Eye Tracking Methods in Webpage Advertisements

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ABSTRACT

Due to its design and integration into webpages, native advertising is a constantly growing topic among web developers and marketing experts [4, 7]. Research has shown that native advertising is not simply a golden ticket for advertisers, and greatly relies on proper implementation to be effective. This study assess native advertising's effectiveness in goal-driven web browsing compared to standard advertisements in two types of web page. Faults in experimental design and inconsistencies in data collection led inconclusive results, however qualitative analysis of scan paths led to support previous research.

INTRODUCTION

Native advertisements have been utilized as creative ways for web developers to integrate advertisements into webpages. While native advertisements have proven to be effective, there is still much research to be done on how to optimally place advertisements within webpage content. Though product placement on webpages comes in many forms including video, audio, or animated and moving advertisements, the webpage advertisements used in the following study will be static images of small to large sizes and positioned both in and outside the content area. For these advertisements to be a valuable investment, they must first catch the attention of the user looking at the webpage and be memorable. The goal of this experiment is to use eye tracking to obtain data on the effectiveness of native advertisements when controlled for location and prominence.

This study should prove to have value to both advertisers looking to increase the efficacy and efficiency of their internet advertising investments, as well as to learn more about how to manage advertisements in a way that will ensure a simplistic and user-friendly manner. Eye tracking will assist this research by providing data on where the participants first looked when shown the web page. As studies show that users may develop their opinion of a webpage in the first 50 milliseconds [2], the data about where the participant's eyes first look toward will carry more significance. Many of the sample articles used in this study were news articles that a user would read through to collect information. In order to gain a better understanding of how advertisement design affects the participant's retention of information, the participants are to be ask questions with details about the articles they viewed. The motivation behind this is to gather information to allow web designers to find space for advertisement that will not inhibit the purpose of the page. Studies also indicate that how a user browses a webpage affects their ability to recall advertisements [11]. Users that browse pages with a task to complete are worse at recalling advertisements than those who simply browsed websites, despite fixating their gaze on advertisements for a similar duration [12]. The goal of varying the position and the size of advertisements will be to examine to the output of the eye tracking tests to draw conclusions on the magnitude of viewership that certain positions and sizes garner, and if they effect advertisement recollection.

There are certain expectations for the results of the studies before beginning. It should be expected that the advertisements will not be the first to catch the viewer's attention, but rather that the page header or the most prominent related image on the web page will be the first thing the user looks at. This would be even more likely in pages where a person's face is at the forefront of the page. It should be expected that the participant's eyes will follow what is commonly referred to as "The F Pattern", where the left column and rows towards the top garner the most viewership [14]. While some websites are typically browsed leisurely, other websites are typically browsed with a specified task or goal in mind. One would hypothesize that users would be able to recall more native advertisements than standard advertisements in task driven browsing, because native ads are within the content area and users spend more time in the content area during task driven browsing. While research indicates that users browsing with a task are less likely to recall advertising [11], native advertising may be even more effective than a standard advertising in task driven internet browsing. With native advertising there is a trade-off of sacrificing space that could be used for content to display an advertisement. If native advertisements are even more effective during task driven browsing, they may become more marketable to advertisers. The eye tracking data studies into web page marketing will provide feedback to these hypotheses and expectations.

BACKGROUND

Native advertising is a newer form of advertising designed to better integrate advertisement placement within webpages [4]. There are large amounts of debate regarding what constitutes a native ad, however Campbell [10] calls native advertising, "A term used to describe a spectrum of new online advertising forms that share a focus on minimizing disruption to a consumer's online experience by appearing in-stream". The Interactive Advertising Bureau argues that native advertisement's definition is arbitrary and should be at the discretion of the marketer, but native ads should to some

degree fit the design of the page, function and behave similarly to surrounding content, have targeted placement across sites, and have metrics to measure success[4]. Effective native advertising has been the source of multiple academic studies [3, 5, 11], looking into how native advertisements can better fit the needs of marketers. Two studies conducted by Wojdynski[7] looked at how varying the language and position of native advertisements disguised as related articles affected consumers' understanding of the advertisements, and examined eye tracking data to see how the position of a native advertisement affected consumers' visual attention. These experiments showed that advertisements placed toward the middle or bottom of the page with wording such as "sponsored" were more likely to be recognized, but also more likely to receive negative reviews. There are many different types of native advertisement such as In-Feed Units and Recommendation Widgets, all with different uses, pros, and cons [4]. Utilizing different types of native advertisements across different platforms has shown to be more effective, and companies that launch multi-platform campaigns have had more success than those who don't[9].

