



School of Management
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Key Success Factors in Internet Advertising

**- With emphasis on Online User Activity
and the Social Context**

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Abstract

Internet advertising (also known as *online advertising*) is the delivery of advertising messages and marketing communications through the Web. It has presented sustainable revenue growth since its inception in the mid-1990s. Internet advertising takes a multitude of forms, ranging from the “traditional” banners to today's rich media ads. Due to its wide success, internet advertising currently constitutes a significant marketing channel for a large number of firms, ranging from news agencies to car manufacturers and retailers, and it is thus gradually gaining attention in the context of marketing communications strategy planning and implementation. However, there has been relatively little empirical research and actionable knowledge on the factors that affect the success of online advertising. Consequently, when relying on insufficient knowledge to make decisions about their internet marketing strategy, companies run the risk of missing marketing opportunities or damaging their image.

To this end, the work presented in the context of this thesis attempts to make a number of contributions to the body of actionable knowledge pertaining to the planning of internet advertising campaigns for a company. More specifically, this report aims at analyzing the impact of *the type of online user activity* as well as of the user's *online social context* on the effectiveness of internet advertising. The objectives of the thesis are pursued through the design and implementation of an online experiment that simulates four types of online activities that are popular among today's plethora of Web 2.0 applications. Such activities range from “traditional” ones, for example online article reading, to recently adopted, for instance photo tagging, social bookmarking and messaging. In addition to the role of online activity type, the experiment plans to investigate the impact of a user's social context, that is the role of a user's online social network on his/her receptiveness to internet advertising.

Starting from the study of the most influential research works in the area of internet advertising effectiveness and following the principles of their experimental methodology, an online experiment was designed and implemented that collected input from a set of 87 users. The analysis of the obtained input reveals significant correlations between the type of online activity of users and the effectiveness of internet advertising. Furthermore, there is evidence that the content of a webpage and the degree of its congruency to the advertising content play a significant role on the impact of online advertising.

Keywords: online advertising, online user activity, user cognitive mode, advertising effectiveness, brand recall, priming study, social context

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Glossary / Acronyms

API	Application Programming Interface
CTR	Click-Through Rate
GWT	Google Web Toolkit
IAB	Internet Advertising Bureau
RIA	Rich Internet Application

1. Introduction

This thesis aims at the study of the effectiveness of internet advertising under the perspective of online user activity and online social context. At the outset, this Section provides some background on the increasingly significant topic of internet advertising, as well as on a series of related issues that have motivated this work. Subsequently, the scope of the presented research work is delimited and the report structure is described in order to prepare the reader for the core research discussion of the following sections, which comprises the related research area, the particular problem formulation, as well as the adopted methodology for the study of the posed research questions.

1.1 Context and Motivation

Internet advertising, that is the delivery of advertising messages and marketing communications through websites, has presented sustainable revenue growth since its inception in the mid-1990s (Hollis, 2005). Internet advertising takes a multitude of forms, ranging from *Search advertising* to *Banner* and *Rich Media Ads* (i.e. ads that incorporate sound, animation and interactive elements). According to the latest annual report issued by the Internet Advertising Bureau (IAB) and conducted by PricewaterhouseCoopers (Internet Advertising Bureau, 2009), online ad sellers have reported aggregate revenues totaling \$23.5 billion for 2008 compared to \$21.2 billion for 2007. In addition, since the third quarter of 2002, revenues have increased 22 out of the past 25 consecutive quarters, which reveals a clear upward trend and increasing significance for the field. The increasing trend of ad revenues is clearly illustrated in the revenue diagram of Figure 1, which has been copied from (IAB, 2009).

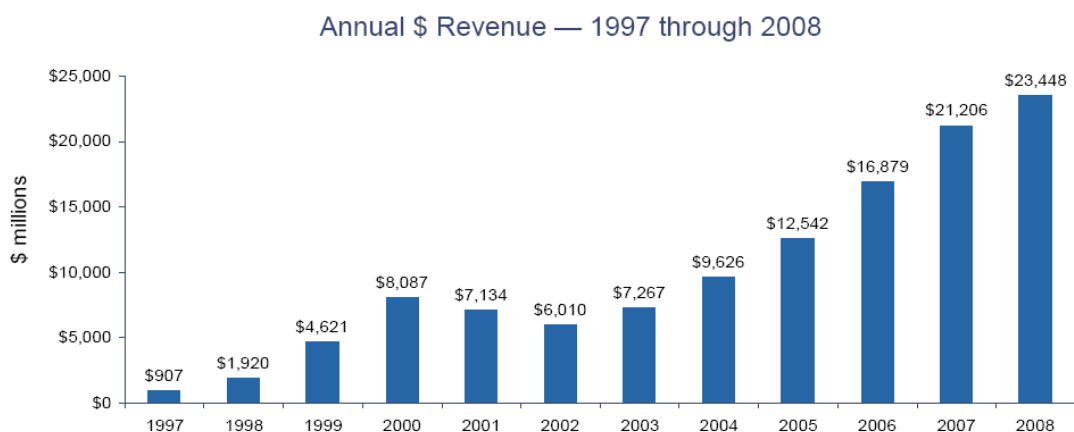


Figure 1: Annual advertising revenue from 1997 through 2008 [taken from (IAB, 2009)]

The prevalent means of internet advertising are *Search and Display Related Advertising*, which together are responsible for more than 70% of the total ad revenues (IAB, 2009). Search Advertising involves two basic methods, namely *paid listings*, where text links appear at the top or side of search results for specific keywords and *contextual search* where text links appear beside an article based on the context of the content. Throughout the thesis, we will refer to such text-based ads as *sponsored link* ads. An example of a sponsored link ad is presented in Figure 2.



[Top 100 New York Events](#)
Top NYC **Events** Listing Exclusively
at clubZone! Info, Tickets & VIP
www.clubZone.com/NewYork

Figure 2: Sample advertisement of type sponsored link

Alternative formats of online advertisements range from the well known banners, to advertisements that incorporate animation and sound and even to digital video commercials. Regardless of the particular ad format, displaying advertising content to online users is driven by two major objectives: (a) build new or reinforce existing brands, and (b) stimulate purchases. For that reason, the success (or effectiveness) of internet advertising has been traditionally measured by means of the *number of clicks* attracted by the ads (*direct* or *behavioral* response), commonly operationalized by means of the well-known *Click-Through Rate* (CTR), which is defined as the ratio of the number of clicks over the number of impressions. In addition, many advertising experts argue that the mere exposure of online users to the advertising message can be beneficial in terms of building brand awareness (Flores, 2000) and increasing purchase intentions, which is termed as *attitudinal* ad response (Hollis, 2005). To measure ad success in these terms, it is necessary to set up controlled experiments and measure the *brand attitude*, *recall* or *purchase intention* rates that can be achieved for particular brands by test subjects. The Thesis adopts the latter method (attitudinal response) to quantify ad effectiveness.

1.2 Scope of Thesis Research

The Thesis investigates the role of two factors on the effectiveness of online advertising, namely (a) *online activity type*, for instance article reading, picture tagging, social bookmarking and message exchanging, and (b) *social context*, that is the perceptual influence that the friends of a user as well as their online behavior have on his/her attention and processing of advertising content within a Web setting.

The decision to delve into the role of these two factors on the impact of online advertising was mainly driven by the widespread success of highly interactive web applications which incorporate social features, commonly known as Web 2.0 applications. Internet users spend increasing amounts of time and attention to the content and features of such applications (Gangadharbatla, 2008). Therefore, it is expected that such applications will constitute one of the main online marketing channels in the coming years. A list of such applications together with their websites is provided in Appendix C.

1.2.1 Online activity type

Online activities can be classified to types based on the nature of the task they involve. In the early days of the Web, the sole online activity that could be performed in the context of the browser was web page browsing, that is seeking and consuming information. The advent of *Rich Internet Application* (RIA) technologies, such as AJAX and Silverlight, has resulted in a multitude of new activities that can be performed online. Typical examples of such activities are picture browsing, article reading and rating, video watching, reading and writing emails, etc. It is natural to assume (based also on previous related studies) that the receptiveness of users to advertising messages will vary greatly depending on the type of online activity in which the user is involved. Thus, part of the thesis work was devoted to the investigation of whether *the effectiveness of internet advertising depends on the type of online activity that a user is engaged in* while being exposed to the advertising message.

1.2.2 Social context

In this thesis, the social context of users is considered with reference to some Web application that incorporates social networking features. Within such applications, which are frequently denoted by the term *Social Web* applications, users form and maintain online friendships and carry out a host of social activities online. In this setting, the social context of a user pertains to the set of influential forces that act on him/her as a result of his/her friends' behavior and actions.

A common feature of Social Web applications, such as Facebook, is their attempt to create viral phenomena by means of making their users aware of what their online friends are doing (e.g. what they read, what they like, etc.). For that reason, part of the thesis work will address the question of whether *such kinds of mechanisms can be used to improve the effectiveness of internet advertising*. Also, the Thesis looked into the question of whether a message exchange application (i.e. a social web application) can affect the receptiveness of internet users to online advertising.

Although substantial research has been devoted to the study of internet advertising effectiveness as a result of different factors present in the online environment during the reception of the ad message (Burns and Lutz, 2006; Dahlén, 2002; Danaher and Mullarkey, 2003; Lohtia et al., 2003), no previous work could be identified that focused on the impact of the aforementioned two factors on the effectiveness of online advertising. Taking into account that a multitude of digital activities (e.g. applications) are now available through the Web and that many of those activities involve social networking features, one can imagine that internet advertising planners should be informed of how these novel Web aspects affect the success of online advertising.

The Thesis objectives were pursued through the design and implementation of an online experiment that simulates some of the online activities that are popular among users of well-established Web 2.0 applications, such as Facebook, Flickr, Digg and Delicious. A set of predefined sponsored link ads (advertising fictitious brands) were displayed to the users during their engagement in these activities and their attitudinal response to these ads was measured after completion of the experiment.

1.3 Outline of the Thesis

After introducing the context and motivation of the Thesis, as well as its scope, this report continues in Section 2 with a presentation of the most prevalent research works on the topic of online advertising effectiveness. The present work is positioned in relation to these works and the specific research hypotheses are formulated. Subsequently, Section 3 details the experimental design that was devised for the primary collection of user data. Section 4 presents the analysis of the collected user input and summarizes the main findings of the study. Finally, Section 5 concludes the Thesis. Following the Conclusions, a list of References and three Appendices are provided: the first Appendix presents a series of snapshots from the experiment website, the second Appendix contains a list of the experiment participants and the third provides a list of popular Web 2.0 applications that have been referenced throughout the document.

2. Literature Review and Problem Formulation

This section presents a summary of the main research findings that have been identified in the literature with respect to the factors that affect the effectiveness of internet advertising.

During this discussion, the thesis scope is related to the one of existing works and the points that differentiate the thesis research from them are highlighted. The section concludes by framing the research problem of interest in terms of a set of concrete and testable hypotheses.

2.1 *The Study of Internet Advertising Success*

Modern literature on internet advertising abounds with theoretical constructs as well as empirical works that investigate the role of a series of factors in the success of internet advertising campaigns. Before proceeding with the discussion of what factors are considered significant in this context, it is necessary to present the most significant measures employed in these works to quantify advertising effectiveness.

2.1.1 *Quantification of advertising effectiveness*

The typical research paradigm adopted when attempting to investigate the effectiveness of some advertising scheme involves a forced exposure to some advertising message followed by some measure of consumer response (Pavlou and Steward, 2000). The assumption behind this paradigm, according to Pavlou and Steward (2000), is that advertising has a direct effect to consumers and therefore advertising is considered as the independent variable, while *consumer response* to advertising is the dependent variable. The authors state that such an assumption is not sufficient in the context of today's highly interactive environments and, that additional factors, such as the online context where advertising takes place, should be taken into account in order to render the studies of advertising effectiveness more insightful. To this end, the Thesis hypotheses incorporate several aspects of the online context such as the type of online activity and the user's social context in the study of the user response to online advertising.

Since the inception of internet advertising, a series of *operational* measures were employed to quantify the effectiveness of advertising campaigns. Common operational measures range from the simplistic *number of impressions* or *exposures* (number of times an ad was displayed to users) to the widely established *Click-Through Rate* (CTR, ratio of the number of click-throughs to the number of impressions). CTR has been considered as the predominant way to measure the performance of online ads. However, there has been a steady decline in the reported CTR levels through the last years; the declined CTR figures (reported

to be below 0.5%) have been mainly attributed to the fact that online users avoid looking at the ad items during browsing (Drèze and Hussherr, 2003).

