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An Experimental Study of Antecedents and Consequences of Online Ad Intrusiveness

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Internet advertising has shown signs of continued healthy growth in spite of the burst Internet bubble. Several types of ads have been used, and there are important generic characteristics that can be gleaned from these ads: whether they obscure content and whether users have the control to remove them. These factors were tested in a laboratory study with 258 student participants. It was hypothesized that the factors would predict intrusiveness, which would predict perceived irritation. This, in turn, would predict attitudes about the site and, finally, intentions to return. Intrusiveness was also predicted to directly relate to recognition of the ads. All hypotheses were supported at high levels of statistical significance using analysis of variance and structural equation modeling. Explained variance was very high for intrusiveness (42%) and irritation (63%), but very low explained variance for ad recognition (11%) resulted in an alternative model that doubled explained variance by removing intrusiveness as a mediator between the factors and ad recognition. The interaction between user control and obscuring of the content behaved as hypothesized, and interaction charts illustrate the effects as predicted. Future studies should continue to focus on characteristics rather than on types of ads and generalize the results to other types of participants and settings.

Internet advertising in the United States reached a record $21.1 billion in 2007, according to the Interactive Advertising Bureau and PriceWaterhouseCoopers (Interactive Advertising Bureau, 2008), an increase of 25% over 2006. Online marketers are finding this segment to be very healthy, with consistent and high increases in both quarter-to-quarter and year-to-year comparisons for the past several years. With such heavy expenditures, firms need to monitor the effects of their advertising efforts closely.

Several online marketing delivery techniques exist. The oldest and most familiar ad is the banner, which is a graphic embedded "in-line" on a host Web

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page. Other in-line ads have emerged, placed in various locations and in various shapes and sizes on a page. Some, called "interstitials," must be cleared or closed before a user can continue. Interstitials sometimes force the user to watch a video or animation before disappearing, shrinking, or moving out of the way. There are also ads that involve a separate window that "pops up" or "pops under" the current window. Methods of taking advantage of these different promotional techniques have been investigated (e.g., Gao, Koufaris & Ducoffe, 2004).

This article considers the potential intrusiveness of these ads and examines promising antecedents and consequences of that intrusiveness. Although other research has considered intrusiveness (Bulik, 2000), there is not much empirical research on the effects of various types of ads on the host site users' attitudes and behavioral intentions. In short, intrusiveness is a measure of how much an ad will cause an unwelcomed distraction or diversion from the user's task at hand.

Ads were not always considered to be negative, however. Early research on banner ads found them to be effective in creating brand awareness and positive attitudes (Briggs & Hollis, 1997), in spite of published evidence of advertising's annoyance in traditional media (Bauer & Greyser, 1968). With the escalation of online advertising, more recent research has described Internet advertising as nonsensical, uninformative, unfocused, forgettable, and ineffective (Bulik, 2000). Li, Edwards, and Lee (2002) reported that because online consumers are goal oriented and advertising can stand in the way of those goals, users perceive online advertisements to be even more intrusive than do the more passive viewers of other media. Furthermore, they found that online consumers develop negative attitudes toward the advertisements, which then lead them to develop intentions to not return to the Web site.

Other studies have reported that consumers despise these intrusive and annoying advertisements, and even feel "violated" and "molested" by their presence (Wegert, 2002). Newer studies have begun to investigate consumers' experiences with various Internet advertising techniques (e.g., Burns & Lutz, 2006; Gao et al., 2004). These other views of online ads point out that it is valuable to determine to what extent the intrusions or diversions caused by the ads lead to irritation, a temporary state of discomfort; to negative attitudes toward the site itself; and finally to intentions to return to the site.

Several issues are examined in this study to answer our overarching research question of how the types of ads affect user perceptions that lead to avoiding Web sites. First, we consider the general effects of online advertising that have been reported in the literature. Second, we investigate whether particular characteristics—namely, whether an ad obscured the content and whether the user had some control over the ad, either to move or close it—affect consumers' perceived intrusiveness of advertisements.

Stated more formally, the questions that this study addresses are the following:

1. Does the type of ad (obscuring and/or closeable) affect users' perceptions of intrusiveness?
2. Does users' perceived intrusiveness affect their (a) perceived irritation of the ad and (b) recognition of the ad?
3. Does the perceived irritation of the ad affect users' attitudes toward the site and in turn intentions to revisit?

The remainder of this article proceeds as follows: First we review previous literature and our research expectations. Then, the research methodology and experimental design used to test the hypotheses as well as the data collection procedure are described, the analysis is detailed, and the results reported. In the penultimate section, discussion of the results and conclusions drawn from the research are provided. The final section outlines limitations of this research and proposes potential future studies aimed at extending this investigation. It is our hope that this research provides additional insight into online advertising and its impact on users by focusing on two important characteristics of online ads.

1. BACKGROUND

Most of the issues related to the research questions can be addressed by consulting the literature of e-commerce. However, some outcomes such as recall of the ads have not been addressed by that research, and research findings have not always been anchored by strong theory. Therefore, we also consult the literature of psychology for theoretical support. A model developed and tested in this research integrates research from those two areas.

1.1. E-Commerce Findings

Intrusiveness and irritation are two central constructs in this study. Strictly speaking, the former describes the advertisement (as perceived by a user) and the latter describes a user's reaction to those ads. These two factors have an interesting history in the e-commerce literature, and several studies have been conducted both in traditional media (such as television) and the online world's "new media."

Research in traditional media has shown that intrusiveness is a major cause of annoyance and irritation (Bauer & Greyser, 1968; Greyser, 1973). Consumers will avoid ads as much as possible, by leaving the room, changing the channel (Abernethy, 1991), participating in another activity, or ignoring the ads altogether and focusing on something else (Krugman & Johnson, 1991).

Some of this intrusiveness seems to have carried forward to the "new media" of e-commerce, contrary to expectations. Some researchers expected online ads to be less intrusive (Rust & Varki, 1996), and even entertaining (Coyle & Thorson, 2001). On the contrary, users find them to be disturbing (Reed, 1999) and annoying (McCoy, Everald, Polak, & Galletta, 2007), detracting from their online experience. In fact, interstitials and pop-up ads force users into a passive mode, much like television commercials in the old media.

The interruption that is created by banners, interstitials, pop-ups, pop-unders, and other forms of advertising has been found to negatively affect consumers' attitudes toward the ads (Rettie, 2001). Different forms of ads are likely to provide different levels of intrusiveness. For example, in-line ads might blend into the Web pages on which they are displayed, whereas interstitials, on the other hand, are *designed* to interrupt.

Many studies (e.g., Bruner & Kumar, 2000) have examined consumer attitudes, behavior, and perceptions related to ads in an online environment. Although

Eighmey (1997) reported that users find information helpful when it is presented in an enjoyable context, many studies have reported that consumers develop such negative attitudes toward the ads that they avoid them whenever possible (Abernethy, 1991; Krugman & Johnson, 1991). One study even found that brand perceptions can be harmed by ad intrusiveness (Mackenzie & Lutz, 1989).

Having to click to close the ad in order to be able to continue viewing a site can heighten a user's level of irritation. This irritation can be intensified when there is an inability to close the ad and users are forced to watch a video or animation or simply wait for the ad to disappear. Moreover, during the time it takes a user to close an ad or to minimize it, the user's attention is taken away from the Web site and is focused on the ad, leading to an increased exertion of effort on the user's part. This exertion alone may lead the user to not revisit the site (Wickens, 1980).

Although the previous work in e-commerce has provided ample documentation of the problem of online ads, there is little theory to understand the intrusiveness and irritation felt by users. We now turn to the psychology literature for additional theory.

