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CONTROLLING DISTRACTION ON THE INTERNET: AN INVESTIGATION INTO THE MECHANISMS INVOLVED IN MINIMIZING THE INFLUENCE OF INTERNET ADS ON AN INFORMATION SEARCHING TASK

By

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ABSTRACT

CONTROLLING DISTRACTION ON THE INTERNET:
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By

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Every day, millions of Internet users encounter advertisements designed to capture their attention. Often, these advertisements are irrelevant to the task that the Internet user is trying to complete, and as such, represent a major source of potential distraction. Previous research indicates that although Internet ads are effective in capturing Internet users' attention (as measured by their ability to recognize previously presented ads), individuals engaged in an information search are surprisingly good at minimizing the processing of ads, to the extent that few, if any, distraction effects emerge in the presence of ads.

The experiments included in this dissertation were designed to investigate the extent to which three features of the task environment are used to guide selective attention and enable Internet users to preserve goal task performance when distractors are present. It is hypothesized that visual attention can be guided by perceptual features, semantic content, and/or spatial location.

Experiment 1 investigated the influence of perceptual and semantic features by varying the semantic relatedness of ads and the likelihood that images contained task relevant information. Participants were college aged adults and older adults (60+). Recognition of images increased for both age groups as their semantic relatedness to target content increased. No reliable influence of perceptual features

was found. Furthermore, no distraction effects from the presence of ads were found in measures of search task performance, indicating that older adults were not differentially susceptible to distraction in this environment.

Experiment 2 investigated whether reliable ad recognition in the absence of reliable distraction effects could be attributed to the use of location cues. It was hypothesized that spatial location could be used to guide attention toward probable target regions, and avoid subsequent processing in regions containing distractors. In order to test this hypothesis, this experiment manipulated the extent to which participants needed to be attentive to the entire area of the web page by introducing a secondary task to the primary information searching task. This experiment again provided support for the role of semantic content in guiding attention, but no evidence of spatial location guiding attention was found.

Dedicated to Case and my family—

If this dissertation's length were proportionate
to the amount of love, support and encouragement
you have given me over the years,
this would be a multi-volume work!

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TABLE OF CONTENTS

LIST OF TABLES....X

LIST OF FIGURES....XII

INTRODUCTION....1
- Measuring Attention to Internet Advertising....4
  - Eye Fixations on Internet Advertisements....4
  - Memory for Internet Advertisements....6
- Factors Influencing Attentional Capture....8
  - Perceptual Features....8
    - Involuntary Attentional Capture....8
    - Contingent Attentional Capture....11
  - Semantic Features....15
  - Location....17

ADVERTISEMENTS THAT SHARE PERCEPTUAL OR SEMANTIC FEATURES WITH WEB PAGE CONTENT....21
- Preliminary Study....21
  - Predictions....21
    - Attention to Advertisements....21
    - Goal Task Performance....23
  - Materials and Methods....24
    - Participants....24
    - Design....24
    - Materials....26
    - Procedure....31
  - Results....32
    - Manipulation Check....32
    - Attention to Advertisements....34
    - Goal Task Performance....38
  - Discussion....41
    - Attention to Advertisements....41
    - Goal Task Performance....42
    - Limitations....42
- Experiment 1....44
  - Age Differences in Distraction....44
    - Older Adults and the Internet....44
    - Increased Susceptibility to Distraction....45
    - Factors Attenuating Age Differences in Attention....46
  - Predictions....49
  - Materials and Methods....50
    - Participants....50
    - Design....50

Materials....52
Procedure....59
Results....61
Manipulation Checks....61
Goal Task Performance....72
Reading With Distraction Task....77
Role of Experience....81
Discussion....84
Attention to Advertisements....84
Goal Task Performance....86
Age Differences....88
Conclusion....89

THE INFLUENCE OF LOCATION-BASED ATTENTIONAL FILTERS ON ATTENTION TO INTERNET ADVERTISEMENTS....91
Predictions....92
Materials and Methods....94
Participants....94
Design....94
Materials....95
Procedure....99
Results....100
Manipulation Checks....100
Participants....100
Dual Task Performance....102
Reading with Distraction Task....104
Attention to Advertisements....106
Goal Task Performance....109
Web Page Viewing Time....110
Content Learning Questions....111
Discussion....113
Attention to Advertisements....113
Goal Task Performance....115
Conclusions....116

