

# Towards Predicting Ad Effectiveness via an Eye Tracking Study

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**Abstract.** This paper presents the pilot study of a project for which the main aim is to implement an evaluation methodology service for the identification of the best locations on Cypriot web space based on eye tracking studies. Advertising budget, social demographics and web usage are some of the factors that are being considered. During this pilot study, a description in existing patterns of advertisement placement on websites is first presented. Then we present the methodologies of two pilot studies where user data are collected with the use of eye tracking technologies in order to understand how users look at Web advertising and how effective each location is as well as Marketers' questionnaire. Stimuli were three Cypriot websites with advertisements of various types and three locations: ads being static and animated, types being skyscraper and display ads and location varied around the page. Eye-tracking data are compared to ad choices of marketing managers in Cyprus who rated the ad position and its attention value. Results demonstrate the correlation between user attention, advert types and the value as rated by marketers. This pilot study revealed conclusions that could form the basis towards predicting ad effectiveness of webpages with the use of ad number, location, size, and type.

**Keywords:** advert attention, online advertising, eye tracking, CPM.

## 1 Introduction

In traditional advertising the main focus is on the consumer's attitudes and behaviors. This was also initially the focus in online advertising research as well; focusing on attitudes and behaviors towards ads, medium reliability, product involvement and website's context congruity for example. This has however now changed. In terms of online advertising, the focus is now on issues of ad effectiveness, such as attention, display-ad advertising formats and visual design issues. Online ad pricing is often based on placement, document arrangement, frequency and size [11]. Other transaction-based measures to determine online ad effectiveness is click-through rates, registrations, and purchases [8]. Media characteristics, informativeness, irritation, and entertainment provided by the ads are also factors that can influence ad effectiveness [5].

The lack of effective measures for online campaign evaluation, as well as, the exponential increase in the number of commercial websites - and consequently the increase

of available online advertising spots - raise the question: “Which advertising locations have to be chosen by an agent in order to optimize the effectiveness and maximize the visibility of an online campaign?” Currently, the answer to that question is ad-hoc, purely subjective, and is provided by advertising agents who typically choose the position based on their personal experience, non-informative web analytics and on the motto: “the higher the position of the ad on the page, the more effective it is”.

Similar with the rest of the world, Internet in Cyprus is now used as a mean of low cost targeted advertising. With more than 30 thousand Cypriot Websites and with Cyprus Web usage rising to 50,2% in 2010, online advertising is now the upcoming trend in advertising expenses in Cyprus. The increase in the number of commercial Cypriot Website, and consequently the increase of available online advertising spots raise the question: Which advertising locations has to be chosen by an agent in order to optimize the effectiveness and maximize the visibility of an online campaign? There are currently around 10 thousand available advertising positions and types of advertisements. Currently, online advertisement placement is highly subjective and is performed by an advertising agent who typically chooses the position based of his personal experience, generic statistical data and on the motto that “the higher the position of the ad on the page, the more effective”.

In this paper we present the results of a pilot study towards the implementation of a novel methodological framework for the evaluation of the effectiveness and the impact of online advertising based on the ad’s visibility. First we present an overview of online advertisement studies. Then we describe the methodology of the two studies: user evaluation with an eye tracker and the questionnaire given to marketers. Results are then presented and discussed.

## 2 Online Advertising

Online advertising is more popular and economical than traditional advertising methods. However, the effectiveness of internet advertising remains controversial. Comparing how well both forms of advertising (online vs. traditional) attract viewers’ attention is worth further research investigations. It has been reported in one study that online users are less likely than readers of printed media to register ads [10]. Others have argued that traditional principles in advertising do not apply to the web [4]. In traditional advertising the main focus is on the consumer’s attitudes and behaviors. This was also initially the focus in online advertising research as well; focusing on attitudes and behaviors towards ads, medium reliability, product involvement and website’s context congruity for example. This has however now changed. In terms of online advertising, the focus is now on issues of ad effectiveness, such as attention, display-ads advertising formats and visual design issues.

### 2.1 Ad Placement and Pricing

It has been reported by PricewaterhouseCoopers that advertising revenue reached \$5.1 billion in 2009, in the US alone. A total of 47% of that amount is represented in Internet advertising revenues. Display ads generated \$2.4 billion in the same period. The

IAB internet advertising revenue report (2012), conducted by PricewaterhouseCoopers, states that internet advertising revenue in the US reached \$17.0 billion, for the first six months of 2012. This represents a 14% increase over the first six months of 2011. Search and display ads generated the most revenue in the second quarter of 2012. Search revenues were estimated at \$4.1 billion and display-related advertising at \$2.9 billion respectively for this period. The auction-based pay-for-click advertising model has contributed to search advertising revenue growth [8]. Two differences between display-ad and search advertising relate to their design and placement. A search ad is text-based, has a title, description and a link to a landing page. Advertisers have little control over design elements, such as colour, animation and image. This is not the case in display advertising, where there is control over such elements. Display ads may be placed on any part of the web page, unlike search ads, which are placed on either on top or right-hand side of the search results. They are also displayed together with competing ads.