A more sophisticated measure of online ad effectiveness is the *number of post-impressions* that is the number of visits to a website, after exposure to an internet advertisement, without clicking through the advertisement (Rettie et al., 2004). This measure captures both the direct performance of the ad message and the subliminal effects that this message may have on the online user. However, post-impressions are hard to track and miss some aspects of advertising effectiveness, for example the attitudes of users towards the advertised brand.

For the aforementioned reasons (viz. declining CTR and difficulty in tracking post-impressions), traditional memory-based measures of advertising effectiveness have been revived in the context of internet advertising. Such measures reflect the *attitudinal* response of online users to the ads displayed to them. *Unaided* and *aided recall*, *brand recognition* (Drèze and Hussherr, 2003), *purchase intention*, as well as *purchase consideration sets* (Yoo, 2008) are suitable measures for quantifying the effect of online ads to the user, assuming that some unconscious ad processing takes place during the pre-attentive webpage viewing (Shapiro et al., 1997). Yoo (2008) differentiates between explicit and implicit memory and notes the different measures that are suitable to quantify the effects of web advertising on them¹: recall and recognition tests measure the extent to which web advertising affects the explicit memory of consumers, while *priming* studies quantify the implicit memory effects of advertising.

Priming studies constitute a significant class of ad effectiveness measurements (Grimes and Kitchen, 2007). Priming refers to the exposure of a person to some prior event / stimulus, the prime, that results in increased accessibility of information related to this stimulus (Mandel and Johnson, 2002). Three types of priming are considered by Grimes and Kitchen (2007): (a) *feature priming*, which tests the accessibility and readiness of the priming information, for example by means of word-completion tests, (b) *semantic priming*, which investigates the possibility for semantic changes in implicit memory through the measurement of reaction times to stimuli following semantically related primes and (c) *categorical priming*, which looks into implicit associations between categories, for instance implicit attitudes to brands.

¹ The author states that explicit memory is affected as a result of directed attention to ads, while implicit memory traces are formed independently in reduced attention mode. The Thesis adopts a different stance by considering that the implicit and explicit memory formation processes take place simultaneously during an online activity.

The experiment conducted in the context of the Thesis focused on two measures of advertising effectiveness: (a) aided brand recall, to provide evidence on the extent of conscious ad processing which takes place by online users, and (b) categorical priming, implemented as a brand-product category association test, in order to quantify the implicit memory effects of online advertising.

2.1.2 Factors affecting the effectiveness of internet advertising

Rodgers and Thorson (2000) introduced a model comprising a series of factors with an influence on the processing of internet advertising by the consumer. Fundamentally, they distinguish between *functional* and *structural* elements in their advertising model. Functional elements pertain to the motives of online users and their behavior within the online setting, i.e. they revolve around the user (who also happens to be the advertising target) of the online application within which advertising takes place. On the other hand, structural elements of advertising concern the physical presentation and format of the ads, for example their position on the screen, size, type (banner, sponsor link, pop-up), and so forth.

The effect of *page viewing duration* was established as a major factor affecting brand recall in the study described in (Danaher and Mullarkey, 2003); more specifically, the longer a user was viewing a page, the more likely the user would remember the advertising material on this page. In the same study, the influence of additional factors, such as background complexity, was found to be insignificant, while the *user viewing mode* (*goal-directed* vs. *exploratory*) appeared to affect ad recall, i.e. people in goal-directed mode were less likely to remember the advertising material they had been exposed to. Related findings were gathered by the study of Dahlén (2002), where the product type (functional vs. expressive) and number of exposures were found to significantly affect user response as measured in terms of CTR. In our study, we implicitly consider the user viewing mode through the investigation of the role of user online activity on advertising effectiveness. The role of product type and number of exposures is out of the scope of this thesis.

The impact of *banner ad design elements* (color, animation) and the provision of incentives through the advertising message on the achieved CTR were investigated in the work of (Lohtia et al., 2003). The study differentiated between Business-to-Consumer (B2C) and Business-to-Business (B2B) advertisements. It was found that incentives and interactivity have a negative impact on CTR. The presence of emotions was found to have a positive influence on the CTR of B2C ads and a negative one for B2B banner advertisements. Medium

level of color resulted in the optimal CTR performance. In general, B2B presented a higher CTR than B2C advertisements. Another study provided evidence on the effect of *the type of advertising material* (inline, pop-up, pop-under) on user perceptions regarding the attractiveness of the web pages (McCoy et al., 2007). Users appeared significantly more frustrated by the intrusiveness of pop-up and pop-under type ads in comparison to the inline ads. Also, they exhibited higher brand recall levels when the ad material was congruent with the website content. Another study focused on the *format of online advertising* revealed different user attitudes towards ad formats, e.g. users perceived pop-ups as more annoying and skyscraper ads as more informative (Burns and Lutz, 2006). Compared to the aforementioned works, our study attempts to mitigate the effect of design elements and ad format in the online environment of the user by using text-based advertisements and neutral design elements.

Regarding the role of social context on advertising effectiveness, most prior work has concentrated on the topic of word-of-mouth / viral marketing effects. For instance, an online recommendation network is studied in (Leskovec et al., 2007) and the observation was made that online recommendations are not as effective as would be expected by epidemic or innovation diffusion models. In contrast, Richardson and Domingos (2002) find that viral marketing can lead to considerable profit increase over direct marketing when the social ties between individuals of a knowledge sharing network are taken into account to devise the marketing plan. Such studies study social context under a different perspective compared to this thesis, since they do not focus on the “conventional” online advertising mechanism (implemented through sponsored link ads), but investigate the viral processes taking place on online social networks.

A recent study has dealt with the impact that a user’s social network may have on his/her response to internet advertising. More specifically, the work in (Bagherjeiran and Parekh, 2008) provides evidence to support the claim that social links are correlated with ad response rates (measured by means of CTR) and whether they can be used as predictors of these rates. Compared to this, the experimental study conducted within this thesis attempts to uncover associations between social context and implicit ad response.

2.2 Problem Statement and Hypotheses Formulation

People resort to online activities to satisfy several of their needs or to pursue some of their goals. Since RIA technologies enable rich functionality to be delivered over the Web, today's internet users engage in online activities of a varied nature, for instance information seeking (through a search engine), entertainment (by watching video clips or playing online games), keeping up-to-date (by reading news), communicating with each other (through some online social network), and so forth. Lately, a series of activities have also become popular that involve intensified user participation and interaction, for example creating and uploading their own content (pictures, articles) or rating and commenting on online content uploaded by others; such activities are often framed by use of the term *Web 2.0*, which additionally entails connotations to the social aspects of web usage, that is the online social context of internet users.

Since previous research on the topic of advertising effectiveness has revealed connections between user related, as well as online-environment residing factors and the effectiveness of online advertising, one could hypothesize that a connection exists between the type of online user activity and the effectiveness of the advertisements that are displayed during this activity. Such a hypothesis is particularly pertinent to the business model of a host of popular Web 2.0 applications, such as Flickr, Digg and Delicious, which attract millions of users on a daily basis.

At the moment, the following activities are considered for investigation:

1. *Article reading and rating*: Article reading has been a common online activity since the first years of the Web. In the recent years, this activity has been enriched by rating and commenting features, that is the reader is endowed with the capability to express his/her opinion on the article and rate it according to some given scale.
2. *Picture browsing and tagging*: Once broadband internet became commonplace, online users were increasingly attracted to photo sharing and organizing web applications, such as Flickr. These applications enable their users to upload their own pictures and organize them by attaching *tags* (keywords) to them. Most of the times, users share their pictures with the rest of the online community or at least with their online friends.

3. *Social bookmarking*: This activity involves the collaborative collection of interesting hyperlinks and their access through a common application. When users discover some interesting webpage, they can submit this hyperlink to a social bookmarking service so that they can refer to it at a later time. Other users can give the thumbs up or thumbs down to such links, thus leading to an online barometer of website popularity. Two popular examples of social bookmarking sites are Delicious and Digg.
4. *Message exchanges between online friends*: Traditionally users have resorted to instant messaging applications, such as ICQ and MSN Messenger for exchanging messages between each other. Lately, a popular way of conducting this activity is by means of social networking applications such as Facebook, where a user can either send private messages to his/her friends or even post a message to their “wall”, so that they are visible by the rest of his/her friends.

A primary hypothesis that the thesis will investigate was stimulated by previous research on the effect of the user mode (goal-directed versus exploratory) on attitudinal response to ads (Danaher and Mullarkey, 2003). We hypothesize that article reading and rating as well as social bookmarking involve more reasoning and mental skills than picture browsing and message exchanges between friends. Therefore, our first set of hypotheses concern this distinction.

H_{1a}. Users engaged in article reading and rating will present lower ad recall rates than users engaged in picture browsing and tagging assuming that during both activities the ad stimuli remain the same (in terms of both content and position on the screen).

H_{1b}. Users engaged in article reading and rating will present lower ad recall rates than users engaged in message exchanges with their friends under the same assumption as in H_{1a}.

H_{1c}. Users engaged in social bookmarking will present higher ad recall rates than users engaged in picture browsing and tagging under the same assumption as in H_{1a}.

H_{1d}. Users engaged in social bookmarking will present higher ad recall rates than users engaged in message exchanges with their friends under the same assumption as in H_{1a}.

An additional hypothesis that the thesis will test was driven by previous research regarding the unconscious processing of ad exposures (Drèze and Hussherr, 2003; Yoo, 2008). Among the online activities described above, one can distinguish picture browsing as different from the rest, since picture browsing stimulates visual analysis processes in the brain of the subject. Consequently, the effect of peripheral website elements (such as ads) will be different in the case of picture browsing than in all other activities.

H₂. Users engaged in picture browsing and tagging will present different priming response than users engaged in article reading and rating, social bookmarking and message exchanges with their friends under the same assumption as in H_{1a}.

An additional aspect of unconscious ad processing that the Thesis will investigate is whether *congruence* between the main page and the ad content affects the priming response of users to the advertising message. Previous studies conducted on traditional media (TV and print news) have suggested that under certain conditions the appreciation and congruence of ad context can affect ad content and brand recall (De Pelsmacker et al., 2002). Previous studies have demonstrated that affective response towards a target object (viz. brand) could be affected by mere exposure to a target-related stimulus, that is preferences are partly formed without conscious processing of stimuli (Zajonc, 1980). For that reason, we expect that even when online advertising is not consciously attended by a user, its effectiveness will depend on its congruence with the context (webpage) where it appears. For instance, users exposed to an advertisement about an mp3 player when they read an online laptop review are expected to develop more favorable attitudes to the mp3 player compared to the case that they were exposed to the same ad during reading an article of a completely different topic (e.g. soccer).

H₃. Users exposed to advertising during an online activity will present increased priming responses when the advertising is congruent with the activity content than in the opposite case.

The next hypotheses of this study have been driven by the work of Ramanathan and McGill (2007), which indicates that at the presence of others, consumers are likely to be affected when evaluating products, that is there is an element of mimicry and contagion in product consumption. Stimulated by this observation, we expect that the awareness of a friend's online activity (i.e. a kind of online presence) will affect the receptiveness of individuals to the advertising message.

Assume that you are reading a review article about a new car and at the top of the article you read the message “Your friend George has also read this article and found it useful.” Then, your response to the advertising material beside the article may be different compared to the case that you would receive no such message by your friend. This hypothesis is based on the assumption that the knowledge of endorsement by a trusted person about a piece of information (article) lends credibility to both this piece of information and its surroundings (advertisement). More specifically, the testable hypothesis is formulated as follows:

H₄. If a user is made aware of the fact that one of his/her online friends performed the same online activity (e.g. read the same article) as the one he/she is currently involved, he/she is more likely to develop a positive attitude towards the advertising material accompanying the current online activity compared to the case that he/she would perform this activity in isolation.

Further, imagine a web application offering the functionality of personal message exchanges. If an advertising message is displayed in proximity with the last message left by a friend, then the impression of the user towards the advertised object will improve. More specifically:

H₅. If the advertising message is placed close to the name of a user's online friend from whom the user is receiving some notification, the user will present increased purchasing intention towards the advertised object than in the case where the message would be placed in its typical placeholder (Figure 3).

Although this hypothesis may seem obvious, it could actually lead to the reverse conclusion; that is the impression of the user of the particular object deteriorates. This could be the result of the advertising message being perceived as an obstruction between the user and his/her online friend (or even worse as a conscious recognition by the user that an attempt is made by the advertiser to exploit his/her friendship).