GENERAL DISCUSSION....118
Summary of Experimental Results....118
Role of Perceptual Features....118
Influence of Semantic Content....120
Influence of Spatial Location....123
Conclusions....126
Implications for Advertisers....127
Implications for Internet Users....128

APPENDIX A: SCREEN SHOTS FROM THE PRELIMINARY EXPERIMENT....130
Baseline Conditions....130

Ad Conditions in the Uniform Presentation Condition....................131
Ad Conditions in the Hybrid Presentation Mode....................132

APPENDIX B: SCREEN SHOTS FROM EXPERIMENTS 1 & 2....................133
Baseline Conditions....................133
Ad Conditions in Uniform Presentation Mode....................134
Ad Conditions in Hybrid Presentation Mode....................135

APPENDIX C: COMPUTER EXPERIMCE QUESTIONNAIRE....................136

APPENDIX D: INTERNET EXPERIENCE QUESTIONNAIRE....................138

APPENDIX E: EXIT QUESTIONNAIRE....................140

REFERENCES....................141

LIST OF TABLES

Table 1: Image types displayed in each presentation mode in the preliminary study. 25

Table 2: Means (and 95% confidence interval) on the demographic variables included in the preliminary study. 33

Table 3: Proportion of hits and false alarms (FAs), and their corresponding discrimination index (dL) for image recognition in the preliminary study....36

Table 4: Mean time in seconds (and 95% confidence interval) taken to make a correct Old/New decision for images in the preliminary study memory test. 38

Table 5: Mean time in seconds spent viewing web pages (and 95% confidence interval) in the preliminary study....39

Table 6: Mean accuracy (and 95% confidence interval) on content learning questions in the preliminary study....40

Table 7: Image types displayed in each presentation mode in Experiment 1....51

Table 8: Counterbalancing of passage topics and image type conditions in Experiment 1....52

Table 9: Means (and 95% confidence interval) on the demographic measures included in Experiment 1. 62

Table 10: Mean time (and 95% confidence interval) in seconds spent viewing web pages in Experiment 1....73

Table 11: Mean accuracy (and 95% confidence interval) on content learning question in Experiment 1....76

Table 12: Scores on the demographic measures included in Experiment 2....101

Table 13: Average number of gems collected per page in Experiment 2....................103

Table 14: Mean proportion correct on content learning questions in Experiment 2. 112

Table 15: Mean time (in seconds) taken to select a correct answer on the content learning questions in Experiment 2...112

LIST OF FIGURES

Figure 1: Mean discrimination indices for the images presented in the preliminary study memory test....................35

Figure 2: Percent of images recognized by (a) young and (b) older adults in the Experiment 1 image memory test....................66

Figure 3: Percent of images recognized by participants in the Hybrid presentation condition on the Experiment 1 image memory test....................68

Figure 4: Mean time (in seconds) taken for (a) young adults and (b) older adults to make a correct decision in the Experiment 1 image memory test....................70

Figure 5: Mean time (in seconds) taken to correctly recognize images by participants in the Hybrid presentation condition on the Experiment 1 image memory test....................71

Figure 6: Mean reading time in the Experiment 1 reading with distraction task.......78

Figure 7: The six gem shapes and colors used in the dual task component of Experiment 2....................96

Figure 8: Representation of the gem materialization animation sequence in Experiment 2, with timestamps (in ms) below each image....................97

Figure 9: Page layout indicating image positions (open squares) and gem locations (filled squares) for all six pages of the Health Information passage....................98

Figure 10: Average RT (in seconds) to collect gems in Experiment 2....................104

Figure 11: Mean passage reading time (in seconds) on the reading with distraction task in Experiment 2....................105

Figure 12: Proportion of images recognized in the Experiment 2 image memory test. 107

Figure 13: Time taken (in seconds) to make a correct decision on the image memory test in Experiment 2........109

Figure 14: Mean time (in seconds) spent viewing website pages in Experiment 2.110

Figure A1: Screen shot of the first page displayed in the text only condition........130