Advertising effectiveness has been the subject of multiple eye tracking studies [11, 12, 14]. These studies mainly examine two factors, advertisement recollection and the amount of time a user's gaze is spent on an advertisement. This stems from an early eye tracking study of cigarette magazine advertisements [6] that found fixation duration over the Surgeon General's Warning directly correlated with recollection of the Surgeon General's Warning. A study conducted by Danaher & Mullarkey [11] found that users were able to recall advertisements within a webpage better the longer they were exposed to it, and found that how a user browsed a webpage played a role in recollection of webpage advertisements. Web users were classified in "goal-directed mode" and given a task to complete on a webpage or were told to browse the site in a way that they normally would. Users in "goal-directed mode" showed lower ad recognition than those who simply browsed the sight regardless of viewing time.

However there is conflicting research on whether or not gaze duration actually correlates to advertisement recollection [13, 14, 15]. Advertisement's that are better integrated with the design of a webpage are more likely to be recalled, despite having the same fixation duration as poorly integrated advertisements [14]. A term called "banner blindness" describes a phenomenon where despite users gazing over an advertisement, it is not recalled because the user ignores advertisements [13]. Banner blindness may not be due to advertising itself, but how the advertisements are implemented in the webpage. Banner blindness has been mitigated by utilizing algorithms to position advertisements on likely scan paths or pages linked to one another [15].

Different studies have been able to utilize webpage scan paths to determine optimal locations to place ads [15, 16]. The most notable scan path of webpages is the "F-Shaped" pattern [17], and advertisements placed on the pattern are more likely to be viewed [16]. While the "F-Shaped" pattern is common there are many other scan paths that correspond to different types of websites [17]. Algorithms can be used to predict these scan paths and determine optimal places along these scan paths, to place advertisements using webpage elements and eye tracking data [16]. The trend of catering webpages advertisements to specific users based on metadata has become more popular due to its profitability [4]. This is important to note because scan path patterns have been shown to demonstrate trends based on gender [19] and certain personality characteristics [18].

METHODOLOGY

Apparatus

Participant's eye tracking data was collected using a Gazepoint GP3 pupil corneal reflection eye tracker at a 60 Hz sampling rate, calibrated using 5-point calibration, with 0.5-1 degree of visual angle accuracy. The GP3 eye tracker was mounted underneath a Dell Professional P2213t 22" LED monitor with 60Hz refresh rate and a screen resolution of 1680 x 1050. Stimuli were shown to participants on this monitor. Eye movement and gaze data were collected using Gazepoint Analysis software v3.1.0. The system was run on a Dell Optiplex 9020 PC. The PC had a Windows 7 operating system, an Intel Core I7-4790 3.6GHz/ 8MB cache processor, a nVidia GeForce GTX 745 4GB DDR3 video card, 16GB (2 x 8GB) 1600 MHz DDR3 Non-ECC Ram, and a 500GB 7200 RPM hard drive.

Subjects

There were 23 participants in the study, data was only used from 19 participants. with 16 males and 3 females. The study drew from undergraduate students at Clemson University, with an age range of 18-23. The Gazepoint GP3 is not affected by most glasses or contacts, but if a user wore glasses or contacts it was recorded on the off chance it affected eye tracking data. Participants were recruited in person or via email. Participation was entirely voluntary and participants received no compensation for their participation.

Stimuli

There were 5 Stimuli. 1 Stimulus was a screenshot of the front page of Reddit to serve as a tutorial. 2 of the Stimuli were doctored screenshots of articles from the Roanoke Times and 2 of the Stimuli were doctored screenshots of Pintrest searches. For both the articles and the Pinterest searches, one screenshot is edited so that the advertisement is seamlessly inside of the content and the content is spread throughout the page. The other is edited so that advertisement is in the margin and outside of the content, in a more "standard" or off to the side position. The articles were chosen because of the familiar format. Pintrest however, is formatted very differently from most websites.

