

Interruptions and Online Information Processing:
The Role of Interruption Type, Interruption Content, and Interruption Frequency

Abstract

Recent new media research has identified the construct of interruptions as an important variable in online information processing environments. We report results from two experiments that examine how online interruptions influence users' cognitive and affective perceptions toward both the interruptions and the Website that features them. Study 1 examines a social characteristic of interruptions and manipulates interruption type in terms of pop-ups and pop-unders. Study 2 employs a factorial design and explores the interaction between a social characteristic (interruption type) and a cognitive characteristic (interruption content), while increasing the frequency of interruptions during an information-processing experience. Findings from the two studies point to the psychological relevance of interruptions and provide a holistic perspective on the role of interruptions in influencing user cognitions and attitudes in Web-based environments.

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With over ninety percent of Americans classifying the Internet as an important provider of information (UCLA, 2003), the diffusion of the Internet in modern society is indisputable (Rieh, 2004). Even as users employ the Internet and World Wide Web (WWW) for a variety of information-seeking functions, the rapid advancement of new technologies has contributed to messages being disseminated in a myriad of ways, as evident from the proliferation of multimedia and rich media technologies (Klein, 2003). Not surprisingly, online environments have been proclaimed as “information-saturated” (Bakos, 1997), compared to more traditional media environments. This saturation reflects an uneasy struggle between Web users and information providers: on the one hand, users can satisfy diverse needs with the click of a mouse; on the other hand, they must also cope with Website designers, publishers, and marketers who seek to capitalize on potential corporate benefits and hence resort to various advertising strategies to increase user attention.

These strategies such as type of ad, multimedia element, and electronic agent may enhance user attention but can also impede online information processing (Xia & Sudharshan, 2002). For instance, if users are involved in a specific online activity (e.g., seeking news about a topic), the intrusion of an unexpected element into their visual field is likely to affect not only their immediate processing goals (reading news) but also their perceptions of the intrusion. Presumably, the intrusion can succeed in attracting attention but may also impede news information processing by negatively impacting users’ cognitive and affective perceptions. Such intrusions are formally classified as “interruptions” and have been recognized as an important factor in decision making environments (Bettman, 1979). However, little empirical research has focused on the effects of interruptions. Xia and Sudharshan (2002) acknowledge limitations of traditional environments and propose that the online environment is especially relevant to examine effects of interruptions.

Although one empirical study has explored the effects of interruptions, it has been in the context of an e-commerce scenario and concerned with typical consumer behavior

variables such as satisfaction with product choice and with the decision-making process (Xia & Sudharshan). We extend this line of investigation to Web-based communication research and explore how online interruptions affect information processing in news Websites. Specifically, we report results from two experiments designed to provide cognitive and affective insights into characteristics of both the interruptions as well as the news sites that feature them. Study 1 employs a between-subjects design and manipulates a common type of interruption (pop-up versus pop-under). Study 2 builds upon findings from Study 1 and employs a between-subjects factorial design manipulating both type of interruption (pop-up versus pop-under) and interruption content (relevant versus irrelevant) in a more ecologically valid environment. In the following sections, we review the literature on interruptions and delineate theoretical frameworks to derive hypotheses for examination in Study 1.

Interruptions

According to Corragio (1990, p. 12), an interruption is “an externally generated randomly occurring, discrete event that breaks continuity of cognitive focus on a primary task” (see Xia & Sudharshan, 2002, for an excellent review of interruptions). Another consideration of interruptions categorizes them as events that mandate involuntary attention (Xia & Sudharshan, 2002; see also Bettman, 1979). Typically, an interruption is caused by someone or something outside the volitional control of the individual user. That is, if an individual is involved in some task, the introduction of an interruption can intrude upon that task and influence subsequent task performance. The individual neither controls the appearance nor timing of the interruption because it is induced by some external entity. Prior research in organizational behavior has shown that interruptions can instantiate feelings of frustration (Baron, Baron, & Miller, 1973), increase time spent on the primary task (Laird, Laird, & Fruehling, 1983), and constrain information processing resources by serving as distractors (Norman & Bobrow, 1975). Interruptions exhibit both cognitive and social characteristics (Xia & Sudharshan, 2002). Cognitive characteristics refer to the frequency of interruptions, the duration or time required to respond to interruptions, the content or actual information contained in interruptions, the

complexity of interruptions, and the time at which interruptions intrude on the primary task; social characteristics refer to the specific form or structure of interruptions, the generator or source of interruptions, and the social expectations surrounding the advent of interruptions (see Speier, 1996; Xia & Sudharshan, 2002).

In Study 1, we examine one of the social characteristics of interruptions by manipulating the *form* of an interruption. In the online context, form essentially refers to the format in which the interruption is presented. These formats refer to features such as side windows and replacement windows that intrude upon a Web page with varying degrees of obtrusiveness (Xia & Sudharshan, 2002). In the experiment reported here, we operationalize interruptions in the context of pop-up and pop-under ads. Pop-up ads appear in front of the Website that is being viewed while pop-under ads appear as a window below the Website that is being viewed (Calishain, 2003). Typically, pop-under ads are perceived as less “in your face” relative to pop-ups, and are normally seen only after users close their browser window (Taylor, 2001). Our choice of this particular format is governed by several factors: pop-ups have been universally reviled as intrusive and annoying (Armitt, 2004). There is also a discernible difference in the degree of obtrusiveness between pop-ups and pop-under ads (Edwards, Li, and Lee, 2002). Finally, most online news sites employ these features with disconcerting regularity (Neuborne, 2001). Thus, the deployment of pop-ups and pop-under ads is not only theoretically grounded but also ecologically valid.