Figure A2: Screen shot of the first page displayed in the graphics only condition........130

Figure A3: Screen shot of the first page displayed in the related ads condition......131

Figure A4: Screen shot of the first page displayed in the unrelated ads condition........131

Figure A5: Screen shot of the first page displayed in the related ads condition......132

Figure A6: Screen shot of the first page displayed in the unrelated ads condition........132

Figure B1: First page of the travel passage displayed in the text only condition........133

Figure B2: First page of the travel passage displayed in the graphics only condition........133

Figure B3: First page of the travel passage displayed in the related ads condition........134

Figure B4: First page of the travel passage displayed in the unrelated ads condition........134

Figure B5: First page of the travel passage displayed in the related ads condition........135

Figure B6: First page of the travel passage displayed in the unrelated ads condition........135

INTRODUCTION

Increasing numbers of Americans are turning to the Internet as a leading source for information ("America Internet usage and population statistics, " 2007; Czaja & Lee, 2001; Morrell, Mayhorn & Bennett, 2002; Spiezle & Moulton, 2001; Thorson, Duffy & Schumann, 2007; United States Department of Commerce, 2000). The Internet offers a wealth of information in a single place, available to many individuals in the comfort of their own homes. The ability to easily access vast amounts of information on the Internet has revolutionized the way many people pursue information gathering tasks.

The Internet is not only unique in that it conveniently offers access to a nearly infinite amount of information, it is also unique in its ability to deliver requested information to people side by side with unrequested, often irrelevant information. This irrelevant information can come in a variety of forms, from search results that do not meet the searcher's needs, to professionally developed marketing campaigns designed to attract attention and turn would-be information-seekers into consumers. The focus of this dissertation is on the latter (and arguably the largest) category of distractors on the Internet—Internet advertisements.

Advertisers have increased spending on Internet advertising drastically in the last five years (annplugged, 2007; Internet Advertising Bureau), resulting in an increased presence of advertisements on the Internet. Increasing Internet-based advertising has proven to be lucrative to advertisement agencies. Revenue from Internet advertising has shown steady growth over the course of the last 10 years

("America Internet usage and population statistics, " 2007), and shows no indication of slowing down ("Internet advertising revenues grow 35% in '06", 2007; Li & VanBoskirk, 2005). As ad spending increases, so do the number of Internet advertisements vying for Internet users' attention.

Advertisers recognize that the Internet "is a medium that can uniquely affect consumer behavior" ("America Internet usage and population statistics, " 2007). The question is, "What are these unique effects of Internet advertising?" On the one hand, increased spending on Internet advertising indicates that advertisers believe that the Internet is an effective medium for capturing users' attention and prompting them to engage in "consumer behavior." On the other hand, the resulting increase in advertising has, in many cases, lead to public outcry, with critics claiming that ads are intrusive and ultimately impair Internet users' abilities to use the Internet as desired. As Barbara Holt and Roger Morrell (2002) describe, "The majority of web sites are multi layered with advertisements, pop-up screens, reams of pages of scrolled text, irrelevant graphics, and flashing banners announcing soon-to-pass purchasing opportunities" (p. 109).

By design, Internet ads are designed to attract the attention of potential consumers engaged in non-consumer activities on the Internet. Nevertheless, many of these potential consumers object to having their attention diverted by advertisements. Since attention is commonly conceptualized as a limited resource, it seems plausible that Internet users have a valid complaint. Factors that make ads effective in attracting attention could also make it difficult for Internet users to efficiently carry out the task they intended to complete on the Internet. If Internet users are unable to guide attention away from ads when attending to ads is not relevant to the user's goal, these users may have increased difficulty attending to and completing their goal. In this latter case, objections to increased advertising volume on the Internet would seem justified.

The following dissertation stems from research investigating the abilities of Internet users to control distraction as it occurs in the form of Internet advertisements. I begin by reviewing research that assessed the effectiveness of Internet advertisements, followed by a discussion of factors likely to contribute to attention capture by advertisements in an Internet environment. This discussion focuses on three features hypothesized to guide selective attention: perceptual features, semantic content, and spatial location.