1.2. Psychology Research on Attention

The perceived intrusiveness of ads can perhaps also be explained more thoroughly by cognitive psychological models of attention and attendant effort that is required to process the additional, interruptive, and unsolicited information provided by ads. In a wide variety of contexts, researchers have studied the effects of being interrupted while working on a task (e.g., see Bailey, Konstan, & Carlis, 2000, 2001; Czerwinski, Cutrell, & Horvitz, 2000; Rennecker & Godwin, 2005).

Theories of attention have been well established over the last 50 years (Broadbent, 1958; Treisman, 1988), forming the basis for some of the fundamental hypotheses in this study. Although different tasks and interruptions have varying effects (see Naveh-Benjamin, Guez, & Marom, 2003), experiments have consistently shown that participants remember less when interrupted (at the time of "encoding" when material is encountered before being moved into long-term memory for later retrieval). Naveh-Benjamin and colleagues explain that encoding requires attention, and interruption interferes with that attention.

Explanations for this effect are still under investigation, but they are very helpful in understanding the impact of interruptions. Craik (1982) posited that people process information more superficially when interrupted. This has been explained by a potential reduction in processing time because of the interruption (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996) or an increase of fragmentation in attending to the main task (Naveh-Benjamin, 2000), impairing a user's ability to form a cohesive mental framework. Interruptions impair the all-important process of encoding (Naveh-Benjamin et al., 2003), thus requiring additional effort.

These explanations account for cognitive impacts of interruption but not affective (attitudinal) impacts. It is perhaps intuitive to state, as previous Web ad researchers have, that individuals would prefer not to be interrupted. However, the mechanism by which this preference is formulated is not provided by intuition.

Psychological models of information processing provide insight into affective reactions to interruptive tasks. Bailey et al. (2001) found that there is additional effort required when a person is interrupted while performing a task. This effort is expended on active monitoring (Kahneman, 1973) and filtration (Kahneman & Treisman, 1984) for deciding where to devote attention. The central executive processor determines where and how attention may be shifted (DiDomenico, 2003), but that processor requires additional effort.

The most important way in which divided attention can be managed with a minimum of effort is by using multiple channels, which interfere with each other very little (Wickens, 1980). Examples include processing verbal information and images simultaneously, and performing manual operations while speaking, listening to music, or even singing. However, in the case of Web browsing, similar visual channels (text and illustrations) are used in target pages and advertisements, so Web advertisements do not usually use multiple channels to diminish the strain on cognitive processing.

The additional effort has been shown to result in subjective reactions (Reid & Nygren, 1988), which vary with the demands imposed on participants (Eggemeier, Wilson, Kramer, & Damos, 1991). Therefore, there is an established link between the cognitive and affective domains. The following section outlines the factors in our research and develops the hypotheses in the areas of intrusiveness, recognition of ads, irritation, attitudes toward the site, and behavioral intentions.

2. DEVELOPMENT OF HYPOTHESES

As outlined in our research questions, this study investigates two general properties of online ads. Some ads obscure site content and others provide users with the ability (or necessity) to "close" them. The dependent variables include intrusiveness, recognition of the ads, irritation, attitudes toward the site, and behavioral intentions.

Intrusiveness refers to the advertisement's ability to interrupt the users so much that their train of thought is disrupted. Recognition of the ads is a step before recall and indicates that the user has seen the ad and that therefore is more likely to purchase the product. Irritation refers to a feeling of annoyance as the advertisement has interrupted the user so much that she is unable to continue her task. Attitudes toward the site and behavioral intentions are constructs related to the theory of reasoned action, the theory of planned behavior, and the technology acceptance model. In our context, we are concerned with the feelings of users toward the site. The more positive a user's feelings toward the site, the more likely it is that she will return to the site. These factors are illustrated in the research model (see Figure 1) and are described in more detail in the development of hypotheses that follows.

2.1. Intrusiveness

The goal of online advertisements is to interrupt editorial content and to attract the attention of Web users (Ha, 1996). To do so, some online advertisements

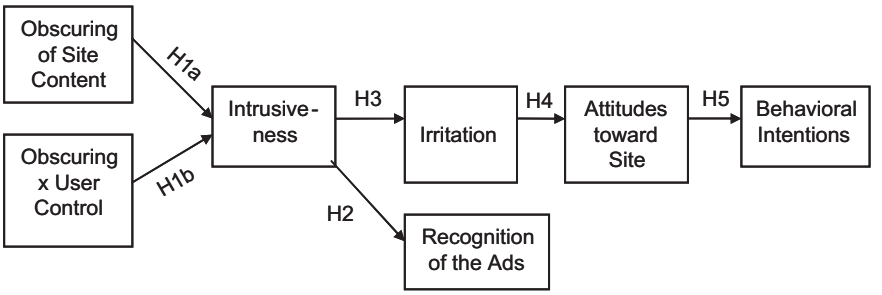

FIGURE 1 Research model.

obscure Web site content, either fully or partially. Although it is by design that the ads provide an interruption, this interruption may be considered intrusive by users as they disrupt their train of thought. As we discussed earlier, theories of attention and the effort involved in the additional information processing load provide ample theoretical support for such assertions (Bailey et al., 2001; Broadbent, 1958; Treisman, 1988).

Ads behave in a variety of ways. Ads can be large or small, in nearly any position on the screen, and in separate windows or on the same page as the content. It is somewhat difficult to make sense of the myriad of options. We propose that two generic features stand out as more important than those details in sorting out the options: whether the ads block the user's view of the content being read and whether the user has the ability to remove the ad from view. These generic features link directly to psychological theories of attention and interruption.

Obscuring Web content is an important consideration. Some banner ads (horizontal ads at the top and/or bottom of the page) and "skyscraper" ads (tall ads at the right or left) do not obscure any content. They stay in constant view (sometimes until the user scrolls down the page). In contrast, some pop-up ads appear in a separate window that blocks the site content that users are attempting to read. Because users are not mere viewers, and have a particular goal in attempting to view the page, their goal has been interrupted. The goal orientation of Web users (Li et al., 2002) is likely to strengthen the impact of the interruption.

Coupling the idea of goal orientation with theoretical support from the psychology literature, obscuring the site has great potential to increase ad intrusiveness. The key issue is the additional effort required to attend to the interruption (Bailey et al., 2001), which requires the user to monitor and filter the unsolicited information (DiDomenico, 2003; Kahneman, 1973; Kahneman & Treisman, 1984). Users react negatively to the increased load (Eggemeier et al., 1991; Reid & Nygren, 1988). Therefore, there is the following hypothesis:

H1a: Ads that obscure the site content will be perceived as more intrusive than ads that do not obscure the site content.

A user's control over the ad is the second consideration. Banner and skyscraper ads most often cannot be removed. Although it is possible for a user to close some ads, other ads are designed to play out an animation or video, or otherwise

remain on the screen for a predetermined time, forcing users to be a captive audience or to abandon their goal and close the entire site. Although on the surface this lack of control can be expected to contribute to the user's sense of intrusiveness, such a simple, direct relationship cannot be supported theoretically.

It is important to begin by noting that several researchers (e.g., Eggemeier et al., 1991; Reid & Nygren, 1988) have reported that people have a strong affective preference for avoiding barriers that distract them from their goal. As common sense would dictate, an ad that is in the way of site content without any possibility of its removal will interrupt users' paths toward their goal. Providing the ability to close the ad would certainly provide users with a way to minimize the interruption. Therefore, the lack of control will be intrusive.