Interruptions and Pop-up Ads

In the context of the operationalization employed in Study 1, two recent studies have examined the effects of pop-up ads. Edwards, Li, and Lee (2002) examined effects of pop-ups by varying congruence of the pop-up ad with editorial content, the duration of the pop-up, and cognitive intensity of the viewer. Congruence refers to the degree that the pop-up ad is perceived as relevant to the editorial content; duration refers to the length of time that the pop-up appears on the screen, and cognitive intensity refers to the specific time at which the pop-up appears during the course of the user’s browsing experience. The primary purpose of the study was to develop a model to gauge user perceptions of pop-ups, particularly as they relate to perceived intrusiveness, irritation, and ad avoidance. Although ad duration did not have any effects, Edwards et al (2002)

found that high levels of cognitive intensity and incongruence between ad and editorial content translated into higher perceptions of intrusiveness, which in turn led to higher feelings of irritation and a greater tendency to avoid the ad.

Another recent study examined differences between type of ad (pop-up versus banner) and degree of animation (animated versus static) on Web users' orienting response and memory for ads (Diao & Sundar, in press). Although the effects of animation were less pronounced, the authors found that pop-up ads evoked greater orienting response (measured by heart rate) than did banner ads. The authors also found significant effects on ad memory, but contrary to hypotheses, banner ads were higher in recognition memory compared to pop-up ads while pop-up ads elicited greater recall compared to banner ads.

Findings from these two studies provide empirical validation to popular claims that pop-up ads have psychological meaning. However, both the Edwards et al (2002) and Diao and Sundar (in press) studies have focused on the perceptions of the ads *per se*. As these authors suggest, pop-ups present an opportunity to undertake a systematic program of research to unravel other cognitive and affective responses. By examining not just cognitive and affective responses to the ad, but also users' cognitive and affective responses toward the site featuring the ads, we attempt to provide a holistic perspective on the role of pop-ups in online information processing.

Interruptions and Cognition

By intruding into the visual field unexpectedly, interruptions force users to attend to them. In the case of pop-ups, they usually pop up when users are browsing a Website or click on a hyperlink during the course of Web browsing. When pop-ups appear, they disrupt users' ongoing task and force them to attend to the interruption. Several frameworks of cognitive psychology can suitably explain the cognitive effects of pop-ups. According to object-based theories of visual attention, different stimuli are perceived as different objects, with a certain amount of attention being allocated to each object (Kahneman, Treisman, & Gibbs, 1992; Kanwisher & Driver, 1992; see also Diao & Sundar, in press). When a new object is introduced into the user's visual domain, a portion of the user's attentional resources will be diverted from the primary task to create an "object file" for the newly introduced object. In a similar vein, the split-attention

effect suggests that attention is distributed or “split” when users have to attend to multiple sources of information (Sweller, Chandler, Tierney, & Cooper, 1990; Tindall-Ford, Chandler, & Sweller, 1997). When new information in the form of a pop-up is suddenly forced into a user’s existing site, their attentional resources will be split between the current task and the newly introduced information. Such forced exposure is likely to elicit greater involuntary attention toward the interruption (Kahneman, 1973) and compel users to process the interruption closely, resulting in increased memory for the interruption (Edwards et al., 2002). In the case of pop-under, they appear underneath a Web user’s browser window and do not interrupt the primary task. Because they are less obtrusive and intrusive than pop-ups, existing attentional resources need not be disbursed or split to attend to them. Therefore, they may not be perceived as memorable as pop-ups. Accordingly, we propose the following hypotheses:

H1a: A pop-up ad will elicit greater attention than a pop-under ad.

H1b: A pop-up ad will be more memorable than a pop-under ad.

Interruptions and Affect

Although pop-ups are hypothesized to be more memorable than pop-under, they can also generate negative perceptions about the ads. Previous research has shown that interruptions can be perceived as frustrating and stressful because they impede the performance of the primary task (Baron et al., 1973). Users’ acceptance or rejection of the interruption will be contingent on the quality of the interruption (Xia & Sudharshan, 2002). As Edwards et al (2002) have shown, an interruption that is incongruous with the primary task is perceived as intrusive and results in feelings of irritation and avoidance. To the extent that users perceive the interruption as intruding upon their primary task, they are likely to exhibit some semblance of psychological reactance toward the interruption (Brehm & Brehm, 1981) and form counterarguments against the claims made in the interruption (Petty & Cacioppo, 1979). If the interruption is identified as a threat (Brehm, 1966) to the primary task, it can induce the user to rebel against the interruption (see Edwards et al., 2002). In the online environment, pop-up ads that are irrelevant to

the site content and intrude upon the site are likely to produce a high degree of reactance, especially because they are pushed into an already limited field of vision, namely the computer monitor (Xia & Sudharshan, 2002). This intrusion may also lead to perceptions of ad clutter (Lee & Sundar, 2002), which, in turn, could lead to negative perceptions about the ads (Ha, 1996). In contrast to pop-ups, pop-unders are less intrusive and do not impede the primary task as they are not visible until the user has closed the browser window. Similarly, by not taking away any “real estate” from the primary task, they do not contribute to any feelings of clutter. Therefore, they are likely to invite less negative perceptions, compared to pop-ups. This rationale leads to the following hypothesis:

H2: A pop-under ad will elicit more positive attitudes toward the ad than will a pop-up ad.