Online ad pricing is often based on placement, frequency and size [11]. Other transaction-based measures to determine online ad effectiveness is click-through rates, registrations, and purchases [8]. Web document arrangement is another factor that must be considered for pricing, as previously discussed by [11]. This is determined by the depth of a website on a meaningful path. Media characteristics, informativeness, irritation, and entertainment provided by the ads are also factors that can influence ad effectiveness [5].

Consumers' online shopping behaviors have also gained researchers' interest. Luo [8] focused on determining the impact of a search ad on brand attention. It is based on a user recalling a search and recognizing the brand that was displayed in that search ad. By determining this, it is then possible to examine the effect of search ad placement on brand recall and recognition. The theoretical lens of the limited capacity model of attention and theories of search behavior were considered. The study investigated three key variables for search ad recall and recognition: ad positioning, search ad keyword association and search result quality. Interesting results were that a top-positioned search ad did not generate more attention than a side-positioned search ad. Top-position ads have been regarded as the most marketable, with a premium price associated to them. The study questions whether this premium price is warranted and if it is actually worth being the highest bidder for all related keywords. They suggest a more cautious and uniform bidding strategy when perusing top-positioned ads at least. Interactions between keyword selection, search ad position, and search result quality must be considered by advertisers in their strategies. Defining semantically related keywords that can represent company brand however, will result in a bidding war between competitors. It is thus suggested that advertising budgets be used more wisely and creatively to identify relevant contextually related keywords instead. As a result, there will be less competition for those types of keywords, thus ads being displayed more often with the same budget [8].

Wang and Day [11] explored the changes in attention distribution on banners, as users' advances along a meaningful path, through an eye tracking study. Their findings indicate that web document arrangement can be more efficient if the most interesting content is placed in either the earlier or later phases, while material more demanding of mental resources is placed in the middle phases. This is based on the notion that

when following a path, user attention is not the same at every point in time. The user's peripheral vision is more sensitive at the earlier and later phases of the path. This vision declines in the middle phases of the path, resulting in side ads being mostly ignored in this phase. Consequently, pricing of ads should also be based on the depth of the webpage on a meaningful path [11]. Conventionally, pricing has been determined on the basis of placement, frequency and size. The findings suggest that web document arrangement is important too. To induce user interest the most intriguing content should be displayed in the early and later phases. Only once the content has captivated the user does it make sense to present material which is more demanding of mental resources, as user attention is already high.

## 2.2 Attention Evaluation

Ad type also has a significant impact on ads being noticed. Therefore, investigating ad types has also been area of prime interest for the research community. The effect of different ad types on users' attention, intrusiveness and ability to remember these was the focus of [9] investigations. Results indicated that participants who were exposed to ads were 11% less likely to visit or recommend that particular website. Lin and Chen [7] concluded that in addition to ad type, ad position and animation length significantly impact user's attention. In this study, the click-through rate for advertising effectiveness was examined. The aim was to determine the effects of design factors on animated on-line advertisements. An eye tracker was used to monitor users while browsing websites. Results indicated a logistic regression model with an order effect. A significant interaction effect between the ad type and the ad position was also observed. Lastly, there was an interaction between ad position and animation length.

The effect of animation and ad format on the attention and memorization of on-line ads has also been investigated in [6]. This study was conducted in the context of consumer perception and processing of advertising. Eye tracking was used to measure consumer attention in a variety of real-world ads. Recognition and recall tests were used to assess ad memory. The results indicated that animation had little or no effect on attention. This is its main advantage, as memory evaluation tasks can be executed without requiring participants to clearly recall test material. In essence it involves reminding the participants by providing them with cues within the environment. Recall tests however is based on recalling information from memory without assistance from an external source. Recognition tests are usually easier than recall and were also applied in Hsieh and Chen's study [4]. As an example consider a GUI interface in comparison to a command line interface. GUIs are easier to use because they do not require the user to remember commands, as is the case of a command line interface. Buscher et al. [1] used an eye tracker to investigate how people view and interact with the results of search engines. Factors that were found to influence the viewing behavior are task type, ad quality and the sequence in which ad quality is alternated. To determine what makes a web page appealing for generation Y users an eye-tracker was used to follow the eye movements of the users, as they browsed selected pages [3].