However, if an ad that does not block site content from the user must be closed, removing it will be an unnecessary barrier, a distracting interruption. Therefore, the control that enables removal can actually be intrusive as users face and handle a barrier that they really would prefer to avoid. Therefore, requiring control in that case will *introduce* intrusiveness because there is little gain from removing the ads. We hypothesize, therefore, that the presence of user control will interact with obscuring of content. When ads obscure the page content, users with no control will perceive higher ad intrusiveness than users with control. Conversely, when ads do not obscure the page content, users with no control will perceive lower ad intrusiveness than users with control. Stated more succinctly in our hypothesis,

H1b: Control to remove an ad will lower perceived intrusiveness if the ad obscures web page content but will raise intrusiveness otherwise.

2.2. Recognition of the Ads

Common sense tells us that ads that are most visible will be remembered. Recall is an outcome that can be very important to e-commerce sites. However, as Stapel (1998) indicated, recognition is a step before recall, although they are highly correlated. In previous experiments (Galletta et al., 2006), we found that participants had a difficult time with recall questionnaire items. We believe that recognition is an important construct in and of itself, as customers will be more likely to buy from a familiar brand than an unfamiliar one (Monroe, 1976). Advertisers are likely to agree as well. Therefore, although we acknowledge that recall is an important outcome, we focus here on recognition.

According to Diao and Sundar (2004), when a user is confronted with an advertisement on a Web site, a sudden change occurs in the visual field, and the new objects on the screen demand the user's attention. As this new intrusive stimulus attracts and holds the viewer's attention, the content of the Web advertisement stands a greater chance of being recorded by the user. Stated another way, a more intrusive ad is expected to be noticed more, and therefore remembered more vividly. Hence, our next hypothesis:

H2: Higher levels of perceived ad intrusiveness will be associated with higher levels of ad recognition by users.

2.3. Irritation

Previous research in traditional media has shown that when advertisements are considered intrusive, the resultant feeling is one of irritation (Kennedy, 1971; Krugman, 1983; Soldow & Principe, 1981). This reaction is most likely a result of interrupting users from reaching their goals (Aaker & Bruzzone, 1985). Evidence of the relationship between perceived intrusiveness and irritation was found by Edwards, Li, and Lee (2002). Therefore, we hypothesize the following:

H3: There will be a direct positive relationship between perceived ad intrusiveness and user irritation.

2.4. Attitudes Toward Site

Site owners must balance revenue gained from ads against the potential for disenfranchising their users. A small amount of advertising revenue might cause significant degradation in the way a site is viewed. Although many site owners are interested in behavioral reactions, we believe these reactions are mediated by attitudes and hence expect that a sense of irritation triggered by the ads will lead to negative attitudes on the part of users.

H4: As user irritation increases, user attitudes toward the site become more negative.

2.5. Behavioral Intentions

Abernethy's (1991) findings that viewers sometimes leave the room or change the channel provide ample behavioral caution because of the potential degradation of attitudes that can be attributed to ads. These behavioral outcomes are not universal, however, as Clancey (1994) and Krugman and Johnson (1991) found that some viewers just ignore the ad.

Previous Web advertising research has provided adequate theory for forming expectations about behavioral intentions when a search task is interrupted, or impeded, by advertising: Online consumers are goal oriented and perceive ads to be even more intrusive than when they are viewed in other media (Li et al., 2002). As a result, consumers' negative attitudes can affect brand perceptions and attitudes (MacKenzie & Lutz, 1989) and can lead to ad avoidance (Abernethy, 1991; Krugman & Johnson, 1991). As previously outlined, when the only option to avoid the online ad is to abandon the site, the intention to return will be low. Although awareness is considered to be positively related to purchase intentions, researchers have acknowledged that online users penalize brands that use intrusive ads and mistrust the companies that host them (Chan, Dodd, & Stevens, 2004).

This leads to our final hypothesis:

H5: There will be a direct positive relationship between attitudes toward the site and intentions to revisit the site.

3. RESEARCH METHODOLOGY

The study was conducted as an experiment to manipulate the location and types of the advertisements and to ensure a controlled setting for outcome measurement. A between-subjects experimental design with eight treatments provided us with the conditions to test the research model.

3.1. Experimental Design

A Web site was adapted from a previous study (Galletta et al., 2006). Using our own site allowed us to have complete control over ad type, placement, size, and timing. The site mirrored a "general store" Web site with familiar everyday products, such as food, household, and health items. The site was organized into familiar, easy-to-understand categories and included product descriptions, images, and prices.

Six original advertisements were created and inserted into specific locations within the Web site structure. The ads were congruent with the site content (the displayed ad was about a product related to the one on the hosting Web page) and contained a simple animation. Their locations in the Web site were chosen so that each participant who successfully completed the experimental task was guaranteed to be exposed to all six ads. Only one ad was placed along the path for each of the selected tasks to minimize interference of ads with each other. The experimental conditions differed only in the form of the ads and placement on the page. The ads either popped up, appearing in a small window on the top of the designated Web page, or were presented in-line, built into the same window as the site content. The placement of ads varied only horizontally along the page—toward the left or the right edge of the main content window—and was used to manipulate whether the ad blocked page content underneath it. The ads were presented in eight treatment conditions, which were subsequently collapsed into a 2×2 factorial design (see Table 1 for details). The treatments were obscuring pop-ups, obscuring banners, nonobscuring pop-ups, nonobscuring banners,

Table 1: How the Eight Versions were Collapsed Into Four Treatments (2 × 2)

Type	*Location*	*Size*	*Timing*	*Treatment 1: Obscuring*	*Treatment 2: Control*
Pop-up	Right	Large	Closable	Nonobscuring	Controllable
Pop-up	Right	Small	Closable	Nonobscuring	Controllable
Pop-up	Left	Large	Closable	Obscuring	Controllable
In-line	Right	Large	Permanent	Nonobscuring	Noncontrollable
In-line	Right	Large	6-sec vanish	Nonobscuring	Noncontrollable
In-line	Right	Small	Permanent	Nonobscuring	Noncontrollable
In-line	Left	Large	6-sec vanish	Obscuring	Noncontrollable
In-line	Left	Large	6-sec spin away	Obscuring	Noncontrollable

Note. All in-line ads were noncontrollable and all pop-up ads were noncontrollable. Location and size of pop-up determined whether the ad obscured any text. Some in-line ads that obscured content on the left either disappeared or spun away after about 6 sec.

closable pop-ups, closable banners, nonclosable pop-ups, and nonclosable banners. The resulting 2 × 2 design is described in the following section.

3.2. Independent Variables—Experimental Manipulations

Advertisement visually blocking website content—obscuring ads. The Web pages on the site were designed in a similar fashion to many pages on the Internet—with the page content (image and text) aligned along the left edge of the browser window and navigation links underneath. The page content fit onto one screen; no scrolling was necessary to see the entire page. The screen was wide enough to leave a sufficiently large blank space at the right edge of the screen.

Two placements for the ads were chosen in order to provide variation in the Web site content blocking factor. A nonobscuring ad was placed at the right edge of the screen over the blank area with no information-carrying content underneath it (only part of the subtle and faint pattern in the page background graphics was blocked). An obscuring ad was positioned at the left edge of the screen where it visually blocked the page content relevant to the experimental task (text or navigation links). Both pop-ups and in-line banner ads were used for obscuring and nonobscuring conditions, respectively. An example of an obscuring and nonobscuring pop-up from the experiment can be seen in Appendix A.