Effects of Interruptions on the Website

In addition to affecting memory and attitudes toward the interruptions themselves, interruptions can also influence information processing of the Website that features them. While interruptions can increase user attention, they may also impose cognitive overload (Norman & Bobrow, 1975), which refers to the activity or workload imposed on mental processes. When an interruption is unrelated to the primary task, it can divert attentional resources assigned to the primary task and hence obstruct performance on the primary task (Chandler & Sweller, 1991; Sweller et al., 1990). In an interactive environment like the Web, if processing resources are restricted (Broadbent, 1971; Kahneman, 1973), information processing on the primary task may suffer (see Ariely, 2000). Additionally, the limited capacity theory of information processing suggests that humans are finite processors of information and may not have enough cognitive resources to perform all tasks (Lang, 2000). That is, allocation of cognitive resources to an interruption will reduce the amount of resources available on the primary task. As a result, performance on the primary task will deteriorate. In the context of the current study, the introduction of a pop-up will take away resources from the primary task (reading the news Website). Consequently, users’ processing of news stories will be impaired and presumably result in decreased performance on story memory. However, when a pop-under is introduced, it

will not take away valuable attentional resources from the primary task, and hence not negatively affect story memory.

Just as interruptions can affect attitude toward the ad, they can also have a pronounced effect on affective dispositions toward the Website. If users develop psychological reactance to the interruption, it can also carry over into perceptions of the source of the interruption (see Edwards et al., 2002). Consistent with Xia and Sudharshan's (2002) explanation, the type of interruption may influence user attitudes toward the generator, or source, of the interruption. Applied to the Web, when users are exposed to interruptions on a particular Website, they are likely to display some affective response toward the site since they would consider that site to be the generator of the interruption. Indeed, this expectation is supported in the popular literature: over seventy-five percent of Web users claimed that the presence of pop-ups interfered with their Web browsing activity (Denes, 2001), with over forty percent reporting a lowered tendency to revisit a site featuring pop-ups (Benitez, 2002). Obviously, when users close their browser window, they will be exposed to the pop-under and will also perceive the browsed site as the generator of the pop-under. Therefore, while they may still display some negative feelings toward the site, those feelings are likely to be ameliorated by the recognition that it did not interfere with their browsing experience and that it was not "in their face." This discussion leads us to propose our final set of hypotheses:

H3: Memory for stories featured on a Website will be higher for a site containing a pop-under ad than for the same site containing a pop-up ad.

H4: A Website featuring a pop-under ad will elicit more positive attitudes toward the site than will a Website featuring a pop-up ad.

Method

All participants ($N = 64$) in a two-condition, between-subjects experiment were randomly assigned to one of two experimental conditions. Each condition was manipulated to introduce an online interruption on a news Website, as either a pop-up ad

or a pop-under ad. All participants were equally distributed between the two conditions. After participants were exposed to the site, they filled out two paper-and-pencil questionnaire eliciting their evaluation of the interruption and the site on which it appeared.

Participants

Sixty-four undergraduate students enrolled in communication courses participated in the experiment for extra course credit. All participants signed an informed consent form prior to their participation in the experiment.

Stimulus Material

A Website was constructed for use as the stimulus material in the experiment. This Website was designed to closely replicate the "Offbeat" section of *USA Today* online. Every participant was exposed to one "Offbeat" page featuring six stories. These stories were selected from existing newspaper archives, and care was taken to ensure that none of the stories were either limited by specificity of content or time period. Consistent with the *USA Today* online look, both sites featured a *USA Today* News logo, with links to other sections. However, these links were disabled so that participants would not be able to surf pages other than the stimulus pages.

Each condition had one pop-up or pop-under ad appear when the participant clicked on the hyperlink to access the *USA Today* Website. Four different ads were chosen and each appeared as a pop-up or pop-under for each condition. The four ads were used to eliminate any effects resulting from specificity of ad content. The pop-up ad appeared in the top left corner of the computer screen as did the pop-under ad. In both conditions, the ad appeared on the screen after the *USA Today* page had fully loaded on the browser window. During the entire course of the experiment, both navigation and location toolbars were hidden.

An extensive Web search was conducted to find four pop-up ads that would be unknown to most people and that had enough content in them to gauge participants' ad memory. Based on a list of nineteen pop-up ads, a pretest ($N = 20$) was conducted to select four ads that were perceived as least familiar (on a 1-7 scale). Based on the pretest, the four ads used in the study were for Junum credit reporting, University Alliance online degrees, Total Bliss cosmetics, and Simple Tech external hard drives. All four ads were

sized at 250X250 pixels and were manipulated to appear as either a pop-up or pop-under. Furthermore, the stories that appeared on the site were selected such that they were not related to any of the four ads

Dependent Measures

The dependent measures of advertising effectiveness was operationalized using commonly employed advertising measures of attitude toward the ad (A_{ad}), attitude toward the brand (A_{br}), and behavioral intention (BI). These measures were adopted from Kalyanaraman and Oliver (2001).

The dependent variables used to evaluate attitude toward the ad (A_{ad}) were operationalized in the form of 14 questions in the questionnaire. Participants were asked to rate their overall reaction to the ad on 14 semantic differential measures (Appealing-Unappealing; Informative-Uninformative; Unexciting-Exciting; Boring-Interesting; Good-Bad; Pleasant-Unpleasant; Dull-Dynamic; Clear-Confusing; Unattractive-Attractive; Favorable-Unfavorable; Likable-Dislikable; Ordinary-Sophisticated; Persuasive-Unpersuasive; Low Quality-High Quality) anchored on a 7-point scale. These 14 items were averaged to form an index of attitudes toward the ad (A_{ad}). This index was reliable and unidimensional (Cronbach's $\alpha = 0.94$).

Attitude toward the brand (A_b) was measured by asking participants to respond to 7 semantic differential measures (Appealing-Unappealing; Good-Bad; Pleasant-Unpleasant; Unattractive-Attractive; Favorable-Unfavorable; Likable-Dislikable; Low Quality-High Quality) anchored on a 7-point scale. These averaged scores composing the index exhibited a high degree of internal consistency (Cronbach's $\alpha = 0.92$).