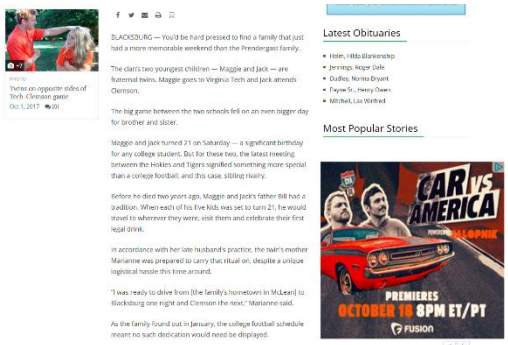

Figure 1: Roanoke Times article with "standard" advertisement placing

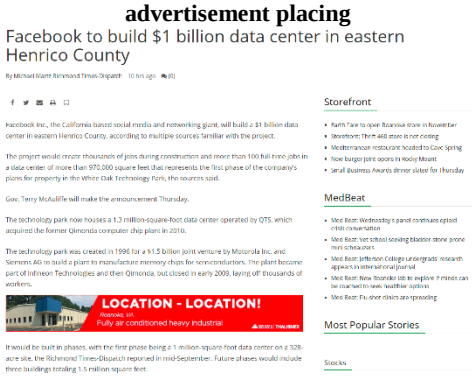

Figure 2: Roanoke Times article with native advertisement placing

Experimental Design

This experiment was a 2 x 2 (*Advertisement Placement vs. Web Page type*) within-subject structured experiment. The experiment consisted of a tutorial section and four subsequent data collection sections. Participants viewed a web page for 30 seconds and answered questions after viewing each webpage to test comprehension. The Web Page types were formatted the same but had different content. For each web page format, one web page had standard advertisement placement and one web page was edited to place a native ad within the content. This is then repeated for a different web page layout. After all webpages have been viewed the participant was asked to recall the advertisement on each page to test comprehension. The webpage comprehension tests simply serve as a task for participants to simulate a goal-directed mode of browsing a web page. The advertising comprehension quiz serves as the metric for advertisement recollection.

It is anticipated that the comprehension questionnaires may skew eye movements, as participants will know what to look for on the webpage after viewing the first questionnaire. However it most likely will not skew the fixations on advertisements as websites are accessed in a goal-directed mode to accomplish tasks, not to look at advertisements. As a preventative measure to mitigate possible skewing of data, the order the webpages are shown will rotate so that all webpages are shown 1st, 2nd, 3rd, and 4th equally in a 2x2 Latin square. The rotation will also mitigate possible skewing of advertisement comprehension data as the last webpage viewed will be fresh in the head of the participant.

Procedures

At the beginning of the experiment, participants were briefed about the study and different aspects of the study. Participants were told that the experiment is about eye tracking data and comprehension of webpages, but the word advertisement was not explicitly said to prevent bias. After agreeing to participate in the experiment, participants took a 5-point calibration test to calibrate their eye movements to the eye tracker. After calibrating their eyes, the participant was told that they had 30 seconds to read a web page, and then complete a comprehension quiz about the webpage's contents when 30 seconds is up. As a tutorial participants were then shown a webpage for 30 seconds, after 30 seconds the screen no longer showed the webpage. The participant then completed a web page comprehension quiz about the webpage. This was repeated for 4 more webpages. After the participant had viewed all webpages and completed all comprehension quizzes, they were given a quiz asking to recall the advertisement on all the webpages. Once the participant had finished answering these questions they were thanked for their participation and the experiment concluded.

RESULTS

Data Summary

Eye tracking data was collected for 23 participants, but only 20 trials of data were analyzed for their gaze data. 3 participants lost tracking during the test and their gaze data was unusable. Pre-study surveys were collected to obtain background information about participants in the study. Post Webpage Quizzes were collected however the data was not analyzed because the purpose of the Post Webpage Quizzes was to simulate a task and not to gauge reading comprehension. A Post Experiment Quiz was collected to see what advertisements participants remembered.

Stimulus Data

Gaze data over the stimuli focused on gaze duration on webpage content and gaze duration on webpage advertisements. These metrics were taken by calculating the amount of time the users gaze was within the bounds of the advertisement or webpage content. As native advertisements are integrated within the content of a webpage, gaze duration of webpage content on pages with native advertising were calculated by subtracting the advertisement gaze duration from the original content gaze duration to yield the final content gaze duration. An additional metric was developed to determine the effectiveness of advertisements relative to their size, we called size effectiveness was calculated:

$$size\ effectiveness = \frac{webpage\ size}{advertisement\ size}(advertisement\ gaze\ duration)$$

Article Type	Content Gaze Duration(s)	Advertisement Gaze Duration(s)	Size Effectiveness
Article Standard	17.5	1.37	9.2
Article Native	12.84	3.2	65.32
Pintrest Standard	18.71	2.32	17.75
Pintrest Native	12.86	2.63	43.661

Figure 3: Table of Gaze Metrics corresponding to webpages

Advertisement Quiz Data

The answers from advertising the Post Advertising Quiz were collected and graded. If the participant was able to name the company that was advertising the answer was marked correct. If the participant wrote down something that pertained to the advertisement, but was not the correct answer, they were given a partial. If the participant wrote down something that did not pertain to the advertisement or wrote down nothing the answer was marked wrong. Totals were then counted and assigned to their corresponding webpage.