User control over dismissal of the advertisement (Ad closeability). Whether the users had control over closing the advertisement window was operationalized through a choice of ad type. A pop-up ad often can be easily dismissed by closing its window via the X in the top right corner. A condition in which the advertisement was a form of a pop-up was classified as user closeable where users had control over its dismissal. Advertisements implemented in the form of in-line graphics (banners) were deemed as noncloseable and users were left with no control over their appearance. Noncloseable banners came in two forms—some participant groups were exposed to banners that would stay on the page until the subject navigated to a different page, whereas other participant groups had banners that disappeared on their own after a 6-sec delay. The disappearing banners blocked important page content, and once the banner disappeared, the participant could resume his or her task.

3.3. Dependent Variables

The full list of measures used in assessing dependent variables can be found in Appendix B. Here we briefly summarize their main characteristics.

Behavioral intentions. Behavioral intentions were measured using four questions that focus on two related future behaviors (Galletta et al., 2006): how readily the participant would visit the site again and how likely he or she would

recommend that others visit the site (7-point scales). Reliability analysis revealed Cronbach's alpha to be .91.

Attitudes towards the site. User attitudes toward the Web site were measured using an instrument taken from Galletta et al. (2004, 2006), which includes seven questions adapted from Part 3 of the long form of the Questionnaire for User Interaction Satisfaction (Shneiderman, 1998, p. 136). Cronbach's alpha was .89.

Intrusiveness of the ads. Intrusiveness of the ads was measured using a seven-item subscale of a larger instrument by Li et al. (2002). The 7-point Likert scale items captured participants' negative attitudes toward the ads. Cronbach's alpha was .96.

Irritation of users. Irritation felt by the participants because of the advertisements was measured by five 7-point Likert items. Alpha was .91. The instrument was adapted by Li et al. (2002) from an original study by Wells, Clark, and McConville (1971).

Advertisement content recognition. Ad recognition was measured by asking participants whether they remembered the six ads they saw. True–false questions were used because respondents were not asked to memorize anything, and we wished to avoid situations in which a person might only partially recall the answer. By making use of recognition rather than recall, we eliminated the need to make judgments about "partial credit" when answers were close but not exactly correct. Also, we presented 18 ads (12 distractors) to participants so they would not simply guess "yes" for all of them. The responses ranged from 0 to 4 (M = .76, SD = .87) on a scale of 0 to 6 (six ads were presented to the participants).

3.4. Participants

Undergraduate students enrolled in three U.S. universities and one Mexican university were invited to participate in the study. An incentive for participation was offered, and nearly 100% of the students who were invited participated in the study. In the United States, instructors provided extra credit points to those who completed the entire task, and in Mexico random drawings for several $100 cash prizes were held. Of the 263 undergraduate business students who completed the experiment, 5 participants were eliminated from the analysis because of incomplete responses. Further examination showed that the remaining 258 participants were suitable for data analysis.

3.5. Procedure

A computer laboratory containing identically-sized XGA screens (1024 × 768) provided a controlled environment for the experiment. An experimenter presented

introductory comments and directions to the participants, who were then randomly assigned to treatment groups. Participants browsed the experimental Web site over the Internet on an authors' Web server with the goal of finding information (price, shipping charges, or packaging) on nine different products. As the participants browsed through the site, they were presented with the advertisements upon reaching each of the ad trigger pages. To avoid having an advertisement associated with each of the nine product searches, the design included only six ads. Therefore participants were not presented with ads when searching for three of the nine products. After completion of the assigned task, participants completed online questionnaires, which concluded the experiment. Their browsing behavior and their treatment conditions were automatically recorded.

4. RESULTS

This section describes the results of both our measurement and research models.

4.1. Measurement Model Results

Given the promising alpha scores, the model was examined more rigorously using PLS Graph version 3. Table 2 shows the results of the initial PLS loadings, painting a promising overall picture of convergent validity.

All items except one had factor loadings that exceeded .7. The third item of the attitudes toward site construct (AT3) seemed to fall slightly short, in contrast to previous studies where the instrument was used (Galletta et al., 2004, 2006). Given that the instrument displayed adequate reliability in the past, and that the coefficient is very close to .7, we did not remove AT3. The results of structural equation modeling, described next, are nearly identical with and without AT3.

Discriminant and convergent validity were further examined using the procedures recommended by Gefen and Straub (2005), and the results of correlating each item with each of the four latent constructs are provided in Table 3. Following Gefen and Straub, we computed the set of latent constructs by using PLS and inserted those constructs into an SPSS file to obtain the correlations. Average variance extracted (AVE) scores and correlations of all latent constructs are shown in Tables 4 and 5. Values in Tables 4 and 5 are shown at this stage ("before") and after dropping troublesome items, described next.

It appears that, rather than AT3, our most problematic cross-loading is found with the item Irrit1. This item appears not only to cross-load but to load more strongly with the intrusiveness construct than with the irritation construct. Further evidence of this difficulty was provided by computing the square root of the AVE scores provided by PLS analysis and comparing them to the correlations among latent constructs. Although the square root of all of the AVE scores indeed exceeded the correlations of those constructs with the other constructs, the difference was not very large in the case of irritation (square root of AVE = .859 vs. a correlation of .792 between irritation and intrusiveness). The difference was certainly under the .10 magnitude difference recommended by Gefen and Straub.

Table 2: PLS Measurement Coefficients

Measures	*Coefficients*	SD
Intrusiveness		
intrus1	.877	0.150
intrus2	.828	0.143
intrus3	.888	0.156
intrus4	.943	0.168
intrus5	.947	0.161
intrus6	.925	0.162
intrus7	.915	0.166
Attitudes toward site		
at1	.820	0.256
at2	.825	0.202
at3	.673	0.203
at4	.761	0.139
at5	.798	0.169
at6	.741	0.159
at7	.814	0.156
Irritation		
irrit1	.818	0.291
irrit2	.779	0.192
irrit3	.887	0.221
irrit4	.903	0.223
irrit5	.902	0.239
Behavioral intentions		
bi1	.865	0.349
bi2	.890	0.254
bi3	.915	0.273
bi4	.876	0.254

To address these difficulties, we removed the Irrit1 item from analysis and started over with the Gefen and Straub procedure. The correlations of items with latent constructs were cleaner and the square root of the AVE score for irritation (.859) more acceptably exceeded the correlation of irritation and intrusiveness (.687). Other differences were far above the recommended .10 magnitude.

One difficulty with dropping Irrit1 is that the label ("irritation") is central with respect to the construct ("ad irritation"). We did not see a discussion of cross-loading in our source for the intrusiveness and irritation instruments, in either Li et al. (2002) or Wells et al. (1971). After examining the other items in the ad irritation construct, we concluded that the concept of "irritation" is a multidimensional reaction. Without Irrit1, the irritation instrument focuses on the user's appraisal of the inappropriateness of the site's advertising. Irrit1 correlates more closely to intrusiveness because they are both an assessment of a user's emotional reaction. We believe this measurement model finding is a contribution to the literature of advertising intrusiveness. In the rest of this article, we continue to refer to the constructs by the names established by Li et al. (2002) and Wells et al. (1971), but future researchers should investigate the possibility of refining the constructs and

Table 3: Loading of Measurement Items to Latent Constructs

	Intrusiveness	*Attitudes*	*Irritation*	*Intentions*
intrus1	**0.879**	–0.178	0.667	–0.053
intrus2	**0.828**	–0.188	0.647	–0.068
intrus3	**0.889**	–0.213	0.703	–0.101
intrus4	**0.944**	–0.226	0.755	–0.106
intrus5	**0.946**	–0.210	0.737	–0.116
intrus6	**0.924**	–0.190	0.727	–0.101
intrus7	**0.914**	–0.273	0.765	–0.152
at1	–0.157	**0.820**	–0.274	0.606
at2	–0.254	**0.825**	–0.336	0.401
at3	–0.073	**0.673**	–0.197	0.494
at4	–0.237	**0.761**	–0.292	0.239
at5	–0.182	**0.798**	–0.230	0.368
at6	–0.190	**0.741**	–0.243	0.331
at7	–0.218	**0.814**	–0.276	0.301
irrit1	**0.878**	–0.251	0.818	–0.161
irrit2	0.504	–0.336	**0.779**	–0.202
irrit3	0.622	–0.292	**0.887**	–0.207
irrit4	0.625	–0.306	**0.903**	–0.225
irrit5	0.682	–0.290	**0.902**	–0.154
intent1	–0.139	0.571	–0.235	**0.865**
intent2	–0.103	0.416	–0.189	**0.890**
intent3	–0.077	0.447	–0.166	**0.915**
intent4	–0.061	0.415	–0.171	**0.876**

Bold indicates strongest factor loadings.
Note. Per Gefen and Straub (2005).

