.

Table 2

Planned Comparisons for Distraction (Observation Length/Observation Count)

	Short			Long			
	M	SD	N	M	SD	N	t-test
no ad	8.41	4.62	20	12.96	7.21	17	-2.24*
static ad	12.36	6.83	20	10.04	6.99	19	1.04 n.s.
animated ad	12.63	6.62	19	13.21	7.43	20	-0.26 n.s.
One-way ANOVA (F)		2.97[a]			1.12 n.s.		

Note. The lower the score the more a reader was distracted. * $p < .05$, [a] $p < 0.10$.

Table 3

Planned Comparisons for Observation Length (Seconds per Million Pixels)

	Short			Long			
	M	SD	N	M	SD	N	t-test
no ad	110.62	54.73	20	127.18	56.18	17	-0.904 n.s.
static ad	150.3	59.98	20	83.73	48.12	20	3.87***
animated ad	117.46	52.77	19	114.96	69.53	18	0.12 n.s.
One-wayANOVA (F)		2.86[a]			2.78[a]		

Note. *** $p < 0.001$, [a] $p < 0 .10$.

Table 4

Planned Comparisons for Observation Count (per Million Pixels)

	Short			Long			
	M	SD	N	M	SD	N	t-test
no ad	15.14	8.56	19	9.72	4.99	19	2.38*
static ad	12.06	3.86	18	9.46	5.85	20	1.60 n.s
animated ad	11.62	7.64	20	8.83	4.06	18	1.42 n.s.
One-way ANOVA (F)		1.42 n.s.			0.15 n.s.		

Note. * $p < 0.05$.

Table 5

Planned Comparisons of Fixation Count (per Million Pixels)

	Short			Long			
	M	SD	N	M	SD	N	t-test
no ad	295.14	131.99	20	346.83	157.53	18	-1.09 n.s.
static ad	384.53	126.96	20	294.46	143.99	20	2.10*
animated ad	297.65	116.86	19	315.56	191.05	20	-0.349 n.s
One-way ANOVA (F)		3.26*			0.48 n.s.		

Note. * $p < 0.05$.

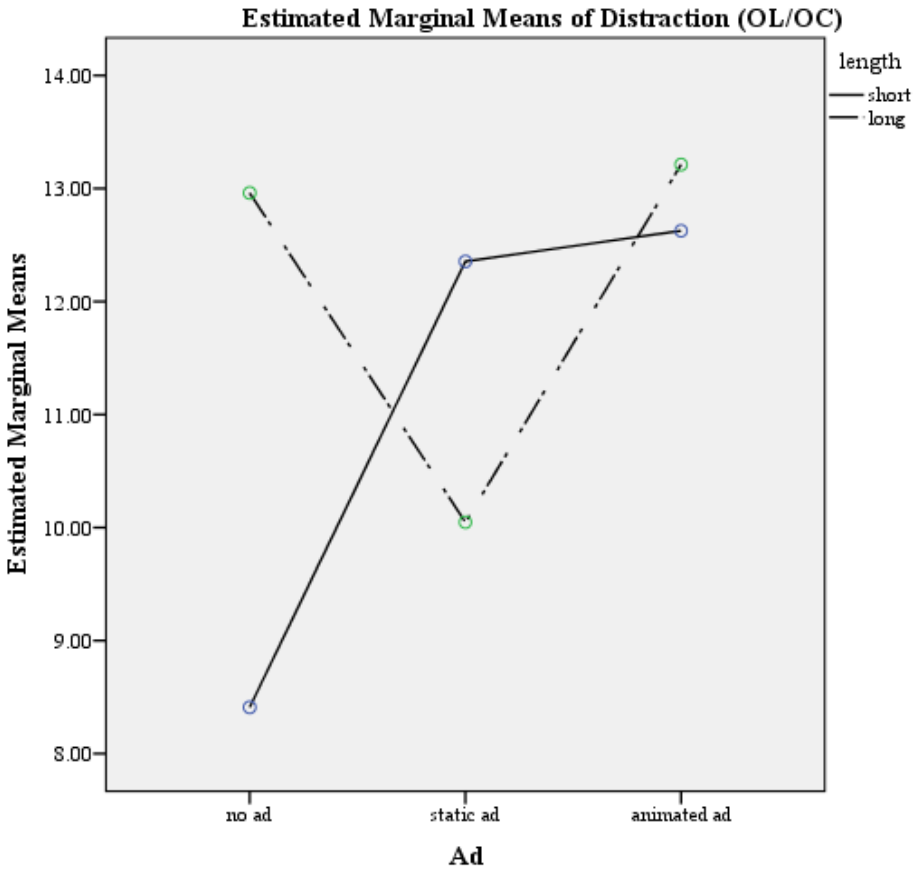

Figure 1. Estimated marginal means of distraction (OL/OC).