Behavioral intention (BI) was measured via a two-item, 7-point scale (7 = "Strongly Agree," 1 = "Strongly Disagree") preceded by "I am likely to try the product featured in the ad," and "I am likely to buy the product featured in the ad." These two items were averaged to form an index labeled Ad Conation. This measure was also internally consistent (Pearson's $r = 0.57$).

Attention toward the ad was operationalized via a two-item, 7-point scale (7 = "Strongly Agree," 1 = "Strongly Disagree") preceded by "I paid a great deal of attention to the pop-up (pop-under) ad," and "I was thoroughly focused on the pop-up (pop-under)

ad.” These two items were averaged to form an index labeled Ad Attention. This measure was highly reliable (Pearson’s $r = 0.56$).

Ad memory was operationalized by asking participants one recall question and one recognition question. A “1” was awarded for a correct response and a “0” was awarded for an incorrect response. The two items were averaged to form a composite ad memory score.

Story memory was operationalized in the form of six recall (e.g., Out of a total of 43 subjects in the nerve gas study, 23 were members of a Naval Mobile Construction Battalion, known as _____.) and six recognition (e.g., The founder of the International Whistlers Convention is: a) Allen deHart b) Patti Lewis c) Thomas White d) William Smith). A “1” was awarded for a correct response and a “0” was awarded for an incorrect response. Both recall and recognition items were averaged to form an index labeled “Story memory.”

The dependent measure of Attitude toward the Website (A_w) was based on measures from Bruner and Kumar (2000) and Chen and Wells (1999). This variable was operationalized by asking participants to respond to seven questions (e.g., This Website makes it easy for me to build a relationship with this company; I am satisfied with the service provided by this Website) pertaining to the *USA Today* Website and assess their level of agreement with each question on a seven-point scale anchored between “Strongly Disagree” and “Strongly Agree.” These seven items were averaged to form an index of Attitude toward the Website (A_w) and exhibited a high degree of internal consistency and unidimensionality (Cronbach’s $\alpha = 0.90$).

Finally, in consideration of the possibility that perceptions of Website credibility could be affected by the interruption (see Xia & Sudharshan, 2002), we employed suggestions from Metzger, et al (2003) and adapted Bucy’s (2003) Website perceptions scale. The six items comprising this scale pertained to the quality, credibility, accuracy, reliability, trustworthiness, and believability of the *USA Today* site and were measured on a seven-point scale anchored between “Strongly Disagree” and “Strongly Agree.” This index, labeled “Website credibility” was found to be internally consistent and unidimensional (Cronbach’s $\alpha = 0.92$).

Control Measures

Ad familiarity was measured by a one-item, 7-point scale (1 = “Very familiar,” 7 = “Not at all familiar”) preceded by the question “How familiar are you with the ad that you just viewed?” In order to control for whether participants had used the featured product or service previously, they were asked the following question: “Have you ever used this product/service before?”

Website familiarity was also measured by a one-item, 7-point scale (1 = “Very Familiar,” 7 = “Not at all familiar”) preceded by the question: “How familiar are you with the USA Today.com Website that you just viewed?” In addition, participants were also asked to list their favorite newspaper (including online newspapers).

In addition to these measures, additional questions asked participants to report time spent online as well as some demographic information (e.g., age, gender).

Procedure

The experiment was administered to groups of students in a campus computer laboratory that contained several computers with Internet connection. Each group consisted of a maximum of twelve participants. Upon arrival, participants were informed that they would be participating in a study to determine how users processed online information. As part of the study, they were told that they would be asked to go through a news site, and be asked to fill out a couple of questionnaires after exposure to the site. Participants were informed that, in that particular session, the featured page was from USA Today. Participants were told that due to time constraints, they should only scroll down the page that came up, and not click on any hyperlinks. Once participants had finished listening to the instructions, they were asked to click on the hyperlink on the screen in front of them to begin the experiment. After going through the stories/site, they were told to close the browser window, turn off the monitor, and raise their hand for the first of two paper-and-pencil questionnaires. The first questionnaire pertained to ad memory. They were requested to raise their hand again upon completion of the questionnaire to receive the second one. The second paper-and-pencil questionnaire pertained to all other dependent measures, control measures, and demographic information. Upon completion of both questionnaires, participants were debriefed, thanked for their participation, and dismissed.

Results

Prior to testing hypotheses, we performed preliminary analyses of variance (ANOVAs) to ensure that, within each condition, the primary dependent measures were not affected by specificity of ad content. Once analyses confirmed that effects of interruption (pop-up versus pop-under) were not contingent on any one specific ad, we proceeded with further analyses to examine differences between pop-ups and pop-under.

H1a predicted that pop-up ads would be more attention grabbing than pop-under ads. A *t*-test with type of interruption as the between-subjects factor was performed on ad attention and revealed that participants did not perceive the pop-up ad ($M = 1.74$, $SD = .88$) as more attention-grabbing than the pop-under ad ($M = 1.42$, $SD = .64$, $t(62) = 1.57$, $p > .05$). Thus, H1a was not supported.

H1b predicted that participants exposed to a pop-up ad would score higher on ad memory, compared to participants exposed to a pop-under ad. A similar *t*-test was performed with ad memory as the dependent measure. The results revealed no significant differences between the two conditions. On average, participants exposed to pop-ups scored slightly higher ($M = .46$, $SD = .56$) than their counterparts in the pop-under condition ($M = .34$, $SD = .54$) but this difference was not statistically significant, $t(62) = .9$, $p > .05$). Therefore, H1b was not supported.