Table 4: Average Variance Extracted (AVE) and Square Root of AVE before/after Removing Certain Questionnaire Items

	AVE	*Square Root of AVE*
Intrusiveness	.818/.818	.904/.904
Attitude	.605/.696	.778/.834
Irritation	.738/.793	.859/.891
Behavioral intentions	.786/.784	.887/.885

Table 5: Correlations of Latent Variables before/after Removing Certain Questionnaire Items

	Intrusiveness	*Attitude*	*Irritation*
Attitude	–.234/–.261		
Irritation	.792/.687	–.339/–.330	
Behavioral intentions	–.111/–.113	.532/.407	–.218/–.222

perhaps modifying intrusiveness and irritation to more clearly reflect affective and cognitive categories, respectively.

The second set of numbers (the "after" numbers) in Tables 4 and 5 represent our improved results of AVE and correlation analysis after item removal was completed.

4.2. Hypothesis Testing Results

As in Galletta et al. (2006), because the main independent variables were two dichotomous experimental factors, the model was tested in two parts to gain a more thorough understanding of each part. An overall structural equation model is presented later after detailed analysis of the experimental effects and mediation testing. In this section, the "back end" of the model (focusing on antecedents) is assessed with a two-way analysis of variance (ANOVA) and the "front end" (focusing on consequences) with PLS.

4.3. "Back End" Results

A 2×2 ANOVA model included two experimental factors, obscuring and control, and the interaction term, with intrusiveness as the dependent variable. Figure 2 illustrates the pattern of cell means for intrusiveness for the four conditions and

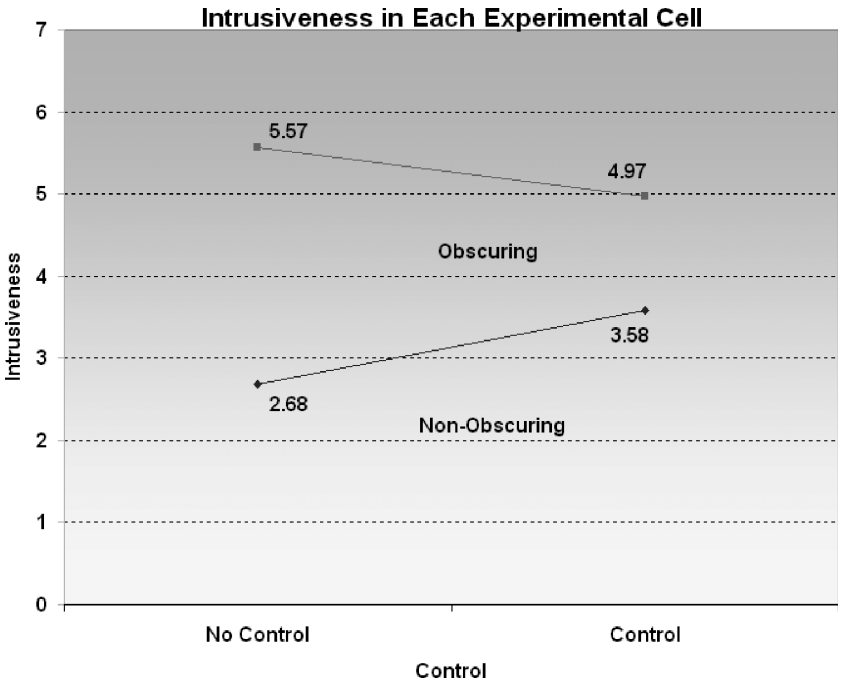

FIGURE 2 Cell means for ad intrusiveness.

Table 6: Results of Analysis of Variance

Source	*Sum of Squares*	*df*	*Mean Square Error*	*F*	*p*
Obscuring	254.0	1	254.0	126.6	.000
Control	1.2	1	1.2	0.6	.436
Obscuring × Control	31.4	1	31.4	15.6	.000
Error	509.7	254	2.0		

Table 6 presents the partial ANOVA table for testing the means. Adjusted R^2 is .416, indicating that substantial variance in intrusiveness is accounted for by the model. The main effect for obscuring is highly significant ($p < .001$), in support of H1. The interaction effect is also highly significant ($p < .001$), in support of H2. A t test was run to determine if the changes shown in Figure 2 were significant. For both the obscuring, $t(98) = 2$, $p = .048$, and the nonobscuring group, $t(158) = -3.8$, $p < .001$, the differences in means were significant. For both tests, Levene's test for equality of variances was not significant so the equal variance assumption was not rejected.

4.4. "Front End" Results

PLS Graph 3.0 was used to evaluate the results of the rest of the model. Figure 3 provides the graphic model and path coefficients. All paths are significant ($p < .001$), using bootstrapping with 1,000 subsamples, indicating support for all remaining hypotheses.

4.5. Exploratory Analysis

Although all hypotheses were supported, closer inspection of Figure 3 reveals that, although the path coefficients were highly significant, the magnitudes of R^2 of the explanation provided for the attitudes and ad recognition variables were

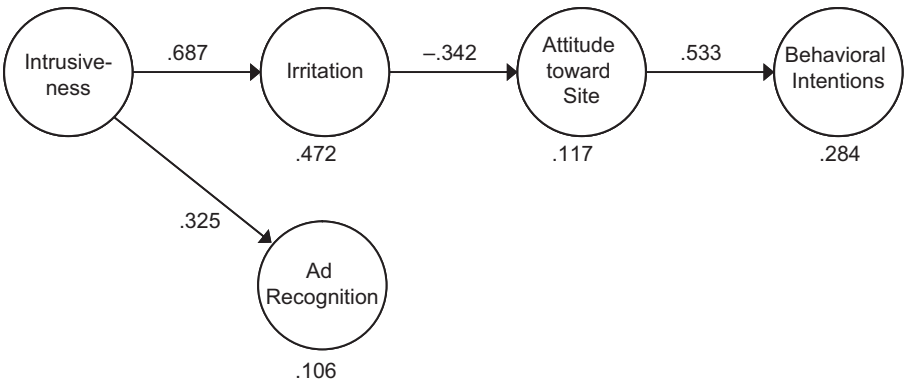

FIGURE 3 PLS model for Hypotheses 2 through 5 (all paths are significant at $p < .001$).

not as high as those of the irritation and behavioral intentions constructs. When R^2 is low, it is presumably because other variables account for significant variance, or because the model has been constructed inappropriately. Therefore, alternative models were explored.

First, the attitudes toward site construct was examined using PLS to see if it is truly needed to explain behavioral intentions. An alternative model without attitudes toward site shows that irritation explains only 4.8% of the variation in behavioral intentions, in contrast with the 28.4% that is explained by the mediator attitudes toward site. Likewise, eliminating irritation shows that intrusiveness explains only 5.4% of the variation in attitudes toward site, in contrast with the 11.7% that is explained by the mediator irritation.