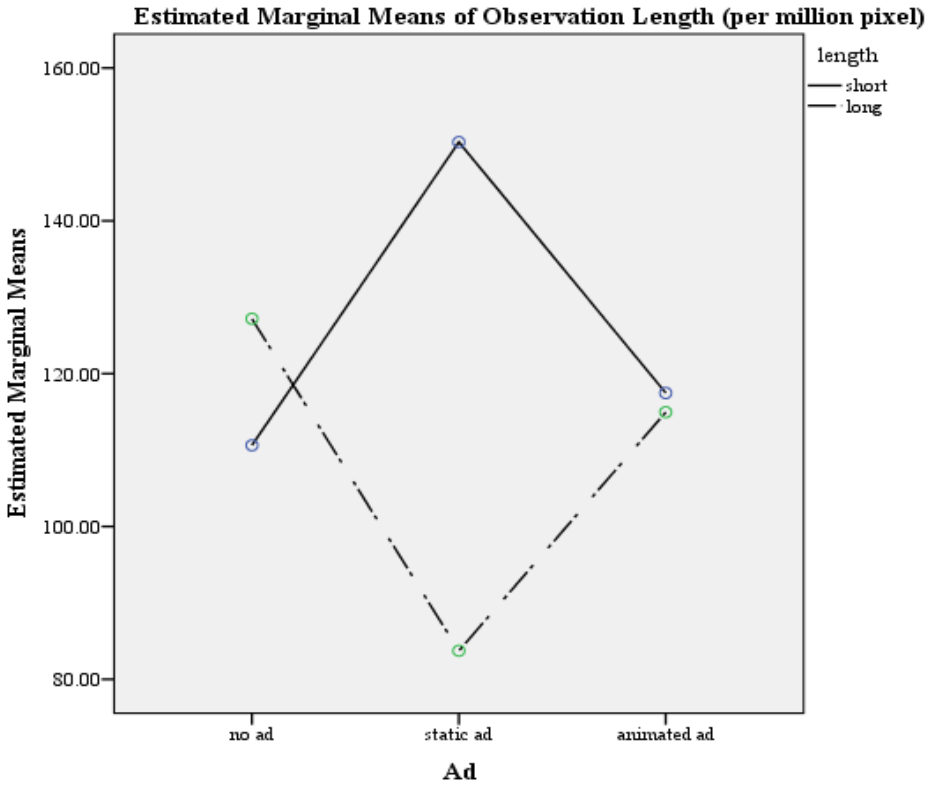

Figure 2. Estimated marginal means of observation length (per million pixels).

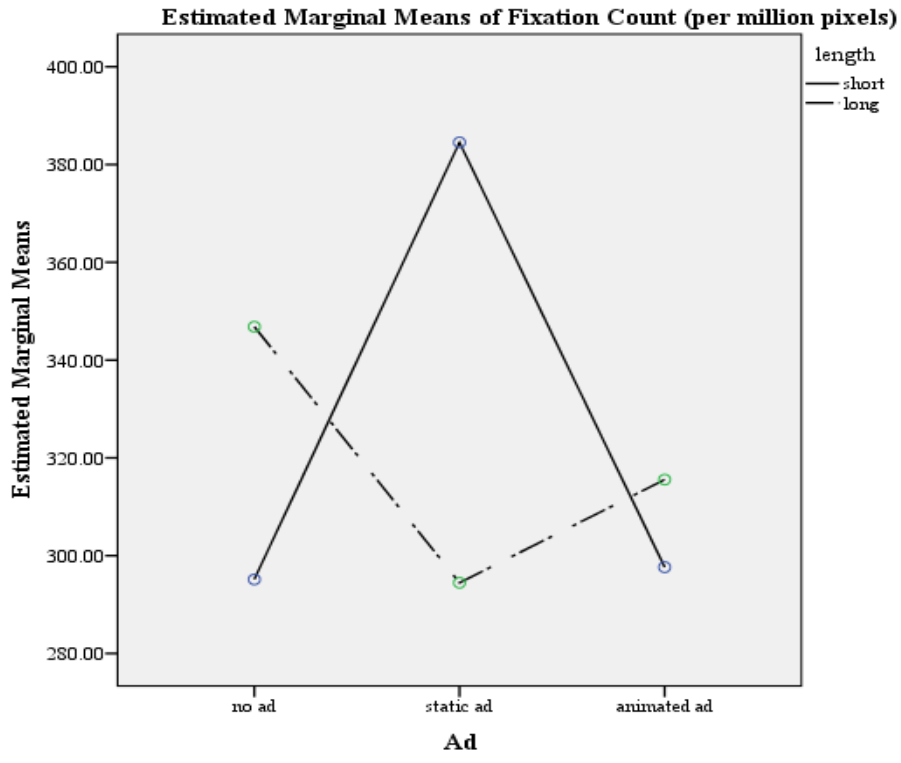

Figure 3. Estimated marginal means of fixation count (per million pixels).

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