H2 predicted the psychological superiority of pop-under in eliciting more positive attitudes toward the ad. Fourteen participants who did not fill out their responses on this measure were excluded from this analysis. A *t*-test showed a marginally significant effect for interruption type such that participants' attitude toward the ad was more positive in the pop-under condition ($M = 3.14$, $SD = 1.11$) than for participants in the pop-up condition ($M = 2.54$, $SD = 1.08$, $t(49) = 3.65$, $p < .10$). Thus, H2 received partial support. However, similar *t*-tests performed with attitudes toward the brand and behavioral intention failed to reveal statistically significant effects.

H3 proposed that participants exposed to a pop-under would have higher memory for stories featured on the site, compared to those participants exposed to a pop-up. Like before, a *t*-test examining differences between type of interruption on story memory was

performed. The analysis revealed a marginally significant effect such that participants in the pop-under condition scored higher on story memory ($M = 4.64$, $SD = 1.91$) than did those participants in the pop-up condition ($M = 3.93$, $SD = 1.43$, $t(62) = -1.67$, $p < .10$). The direction of findings suggests moderate support for H3.

Finally, H4 predicted that participants in the pop-under condition would be more favorably disposed toward the Website than their counterparts in the pop-up condition. A t -test revealed a significant difference between the two conditions such that participants in the pop-under condition rated the Website more positively ($M = 5.22$, $SD = 1.23$) than did participants in the pop-up condition ($M = 4.68$, $SD = .70$, $t(62) = 4.51$, $p < .05$). Thus, H4 was fully supported. However, the type of interruption did not have any effect on participants' perceptions of Website credibility, as there were no appreciable differences between the two conditions.

Follow-up analyses with amount of time spent online and ad familiarity yielded essentially redundant results, indicating that these variables did not influence the relationship between type of interruption and cognitive and affective measures.

Discussion

Findings from this study offer several insights that are worthy of closer scrutiny. With the exception of H1a and H1b, the rest of the hypotheses received either partial or complete support. H1a predicted differences in attention. The results indicate that Web users (or at least the participants in this study) do not discriminate between an interruption that appears as either a pop-up or a pop-under as they hardly attend to it. This lack of difference is also reflected in the ad memory score with the majority of participants hardly being able to recall or recognize any aspect of the ads. On the one hand, study participants may not have perceived just a single interruption as worthy of their attention and may have chosen to largely ignore it. On the other hand, perhaps our operationalization of ad memory was not robust enough. By asking just one question each about recall and recognition, it may have proved ineffectual in eliciting differential responses. However, considering the nature of the design as also the fact that we employed "real" ads, the ad memory measure was a bonafide representation of the

experimental context (that is, it was difficult to have more than one recall and recognition question for each ad). Nevertheless, it is a limitation that needs to be examined more closely.

More importantly, support for H2, H3, and H4 testify to the primary purpose of this study: to show that interruptions are relevant in the online environment and that even a simple operationalization of one of the most common types of interruptions (pop-up versus pop-under) can affect information processing. Even though interruptions (or rather a single interruption) appear to be altogether ignored, they evidently have psychological meaning as evidenced by the effects on story memory as well as attitudes toward both the ad and the Website generating the interruption. Although only H4 was fully supported, the moderate support for H2 and H3 is quite promising given the direction of the means. It appears that even a single instantiation of an interruption can trigger certain perceptions (attitude toward the Website) but that it may not be enough to detect robust differences on certain other measures (attitude toward the ad and story memory). Perhaps, there is a certain threshold that needs to be reached before the effects of interruptions can be suitably captured. In fact, this possibility has been examined in both the advertising and interruptions literature. For example, the three-hit theory (Krugman, 1972) suggests that advertising effects can be most effectively observed in the form of an S-shaped curve, in which the third exposure indicates the threshold (see also Lee & Sundar, 2002). In a related vein, Speier (1996) and Xia and Sudharshan (2002) state that the frequency or number of interruptions that materialize during a given information-processing task can have a significant influence on outcomes. Also, from an ecological validity standpoint, most Web users do not restrict their browsing experiences to just one page in a given session. In all likelihood, they probably go through multiple pages. Moreover, if they are interrupted during their browsing activity, those interruptions are likely to occur more than once. This discussion, along with our earlier explanation for lack of differences on ad memory, prompts us to propose a follow-up study.

Study 2

Study 2 was designed to address some of the limitations arising from Study 1, while also endeavoring to discern stronger findings. In addition to the type of interruption, we also introduce another variable for study in the present investigation, namely relevance of interruption content. The inclusion of this additional variable in Study 2 is based on both conceptual and practical considerations. To reiterate what we mentioned in the introduction to this paper, interruptions possess both social and cognitive characteristics. Study 1 manipulated a social characteristic (form or type of interruption). The content of an interruption is a cognitive characteristic that is related to the relevance of the interruption to the ongoing information-processing task (Xia & Sudharshan, 2002). By examining how a social characteristic interacts with a cognitive characteristic, we hope to provide a better understanding of factors governing the relationship between interruptions and online information processing. In addition, principles of contextual marketing suggest that Web users may be more tolerant of persuasive messages that are relevant to ad content (Ives, 2003), with many major Websites, portals, and search engines beginning to practice contextual advertising (Child, 2004; Dillabough, 2004). For these reasons, we examine how the type of interruption (pop-up, pop-under) can interact with the content of interruption (relevant, irrelevant) in influencing cognition and affect. In addition to the hypotheses proposed in Study 1, we review the literature on relevance of interruption content and propose additional hypotheses for Study 2.