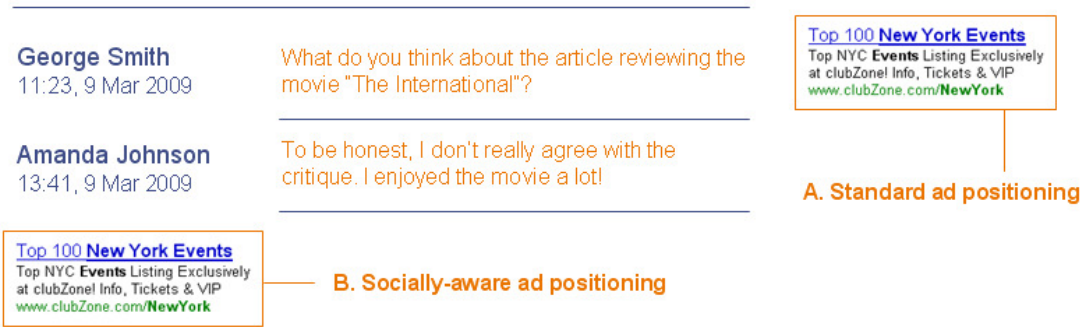


Figure 3: Exemplary alternative positioning taking into account the social nature of web users.

3. Experimental Design

The hypotheses of the proposed research were tested through a controlled online experiment. The experiment involved the simulation of a set of online user activities (searching, reading articles, browsing and tagging pictures, browsing products, writing messages). During these activities the users were exposed to a set of predefined advertising messages and at the end their response to these messages was measured. This Section details the design of the experiment and relates it to the research objectives of the Thesis.

3.1 Participants

After contacting a convenience set of potential participants from the professional and social network of the author, 106 people expressed interest in participating in the experiment. Together with expressing their interest in the experiment, the prospective participants were asked to send a short list of keywords that describe their topics of interest. This was necessary in order to collect online content that would be sufficiently stimulating for the users to get involved in the experiment, thus avoid the situation that some user hurries through the experiment tasks without paying attention to it. Since many of the participants were Greek and some of them were not particularly fluent in English, the experiment instructions and content (including ad messages) were available in both English and Greek. An additional note regarding the participants is that several of them are acquainted or friends with each other, which enabled the testing of hypotheses H_4 and H_5 . A demographic analysis of the experiment users is presented in the following section.

3.2 Online Content, Brands and Advertising Material

The online activities were based on **content** that was manually selected based on the interests expressed by the participants during the invitation phase. In order to reduce the effort required for the subsequent content collection step, the collected keywords were clustered in the nine topic groups of Table 1. For each of those categories, online articles were selected from the popular sections of Digg (English) and Digma, Pineza (Greek) as well as online news articles; photos were downloaded from Flickr by use of the public Flickr API. In that way, each user was assigned (based on the keywords he/she provided) to one or more of these nine clusters. This enabled the personalization of the experiment content in some of the tasks (viz. article reading, picture browsing) with the goal to render the experiment participation more stimulating for the users.

Topic	Keywords
arts	architecture, literature, reading, art, theatre, painting, research on social interaction in the cityscape, photography, theater, arts, handcraft, Decoration, Art, urbanization, creativity, Photography & Digital Imaging, Literature Reading, cob houses, straw bale houses, earth houses, books
music	music, dancing, rock music, dance, heavy metal music, Hip-Hop (Dancing), Jazz, Salsa, pop, rock, disco, dj-ing
cars	cars, car, automobile, austin metro, corvette
travel	travels, travel, traveling, camping, travelling, sailing, tourism, wandering-strolling, Travel, people, cheap flights, cultures
movies	tv, cinema, tv-series, movies, Bollywood
computers	internet, gadgets, computers, high technology, mobiles, software, technology, web technologies, PC, Computer science, programming, web data mining, video games, torrent, Warcraft, abandonware, electronics, apple
sports	sport, football, sports, basketball, tennis, skiing, gymnastics, Water sports, swimming, athletics, trekking, ski, boxing
science	Science fiction, science, math, extraterrestrial
general	environment, food, nature, textile, puzzles, politics, news, sociology, health, psychology, foreign policy, animals, children, Judo, Aikido, economic crisis, unemployment, globalization, chess, finance, history, Japanese, roulette, paranormal, cooking, Anthropology, Horses, management, politics, marketing, production machinery, g700, zeitgeist, weapons, fashion, industrial design

Table 1: The nine topic clusters that were derived from the participants' keywords and which were used to collect digital content (articles and pictures) from the Web

Four *brand sets* were considered: (a) laptops, (b) movie review sites, (c) hotels, and (d) sunglasses. The hypotheses of paragraph 2.2 were tested by use of representatives from all four brand sets to check whether the derived conclusions-observations can be generalized or they are product specific. Each of the brand sets, listed in Table 2, contained three fictitious brands. The advertising text was identical for each ad of the same brand set (the templates used to create it are also presented in the table).

Laptops	Movie reviews	Hotels	Sunglasses
AEGIS TAMA SOLUBO	BUZZM SPLASH M-POINT	AZZUR INDIGO AMETHYST	MELIBLU JOLLIE MONTY
X: Your new laptop! Tap into the power of X! Core Duo 2.8MHz, 4G RAM, 400HDD, EUR 1,600. www.X-laptops.com	X: Read the latest movie reviews! Independent movie reviews for latest Hollywood and European movies! www.X-movie-reviews.com	Hotel X: Stay in comfort! Visit our new hotel. Lux rooms, modest prices. Book now! www.hotel-X.com	X sunglasses! Ultimate protection for your eyes. Summer collection. www.X- sunglasses.com

Table 2: The four brand sets considered. The brands of a given brand set are advertised using the same advertising text. In order to derive the three different ad instances for each brand set, just replace placeholder *X* with each brand's name.

3.3 Experiment Workflow

The experiment comprised four major steps: (a) user registration and sign-in, (b) online activities involving forced exposure to advertising, (c) decoy activities and a (d) test / response measurement phase. Instructions were available throughout the whole experiment

that guided the user to the required actions. Snapshots of the experiment screens displayed to the users are presented in the figures of Appendix A.

3.3.1 Registration and sign-in

Once the online experimental setup was prepared and beta tested, a mail was sent to all enlisted candidates in order to request their participation to the experiment. The mail linked to the experiment registration webpage (Figure 4 / Figure A.1), where the users were informed that they would take part in “an online experiment that investigates the dynamics of website usage”. In that way, the real research objective of the experiment would remain unknown to them; thus, users would not be biased or predisposed to attending the advertising messages that would be displayed to them. In the registration screen, the users were also informed that some of their online actions would be tracked during the experiment. After filling-in some necessary information (name, email, gender, age, country), the users were prompted to sign in. Once signed in, each user was prompted with the list of participants and was asked to tick only those that he/she considered as acquaintances or friends (Figure A.2). In that way, it was possible to have a list of friends per user, which would enable the testing of Hypotheses 4 and 5 as specified in Section 2.2.

Online Experiment
Investigating the interaction between Content and User in Online Applications

Dear visitor!
Thank you for your interest in participating in this online experiment. The purpose of the experiment is to investigate the dynamics involved in the interaction of users with online content and associated activities.
The experiment is carried out in the context of the MBA thesis preparation by Symeon Papadopoulos. Throughout the experiment, the system will track some of your actions. This data together with the registration information that you will be asked to provide will remain strictly confidential and will be deleted after the completion of the thesis work.
In order to start the experiment, you first need to register with the system by filling in the requested information in the "Registration" form at the right of the screen. Make sure that the e-mail address that you enter is **the same as the one you used to express your interest in the experiment**. Moreover, enter the same password (of your choice) in the two respective fields of the form. Also, don't forget to fill in your Full Name, your Age, your Gender and the country where you come from. Finally, fill in (in numeric form) the result of the arithmetic operation that appears in the form so that the system can verify that you are a human user (and not e.g. a bot). For any problem during your registration don't hesitate to contact me at: symeon.papadopoulos.it@AT gmail.com.
Once you are notified that the registration is successful, provide your login information (username + password) to the "Sign In" section and you are ready to start. You will receive further instructions after you sign in. Moreover, throughout the experiment you may click on icon at the top right corner of the screen and view the necessary instructions. In order to check which step of the test you are currently going through, just click on icon .

Please make sure that you DO NOT click on the "Back", "Forward" and "Refresh" buttons of your browser until you complete the experiment (or else some of the data you enter could be lost)!

Site and experiment created by [Symeon Papadopoulos](#) under the supervision of Klaus Solberg Söilen.

Registration

Sign in

Figure 4: Registration screen of the experiment website

3.3.2 Online activities

After successfully completing the registration and sign-in process, each user went through the core part of the experiment comprising a set of tasks based on the four different types of online activity that were described in Section 2.2. The order that the activities were presented to users was different per user in order to remove potential bias stemming from a predefined activity ordering. For instance, the third user was requested to first read and rate an article (Figure A.3), then tag a set of photos (Figure A.4), subsequently to comment on socially bookmarked sites (Figure A.5) and finally to send messages to friends (Figure A.6), while the fourth user performed these tasks in reverse order. The order of tasks was specified at random when the user logged in the system. It was during these online activities that the users were exposed to the predefined sets of ads that were described above. Note that some users did not have any online friends within the participants group. For those users, the message exchange activity was skipped.

In order to test the hypotheses of Section 2.2, a predefined ad scheduling scheme was devised. This is specified in Table 3. To facilitate the discussion, we use the following notation:

- The four online activities are denoted as A_i (article reading and rating), P_i (picture browsing and tagging), S_i (social bookmarking), and M_j (message exchanges), where $i = 1, \dots, 4$ (since for each activity, each user will be asked to perform four tasks) and j depends on the number of friends that the user has among the experiment participants.
- In some cases, we split the set of all participants U into two (almost) equally-sized sets, which we denote as U_1, U_2 . In some cases, we obtain reduced sets of users (e.g. when a user has no friends among the participants, he/she does not go through the M tasks). The reduced sets are denoted as U_1', U_2' .
- The ads displayed to the users of the experiment are denoted by the names of the brands that they advertise.
- In activities A_3, A_4 and P_3, P_4 , the symbols C, NC are used to denote *Congruence* and *Non-Congruence* of the content with the advertising message. For instance, in activities A_3, A_4 (which are scheduled as C for the users of U_1) half of the users are given two articles related to movies, while at the same time they are exposed to an ad about a movie review site (*M-POINT*). The rest of the users are exposed to the same ad, but they are given two articles that have no association with movies (NC).

- In activities S_3, S_4 , the symbols F and N are used to denote *Friend recommendation* and *Normal* mode respectively. In the Friend recommendation mode, the user receives a notification that the websites that he/she currently sees have been recommended by a friend of his/hers, while in the Normal mode the user does not receive such a message.
- In activities M_3, M_4 , the symbols S and N are used to denote *Socially-aware* and *Normal* ad placement respectively. These two ways of ad placement were illustrated in Figure 3.

task #	A		P		S		M	
1	AEGIS	BUZZM	TAMA	INDIGO	AZZUR	MELIBLU	SPLASH	JOLLIE
2	AEGIS	BUZZM	TAMA	INDIGO	AZZUR	MELIBLU	SPLASH	JOLLIE
3	M-POINT		MONTY		SOLUBO		AMETHYST	
	C	NC	C	NC	F	N	N	S
4	M-POINT		MONTY		SOLUBO		AMETHYST	
	C	NC	C	NC	F	N	N	S

Table 3: Ad scheduling scheme used in the experiment. The following acronyms are used: A → Article reading and rating, P → Picture browsing and tagging, S → Social bookmarking, M → Message exchange. The cells that are split in two denote that during these tasks, the first ad was displayed to users U_1 , while the second ad was served to users U_2 .

Hypotheses $H_{1a} - H_{1d}$ would be tested by forming four pairs of activities advertising “competing” brands, for instance the users of set U_1 were presented with an ad about *AEGIS* laptops during the first two tasks of article reading and rating (A_1, A_2), while the same users were presented with the competing brand *TAMA* during the first two tasks of picture browsing and tagging (P_1, P_2).

Hypothesis H_2 would be tested by comparing the user categorical priming ad response (see next paragraph) during photo tagging (P) to the response during the three other activities (A, S , and M). Hypothesis H_3 is investigated by use of the third and fourth task of article reading and rating (A_3, A_4) and photo tagging (P_3, P_4). For half of the users (U_1), the content presented in these two tasks was congruent with the displayed ads (i.e. movie reviews for article reading and rating and sunglasses for photo browsing and tagging), while for the other half of the users (U_2) the content was unrelated to the ads. Hypothesis H_4 would be tested by notifying half of the users (U_1) performing tasks S_3, S_4 that one of their friends recommended the sites they are viewing, while giving no such notification to the rest of the users (U_2). Finally, hypothesis H_5 would be tested by means of changing the ad display position for half of the users (U_1) carrying out tasks M_3, M_4 according to the paradigm of Figure 3. Figure 5 depicts succinctly how the hypotheses of Section 2.2 were going to be tested from the data collected from the ad scheduling scheme of Table 3.