Studies have indicated that people attend to advertisements enough to later remember them. Despite this evidence that people tend to remember ads, findings of distraction effects (or performance decrements) due to Internet ads can be characterized as mixed. Although there are some studies that report distraction effects, in general distraction effects from Internet ads range from small to nonexistent, especially when the goal task involves complex cognitive processing. This is a rather surprising result, given evidence elsewhere (e.g. visual search studies) that participants perform more poorly on a primary task when their attention is captured by distractors. The experiments presented in this dissertation were designed to explore the extent to which three features of the task environment are involved in guiding selective attention and enabling participants to maintain steady goal task performance.

It is hypothesized that Internet users may utilize distinctive perceptual features, such as color, shape or size, to guide attention to target content. In particular, it is predicted that users will be more likely to process items that share perceptual features with the goal task. However, as an information searching task requires that users process content for meaning, it is also proposed that Internet users are likely to direct attention to items that are considered topic-relevant. Users are predicted to process all web content for meaning, and ultimately make a determination as to whether an individual item is task relevant or task irrelevant. Attention can then be directed to task relevant objects for further processing. Finally, Internet users could utilize spatial cues to direct attention away from items deemed irrelevant and toward the semantically related, task relevant regions of a page.

Measuring Attention to Internet Advertising

The relatively young field of research on Internet advertising indicates that Internet ads are generally effective in capturing consumers' attention, as measured by eye tracking technology, and various types of memory tests.

Eye Fixations on Internet Advertisements

There is generally assumed to be a direct link between what the eye is looking at and ongoing cognitive processing (Hollingworth & Henderson, 2002;

Rayner, 1998).[1] Eye-tracking studies have shown that participants engaged in a web page reading task divert their attention from reading in order to look at task-irrelevant ads (Burke et al., 2005; Day, Shyi, & Wang, 2006; Dreze & Hussherr, 2003; Lewenstein, Edwards, Tatar, & DeVigal, 2004; Wang & Day, 2007). In one such study, 67 participants who regularly visited Internet news sites were recruited, and asked to do their news reading on web-pages of their choosing while wearing a head-mounted eye tracker (Lewenstein et al., 2004). The investigators found that participants' eyes fixated for an average of 1000ms on 45% of the displayed banner ads. In this experiment, a total of 1,127 banner ads were displayed on 97 of the web pages accessed by participants. Dreze and Hussherr (2003) report similar results. In their study, all of their 49 participants directly fixated at least one of the 8 presented banner ad. On average, each banner ad had a 0.49 probability of being seen, or each person looked at 3.96 banner ads.

A study by Burke and colleagues (Burke et al., 2005) reports that eye fixations occurred directly on commercial advertising banners in approximately 13% of the trials. This study used a visual search paradigm in which participants were either cued with a news headline (verbatim match) or the first sentence of a

1 Burke et al. (Experiment 1, 2005) claim that 94% of banner ads correctly identified on their recognition test were not directly fixated by the participant. The authors do not discuss the significance of this finding in terms of calling into question the link between attention and eye movements, nor do they offer an explanation for this extremely high percentage of unviewed, but recognized, ads. Furthermore, as discussed in the following section on memory for ads, these researchers did not obtain reliable recognition of advertisements in their experiment. As such, the implication and reliability of this finding is difficult to interpret.

news article (semantic match), and asked to find the matching headline in a search set of news headlines. The participants in this study were found to be twice as likely to look at banner ads when they were engaged in effortful processing in the semantic match condition, as opposed to merely matching the exact headline in the verbatim match condition.

Finally, two recent studies by Day and Wang (Day, Shyi, & Wang, 2006; Wang & Day, 2007) also record participant eye fixations on banner ads. However, these researchers report their findings in terms of percent of total fixations directed toward ads, rather than in terms of the proportion of ads fixated. In their first study (Day, Shy & Wang, 2006), participants viewed two grayscale ads , positioned at the top and the bottom of a matrix decision making task, that were set to alternately onset and offset to create an impression of flashing. Participants in this experiment directed 3.62% of their fixations toward these banners. In their second study (Wang & Day, 2007), they report that fixations on small square ads located in each corner of the screen, and fixations on banner ads located at the top and the bottom of each screen accounted for just under 3% of total fixations. These findings indicate that although advertisements are looked at, they are not looked at as often as target content on a website.