Relevance of interruption content

Several studies in psychology, advertising, and consumer behavior have examined the role of message relevance. Wind and Rangaswamy (2002) suggest that online users are likely to be receptive to those messages that are perceived by users as being relevant to their information needs. Websites that dispense relevant, targeted messages are likely to “promote lingering and capture user attention” (Little, 2001, p. 53), and hence lead to more positive perceptions about the site featuring the relevant messages (Kalyanaraman & Sundar, 2003). Edwards et al (2002) suggest that ads that are perceived as congruent

to the editorial content may inhibit perceptions of intrusiveness and can reduce feelings of irritation or annoyance, resulting in the ad being perceived as less of an “interruption.” Edwards et al imply that interruptions that are relevant to the editorial content have psychological meaning for the user. For instance, if a user is browsing a computer-related Website, then an ad for Microsoft will be perceived as more congruent or relevant than if the same site featured an ad for Nissan (see Kalyanaraman & Sundar, 2003; Sherman & Deighton, 2001). Because users exposed to the relevant ad can extract psychological meaning, they may not only pay more attention to it, but also evaluate both the ad and the site more positively. Xia and Sudharshan (2002) also voice a similar opinion and advocate that interruptions that are relevant to the decision task will warrant attention and may be used during the course of the decision process. Finally, findings from the social psychology literature on matching suggest that matching messages to the self can have a positive impact on message evaluation (Petty, Barden, & Wheeler, 2002).

Applied to the context of the current study, interruptions that are relevant to the news content may invite greater attention than will those interruptions that are irrelevant to the news content. Consequently, memory for relevant interruptions is likely to be higher than memory for irrelevant interruptions. Also, relevant interruptions should not only elicit more positive attitudes than irrelevant interruptions, but they should also lead to more positive evaluations of the site generating them. Therefore, by operationalizing relevant or irrelevant interruptions in terms of relevant or irrelevant ads, we propose the following hypotheses:

H5a: A relevant ad will elicit greater attention than an irrelevant ad.

H5b: A relevant ad will be more memorable than an irrelevant ad.

H6: A relevant ad will elicit more positive attitudes toward the ad than will an irrelevant ad.

H7: A Website featuring a relevant ad will elicit more positive attitudes toward the site than will a Website featuring an irrelevant ad.

We do not hypothesize any differences between relevant and irrelevant ads on story memory because irrespective of the degree of relevance, attentional resources will be diverted from the primary task (reading news stories) toward the ad. In the case of a relevant ad, users may attend to the ad because they believe that it is congruent to the stories featured on the site. In the case of an irrelevant ad, they might want to attend to it because they perceive it as an intrusion that interferes with their reading of news stories. Therefore, while the reasons to attend to the ad might be different, the appearance of either ad will still probably detract from performance on the primary task.

In addition to main effects, we may also forward some interaction hypotheses. Given the distinction between pop-ups and pop-unders, it is likely that a pop-up ad with relevant content will be favorably received, relative to a pop-up ad with irrelevant content. In the same vein, users' attitudes toward the Website will likely be more positive when interrupted by a pop-up ad with relevant content than by a pop-up ad with irrelevant content. Obviously, we cannot specify the direction of effects for pop-unders with equal certainty. But, given that users are probably not going to be exposed to the pop-under until the culmination of their browsing experience, it is quite probable that ad relevance will not have as pronounced an effect on pop-unders. Formally stated, we propose the following interaction hypotheses:

H8: Attitudes toward the ad will be more positive for a pop-up ad with relevant content, compared to a pop-up ad with irrelevant content.

H9: A pop-up ad with relevant content will invoke more positive perceptions toward the Website than will a pop-up ad with irrelevant content.

Method

All participants ($N = 120$) in a completely balanced, 2 (Interruption type) X 2 (Interruption content) between-subjects factorial experiment were randomly assigned to one of four experimental conditions. Each condition was manipulated to feature three

online advertisements on three separate pages of a news site, with interruption type (pop-up, pop-under) and interruption content (relevant, irrelevant) serving as between-subjects factors. After participants were exposed to the site, they filled out two paper-and-pencil questionnaire eliciting their evaluation of the interruption and the site on which it appeared.

Participants

One hundred and twenty undergraduate students enrolled in communication courses participated in the experiment for extra course credit. All participants signed an informed consent form prior to their participation in the experiment.

Stimulus Material

Similar to Study 1, the Website in Study 2 was designed to closely replicate the "Offbeat" section of *USA Today* online. All participants were exposed to three "Offbeat" pages featuring four stories on each page.

Each condition had one pop-up or pop-under ad appear on each page when the participant clicked on the hyperlink to access the *USA Today* Website. Three different ads were chosen and each appeared as a pop-up or pop-under for each condition. The first ad appeared on the top left corner of the computer screen, the second ad appeared on the top middle portion of the screen, and the third ad appeared on the top right corner of the screen. The placement of the pop-under was similar to that of the pop-ups. In all conditions, the ads appeared on the screen after the *USA Today* page had fully loaded on the browser window. The three ads chosen for the study were for Junum credit reporting, Simple Tech external hard drives, and Medicine Shoppe online pharmacy. In order to manipulate the second independent variable, these ads were programmed to appear on a page with either relevant or irrelevant stories. For example, in the relevant interruption condition, the Junum ad appeared on a page with financial stories, the Simple Tech ad appeared on a page with computer and technology-related stories, and the Medicine Shoppe ad appeared on a page with health-related stories. In the irrelevant interruption condition, the same ads appeared on pages whose stories were not related to the content of the ad. Like before, all three ads were sized at 250X250 pixels.

All stories were selected from existing newspaper archives, and care was taken to ensure that none of the stories were either limited by specificity of content or time period.