More formal mediation tests were performed in line with Baron and Kenny (1986). The test specifies that (a) the independent variable correlates significantly with the mediator, (b) the independent variable has significant effect on the dependent variable when regressing the independent variable on the dependent variable, (c) the mediator has significant effect on the dependent variable when regressing both the independent variable and mediator on the dependent variable, and (d) the effect of the independent variable on the dependent variable in (b) must be larger than in (c).

Table 7 summarizes the results of the formal mediation test procedure that examined attitudes toward site and perceived irritation. In each case, the independent variable is correlated significantly with the mediator and Step (a) is satisfied. Step (b) is also satisfied, as the effect of the independent variable on the dependent variable is also significant. However, in Step (c), where the mediator is introduced, the effect of the independent variable disappears completely. Therefore, neither irritation nor attitudes, the two mediators in the model between intrusiveness and behavioral intentions, should be removed.

The second alternative model focused on the participants' recognition of the advertisements. Although the path is significant, the explained variance is the lowest in the model. An alternative ANOVA model was run to determine if the experimental factors had a relationship to recognition similar to that of intrusiveness.

Because the model incorporates experimental factors, regression was used for the Baron and Kenny (1986) approach. In such a test, the factors in the ANOVA

Table 7: Mediation Tests for Irritation and Attitudes

Mediator Being Examined	*Candidate Independent Variable*	*Dependent Variable*	*Step (a) Correlation of Independent and Mediator Variable*	*Step (b) Correlation of Independent and Dependent Variable*	*Step (c) Regression of Independent and Mediator on Dependent Variable*
Attitudes toward site	Irritation	Behavioral intentions	–.338**	–.209**	(I) *ns* (M) $p < .001$
Irritation	Intrusiveness	Attitudes toward site	.691**	–.243**	(I) *ns* (M) $p < .001$

**$p < .001$.

model represent the candidate set of "Independent Variables," the dependent variable is ad recognition, and the mediator is intrusiveness. Step (a) was performed with a regression model and the adjusted R^2 value is .412 (comparable to the ANOVA approach in testing H1a). In Step (b), a regression of the factors on ad recognition provides an adjusted R^2 value of .215. In Step (c), introducing both the experimental factors and intrusiveness in a single regression results in an adjusted R^2 value of .213. Intrusiveness (the mediator) fails to reach significance, and Step (c) fails. Therefore, intrusiveness is unexpectedly not a mediator of the relationship between the factors and ad recognition.

An interaction chart provides a picture that is similar to that of intrusiveness, in Figure 4. If an ad obscures a page, without user control to remove it, then it is more likely to be remembered than an ad that does not obscure the page. With user control comes the ability to make the ad disappear, which diminishes ad recognition when it would have obscured the page for a longer time. With user control but no obscuring comes additional attention to the ad, which normally would be ignored by the user. As above for intrusiveness, a t test was run to determine if the changes shown in Figure 4 were significant. For the obscuring group, $t(75.9) = 1.7$, $p = .092$, the difference is only significant at the .10 level. For the nonobscuring group, $t(93.9) = -2.88$, $p < .005$, the difference is highly significant. For both tests, Levene's test for equality of variances was significant so the equal variance assumption was rejected. Although both interaction results were not as strong as for intrusiveness, the presence of an interaction is supported by ANOVA and the results are still quite meaningful.

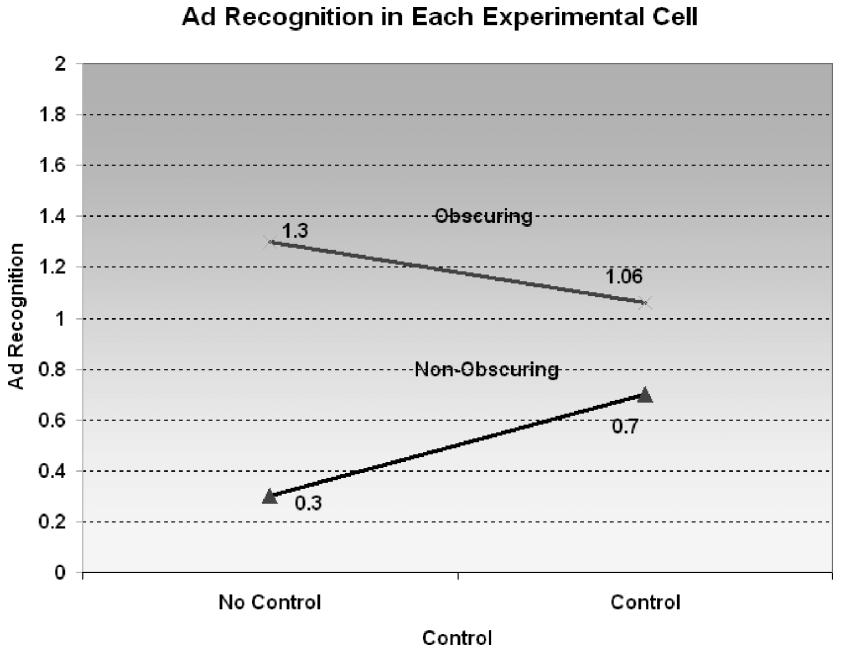

FIGURE 4 Cell means for ad recognition.

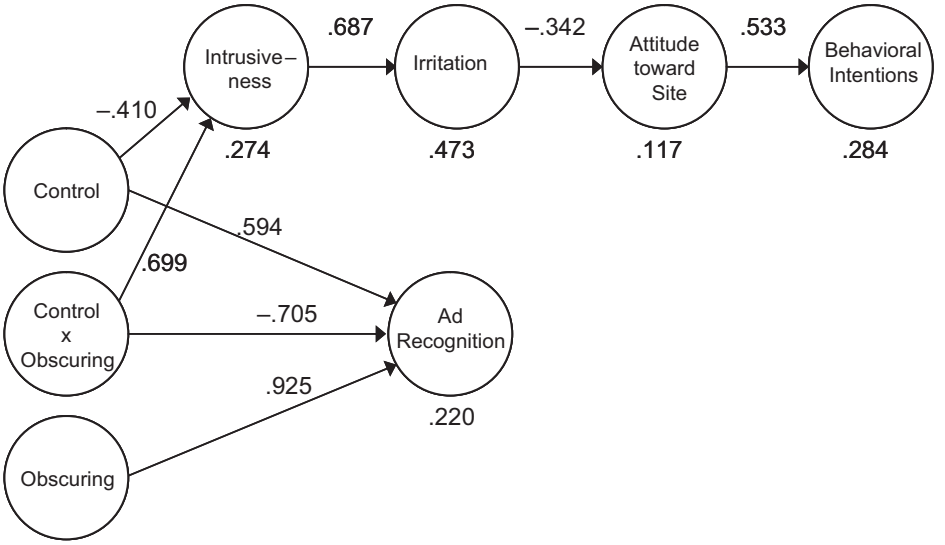

FIGURE 5 Revised model (all paths are significant at $p < .001$).

In light of these results, the model was revised, as shown in Figure 5. Inserting the experimental factors[1] into a PLS model verified the increased strength of the factors on ad recognition. Whereas the explained variance of ad recognition in the original PLS model was 10.6%, 22.0% of the variance is now explained by eliminating intrusiveness as a mediator between the experimental factors and ad recognition.