Webpage Type	Correct	Partial	Incorrect
Article Standard	2	1	16
Article Native	0	1	18
Pintrest Standard	1	3	15
Pintrest Native	2	0	17

Figure 4:Post Experiment Quiz graded results

Discussion

The shortcomings of our data can be directly attributed to poor experimental design and data collection. While there are trends in the data to suggest that native advertising is superior to standard advertising in both attracting longer gaze durations and utilizing web page space more efficiently, gaze data was far too inconsistent to allow for any in depth analysis. Data was only unusable for 4 of the 23 participants' gaze data but, calibration slowly decreased throughout almost all trials. A trend among most data sets was that stimuli collected toward the end of trials tended to have scan paths similar in shape but significantly higher in the y coordinate than their counterparts that were collected earlier. This led the gaze duration on content and advertisements to be skewed. Some participants may have been reading the headline or first paragraph of an article, but the eye tracking data was off of the screen. The native advertisement in the article received the most gaze duration. On analysis of scan paths many of the scan paths patterns on the advertisement were similar to the scan paths of participants reading the paragraphs above. Suggesting that participants were not viewing the advertisement but reading the paragraph below it.

This is most likely because during data collection when users' eyes were calibrated they were seated away from the computer screen, however after having to move their eyes from the screen and readjust to complete the Post Webpage Quizzes on the desk in front of them participants would slowly move closer to the screen. Additionally the participants were seated in roller chairs, which made it difficult for them to return to the same position.

Experimental design also played a large role in the issues. The first issue was not delegating the correct amount of time for each stimulus. Participants were often struggling to finish reading the entirety of an article, but usually exhausted all the content on Pintrest pages well before the 30 seconds was up. Advertisement were also using real world companies, but fictitious advertisements should have been utilized to eliminate bias as in previous experiments [7]. Additionally it is difficult for a participant to recall an advertisement after seeing it once, in a study by Danaher & Mullarkey[11] participants were asked if they could recall an advertisement, then given a hint, then another hint, and then they were incorrect. This puts comprehension on a spectrum and allows for the result to be ordinal instead of binary. This was is what inspired accounting for partially correct answers, but it is not the same thing and much less effective for testing comprehension of advertisements. These shortcomings of the experimental design are what lead to fairly inconclusive Advertising Quiz results.

Despite poor gaze data not allowing for accurate statistical analysis of eye movements, qualitative analysis of scan paths can be utilized to recognize some of the trends in participants' eye movements.

Analysis of Scan Paths

While much of the gaze data was skewed due to inconsistent data collection, analysis of scan path data can give a small look into the eye movements of users. The Standard Article had very few participants reach the end in 30 seconds, and scan paths followed an "F-Pattern". The Advertisement was typically not viewed until about 30 fixations into the stimulus. Back and forth quick fixations were common in the content area of the article. The Native Article showed similar behavior with F-Shaped scan paths and back and forth quick fixations. The scan path however did differ compared to Standard Article because native advertising allowed for a wider content area and more participants were able to finish reading the article. The Standard Pintrest scan paths showed an even distribution across most of the images on the webpage. Fixations were more common on images in the center of the page with the far right and left edges of the page rarely viewed. The Native Pintrest scan paths were similar to the Standard Pintrest's in the seldom viewing of the edges of the page and centralized fixations on the images. There were many brief fixations of the text under the native at that said "sponsored publix". This is most likely because it was the only text on the page and stood out to viewers, but proves the point of Wojdynski[7] in his usage of language in native advertisements.

CONCLUSION

While statistical analysis of eye movement and participant comprehension data turned up inconclusive due to an inconsistent testing environment and unforeseen issues in experimental design, qualitative analysis of scan paths turned up some results that back previous research. Scan paths do change in order, but navigate fairly routinely through the same webpage elements [16]. Predicting scan paths on webpages based on their design can force a user's gaze to navigate over an advertisement, even if they ignore the content [15]. Users are likely to notice language such as "advertisement" or "sponsor" when used next to a native advertisement [7]. While the "F-Shaped" pattern is not present on every webpage, it can be seen quite commonly in webpages of certain formats[15]. The shortcomings of this experiment were quite apparent and due to inexperience in research, but upon

analysis of the faults in the data and previous literature it is evident that a few minor improvements to experimental design could have greatly improved the results of this experiment.

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