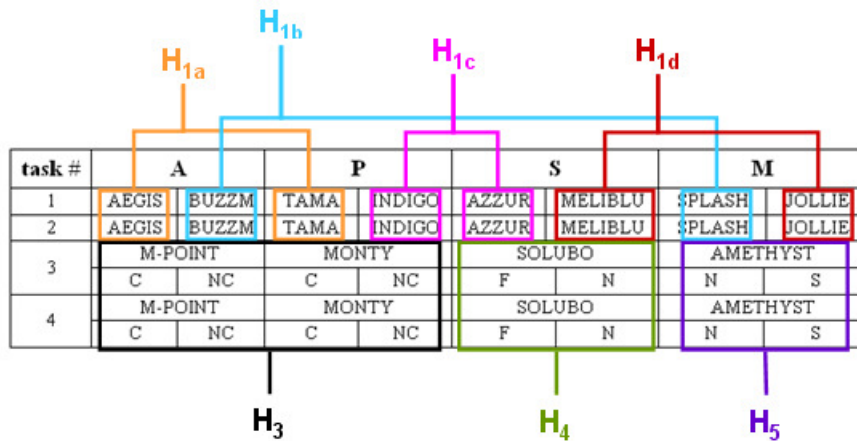


Figure 5: Association between tasks-ad scheduling and the formulated hypotheses

3.3.3 Decoy

After completing the online activities of interest, several decoy activities in the form of a quiz were presented to the users (Figures 7(I-IV)). These required some mental skill in an attempt to distract the short-term user memory from the advertising content that he/she was previously exposed to. More specifically, the first two decoy tasks (Figure 7(I)) involved the recall of the correct version of two company logos (BMW and Google), the third (Figure 7(II)) and fourth (Figure 7(III)) were two logical puzzles and the fifth task involved a quiz question about movies (Figure 7(IV)).

3.3.4 Test/Evaluation phase

This is the phase where the attitudinal user response to advertising was measured. Each user was given two sets of questions:

- Aided recall questions (Figure 8(I)): For each brand that was displayed to the user, the user is asked whether he/she recalls seeing this brand during the experiment (with three possible answers Yes / No / Not sure).
- Categorical priming questions (Figure 8(II)): The user is asked to associate each brand displayed during the test with its category. Apart from the four categories (laptop, movie reviews, hotels, sunglasses), there is also an option “Other” in order to render the task more challenging.

Care was taken to make sure that the selected brand names do not reveal the actual product (e.g. we did not use “Eye Protector” as a brand name for sunglasses).

After the response measurement phase, two additional sets of questions were presented to users. The first set of questions (Figure A.9) aimed at collecting additional demographics

and information about the users in order to check whether there is correlation between some of these variables and the user response. The second question set (Figure A.10) concerned their perception of the test, i.e. whether they found it interesting or boring and whether they understood its real objective. Before the end of the experiment, the users were also asked whether they would like to receive an electronic copy of this Thesis (Figure A.11).

3.4 Experiment Implementation

The experimental website was developed by use of the Google Web Toolkit² (GWT). The particular framework was selected for the following reasons:

- Java-based: GWT-based websites are written in Java, which enables a host of rich interactivity functionalities to be quickly prototyped by means of asynchronous calls to the server.
- State management at the client side: GWT promotes the paradigm of maintaining and controlling user state on the client. This is particularly pertinent to the deployment of a multi-user study, in order to relieve the server from the complexity and overhead of user state management.
- Browser-independence: Although the development of the website is written once, GWT takes care of translating the source code so that the rendering of the website is identical (or at least very similar) across all major browsers (Explorer, Firefox, Safari, Opera). After the experiment launch, some minor rendering problems were reported by users of the latest version of Safari (4 Beta).
- Rich support for interactive testing: GWT offers extensive support for interactive testing of the site during the development process. In that way, multiple debugging and testing cycles can take place at relatively short time.

Before the experiment development, an additional implementation option was considered: to launch the experiment in the form of a Facebook application, which was expected to bring significant participation to the study. However, this option was rejected after discussions with a colleague who had implemented such an application and reported significant development issues and constraints.

² <http://code.google.com/webtoolkit/>

3.5 Learning points on designing and developing an online experiment

Since the beginning of the thesis work, significant attention was paid to the issue of risk management for the development and deployment of the online experiment. Table 4 presents the risks that were identified at the outset of the experiment planning together with the measures that were employed to mitigate them. Although additional effort was needed to devise and execute this risk management strategy, it appeared that the risk mitigation measures were necessary (and sometimes even insufficient) in order to ensure smooth execution for the experiment.

In particular, after going through the whole process of designing, developing and executing the thesis online experiment, a series of learning points have been identified which may be used as recommendations for prospective designers of similar user studies / experiments:

- *Strive for increased user participation.* The more users one can engage in their study, the more reliable the findings that will come out of the study. In the case of this study, user participation was mainly sought through the social and professional network of the author, which resulted in moderate participation. Alternative forms of online studies, which are known to attract higher user participation, are Facebook apps-studies. However, those may come with several implementation difficulties and constraints.
- *Make the experiment engaging.* Experiment participants have limited time and patience. Therefore, the experiment should be either short (in the order of ten minutes) or engaging. The present experiment was rather long (between 60 and 90 minutes); for that reason, significant effort was paid to make it interesting and engaging. This was especially difficult since each online activity of the users had to be repeated four times (in order to collect sufficient data for testing the formulated hypotheses). Based on the feedback collected from the participants (see Section 4.2), it appears that this goal was achieved for most participants.
- *Plan the experiment development/deployment.* Launching online applications which involve significant interaction with users may also be challenging from a development point of view. In such cases, additional time should be allocated for potential delays, debugging and implementation refinements.

Risk	Measure
Insufficient number of participants	<ul style="list-style-type: none"> * Notify people about intention to launch experiment early on (~two months in advance). Request an email of participation intention. * Provide the experiment in both English and Greek in order to maximize the number of potential participants. * Get in personal touch with participants to motivate them to participate.
Boring/Non-engaging online experience	<ul style="list-style-type: none"> * Collect user interests together with the participation intention email. * Manually select online articles and websites (activities A and S). * Manually filter photos collected from the Flickr API (activity P).
Development issues (framework learning, bugs, etc.)	<ul style="list-style-type: none"> * Allocate plenty of time for development. * Allocate time for pilot testing and experiment refinement.
Scalability (increased server load)	<ul style="list-style-type: none"> * Distribute much of the experiment logic and state management to the client (one of the reasons for selecting GWT for the site development)
Comprehensibility issues	<ul style="list-style-type: none"> * Add detailed and unambiguous instructions to each step of the experiment. * Progressive roll-out of the experiment (first notify a reduced set of users, get feedback and then send notifications to all participants). * Provide support upon request.

Table 4: Risks and risk mitigation measures at the outset of the experiment planning

4. Data Analysis and Research Findings

This section presents the analysis of the user input that was obtained from the execution of the Thesis online experiment. The experiment was launched on May 7, 2009 and remained online for two weeks until May 25, 2009. Out of the 91 people that attempted to participate, 87 managed to successfully complete the experiment (three participants left the experiment incomplete, and one participant faced a browser crash which resulted in partial loss of his recorded information).

4.1 Demographics of the Participants

The characteristics of the participants' population are presented in Table 5. According to them, there is a balance between male and female participants, that the majority of participants are in their mid- or late- 20s and that their education level is high (university degree or higher). In addition, participants have either no or low income (students or just began to work), but mostly they earn an average income. Finally, most of the participants spend much of their time online, consider themselves as medium or advanced users and are familiar with many popular Web 2.0 applications such as Facebook, YouTube and Flickr.

Variable	Values					
Number	87					
Gender	Male			Female		
	52.9% (46)			47.1% (36)		
Age	[20-23]	[24-26]	[27-29]	[30-32]	[33-35]	[36-39]
	5.7% (5),	41.4% (36)	25.3% (22)	12.6% (11)	12.6% (11)	2.3% (2)
Country	Greece	NL	Armenia, Cyprus, France, Mexico, Romania, Sweden, USA			
	89.6% (78)	2.3% (2)	1.1% (1 each)			
Education	High-school		Vocational School		Univ. Graduate	
	1.1% (1)		2.3% (2)		48.3% (42)	
Income	No Income		Low		Medium	
	13.8% (12)		13.8% (12)		67.8% (59)	
Internet Usage	Rare		Not much		Regular	
	4.6% (4)		6.9% (6)		25.3% (22)	
Computer skills	High		Very high			
	39.1% (34)		24.1% (21)			
Computer skills	Basic		Medium		Advanced	
	0% (0)		35.6% (31)		44.8% (39)	
Web 2.0 usage	Guru					
	19.5% (17)					
	Facebook		MySpace		LinkedIn	
	87.3% (76)		34.5% (30)		29.9% (26)	
YouTube		Flickr				
91.9% (80)		54.0% (47)				
Last.fm		Digg		Twitter		
41.4% (36)		8.0% (7)		20.7% (18)		
Delicious						
				16.0% (14)		

Table 5: Demographics calculated on the population of the participants

4.2 Evaluation of the Experiment

Table 6 presents the statistics that represent the impression that the experiment made to the participants. Overall, the majority of the participants found the experiment interesting, while there were some participants that found it indifferent. Fortunately, it was perceived as boring by only few participants and annoying by only one. Regarding the time that was necessary to complete the experiment, it was mostly found that the experiment requirements were either reasonable or sometimes long (but not in an annoying way). Based on the free-text feedback collected during the evaluation phase, it was noted that the main reasons for user frustration were the repetitiveness of the tasks (four times for each online activity) and the length of some articles that the users were requested to read.

Regarding the experiment tasks and instructions clarity, it appears that the instructions provided throughout the experiment were sufficient to complete it (only 10% of the participants reported facing several problems in their effort to understand the experiment tasks). Finally, the exact goal of the experiment was not obvious to most of the participants before the completion of the ad recall test. Even then, most of the participants could not relate the experiment tasks to any of the research hypotheses of the Thesis. This is a desired response, since it indicates that the ad response of most participants was not biased by their preconception about the experiment objectives. Overall, the evaluation provided by the participants suggests that the experiment was well-designed and in line with its original requirements as described in Section 3.

Variable	Values				
Overall	Exciting	Interesting	Indifferent	Boring	Annoying
	3.4% (3)	74.7% (65)	17.2% (15)	3.4% (3)	1.1% (1)
Time	Short	Normal	Long	Excessively Long	
	5.7% (5)	57.8% (50)	27.6% (24)	9.2% (8)	
Clarity	Clear	Almost clear	Often unclear	Confusing	
	23.0% (20)	66.7% (58)	10.3% (9)	0% (0)	
Purpose	Not understood	Understood mistakenly after the ad recall test	Understood partially after the ad recall test	Understood from the beginning	
	25.3% (22)	45.9% (40)	20.7% (18)	3.4% (3)	

Table 6: Experiment evaluation statistics calculated on the population of the participants

4.3 Research Hypothesis Testing

The ad response measurement phase resulted in the completion of Table 3 (the ad scheduling table introduced in the previous section) with the following measurements (for each brand):

- *Y*: Percentage of participants who could recall seeing the particular brand during the experiment.
- *M*: Percentage of participants who were not sure whether they had seen the particular brand during the experiment.
- *C*: Percentage of participants who could correctly associate a brand with its product / service category.

Table 7 provides an overview of the participants' responses for all brands that were advertised during the experiment online activities.