In addition, all stories on all three pages were of equal length. The efficacy of the relevance manipulation was tested with an independent sample of thirty-two ($N = 32$) students. Sixteen participants read the stories with relevant interruptions while another sixteen participants read the stories with irrelevant interruptions. Participants rated the relevance of the ad to the page on seven-point scales, with higher numbers indicating greater perceptions of relevance. On average, the relevant interruptions condition received a score of 6.1, while the irrelevant interruptions condition received a score of 1.3, thus confirming the success of the manipulation. In the experiment, the order of presentation of the ad and the pairing of the ad with a particular page was completely counterbalanced to rule out any possibility of order, primacy, or recency effects. Figures 1 and 2 show examples of a pop-up ad with relevant and irrelevant content, respectively. In the case of pop-unders, the ads appeared underneath the browser window.

Dependent Measures

The measures employed in Study 2 were essentially the same as the ones used in Study 1. The reliabilities of the scales employed for analyses were high and mirrored the metrics reported in Study 1 almost exactly. Since participants were exposed to three ads, ad memory was operationalized on a “0” to “6” scale (two questions per ad). Furthermore, since we had twelve stories (four per page), we had a total of twenty-four questions for the story memory measure (two per story).

Procedure

The procedure was similar to that reported in Study 1, except that participants were told that they would be going through a news Website featuring three pages. After they had finished going through the stories on one page, they were asked to click on a hyperlink labeled “Click here for more stories” to access the next page. At the conclusion of their browsing experience, they were requested to fill out two paper-and-pencil questionnaires.

Results

Before proceeding with hypotheses tests, we performed preliminary analyses to determine that none of the three ads employed for the study displayed unique effects.

Once this was ensured, we created composite indices for overall attitudes toward the ad, overall attention to the ad, and total ad memory and then performed a series of two way, factorial ANOVAs to examine the effects of both interruption type and interruption content on the dependent measures.

When the ad attention index was subjected to a 2X2 factorial ANOVA, a significant main effect for interruption content was obtained such that participants paid more attention to the relevant ad ($M = 1.51, SD = .85$) than they did for the irrelevant ad ($M = 1.11, SD = .54$), $F(1, 116) = 8.03, p < .01$, thus confirming H5a. The lack of a main effect for interruption type meant that H1a was not supported. In addition, the interaction effect failed to attain statistical significance.

When ad memory was subjected to a factorial ANOVA, neither the main effects for interruption type nor interruption content attained significance, thereby failing to provide support to both H1b and H5b. However, the two-way interaction was statistically significant, $F(1, 116) = 9.13, p < .01$. The interaction revealed that, for an irrelevant ad, ad memory is not affected by whether the ad is presented as a pop-up or pop-under, but for a relevant ad, ad memory is higher when it is presented as a pop-up rather than as a pop-under.

When story memory was subjected to the same factorial ANOVA, a significant main effect for interruption type emerged such that participants in the pop-under condition scored higher on memory for news stories ($M = 11.1, SD = 2.86$) than did those participants in the pop-up condition ($M = 9.85, SD = 2.84$), $F(1, 116) = 5.53, p < .05$. This finding is stronger than that observed in Study 1, and supports H3. As speculated, interruption content did not have any effect on story memory but the interaction between interruption type and content was statistically significant, $F(1, 116) = 16.22, p < .01$. When the ad was relevant, story memory was not affected by whether the ad appeared as a pop-up or pop-under, but when the ad was irrelevant, story memory was higher when it appeared as a pop-under, rather than as a pop-up.

Next, we performed the same factorial ANOVA on affective measures. The ANOVA with attitude toward the ad revealed a main effect for interruption content, $F(1, 116) = 8.63, p < .01$. Specifically, when an ad was perceived as relevant, it elicited more positive attitudes ($M = 3.45, SD = 1.24$) than when it was perceived as irrelevant ($M =$

2.75, $SD = 1.11$), thus supporting H6. Interestingly, the moderate support that we observed for H2 in Study 1 disappeared here because interruption type did not have a significant influence on attitude toward the ad. In addition to the main effect for interruption content, the interaction effect was statistically significant, $F(1, 116) = 16.82$, $p < .01$. This interaction suggests that for pop-unders, the perception of relevance or irrelevance of ad content does not affect attitude toward the ad, but for pop-ups, interruption content is critical such that a pop-up ad with relevant content leads to more positive evaluations of the ad than a pop-up ad with irrelevant content. The interaction effect is consistent with our expectation and lends support to H8. This pattern of results was almost exactly identical with both the attitude toward the brand and behavioral intention indices. Again, main effects were found for interruption content on both of these measures but such effects were not found for interruption type. Similarly, the interaction effects were more or less identical to the one obtained with attitude toward the ad.

In order to test our final set of hypotheses, we performed a factorial ANOVA on attitude toward the Website. This analysis revealed a main effect for interruption type, $F(1, 116) = 34.34$, $p < .01$, such that participants in the pop-under condition rated the Website more positively ($M = 5.23$, $SD = .74$) than did those participants in the pop-up condition ($M = 4.24$, $SD = 1.22$). Thus, H4 was supported. However, the main effect for interruption content was not statistically significant, thereby failing to support H7. But, the interaction effect was statistically significant, $F(1, 116) = 22.27$, $p < .01$. Mirroring the pattern of some of the previous interaction effects, the data suggest that a pop-up ad with relevant content will generate more positive perceptions toward the site than will a pop-up ad with irrelevant content. However, for a pop-under ad, the perception of content relevance is not as important. This finding offers support to H9.

Analyses with the Website credibility index did not yield any significant effects. Like before, the control variables of time spent online and ad familiarity did not alter the findings reported here.