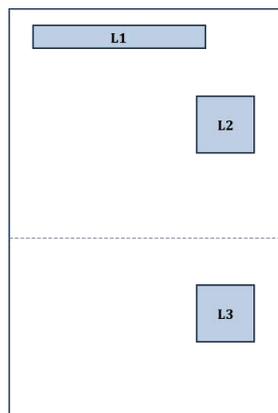
However, an interaction effect between animation and ad format was observed. This suggests that the animation effect is conditioned by the ad format. Similar results were discovered in Lin and Chen [7] investigations as well. Furthermore, animation on

skyscrapers had a positive effect while on banners it was negative. Yet, improved recognition was observed on banners containing animation.

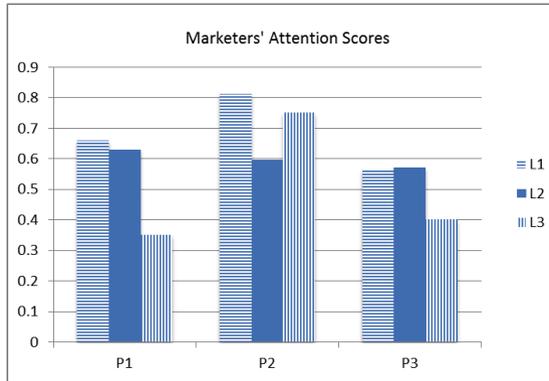
In Castagnos and Pu's [2] consumer behavior and decision support systems' study, the selected decision entities and information entities were observed, as consumers searched for products. The eye-tracker followed the consumers gaze, and to analyze their eye movements, heat maps were applied. This aided the process of determining where their eyes fixated the most. Access logs that contained the time users spent on each webpage and the clicks they made were also used for data collection.

### 3 Methodology

Two studies were performed in order to investigate marketers' and user's advertisement perception and attention. Both are used as pilot studies towards the design of the final study that will be used for the framework implementation. This section presents the methodology of both studies that included eye tracking and questionnaire techniques. Stimuli were three Cypriot websites with advertisements of various types and locations: ads being static and animated, ad types being skyscraper and banner and ad location varied around the page. An eye-tracking platform was used to collect gaze points and fixation of participants while navigating each webpage. Subsequently, a number of eye-tracking statistics were calculated based on the fixations in each area of interest. These statistics include a percentage of visitors attending to the ad, time to first fixations and attention-bounce rate (percentage of single-fixation glance at the ad). The websites and advertisements shown will not be named and instead special coding will be used throughout the paper. However, as all three pages had the same layout, advertisements shown and locations that were examined followed the schema that Figure 1 shows. The dotted line divides the page into the two sections: above and below the fold.



**Fig. 1.** Website Schema representing the three locations



**Fig. 2.** Marketers' Perceived Attention Scores

### 3.1 Study I: Marketers' Ad Perceived Attention with a Questionnaire

The questionnaire study was performed during a local marketing conference. Eighteen (18) marketing managers from various Cypriot companies were given a questionnaire to complete. They were given three (3) screenshots of Cypriot websites and three advert placements on each page were highlighted and empty. Each Marketer was asked to select one location on each website that they would place a given ad. The given ad had a travelling theme and was the same for all participants and for both studies. Then they were asked to provide the percentage of views (impressions) they feel that, based on their experience, will actually attend to the advertisement at the selected location. The score indicates the perceived value of the particular location to the Marketer. For example, if a Marketer specifies a score of 80% indicates that the marketer anticipates a 20% of paid inventory to be unnoticed. Moreover, the Marketer is willing to accept the fact that 20% of his paid impressions will not be seen.

### 3.2 Study II: User Ad Attention with an Eyetracker

Eyetracking allows us to carefully follow and analyze what is being looked at and when it is being viewed. The second user study aimed to understand users' advert attention on the three locations for each examined website with the use of an eyetracker. The study took place at the Cyprus University of Technology and participants recruited were aged from 21 - 50 and included staff and students. During the study, 80 participants took part on the eyetracking study. Eye movements were recorded during the experiments with an eye tracking system developed in-house.