	A		P		S		M	
	AEGIS (43)	BUZZM (44)	TAMA (43)	INDIGO (44)	AZZUR (43)	MELIBLU (44)	SPLASH (42)	JOLLIE (43)
Y	11 (.255)	2 (.045)	9 (.209)	8 (.182)	14 (.326)	13 (.295)	8 (.190)	6 (.139)
M	19 (.442)	15 (.341)	17 (.395)	16 (.364)	14 (.326)	8 (.182)	17 (.405)	20 (.465)
C	7 (.163)	11 (.250)	7 (.163)	10 (.227)	15 (.349)	10 (.227)	11 (.262)	25 (.581)
	M-POINT		MONTY		SOLUBO		AMETHYST	
	C (43)	NC (44)	C (43)	NC (44)	F (43)	N (43)	N (36)	S (35)
Y	7 (.163)	3 (.068)	14 (.326)	4 (.090)	4 (.093)	6 (.139)	8 (.222)	7 (.200)
M	18 (.419)	16 (.364)	13 (.302)	17 (.386)	21 (.488)	15 (.349)	16 (.444)	12 (.343)
C	10 (.233)	7 (.159)	18 (.419)	7 (.159)	7 (.163)	5 (.116)	9 (.250)	12 (.343)

Table 7: User responses for each ad served to the experiment participants. The reported numbers are respectively (a) direct recall (*Y*), (b) fuzzy recall (*M*) and (c) implicit recall (*C*)

A first important observation on the collected responses is that online advertising is effective for creating awareness for new brands. Considering that the brands, to which the users were exposed during their online activities were fictitious, and that the participants were exposed only twice to each one of them, one may consider the direct and implicit ad responses of participants as high. Specifically, the aggregate direct brand recall over all participants and all brands was as high as 18.3% (124 out of 677), while the correct brand-product category association was even higher, 25.3% (171 out of 677). This implies that even limited online exposure of subjects to advertising messages can lead to substantial percentages of brand awareness, which is crucial for the marketing of new products and services.

Furthermore, in order to test for significant differences in the ad responses of users, the response to ad i is considered to be described by two binomial distributions: one for the direct ad response (whether participants could recall seeing the ad during the test) and the other for the categorical priming response (whether the participants could correctly associate the advertised brand with its category). Each binomial distribution will be described by a single parameter p_i , which respectively denotes the proportion of participants that could recall the particular ad or that could correctly associate the advertised brand with its product category. Thus, it is possible to conduct pairwise statistical tests between two responses x and y by means of the z test statistic:

$$z = \frac{\hat{p}_x - \hat{p}_y}{\sqrt{\hat{p} \cdot (1 - \hat{p}) \cdot \left(\frac{1}{n_x} + \frac{1}{n_y}\right)}}$$

In the above formula, \hat{p}_x and \hat{p}_y stand for the observed proportions of participants that could recall brands x and y respectively, n_x and n_y denote the numbers of participants who were exposed to the respective ads and \hat{p} is the mean proportion of participants that could recall either ad (i.e. \hat{p} is the mean value of \hat{p}_x and \hat{p}_y). Note that z follows a standard normal distribution and can therefore be used to infer the test p -value that is the probability of falsely rejecting the null hypothesis. Apart from testing for significance between pairs of observed ad response distributions, the *standardized difference* (Austin, 2009) between them is also reported. The standardized difference between two binomial distributions p_x and p_y is computed as follows:

$$d = \frac{100 \cdot (\hat{p}_x - \hat{p}_y)}{\sqrt{\frac{\hat{p}_x(1 - \hat{p}_x) + \hat{p}_y(1 - \hat{p}_y)}{2}}}$$

This measure provides an estimate of the extent (expressed as a percentage of the mean response variation) to which the two observed responses differ from each other. This is different from the reported p -value of the statistical significance test. In practice, distance values greater than 10% denote non-negligible differences between the two observed sets of measurements.

4.3.1 Role of online activity on ad effectiveness

Table 8 summarizes the pairwise comparisons between the users' ad response during different online activities. For each pair of online activities, two comparisons are conducted: (a) one based on the particular pair of brands of the same category, and (b) one based on the aggregate ad response irrespective of the advertised brand. Within each of these comparisons, there are three statistical tests between pairs of binomial distributions where parameter p stands respectively for: (a) percentage of participants who could recall brand X (denoted as D_I in the table), (b) percentage of participants who could either recall or were not sure about recalling brand X (D_{II}), and (c) percentage of participants who could associate brand X with its true category (I).

Based on the tabulated results, one can see whether the four null sub-hypotheses of H_I can be rejected (and thus their alternate hypotheses asserted).

			\hat{p}_A	n_A	\hat{p}_B	n_B	\hat{p}	z	$p\text{-val}$	d (%)
H_{1a} A vs. P	Laptops (AEGIS-TAMA)	D_I	.256	43	.209	43	.236	0.510	.610	11.03
		D_{II}	.698		.605		.651	0.905	.365	19.61
		I	.163		.163		.163	0.000	1.00	0.00
	All	D_I	.132	174	.201	174	.167	-1.726	.084	-18.59
		D_{II}	.523		.563		.543	-0.753	.451	-8.08
		I	.201		.241		.221	-0.904	.366	-9.70
H_{1b} A vs. M	Movie reviews (BUZZM-M-POINT)	D_I	.045	44	.190	42	.118	-2.084	.037	-46.14
		D_{II}	.386		.595		.491	-1.937	.053	-42.72
		I	.250		.262		.256	-0.126	.899	-2.73
	All	D_I	.132	174	.186	156	.159	-1.332	.183	-14.73
		D_{II}	.523		.603		.563	-1.455	.146	-16.09
		I	.201		.365		.283	-3.306	<.001	-37.07
H_{1c} S vs. P	Hotels (AZZUR-INDIGO)	D_I	.326	43	.182	44	.254	1.541	.123	33.50
		D_{II}	.651		.545		.326	1.052	.293	21.69
		I	.349		.227		.288	1.252	.211	27.09
	All	D_I	.214	173	.201	174	.207	0.292	.770	3.14
		D_{II}	.549		.563		.556	-0.264	.792	-2.84
		I	.214		.241		.228	-0.611	.541	-6.56
H_{1d} S vs. M	Sunglasses (MELIBLU-JOLLIE)	D_I	.295	44	.139	43	.217	1.763	.078	38.49
		D_{II}	.477		.605		.541	-1.192	.233	-25.77
		I	.227		.581		.404	-3.365	<.001	-77.37
	All	D_I	.219	173	.186	156	.199	0.634	.526	6.99
		D_{II}	.549		.603		.576	-0.979	.327	-10.83
		I	.214		.365		.289	-3.025	.002	-33.88

Table 8: Ad response differences between pairs of online activities (p-value legend: green → significant @ 10%, blue → significant @ 5%, red → significant @ 1%)

H_{1a}: From the collected results so far, it is not clear whether the ad response of the users differs between article reading and picture browsing. Article reading appears to result in slightly better ad response when the comparison is restricted to the laptop advertisements.

However in the case of aggregate comparison (i.e. comparison over all brands) picture browsing appeared to favor ad recall and priming more than article reading. For instance, direct recall of all brands during picture browsing was found significantly higher than the one during article reading and rating (at a p-value of 0.084).

H_{1b}: From the so-far collected results, notable differences can be observed in favor of the ad response during message exchanging activities. Both in the case of comparing the ad response between competing brands (BUZZM vs. M-POINT) and in the case of aggregating the comparison over all brands, participants presented significantly higher ad recall and priming response during message exchanging.

H_{1c}: On the competing brands (AZZUR vs. INDIGO) recall and categorical priming test, social bookmarking appears superior to picture browsing (but not at statistically significant levels). When comparing over all brands, however, picture browsing appears to lead to improved categorical priming responses.

H_{1d}: Social bookmarking appears superior to messaging activities when the direct recall between competing brands is considered (the number of participants stating that they recall MELIBLU is significantly higher than the one of those stating that they recall JOLLIE). However, the number of participants who could correctly associate the advertised brands with their product category was significantly higher for message exchanging (both when considering competing brands and when aggregating the comparison over all brands).

4.3.2 Priming response of picture browsing and tagging users

Table 9 indicates that the categorical priming responses between picture browsing and the other online activities are not very different except for the comparison between picture browsing and message exchanging (which favors message exchanging). Thus, the original hypothesis which was based on the assumption that the presence of pictorial content would affect the peripheral vision and thus the perception of side ads by users is not substantially supported by the collected responses.

		\hat{p}_A	n_A	\hat{p}_B	n_B	\hat{p}	z	$p\text{-val}$	d (%)
H₂	P vs. A	.241	174	.201	174	.221	0.904	.366	9.70
	P vs. S	.241	174	.214	173	.228	0.611	.541	6.56
	P vs. M	.241	174	.365	156	.303	-2.446	.014	-27.22

Table 9: Ad priming response differences between picture browsing and other online activities

4.3.3 Ad effectiveness in relation to its congruence with the website

The role of ad-website congruence appears significant in this study. More specifically, according to Table 10, there is measurable difference in the ad response (both direct and implicit) of users that were presented with articles that were congruent with the advertised brand (M-POINT). Moreover, there is statistically significant difference in the ad response of users that were provided with photos that were congruent with the advertised brand (MONTY). The direct ad recall and correct categorical association between the brand and its product category was significantly higher for the participants who were exposed to the ad in the context of congruent content.

Such findings provide evidence in favor of content-targeted advertising (Papadopoulos et al., 2009) techniques, which aim at serving ads that are pertinent to the displayed webpage content and partially justify the large success of the keyword-based advertising scheme promoted by Google.

			\hat{p}_A	n_A	\hat{p}_B	n_B	\hat{p}	z	$p\text{-val}$	d (%)
H₃	C vs. NC (A)	D_I	.163	43	.068	44	.115	1.380	0.167	29.93
		D_{II}	.581		.432		.507	1.395	0.163	30.26
		I	.233		.159		.196	0.863	0.388	18.59
	C vs. NC (P)	D_I	.326	43	.091	44	.208	2.695	0.007	60.37
		D_{II}	.628		.477		.552	1.413	0.158	30.65
		I	.419		.159		.289	2.670	0.007	59.76

Table 10: Ad response differences between congruent and non-congruent web page content (with respect to the advertised brand)

4.3.4 Role of friend recommendation in ad response

Table 11 summarizes the difference in direct and implicit response between users that were presented with an artificial friend's recommendation (e.g. "Your friend X recommended the following bookmarks!") and those that were not presented with such a piece of information. It appears that such messages (or the mental state created by them) do not influence ad perception to a significant degree, that is there is not sufficient evidence to support Hypothesis 4.

			\hat{p}_A	n_A	\hat{p}_B	n_B	\hat{p}	z	$p\text{-val}$	d (%)
H₄	F vs. N	D_I	.093	43	.139	43	.116	-0.673	.501	-14.55
		D_{II}	.581		.488		.535	.865	.387	18.73
		I	.163		.116		.139	.622	.534	13.45

Table 11: Ad response when a friend recommendation notification appears on the web page where the ad is displayed

4.3.5 Role of ad positioning

The ad placement with respect to a friend's name appears to have only marginal effect on the participants' ad response. In particular, Table 5 leaves little room for speculation on the role of ad positioning (in the sense of Hypothesis 5), as there is no significant difference in neither the direct nor the implicit priming response of participants when the ad placement changed.

			\hat{p}_A	n_A	\hat{p}_B	n_B	\hat{p}	z	$p\text{-val}$	d (%)
H₅	S vs. N	D_I	.222	36	.200	35	.211	0.229	.819	5.45
		D_{II}	.667		.543		.605	1.067	.286	25.53
		I	.250		.343		.296	-0.857	.392	-20.44

Table 12: Ad response when the ad is displayed in proximity to the friend's name

4.4 Additional Conclusions

Apart from the investigation of the postulated hypotheses of Section 2.2, a series of tests were conducted to investigate latent associations between demographic or other factors and the response to the advertising message. Since the variation of country, education, income and computer skills was not significant among the experiment participants, they were not considered in this analysis. Among the demographic variables, the role of gender and age was investigated. Both of them were found to be only marginally associated with the response to the advertising message. Tables 13 and 14 illustrate that a hypothesis of the form "men are equally likely than women to recall brands they were exposed to" cannot be rejected upon statistical evidence. Therefore, one may conclude that gender does not affect a user's response to online advertisements. Similar conclusions were drawn for the age of participants (the respective tables are not presented for the sake of brevity).

		gender			
		male	female	total	p-val (χ^2)
direct	yes = 0	17	16	33	0.612
	expected-yes = 0	17.5	17.5		
	yes = 1,2	15	16	31	0.857
	expected-yes=1,2	15.5	15.5		
	yes >= 3	15	6	21	0.049
	expected-yes >= 3	10.5	10.5		

Table 13: Association between gender and direct aided ad recall

		gender			
		male	female	total	p-val (χ^2)
direct	yes = 0,1	17	16	33	
	expected-yes = 0,1	16.5	16.5		0.862
	yes >= 2	29	25	54	
	expected-yes >=2	27	27		0.586

Table 14: Association between gender and categorical priming response

Additional analyses of the associations between online content attributes and the response to the side-ads indicate that there is not substantial correlation between how users perceive a piece of online content (viz. article) and whether they can directly or implicitly recall the brand that was advertised while they were reading the particular piece of content. More specifically, Tables 15-20 present a chi-square comparison between the measured and the expected ad response of participants as a function of their perception of the online content read during ad serving. According to these tables, the interestingness and informativeness of an online article appear to have almost no correlation (p-values $\gg 0.1$) with the response of users to the ads that were served together with the content. A measurable, but still statistically insignificant (p-value=0.194), association was established between the direct ad recall and the degree of content amusingness for a user (Table 19).