Study 2 Discussion

Study 2 was conducted for three purposes: 1) to investigate whether the promising—albeit somewhat weak—findings from Study 1 could be improved in a more ecologically valid experimental context; 2) to examine how information processing is affected by frequency of interruptions; and 3) to explore the interplay between social and cognitive characteristics of interruptions on cognitive and affective perceptions. The results obtained in Study 2 add to those reported in Study 1 and confirm the importance of interruptions as a psychologically powerful variable in the online environment.

To summarize the important results in Study 2, the effects of interruption content (a cognitive characteristic) were more pronounced than were the effects of interruption type (a social characteristic) on attitude toward the interruption (in this case, attitude toward the ad) and attention toward the interruption (ad). In general, when the interruption was perceived as relevant to the news content, it led to greater attention to the ad and also more positive attitudes toward the ad. Of course, these findings are tempered by the fact that the overall means were quite low, indicating that Web users are perhaps wary of online ads. However, based on the results, ads that are perceived as relevant to users' information-processing goals have a superior possibility of being effective compared to ads that are not relevant to ongoing user goals during the course of their Web browsing. On measures of story memory and attitude toward the Website, interruption type had a greater impact than did interruption content. Specifically, an interruption appearing as a pop-under ad not only resulted in higher scores on story memory but also resulted in more positive attitudes toward the generator of the interruption (in this case, the Website). These findings suggest that interruptions can degrade performance on the primary task and can carry over to negatively affect users' evaluations of the interruption generator (Website).

Perhaps of most interest, we discovered interaction effects between interruption type and interruption content on several of the dependent measures. The overall pattern of the interaction effects leads us to recommend that if Web marketers need to advertise their products, then they are best advised to do so by displaying the ad as a pop-up that is relevant to the site on which it appears. A corollary to this recommendation is that

marketers may be well advised to steer clear of bombarding consumers with irrelevant pop-ups. For pop-unders, the effects are more benign, as the issue of conforming to relevance of site content is not as important. While Web advertisers obviously hope that pop-unders may be favorably attended to by users, our findings have more useful implications for owners of sites which feature such interruptions. It appears that users are relatively more favorably inclined to sites that feature interruptions as pop-unders. From the perspective of the site owners, if they have to generate advertising revenue by offering ad space, they would probably benefit by specifying that the featured ad be formatted in as mildly intrusive a fashion as possible.

General Discussion

The findings from the two studies reported here add to the body of recent research examining the effects of interruptions in the online environment. Previous studies have generally focused on interruptions in an e-commerce arena and examined effects on decision-making variables such as time spent on task and user choice in the decision process (Xia & Sudharshan, 2002). In terms of pop-ups, recent experimental research has focused on the effects of the interruption *per se* and shown that interruptions can impact both memory and attitudes (Diao & Sundar, in press; Edwards et al., 2002). The experiments reported here make a conceptual contribution to this stream of research by showing that, in addition to affecting memory and attitudes toward the interruptions themselves, interruptions can also affect memory and attitudes of an external source (Website).

By manipulating interruption content, we hope to demonstrate the importance of content in new media research. The preponderance of current experimental research in human-computer interaction is concerned with manipulation of some technological element, while normally ignoring the effects of content. Typically, new media scholars suggest that a particular technological element must be examined in different content situations, but these suggestions are generally included in discussion sections to point out the limited external validity of such studies. As can be surmised from the results reported in this paper, content has an important role to play in information-processing situations,

especially when examined in conjunction with technological variables. Therefore, we forward a call to new media researchers, particularly those studying technology from a media effects perspective, to consider the inclusion of content in future experimental designs. We believe that the variable-centered approach to studying technology (Nass & Mason, 1990), combined with content, would serve as a promising avenue for future research.

From the interruptions perspective, we have examined only some of the important components that characterize them. Indeed, as Xia and Sudharshan (2002) point out, interruptions offer several variables of interest for future examination. Those that are especially relevant in online environments pertain to interruption duration, interruption complexity, and interruption timing. Some interruptions may require more time for users to respond to them than others. The instant at which an interruption appears may also affect online processing. For example, an interruption that arrives in the middle of a browsing experience may be perceived as more detrimental than an interruption that arrives either at the beginning (as reported in this paper) or toward the end of the experience. Also, the complexity of an interruption could be an important factor in online information processing because more complex interruptions warrant more cognitive resources from the primary task (see Xia & Sudharshan, 2002).

Obviously, like most research, the research reported here is not without limitations. In addition to the usual external validity limitations that are characteristic of experimental research, there are other shortcomings that need to be pointed out. Our operationalization of attention relied on self-reported measures. As recent research on pop-ups has shown, employing a physiological measure (such as heart rate) would perhaps be a more reliable indicator of attention (Diao & Sundar, in press). Second, while time spent on interruptions has shown to be a predictor of task performance, we did not observe any effects of this variable. Although participants in different conditions did not differ significantly in terms of time spent browsing through the news site, it could be that a different operationalization of interruptions would lend insights into how time spent on attending to interruptions affects user perceptions. Third, we did not account for the role of interruption expectations on users. Quite possibly, if users had been conditioned to expect an interruption during their browsing experience, their expectations

could have influenced the results, thereby possibly attenuating the effects of the manipulations. Finally, we have only examined the distinction between two types of interruptions: the pop-up and the pop-under. Given the interactive nature of current new media environments, other interruption types such as skyscrapers, interstitials, and intelligent agents may exhibit more powerful effects on users.

In conclusion, we believe that the issue of interruptions is an important one and worthy of further attention in human-computer interaction. A systematic program of research in this direction will serve to provide a nuanced understanding of the processes—and effects—of information processing in new media environments.

Figure 1. An example of a pop-up ad with relevant content.



Figure 2. An example of a pop-up ad with irrelevant content.



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