Memory for Internet Advertisements

Another measure frequently used as an indicator of attention to advertisements is memory for a brand name, or memory for the ad itself. Studies using these measures report that consumers are able to recall and/or recognize previously viewed ad content (Bayles, 2000; Bayles, 2002; Calisir & Karaali, 2008; Chung, 2006; Dahlen, 2001; Danaher & Mullarkey, 2003; Diao & Sundar, 2004; Dreze & Hussherr, 2003; Edwards, Li, & Lee, 2002; Hong, Thong, & Tam, 2004; Johnson & Neath, 1999; Jones, Pentecost & Requena, 2005; Li & Bukovac, 1999; Moore, Stammerhohan & Coulter, 2005; Sagarin, Britt, Heider, Wood, & Lynch, 2003; Sundar & Kalyanaraman, 2004; Yoo & Kim, 2005, but see Burke et al., 2005 Experiment 2 for findings of unreliable ad recognition). Although both recall and recognition can be used to measure attention to ads, there is some indication that recognition tests provide more sensitive measures of ad memory than recall tests (Bayles, 2000; Bayles, 2002; Danaher & Mullarkey, 2003; see Neath & Surprenat, 2003 for a more extensive discussion of the differences between these two types of memory tests), as recall tests for incidentally processed stimuli such as advertisements are more prone to floor effects than recognition tests.

Few studies in this literature compare memory for non-advertising content with memory for ads. The available studies provide clear indication that people appear to allocate most of their attention to the content of the website, and not to ads. Two studies indicate that although memory for brand names presented in Internet advertisements is reliable, it is significantly worse than memory for a web site's non-advertising content (Johnson & Neath, 1999; Jones, Pentecost & Requena, 2005). This pattern is consistent with eyetracking studies that find only a low percentage of total eye fixations being directed toward ads, with the majority of fixations being directed toward content (Day, Shyi & Wang, 2006; Wang & Day, 2007). Despite this apparent focus on web content, repeated findings of reliable memory for advertisements does indicate that people (willingly or unwillingly) are allocating some of their attentional resources toward processing ads.

Factors Influencing Attentional Capture

The amount of attention allocated to Internet advertisements is likely influenced by several factors, such as the perceptual features of an advertisement, whether or not the content of the advertisement relates to information that the Internet user is seeking, and the spatial location of items on the web page.

Perceptual Features

An ongoing debate in the visual attention literature centers the degree to which attention capture by perceptually distinct features in the visual display is automatic. Some researchers have proposed that these features capture attention automatically, without effort or intention on the part of the viewer. Such automatic attentional capture is sometimes referred to as involuntary attentional capture. Other researchers have proposed that participants' current attentional set directs the likelihood that visually distinctive features will capture attention, often called contingent attentional capture. According to these researchers, visual salience is determined in part by the perceptual features of an item, and in part by the task demands. These two views, as they apply to processing Internet ads, are discussed in the following sections.

Involuntary Attentional Capture

A recent review of the visual search literature by Wolf and Horowitz (2004) suggests that some perceptual features of a target stimulus are associated with very efficient visual searches. Searches are termed efficient when the search slope is not dependent upon the number of items in the search set—in other words, some distinct or unique feature of the target object causes it to pop-out from the field of distractors and immediately become the object of attention. Features that undoubtedly guide attention in this way include color, motion, orientation and size (Wolf & Horowitz, 2004). The efficiency with which these features are able to guide attention suggests that these features may be available pre-attentively. In keeping with this notion, some researchers have suggested that attention capture by these distinct perceptual features may be automatic.

Since advertisements are often more colorful than their surrounding page content, and employ animation (motion) in comparison to static content elements, if attention capture by these features is automatic advertisements should be highly salient and should show evidence of being processed regardless of their relevance to the goal task. A series of studies investigating the influence of Internet visually salient advertisements on an information search task found indication of attention to ads, as measured by ad recognition (Helder, under revision). However, although participants in these studies showed evidence of having attended to ads, recognition rates were quite low, and no performance decrements (as measured by reading rate and content learning) were observed. These last two findings do not seem to be consistent with involuntary attentional capture—rather, they suggest that participants were able to avoid attention capture from visually salient features of advertisements some of the time. Similar findings have been observed elsewhere in the Internet advertising literature. In a study in which ads should have been visually salient compared to text-based content, Sagarin, Britt, Heider, Wood, and Lynch (2003) found no direct influence of Internet ads on the number of anagrams solved.