		interesting				
		very (45.5%)	medium (38.9%)	not (15.6%)	total	p-val (χ^2)
direct	yes	18	23	9	50	
	expected-yes	22.73	19.46	7.81		0.405
	maybe	65	50	21	136	
	expected-maybe	61.82	52.93	21.25		0.848
	no	77	64	25	166	
expected-no	75.45	64.61	25.94		0.965	

Table 15: Association between article interestingness and direct aided ad recall

		interesting				
		very (45.5%)	medium (38.9%)	not (15.6%)	total	p-val (χ^2)
implicit	yes	35	30	7	72	
	expected-yes	32.73	28.02	11.25		0.386
	no	125	107	48	280	
	expected-no	127.27	108.98	55		0.783

Table 16: Association between article interestingness and categorical priming response

		informative				
		very (46.3%)	medium (42.9%)	not (10.8%)	total	p-val (χ^2)
direct	yes	22	23	5	50	
	expected-yes	23.15	21.45	5.39		0.905
	maybe	66	54	16	136	
	expected-maybe	62.98	58.34	14.68		0.746
	no	75	74	17	166	
expected-no	76.87	71.21	17.92		0.904	

Table 17: Association between article informativeness and direct aided ad recall

		informative				
		very (46.3%)	medium (42.9%)	not (10.8%)	total	p-val (χ^2)
implicit	yes	34	32	6	72	
	expected-yes	33.34	30.89	7.77		0.796
	no	129	119	32	280	
	expected-no	129.66	120.11	30.23		0.943

Table 18: Association between article informativeness and categorical priming response

		amusing				
		very (17.6%)	medium (41.2%)	not (41.2%)	total	p-val (χ^2)
direct	yes	4	24	22	50	
	expected-yes	8.81	20.60	20.60		0.194
	maybe	25	57	54	136	
	expected-maybe	23.95	56.02	56.02		0.934
	no	33	64	69	166	
	expected-no	29.24	68.38	68.38		0.680

Table 19: Association between article amusingness and direct aided ad recall

		amusing				
		very (17.6%)	medium (41.2%)	not (41.2%)	total	p-val (χ^2)
implicit	yes	13	27	32	72	
	expected-yes	12.68	29.66	29.66		0.806
	no	49	118	113	280	
	expected-no	49.32	115.34	115.34		0.946

Table 20: Association between article amusingness and categorical priming response

A final interesting observation with respect to the ad response of online users pertains to the difference between their direct and priming response to the advertised brands. Figure 6 depicts the difference in priming response between users that stated to be *ad-blind* (i.e. that they could not recall any of the advertised brands) and the rest (i.e. users who stated that they could recall at least one brand). Surprisingly, only 20% of the ad-blind users produced the expected priming responses (i.e. no correct association between brands and their categories). A substantial number of these users could implicitly correctly associate two or more of the brands with their product category. This substantiates previous studies that provided evidence in favor of the subliminal effects of advertising (Shapiro et al., 1997; Yoo, 2008).

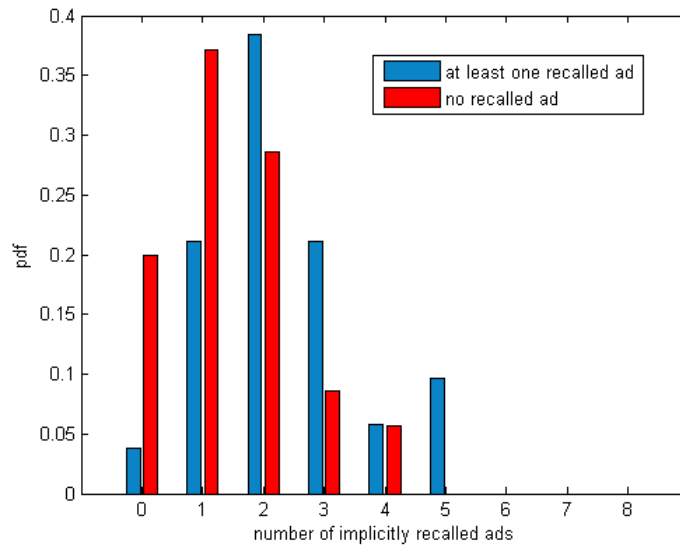


Figure 6: Distributions of implicitly recalled ads for users that stated that they had recalled (a) at least one brand (blue) and (b) no brand at all (red)

5. Conclusions and Future Work

The Thesis examined the effectiveness of online advertising within different online activities and contexts that are prevalent in today's Web environment, where rich interactivity and social networking features are prevalent. More specifically, the Thesis attempted to investigate the role of a user's online activity on his/her response to the advertising messages that are displayed in tandem with the current online activity. Furthermore, the Thesis studied the role of social factors, such as friend recommendation and "socially-aware" ad positioning on advertising effectiveness. The formulated research goals were pursued through a controlled online experiment in which a series of online user activities and social networking features were simulated.

Based on the experimental evidence collected from 87 participants, there is a multitude of observations and conclusions that can be useful in the context of online marketing strategy development. A significant conclusion, which also confirms previous studies, is that online advertising constitutes an effective means for brand awareness creation. Even though the brands employed within the Thesis experiment were fictitious and the experiment participants were only exposed twice to each of them, a significant percentage of them could either directly recall seeing these ads or could associate them with their product categories. On the other hand, there were a substantial number of participants who stated that they are *ad-blind*, that is they pay no attention to side ads during their online activities. Despite their ad-blindness, a large number of these participants were able to correctly associate the advertised brands with their correct product category, which substantiates the subliminal effects of online advertising.

A further conclusion drawn from the conducted study is that the type of online activity that a user is engaged in while being exposed to an advertisement affects the recollection of the advertised brand at a later moment (hypotheses H_1 and H_2). Measurable differences in the ad responses of users were found between pairs of online activities. The most pronounced difference in the user ad response was observed between online message exchanging and the rest of the online activities (Hypotheses H_{1b} and H_{1d} were found significant at 5% levels when the direct recall was considered and at 1% when considering the categorical priming responses of users). More specifically, a higher percentage of users could recall ads that were displayed during message exchanging compared to the ones displayed during other online activities. In contrast, no statistically significant evidence was gathered to support the hypothesis regarding the role of pictorial content on the priming response of users to ads

(hypothesis H₂). In the context of online marketing, one may interpret these conclusions as a hint for directing advertising funds to certain types of online applications (e.g. applications incorporating social networking features).

Furthermore, the congruence of the advertising message with the online content that is displayed in the same webpage was found to constitute a significant factor affecting the effectiveness of online advertising. More specifically, measurable differences were found between the ad responses of users that were given to read articles which were related to the advertised brands compared to the ones of users that were given articles that were irrelevant with the advertisements (standardized difference ~30% in direct recall and ~20% in categorical priming response rates). The differences were more pronounced (statistically significant at 1% levels) in the case of pictorial content, that is when the content of the displayed pictures was related to the advertised brand, users tended to recall the brand much more often than in the opposite case. In summary, the postulated hypothesis H₃ was supported by the empirical observations.

Regarding the role of social context which was tested in the form of hypotheses H₄ and H₅, the collected responses did not provide conclusive evidence. Notifying users that one of their friends recommended a certain website did not result in different (standardized difference < 20%) ad response compared to the regular case (i.e. absence of such notification during social bookmarking). In addition, the placement of ads near a friend's name did not affect the direct recall or implicit response of users to the ads (respective p-values in statistical tests exceeded 0.2). One should note, however, that the simulation of social networking features in an artificial experimental environment was only partially achieved, thus encouraging such studies on data collected from the usage of real applications (e.g. Facebook) to establish whether the online social context affects ad perception and recollection.

Finally, no other factor or variable could be identified that had significant impact on the user response to online advertising. For instance, the gender and the age of participants had no correlation (p-values for χ^2 test exceeded 0.5) with either their direct or their implicit response to the advertised brands. Furthermore, several attributes of online content, such as the degree to which it was perceived as interesting, informative and amusing, were found to have no significant correlation with the measured ad response, apart from some marginal correlation (p-value = 0.194 for the respective χ^2 test) between an article's amusingness and the number of users who could directly recall the side ads.

Following this study, there are a number of questions that remain open for future research. First, one would need to conduct similar studies at a much larger scale (hundreds of participants) in order to confirm or refute the findings of this study. Ideally, such studies should take place in the context of a real web application, thus removing the perceptual bias introduced by the artificial experimental process. Furthermore, additional investigations are necessary in order to establish whether these findings can be generalized to more product/service categories and even to real brands (although studying attitudes towards real brands is complicated by prior user perceptions with regard to these brands). Finally, additional implicit response measures, such as inclusion in purchase consideration sets and brand name completion tests, are expected to yield additional insights to the mechanisms that online ads act on the subliminal level.

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Appendix A: Experiment website screenshots

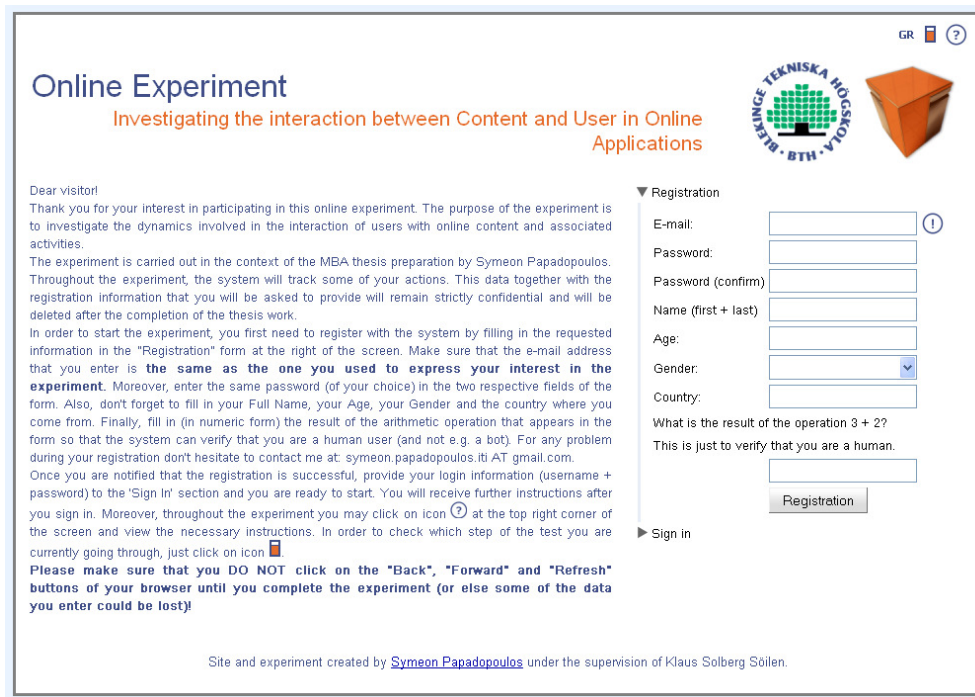


Figure A.1: Welcome screen: Preliminary information about the experiment is provided. Also, the screen contains some basic instructions on how to register and go through the experiment.