The participant was placed in front of the computer and after the eyetracking calibration was asked to browse through the Webpage. There was no specific task to complete as advert attention should be affected by any reason. So the participant was asked to browse the page as he would navigate on his own time. Maximum time for each page was limited to two minutes. Each participant looked at all three webpages but the examined advert was shown on only one of the three locations on each page. The website

**Table 1.** Data collected from Marketing Questionnaire

Location	Pages							
	P1		P2		P3		Total	
	N	Attention (%)	N	Attention (%)	N	Attention (%)	Avg. N	Avg. Attention (%)
L1	6	65.8	4	81	7	56	17	68
L2	10	63	12	59.5	10	57	32	60
L3	2	35	2	75	1	40	5	50

The number (N) of Marketers' who selected each location per page and their average perceived attention for each location per page.

shown was the live version and the advert in question was injected on one of the three locations randomly keeping the balance between the three locations. Stimuli (webpages and advert creation) were the three pages that were given during the marketers' questionnaire.

### 3.3 Data Analysis

The study findings are discussed with respect to the attention that users gave to the advert on the three locations and three pages in relation to the marketers' perceived attention. Then we discuss how this relates with the actual budget that an advertisee will need to spend or ends up overpaying. During the two studies data collected included gaze points, fixations of participants, percentage of visitors attending to the ad, time to first fixations and attention bounce rate and marketers' percentage of perceived attention.

Table 1 shows the cumulative data as per the marketers' location selection. Attention column represents the average attention percentage that the marketers gave for the associate location and page. N represents the total number of the participants that selected the associated location for each page. It is important to note that L2 was selected the most throughout the three pages with an average of 60% perceived attention. This means that most of the marketers would place an ad creative on the second location which is on the right hand side and above the fold of the page and would expect an attention of 60%. On the other hand, the highest attention score was given on the first location even though the specific location was not selected.

Figure 2 shows the scores that each page and location received as per the advertising experts' opinion and perception. Location L2 received almost the same attention score throughout the page. This shows that marketers expect that this location is consistent throughout the pages and "secures" a 60% attention score. Further, L3 receives consistently the lowest score between the three locations for each page. This implies that there is a perception of less attention between the above and below the fold page areas.

During the eyetracking study data collected and used for quantitative analysis included gaze time, dwell time, and first fixation. Table 2 shows the data as per the location per page with a focus on the number of users that actually saw the investigated ad in a percentage score. The rest of the scores are averages between the users as given by the software.

**Table 2.** Data collected from EyeTracking Study

Website	Location	Users Actual Attention	Time to See Effectiveness	Dwell (seconds)	Observation Length
P1	L1	73.68	70.7	32.260788	2085
P1	L2	36.67	34.31	6.567597	597
P1	L3	26.1	19.75	4.7165502	786
P2	L1	44.44	43.52	1.7078292	427
P2	L2	63.64	49.32	1.890108	270
P2	L3	41.67	33.68	1.050084	210
P3	L1	73.9	72.64	12.6445228	658
P3	L2	45	42.08	8.136	904
P3	L3	34.8	26.27	3.719721	465

Eyetracking data per page and location: User's actual attention

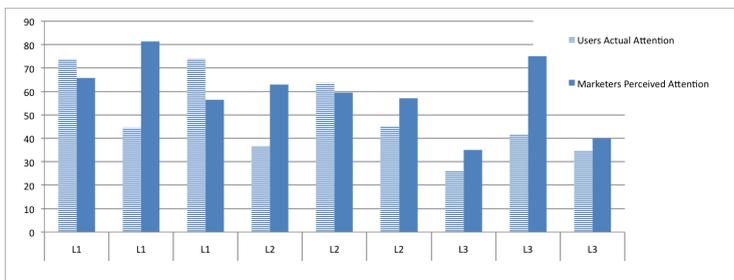
**Fig. 3.** Marketers' Perception vs Users Actual Attention Scores

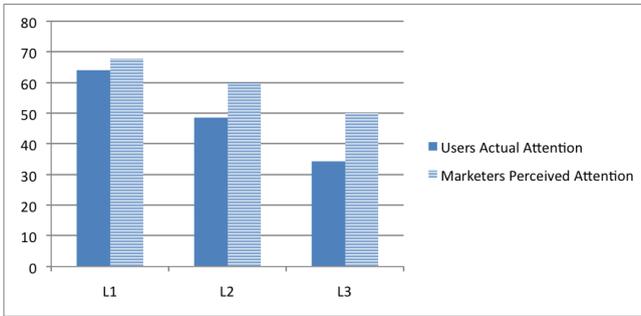
Figure 3 demonstrates the two attention scores collected from marketers and users respectively. One can easily notice that out of the 9 scores given only two of them are lower than the actual users' attention. This implies that marketers tend to overestimate the attention that an advert will receive. In order to notice the difference between the three locations, the average of all three pages was used to draw the chart shown on Figure 4. As the figure shows, marketers have a correct understanding of the overall attention flow but they overestimate the amount of attention that the location will receive. In addition, it is important to note that L3 receives the least attention, something that was concluded previously as well.