On the other hand, Burke and colleagues (Experiment 2; 2005) found results that appear to support automatic attention capture when the search task requires fewer cognitive resources, but not when the search task involves more complex processing. In their study, the time taken for participants to complete a visual search task containing graphics of varying salience was recorded. They found a distraction effect attributable to salient (animated) ads when the task was a simple search task involving matching headlines in a search set to a target pre-cued headline. However, when the task became more cognitively demanding by cuing participants with an opening sentence from an article, and asking them to choose the most likely headline from the search set, the visual salience of the ad no longer influenced search speed.

In conclusion, this pattern of results may suggest that distinctive perceptual features on distractor ads are unlikely to automatically capture attention when individuals are involved in cognitively demanding tasks, such as processing a verbal for meaning. This interpretation is intuitively appealing, as performance on the task itself is likely to be more strongly tied to semantic than basic perceptual processing. On the other hand, involuntary attentional capture may occur in highly constrained visual search type tasks, in which the task itself is defined on the basis of perceptual features.

Contingent Attentional Capture

In the information search tasks (Burke et al., 2005; Helder, under revision) and anagram solving tasks (Sagarin et al., 2003) discussed in the previous section, the bright colors and the use of motion in advertisements were inconsistent with the set of perceptual features considered task-relevant. This set of features is frequently termed the "attentional set". Participants in these experiments were engaged in tasks in which the target information was presented in black text on a white background. Therefore, any objects of a graphical nature, such as the advertisements, should not have shared perceptual features with the attentional set. The finding that participants were able to ignore advertisements in these paradigms may indicate that attentional capture is contingent upon attentional set. Further support for the contingent attentional capture hypothesis comes from studies on attentional set and inattentional blindness outside the domain of advertising research.

Inattentional blindness occurs when individuals fail to see things that are present at the attended location. In perhaps the most famous of inattentional blindness studies, 50 % of participants failed to spot a person in a gorilla suit walking through the middle of a basketball game (Neisser & Becklen, 1975; Simons & Chabris, 1999). Since this study, experimenters have developed displays with carefully controlled visual characteristics to investigate the source of inattentional blindness. Several of these studies suggest that the degree of inattentional blindness is determined by how similar the perceptual features of a distractor are to those in the current attentional set (Most et al. 2001; Most, Scholl, Clifford & Simons, 2005). These findings are consistent with contingent capture views of attention, which propose that distractors sharing features with the current attentional set (meaning they share features with the target) are likely to be noticed, while distractors that do not match the current attentional set are not likely to be noticed.

This basic pattern of results holds even when the distractor should be salient based on its color, movement, or size (Most, et al., 2001), contrary to the predictions of involuntary attentional capture advocates. For instance, if participants are attending to the motion of white objects and ignoring the motion of black objects, even a visually salient red object is likely to go unnoticed by a large proportion of participants because the red object does not share perceptual features with the current attentional set. In summary, inattentional blindness studies have successfully dissociated between focusing attention on the basis of what should be distinctive visual features and focusing attention on the basis of attentional set. In the case of attention to Internet ads, this view predicts that ads that do not share perceptual features with the current attentional set may not be attended.

Similar results have also been found in experiments involving stimuli more characteristic of those encountered on the Internet. The first of these studies is a visual search study that manipulated the degree of perceptual similarity between distractors and targets. The author found that the degree of perceptual similarity between goal task content and distractor content appears to be a strong predictor of distractor influence (Zhang 2000).

In this task, participants were presented with a matrix consisting of nonsense letter strings ranging from 1 to 4 letters in length. At the beginning of each trial, participants were given a target string to search for. Trials ended when participants indicated how many instances of the target string they had found in the matrix. While participants were searching, an animated string of nonsense letters, or an animated picture of an animal was presented around the periphery of the search display. The critical finding was that the animated letter string (which shared perceptual features with the target letter strings) was more disruptive than the animated animal. As such, this study provides support for the idea that when distractors match features of the current attentional set, they are likely to receive more processing than distractors that do not match.