Figure A.2: Friend selection screen: The user is prompted to select up to four friends (if possible) among the experiment participants

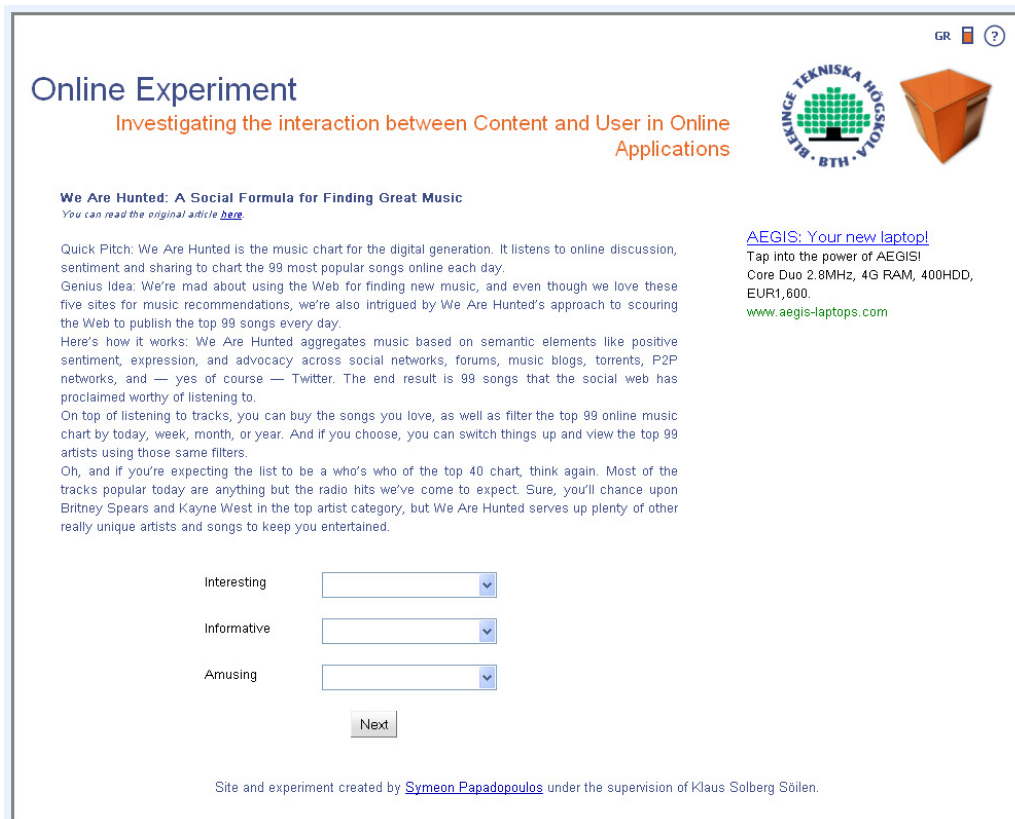


Figure A.3: Article reading and rating screen: An article is presented to the user and his/her ratings for three aspects of this article are requested. This task is repeated four times (four articles).

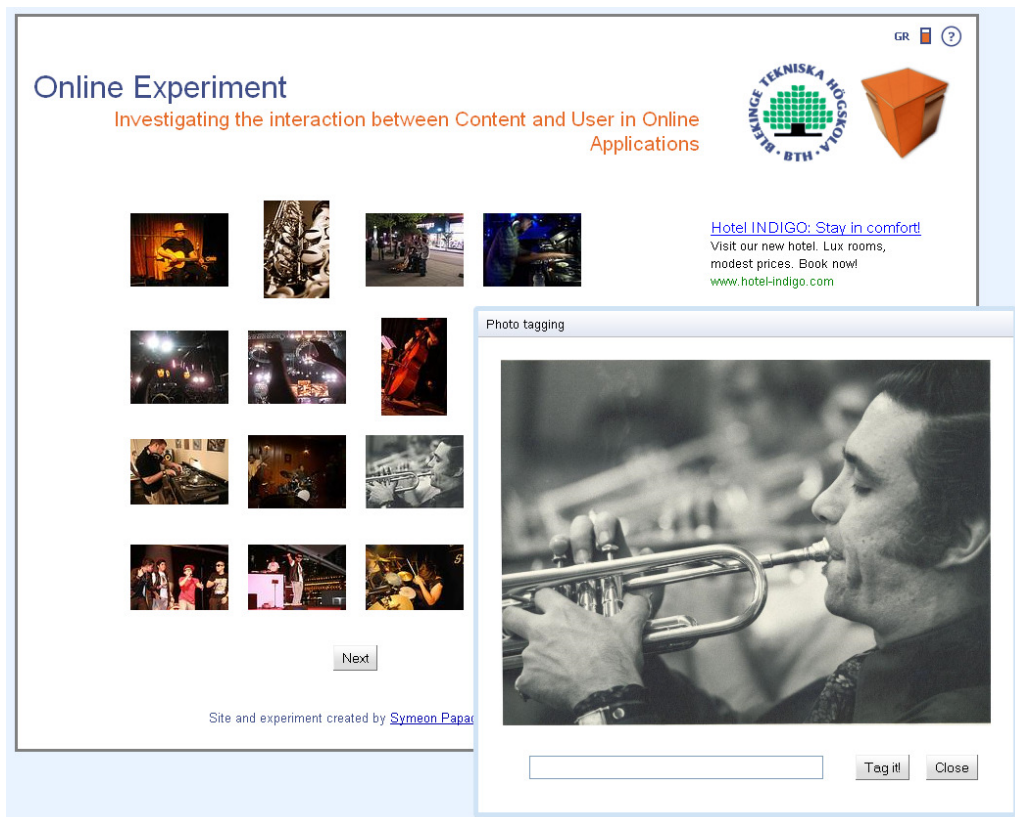


Figure A.4: Picture browsing and tagging screen: The user is requested to select between three and five pictures from the picture array in order to tag them. Once clicking on a picture, a dialog pops up that prompts for the user input (tags). This task is repeated four times.

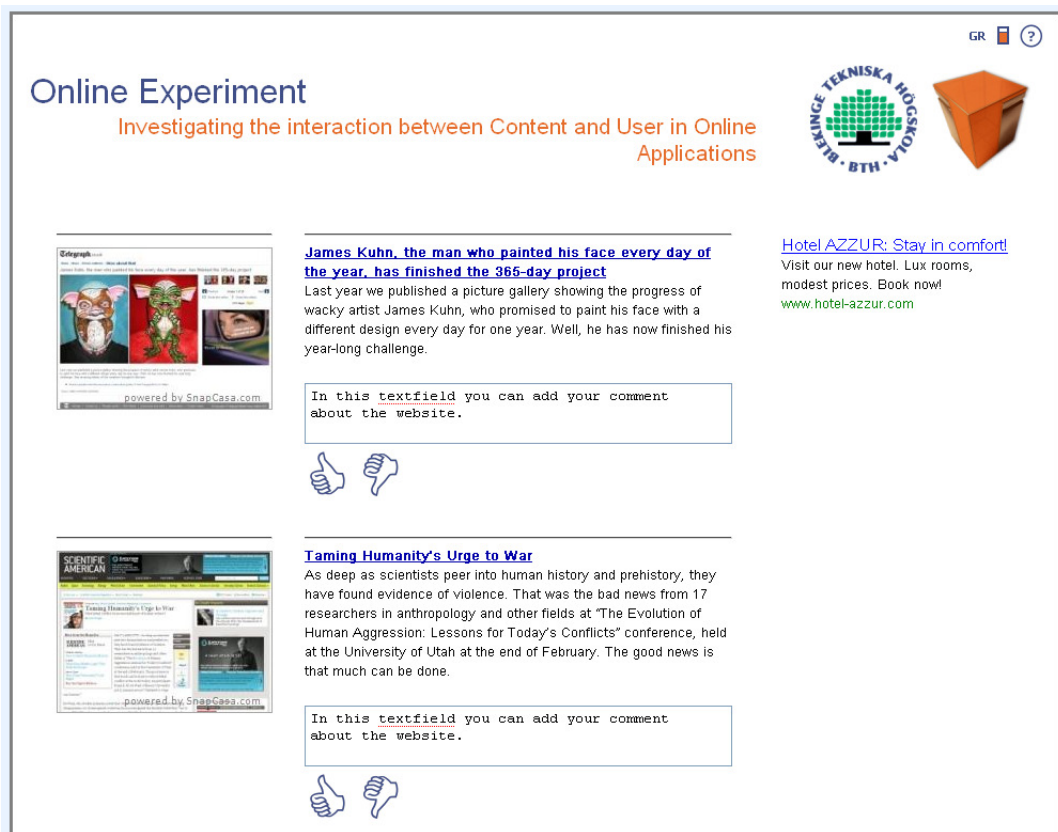


Figure A.5(I): Social bookmarking screen I: The user is asked to rate and comment on one of the three sites appearing on the screen. This task is repeated four times.

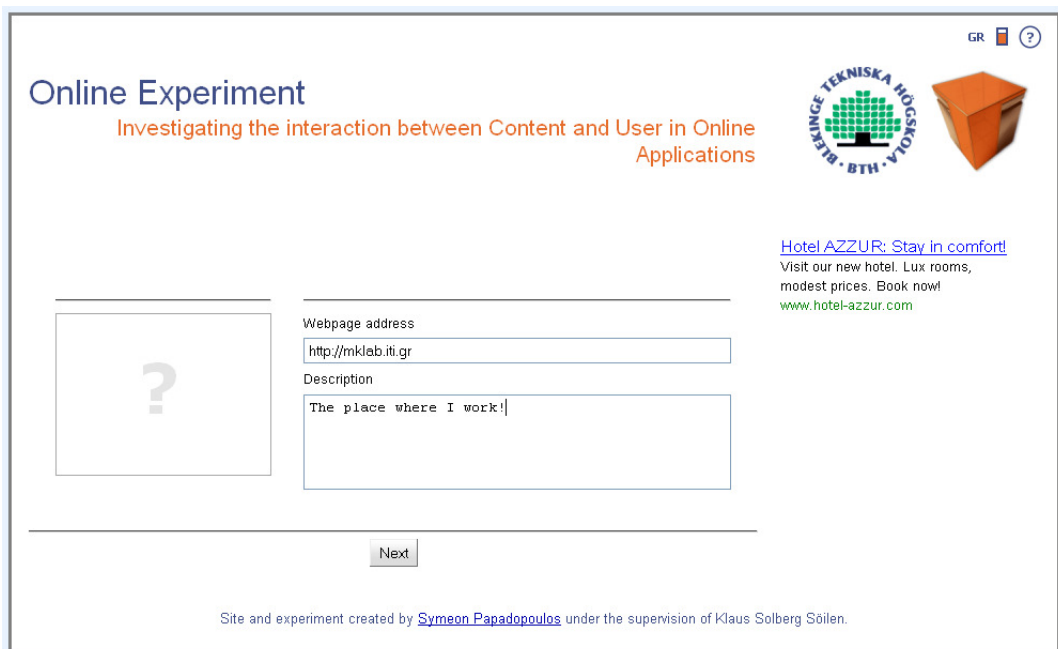


Figure A.5(II): Social bookmarking screen II: The user is asked to submit a site of his own preference along with a short description of its content. This task is repeated four times (but the user may leave the fields blank).



Figure A.6: Message exchange screen: The user is asked to send a message to one of his/her friends. The message should be accompanied by an emoticon (in order to make the task more interesting and retain the user's attention for some time).

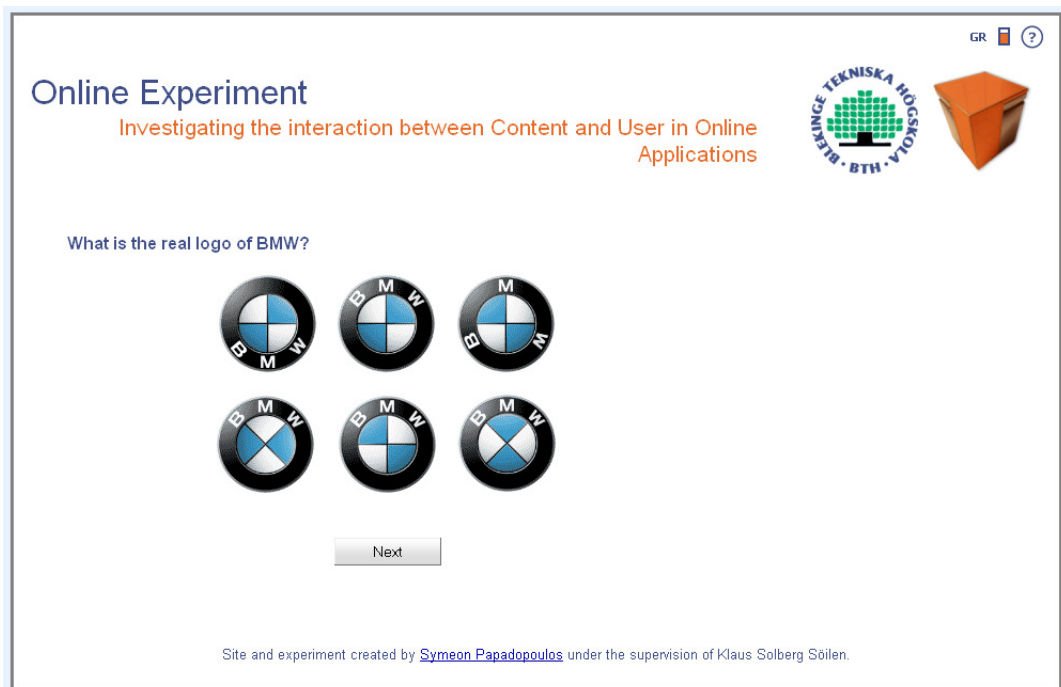


Figure A.7(I): Decoy task screen I: The user is requested to identify the correct version of the logo. There is also a similar logo test for the Google logo.