In order to interpret the location attention overestimation from marketers with respect to the budget, each location was assigned a Cost Per Mille (CPM). The CPMs used were based on the amounts that one of the page advertises and are: L1:€5, L2=€7 and L3=€2. Table3 lists the difference in the two attention scores as well as the respective cost difference in money-wise. Figure5 demonstrates this difference in cost and attention perception. As the figure demonstrates, even though the highest attention discrepancy is on the third location, the highest cost in the second location due to the most expensive CPM. As most advertisers will tend to select the second location, advertisers will make more money due to this location.

**Table 3.** Comparing Marketers’ Perception and Users’ Actual Attention

Locations	Users Actual Attention	Marketers Perceived Attention	Discrepancy	Overpay	CPM
L1	64	67.8	3.82	19.1	5
L2	48.4	59.9	11.4	80	7
L3	34.2	50	15.8	31.6	2

Users’ and Marketers’ attention per location demonstrating the difference in attention and budget allocation



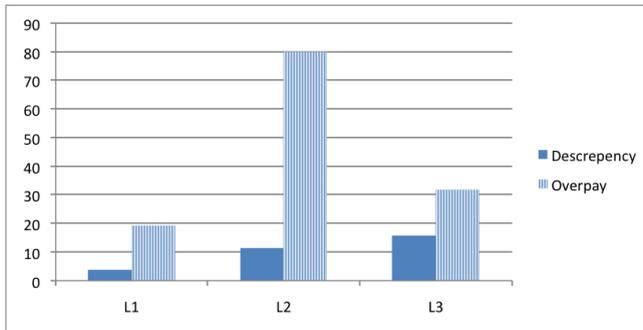
**Fig. 4.** Marketers’ Perception vs Users Actual Attention Scores per Location

#### 4 Discussion and Future Work

As the data revealed, location L2 was selected the most throughout the three pages with an average of 60% perceived attention even though the highest perceived attention score was assigned to the top location, L1. This shows that even though the top location would receive the highest attention, marketers tend to select the right hand side location. This aligns with other studies that users and potential customers tend to recall and recognize adverts that are on the same area with the main content of the page as their peripheral vision “looks” on the creative for a better qualitative time. Further, data showed that there is a perception that adverts placed below the fold of the page do not receive much attention and they are not selected to be presented. This is also supported with the eye tracking data.

The eye tracking evaluation revealed an interesting observation: *Marketers tend to overestimate the attention each ad location receives and underestimate its true cost.* As per the results there is a discrepancy between the marketers’ perceived attention and the actual user attention on the adverts. Transforming this discrepancy with the allocated CPM per location reveals that advertising on the middle of the page costs more and with the highest discrepancy. This result should be noted by both marketers and advertisers in order to provide and distribute their budget on the right locations.

One of the limitations with this study was that the eye tracking study was performed on the live sites. This caused the injection of the advert to fail on some cases limiting the number of participants that saw the specific site. However, both pilot studies will be followed by an extensive and bigger in sample size in order to collect more data. This will provide more robust conclusions to implement the prediction framework. For



**Fig. 5.** Score and Budget Descrepancy

example, data will provide the impact of location, ad creation type, ad size and website content in relation to user's attention and perception.

## 5 Conclusions

This paper presents the pilot study of a project for which the main aim is to implement an evaluation methodology service for the identification of the best locations on Cypriot web space based on eye tracking studies. This study demonstrates the correlation between user attention, advert types and actual market value.

Further data are being collected in order to form more robust conclusions. However, this pilot study revealed conclusions that could form the basis towards predicting ad effectiveness of webpages with the use of ad number, location, size, and type. The results of the project will be based on a large sample of eye-tracking measurements (500 participants, on 2000 advertising location in top performing Cyprus websites). The methodology combines factors such as the advertising budget, target audience, advertising spot pricing, internet reach, and a number of eye-tracking metrics in an optimization framework to pin-point the best campaign placement allocation.

Currently, online advertisement placement is highly subjective and is performed by an advertising agent who typically chooses the position based of his personal experience, generic statistical data and on the motto that "the higher the position of the ad on the page, the more effective". Questions such as "Which advertising locations has to be chosen by an agent in order to optimize the effectiveness and maximize the visibility of an online campaign?" will be answered using this framework. This innovative project would benefit anyone who want to advertise on the Web since it will be based on factual research with an eye tracker and volunteers from Cyprus. Advertising will now be based on facts, not just speculative statistics. The outcome of this project will help the future of advertisement on the Web. Eyetracking should be used as an alternative medium of examining and developing the most effective advert campaign, ensuring that users will look on the ad and money spent are worth spreaded throughout the websites.

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