Two other studies (Hong, Thong & Tam, 2004; Miarmi & DeBono, 2007) investigated the influence of Internet advertisements on goal task performance, and report results that could be interpreted as supporting the role of attentional sets in predicting distraction effects. Hong and colleagues (2004) investigated the influence of "animation" on an Internet shopping task. They found than when the target item was animated (flashed), response time to find the target decreased, supporting the idea that animation increases visual salience. This increase in visual salience purportedly not only captures attention initially, but leads to subsequent processing. Furthermore, response time was significantly longer when a non-target item was animated compared to conditions without any non-target animation. Although details on the target and non-target products were not provided, non-target items were likely to share features with the target item since participants were engaged in an online shopping task. Consequently, the animation may have attracted attention initially to the non-target item, and the non-target may have received additional processing since it shared perceptual features with the current attentional set.

Another study of distraction effects from ads found evidence that advertisements appeared to disrupt goal task performance (Miarmi & DeBono, 2007). Participants in this study were asked to determine an appropriate sentence length for a guilty offender. The researchers found that participants' decisions were affected by racial stereotypes when ads were present during the presentation of evidence. In contrast, participants did not seem to rely on racial stereotypes when no ads were present. These findings were interpreted as evidence that the presence of ads diverted attention away from the sentencing task, resulting in the emergence of racial stereotypes either as a mental shortcut, or as a suppression error when reduced attentional resources failed to correct for the influence of native stereotypes.

The central manipulation in this study involved showing participants a photo of the offender, pictured as either a white male or a black male. Given this task, other content containing human faces are likely to be considered task relevant. Although the actual ads used in this study are not published, the authors' description of ad content indicates that at least half of the ads included in this study contained faces. Therefore, the ads included in this study may have been processed as task relevant information, resulting in the observed distraction effects.

Semantic Features

Increasingly, advertisers are harnessing the power of search engines to make sure that the ads appearing alongside Internet users' search results are relevant to the topic they are searching for (Li & Leckenby, 2007). There is some evidence from research on selective attention supporting this marketing decision. Several studies have indicated that attentional sets may also be sensitive to semantic matches (Edwards et al., 2002; Koivisto & Revonsuo, 2007; Moore, Stammerjohan & Coulter, 2005; Shamdasani et al., 2001), and distractors that are semantically related to the goal task are more likely to be processed than distractors that are semantically unrelated.

Koivisto and Revonsuo (2007) report this basic effect, where items that were semantically related, but did not share any visual features with the target, were able to capture attention. In one version of their inattentional blindness experiment, participants were shown pictures of items arranged around a central fixation point. Four items appeared onscreen at once, with one item in each quadrant of the screen. The task was to find the picture of an animal (piece of furniture), and indicate in which quadrant it appeared. On the critical trial, a distractor word naming an animal (piece of furniture) appeared at fixation. When the word was task relevant (ex. the goal task was to look for animal picture, and the distractor word was "horse"), the word was noticed significantly more often than when the word was task irrelevant (ex. the distractor word was "desk"). They replicated these results using an alternate version of the experiment in which the distractor stimulus was a picture, and the search display contained words. This study suggests that participants engaged in reading a passage on a topic are likely to attend to images that are related to the content—even if the images are not part of the goal task.

Additional evidence for semantic similarity influencing attention comes from findings related to advertising effectiveness in an Internet environment. Researchers have found that consumers have better attitudes toward ads and brands that are related to the content of the web page as opposed to unrelated (Moore, Stammerjohan & Coulter, 2005; Shamdasani, Stanland, & Tan, 2001). Consumers also reported a higher intention to click on the related ads, or purchase the products advertised in related ads. Similarly, Edwards, Li and Lee (2002) found evidence that pop-up ads that related to the reading content were judged to be less intrusive, but potentially more attention-grabbing.