Online Experiment

Investigating the interaction between Content and User in Online Applications

Five people took part in a race. Alex finished before Bill but after Cane. Duncan finished before Edwin but after Bill. What was the finishing order? (First place to the left and last place to the right.)

- Bill, Duncan, Edwin, Cane, Alex
- Cane, Bill, Edwin, Duncan, Alex
- Duncan, Edwin, Cane, Alex, Bill
- None of these

Next

Site and experiment created by [Symeon Papadopoulos](#) under the supervision of Klaus Solberg Söilen.

Figure A.7(II): Decoy task screen II: The user is presented with a logic question that needs some thought.

Online Experiment

Investigating the interaction between Content and User in Online Applications

If 3 men can eat 3 steaks in 3 days, how many steaks can 6 men eat in 6 days?

- 12
- 6
- 24
- 9

Next

Site and experiment created by [Symeon Papadopoulos](#) under the supervision of Klaus Solberg Söilen.

Figure A.7(III): Decoy task screen III → The user is presented with a math question.

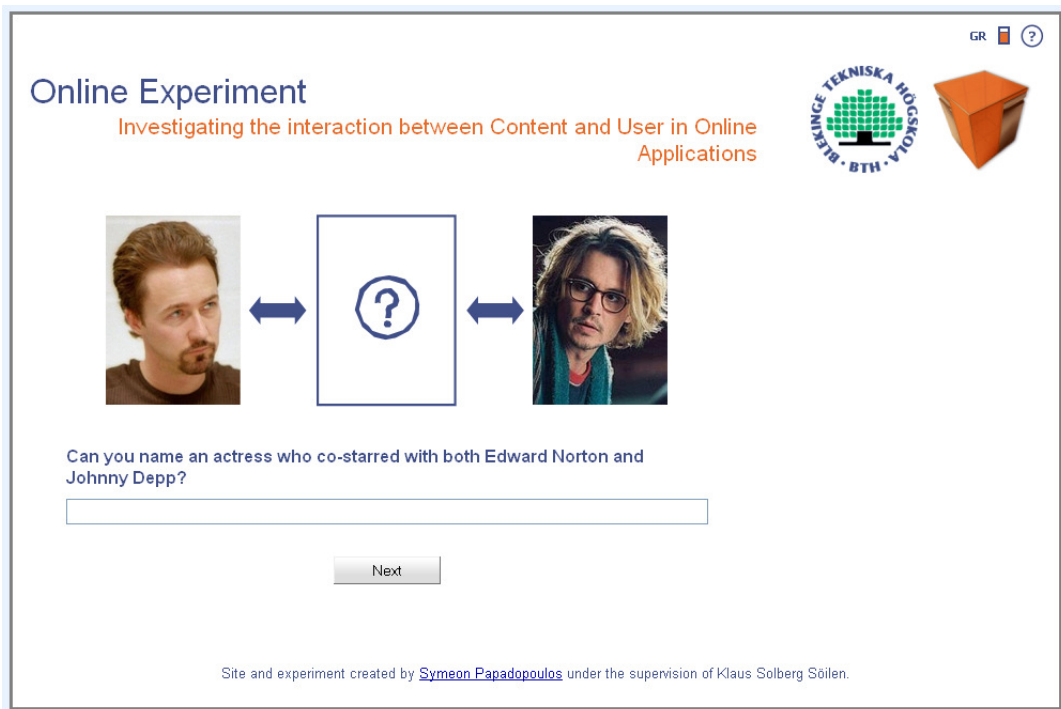


Figure A.7(IV): Decoy task screen IV: The user is asked a question about movies.

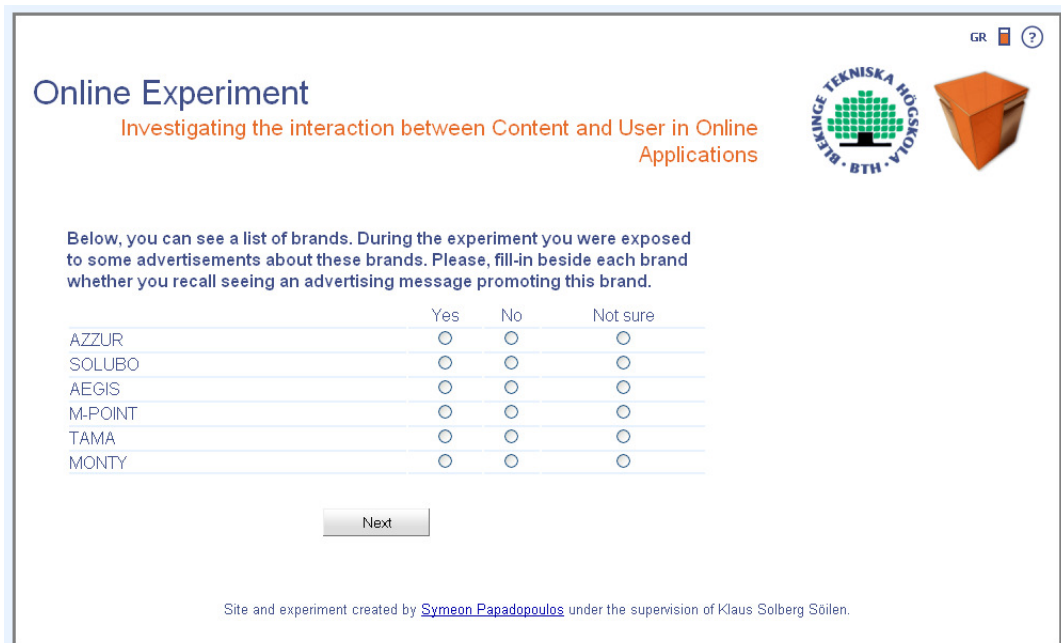






Figure A.8 (I): Ad recall screen I: The user is asked whether he/she recalls seeing each of the brands he/she was exposed to during the experiment.



GR  

Online Experiment





Investigating the interaction between Content and User in Online Applications

Now, you need to decide what kind of product or service corresponds to each of the brands below. Click on one of the available selections even if you cannot recall seeing the respective ad (rely on your instinct).

	Laptop	Movie reviews	Hotel	Sunglasses	Other
AZZUR	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SOLUBO	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AEGIS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
M-POINT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TAMA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
MONTY	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Site and experiment created by [Symeon Papadopoulos](#) under the supervision of Klaus Solberg Søilen.

Figure A.8 (II): Ad recall screen II: The user is asked to match each advertised brand to its category.



GR  

Online Experiment

Investigating the interaction between Content and User in Online Applications

1. What is the highest level of education you have achieved?
 - High school
 - Bachelor's degree
 - Master's degree
 - Ph.D.

2. What is your current level of income (comparative to the average income in your country)?
 - No income (e.g. student, unemployed)
 - Low (I can barely get by)
 - Medium (I manage pretty well)
 - High (I am a big spender)

3. How often and how long do you browse the Web?
 - Rarely (~one hour/week)
 - Not much (~five hours/week)
 - Regularly (~10 hours/week)
 - A lot (~20 hours/week)
 - Webaholic (>30 hours/week)

4. What is the level of your computer skills?
 - Basic (can barely browse the web)
 - Medium (web + office applications)
 - Advanced (e.g. SOAP, WSDL, CAD, SWF mean something to me.)
 - Guru



5. Which of the following web applications have you used or are using at present?


<input type="checkbox"/> Facebook	<input type="checkbox"/> MySpace	<input type="checkbox"/> LinkedIn
<input type="checkbox"/> YouTube	<input type="checkbox"/> flickr	<input type="checkbox"/> last.fm
<input type="checkbox"/> digg	<input type="checkbox"/> Twitter	<input type="checkbox"/> delicious

Figure A.9: Demographics screen: Some demographic information is requested from the user in order to check whether there exist any correlation between user response and such variables.

Online Experiment

Investigating the interaction between Content and User in Online Applications

GR 

1. In your opinion, which of the following best describes the experiment?

Exciting
 Interesting
 Indifferent

Boring
 Annoying

2. Based on the time that you needed to complete the experiment tasks, how would you characterize it?

Short
 Normal
 Long (but I did it with pleasure)
 Long and cumbersome (if I only knew in advance...)

3. Were the experiment tasks always clear enough for you to complete without problems?

Definitely (you could even skip the instructions)
 In principle, yes (there may have been a couple of issues)
 I was troubled by several tasks
 Huh?

4. The experiment aimed at the study of two particular elements in a user's online behaviour. Has it been obvious to you which are these two elements (if yes, write them down in the following text field)?



No way
 I think it became obvious towards the end of the experiment
 Yes, it was obvious right from the start of the experiment


5. Do you have any other comments/suggestions that could be helpful for improving the design of similar experiments in the future?

Figure A.10: Experiment evaluation screen: The user is asked to evaluate the experiment. A significant question pertains to whether the user understood the purpose of the experiment.

Online Experiment

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GR 

Thank you for taking part in this experiment!
 The data resulting from your input will be processed together with the data collected from the rest of the participants. The conclusions drawn from this data analysis will be discussed in my thesis:

Key Success Factors in Internet Advertising
Online User Activity and Social Context

If you wish to receive an electronic copy of the Thesis once it is ready, click on the following button:

Site and experiment created by [Symeon Papadopoulos](#) under the supervision of Klaus Solberg Söilen.

Figure A.11: Goodbye screen: The user is thanked and is asked whether he/she wants to receive an electronic copy of the Thesis.

Appendix B: Experiment participants

Here I append a list of the people who made this study possible through their participation in the online experiment. The participants are listed in alphabetic order. Some of them are printed together with a blue dot, since they acted as attractors for additional participants. Also, the participants that are printed together with a red dot acted as pilot users of the first version of the experiment.

Afgerinakis Konstantinos	Goniadis Yiannis
Alexoudi Theonitsa	Greiner Charles
Anagnostara Tatiana	Greiner Claudia
Angeletou Angeliki	Hengen Mylene
Arapakis Ioannis	Kalfas Giorgos ●●
Arvanitidou Marina Georgia	Karandeinos Giorgos
Asiklari Maria	Kargas Stefanos
Athnasiadou Mando	Katsikas Dimitris
Billis Antonis	Kavakiotis Yiannis
Bratzou Natasa	Ketonis Niovi
Cazares Cesar	King Paul
Charalambidou Jenny	Kostantelou Lito
Chatziioannou Eleftheria	Kourkoulos Dimitris
Chatzilari Elisavet ●	Kourkoutis Leonidas ●
Ciacci Massimo	Koutsari Maria ●
Danelyan Hripsime	Koutsari Matoula
Dimou Anastasios	Koutsonikola Vasiliki
Dividis Kosmas	Kritikos Apostolos
Dokouzgiannis Dimitris	Kyropoulou Mili
Doulaverakis Mpampis	Lakka Christina ●
Doulga Natasa	Litos Giorgos ●
Flouri Ioanna	Malasioti Polyxeni
Fragkouli Chrysa	Manolaki Antigoni
Fragkoulis Alexandros	Meletiadis Yiannis
Froudaraki Nefeli	Moraiti Marina
Georgopoulos Nikos	Moumtzidou Anastasia ●
Giannakidou Eirini	Mouratidis Giorgos
Gidaros Spiros	Mouratidou Maria

Nikolopoulos Spiros
Oikonomou Fanis
Papadopoulos Giorgos
Papadopoulos Thanos
Papadopoulou Maria ●
Papamichael Michael
Pasvanti Angeliki
Psaltis Giorgos
Sarantopoulos Thanasis
Semertzidis Theodoros
Sevastiadis Christos
Sidiropoulos Panagiotis
Solachidis Vassilis
Spiridaki Efi
Stamos Kostas
Stasinou Dimitris

Trigidou Eva
Trigonis Panos
Tsampoulatis Ioannis ●
Tsangaraki Eugenia
Tsatsou Dorothea
Tserverli Ntina
Tsiminaki Vagia
Tsiopoulou Chamaidi
Varvaressou Cecile
Varvaressou Isabella
Vrochidis Stefanos
Xanthopoulakis Charalampos
Xyntas Ioannis
Zigkolis Christos
Zogopoulos Nikos ●●

Appendix C: List of Web Applications Referenced through the Thesis

Web Application	URL
Delicious	delicious.com
Digme	www.digme.gr
Digg	digg.com
Facebook	www.facebook.com
Flickr	www.flickr.com
Last.fm	www.last.fm
LinkedIn	www.linkedin.com
MySpace	www.myspace.com
Pineza	www.pineza.gr
YouTube	www.youtube.com