5. DISCUSSION

Our model predicted that particular features of online advertisements, namely, whether the ad obscures the site content and whether the user can close the ad, resulted in feelings of intrusiveness, leading to perceptions of irritation, degraded attitudes toward site, and diminished intentions to return. The model also predicted that higher intrusiveness of the ads would increase recognition of the ads, making them more memorable. The features of online ads in which we were interested were whether the ad obscured Web site content and whether the users had control over removing the ad. Some ads appear in a separate window on top of site content and therefore obscure site content and are closeable; some ads appear as banners and cannot be removed; some ads obscure content and cannot be removed, disappearing on their own after several seconds; and finally some ads do not obscure content but can be removed by "closing" them. All of these forms are in common usage. As you can see, not all ads can be controlled by the user. Browsers like Microsoft's Internet Explorer and Mozilla's Firefox have built-in

[1]Both factors and their interactions were entered in the final PLS model because there is no theory to suggest, from the advertiser's point of view, whether control and obscuring are valid main effects or their interaction must be considered.

pop-up blockers that can control certain types of ads. However, with the newer ads that overlay the main window, nothing can be done automatically and users must wait until the ad runs its course before it is removed on its own.

The entire model, which is a result of a review of relevant literature, is important to both site owners and advertisers. The variables in the top half of the model have direct relevance to site owners, as many site owners attempt to stimulate return visits partly to accomplish their goals of providing information and partly so that they are a more attractive property for advertisers. Recognition of ads is of indirect importance to site owners and direct importance to advertisers. Designers must choose an advertising style that is simultaneously palatable to users (and site owners) and also effective so that advertisers continue to provide a source of revenue. Because of conflicting goals of advertisers, users, and site owners, how the use of advertising is handled becomes quite a challenge. Advertisers want the users to focus on the ads. The users want to quickly find the information/product/service desired as efficiently and quickly as possible, and the site owner wants to maximize the revenue from both.

All of the model's predictions were supported ($p < .001$), but low explained variance in attitudes toward site and recognition of the ads led us to explore two failed alternative models that, in turn, removed irritation and attitudes toward site from the model. On the other hand, a successful third alternative model removed intrusiveness as a mediator of the experimental factors on recognition of the ads. Therefore, the factors of control and obscuring of site content have stronger immediate effect on ad recognition, explaining more than twice as much variance (see Figure 5). This was a surprising result not entirely predicted by the literature. However, this is a new stream of research and much is left to be learned.

Table 8 summarizes the findings. All hypotheses were supported, and the path coefficients were significant at $p < .001$. Significant variation is explained by the model. The factors obscuring and control explain 27.4% of the variation in feelings

Table 8: Summary of Hypothesis Tests

Hypothesis	*Prediction*	*Result*
H1a	Obscuring part of a site's page will increase perceived intrusiveness of the advertising	Supported ($p < .001$) (overall model $R^2 = .416$)
H1b	Providing user control in removing the ad will decrease perceived intrusiveness, but only when part of the site's page is obscured	Supported ($p < .001$) (overall model $R^2 = .416$)
H2	Increased intrusiveness of the ads will increase recognition of the advertisements	Supported ($R^2 = .106$)
H2 is superseded by the revised model	Obscuring part of a site's page and the interaction between user control and obscuring explain greater variance than H2	$R^2 = .213$
H3	Increased intrusiveness will increase irritation toward the advertisements on the site	Supported ($R^2 = .627$)
H4	Increased irritation with the advertisements on a site will harm users' attitudes toward the site.	Supported ($R^2 = .116$)
H5	Improved attitudes toward the site will assist behavioral intentions to return to the site.	Supported ($R^2 = .281$)

of intrusiveness and 22.0% of the variation in recognition of the ads. In the rest of the model, explained variance is as low as 11.7% and as high as 47.3%. These findings demonstrate the importance of continued research in this area. Much has been learned in this experiment regarding the impact of online advertising, as seen in our revised model (Figure 5). The following section outlines the limitations and conclusions, including directions for future research.

6. LIMITATIONS AND CONCLUSIONS

Although the model resulted in statistically significant values that exhibit strong support for all hypotheses, there are certain limitations to this study. The limitations are categorized into unexplained variance, sampling, laboratory realism, and statistical testing of the model.

Most of the path coefficients and levels of explained variance are strong, but it is important to speculate on other possible unmeasured sources of variance in ad recognition, attitudes toward the site, and behavioral intentions. Recognition of the ads might also be explained by the size of the ads, the size of the wording, animation, and user attitudes about the products advertised. Site attitudes might also be explained by a host of features, such as the appearance of the site (as in Everard & Galletta, 2005–2006), the content of the site, and any salient branding information. Behavioral intentions can be explained by net benefits of visiting the site (Lopes & Galletta, 2006), social norms, and the urgency of information on the site. With so many potentially powerful determinants of these and other variables, the explained variance in this study was higher than might be reasonably expected, serving as evidence for the potent and damaging nature of Web advertising.

Another limitation is the use of students as a sampling frame for this study. Given that college students comprise a significant portion of online shoppers, and are not expected to react differently than others when encountering the tightly controlled versions of advertisements we used, we believe that students are suitable participants for such a study. Nevertheless, future studies should examine similar reactions of a broad cross-section of users.

A further limitation is in the recall task of the ads chosen. If users were presented with visual, rather than textual representations of the ads that they saw, they might have exhibited higher performance (Brown & Rothschild, 1993). In real advertisements, actual products and packaging are shown and the viewer's memory can be accessed more vividly by seeing the same product in a store. However, in real ads, users also have to remember the message of the ad to remember the product's benefits (see Mu & Galletta, 2007).

We were also unable to discern if the obscuring treatment was related to the positioning on the left, versus the nonobscuring treatment being on the right side of the screen. In our design, the links were on the left side and thus there was no way to determine if the issue of "obscuring" is merely an artifact of ad placement. However, we made use of different types of obscuring (one of which involved an ad that began on the left and spun over to the right), and therefore the issue cannot be purely left versus right. Also, given that users were focused on finding the links toward the left, we believe they could have shifted their focus easily to

the right for each page loaded. A future study should investigate thoroughly the effects of different ad placements to separate its effects from the effects of obscuring important elements on the site.

Another limitation is the low amount of ad recognition by the participants, which could cause a statistical difficulty (a "floor" effect). The strong results (with $p < .001$) on the path from the antecedents to recognition were obtained *in spite of* this difficulty. In many cases where the variation is limited artificially, often it is difficult to establish significance. Nevertheless, further research should provide ads that are more prominent or easier to remember. We speculate that it will be difficult to "force" users to pay more attention to the ads, and previous researchers have noted the predilection of users to only look at the X in the upper right corner of the window to delete the ads. Therefore, our results are perhaps more typical of how real users would react in real situations.

A final limitation results from the laboratory setting, where a fictitious site and fictitious advertisements were created. In addition, navigation away from the site was not permitted. Although such constraints served to provide tight experimental controls, the results in our tightly controlled domain should be replicated in the field, involving real Web advertisements on real Web sites. It is reasonable to expect that the results in the field might be magnified by the additional realism.

In conclusion, this study has relevance to both researchers and practitioners—advertisers and site designers alike. Researchers have a model of ad intrusiveness that involves a series of highly related constructs. Adding additional variables as previously described should raise the amount of explained variance and build a more complete picture of how users' affective reactions and behavioral intentions are formed. Researchers can also make use of the various psychological theories of attention, as they relate to research findings in traditional and new media.

For practitioners, it is important for advertisers to consider the issues affecting site owners and conditions under which their ads are remembered more or less strongly. As sites discover the damaging nature of certain types of ads, negotiations could evolve to make it more difficult or costly (to the advertiser) to provide more memorable ads.

It is likewise important for site designers to be aware of the effects of their decisions. This study predicted and supported the existence of a chain of correlations that begins with two important characteristics of ads and ends with impaired intentions to return to the site. As future studies account for further effects of Web ads, site owners might demand more revenue to make up for any lost repeat business or referrals.

Specifically, the interactions among advertisement modalities should be considered by designers. From the site owner's perspective, if ads are included that obscure site content, it is important to provide control to the user to remove them. If ads do not obscure site content, control should not be provided. From the advertiser's perspective, it is important to obscure site content and to provide user control. Both contribute to more effective recognition of the ads in the future.

As advertisers continue to make changes to the types of ads and technologies that drive them, it is important to explore generic characteristics of the ads, such as control or obscuring of site content, rather than the specific types, such as banners or pop-ups. Although future changes in technology might make it impossible or

undesirable to attempt to develop a model that will apply forever, generic ad characteristics are likely to be more stable over a long period than specific ad types.

Some of the recent technological changes represent an advertising "arms race" (Galletta et al., 2006) that will continue for some time. As software reaches the market that blocks some types of ads, advertisers quickly determine how to circumvent those measures and come up with more sophisticated measures. Such a race indicates that the impacts of Web ads will continue to be a topic of interest for practitioners and researchers for some time to come.

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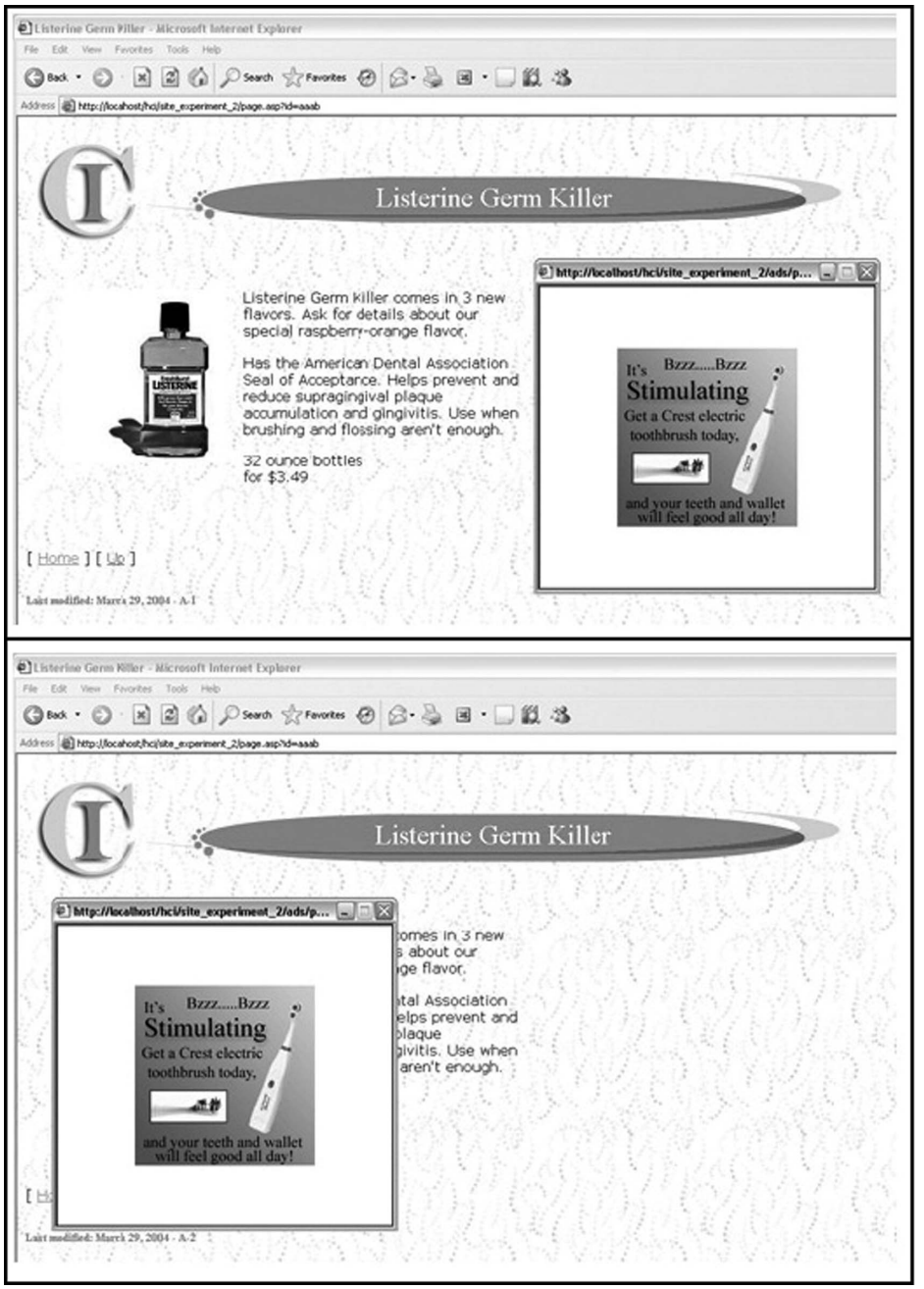
APPENDIX A

Screenshots of Experimental Manipulations

An example of a product Web page (terminal node) with an advertisement. Two conditions are shown: Nonobscuring, closeable pop-up (top) Obscuring, closeable pop-up (bottom)


Listerine Germ Killer - Microsoft Internet Explorer
Listerine Germ Killer
Listerine Germ Killer comes in 3 new flavors. Ask for details about our special raspberry-orange flavor.
Has the American Dental Association Seal of Acceptance. Helps prevent and reduce supragingival plaque accumulation and gingivitis. Use when brushing and flossing aren't enough.
32 ounce bottles for $3.49
[Home] [Up]
Last modified: March 29, 2004 - A-1
http://localhost/hci/site_experiment_2/ads/p...
It's Bzzz.....Bzzz
Stimulating
Get a Crest electric toothbrush today,
and your teeth and wallet will feel good all day!
Listerine Germ Killer - Microsoft Internet Explorer
Listerine Germ Killer
Last modified: March 29, 2004 - A-2

APPENDIX B

Measures

The following section presents the dependent variables and their constituent items.

Behavioral Intentions

Measured by a 7-point scale with labeled ends "Extremely Low – Extremely High" and "Strongly Disagree – Strongly Agree".

How readily would you recommend that others visit this site?
How likely is it that you would want to visit this site again?
Given that I would have access to the site, I would intend to use it frequently.
Given that I would have access to the site, I would intend to be a heavy user.

Attitudes Toward the Site

Measured by a 9-point scale with the following end labels; participants are responding to a statement "Overall reactions to the site:"

Terrible	Wonderful
Frustrating	Satisfying
Dull	Stimulating
Difficult	Easy
Inadequate design	Adequate design
Rigid	Flexible
Difficult to explore	Easy to explore

Intrusiveness of the Ads

Measured by a 7-point scale with labeled ends "Extremely Low – Extremely High." Participants are responding to the statement "When I saw the ad, I thought it was:"

Distracting
Disturbing
Forced
Interfering
Intrusive
Invasive
Obtrusive

Irritation of Users

Measured by a 7-point scale with labeled ends "Extremely Low – Extremely High." Participants are responding to the statement "When I saw the ad, I thought it was:"

Irritating
Phony
Ridiculous
Stupid
Terrible

Advertisement Content Retention – Ad Recognition

Measured by 18 "Yes/No" dichotomous items that correspond with individual ads viewed during the experiment. Participants are responding to a statement "Place a check next to the ads that you saw on this site that correspond with 6 ads viewed and 12 ads not viewed during the experiment."