Finally, Diaper and Waelend (2000) report results that seem to contradict the proposed role of semantic similarity in capturing attention. In their experiment, participants were asked to search short informational web pages for the answer to a question appearing at the top of the web page. Search time was recorded, and web pages were presented with and without animated, clip-art style graphics that were related to the content of the web page. Contrary to expectations, they found no decrements in search performance due to the presence of these content-related graphics. However, the authors point out that despite being content-related, the graphics never contained task-relevant information, and that participants were likely able to learn this relationship quickly during the experiment. Consequently, the participants in this experiment may have implemented attentional filters based on perceptual features, rather than semantic features, in order to distinguish target text from irrelevant graphics, as has been proposed to explain similar results in an information search task (Helder, under revision).

Location

There is evidence that selective attention can be guided by location, such that distractors in unattended locations are less likely to be processed. For instance, the effectiveness of onset distractors in capturing attention is greatly reduced when participants know in advance where a target will appear (Gronau, Sequerra, Cohen, & Ben-Shakhar, 2006; Lamy & Tsal, 1999; Theeuwes, 1991; Yantis & Jonides, 1990). This is relevant for predicting attention to ads, as task-relevant content often appears in a predictable location near the center of the screen. However, in some cases, distractors in unattended locations have been shown to still capture attention (Beck & Lavie, 2005; Gronau, Sequerra, Cohen, & Ben-Shakhar, 2006), and in other cases, distractors in attended locations have failed to attract attention, resulting in inattentional blindness (Most et al., 2001; Most, Scholl, Clifford & Simons, 2005; Neisser & Becklen, 1975; Simons & Chabris, 1999).

According to location-based models of selective attention, advertisements that appear in close proximity to the attended area should be more disruptive than advertisements that appear in more peripheral locations. This prediction was directly tested in a study examining the influence of Internet ads on reading performance in younger and older adults (Helder, under revision). In this experiment, participants read short passages without any ads displayed, with ads displayed around the periphery of the screen, or with ads included in the central text region of the screen and passage text wrapping around the ads.

Contrary to the predictions of location-based models, neither older nor younger adults showed any difference in content learning or in reading rate between the central and the peripheral ad conditions. Furthermore, young adults showed no evidence of any ad-related distraction effects in measures of reading rate and content learning. The older adults read the passages containing ads (in either central or peripheral locations) more slowly than passages without ads, but showed no distraction effects on a measure of content learning.

Although location-based filters did not seem to be employed in this study, it is important to point out that they may not have been necessary, as the ads used in this study were unlikely to share perceptual or semantic features with the goal task stimuli. In this study, target content was comprised of black font printed on a white background, characteristics likely to be visually distinct from colored, graphical ads. Furthermore, participants were reading passages written to be entertaining descriptions of events in different characters' days, which were not likely to share semantic characteristics with advertisements for products or services. Consequently, participants may have used perceptual or semantic features, rather than location cues, to guide selective attention in this experiment.

However, in her visual search study, Zhang (2000) also failed to find support for a location-based model of attention. In her study, animations sharing perceptual features with the letter strings involved in the primary task (animated letter strings) as well as animations not sharing such features (animated animals) both appeared in identical peripheral locations. Location-based models predict that both types of animations should have been equally disruptive to performance on the string counting task. Instead, similarity between the goal task and features of the distractor appears to have been a stronger predictor of distractor influence.

These studies provide evidence that although it seems feasible for location to guide selective attention in an Internet environment, location-based filtering may be likely to occur after perceptual and semantic filtering. In addition, it has been pointed out that web pages tend to be processed as a Gestalt (Moore, Stammerjohan & Coulter, 2005). In keeping with this characterization, it is likely that Internet users who do employ location-based filters may select locations based on the overall context of the page. This is type of filter is proposed to function similarly to the filters used in visual marking studies.

In visual marking studies, some of the distractors appear onscreen slightly before the rest of the display appears. In these experiments, participants are able to efficiently exclude previously presented distractors from the search on the basis of their location (Watson & Humphreys, 1997; Watson, & Maylor, 2002). In the case of attention to Internet ads, ads do not generally appear on the page before the text on most web pages. However, the participants in visual marking studies show sensitivity to the overall location of distractors in the context of the entire page layout. This ability is proposed to generalize to Internet environments, enabling participants to visually mark the locations of objects determined to be task irrelevant. Therefore, once an image has been determined to be task irrelevant, participants may be able to guide selective attention away from that image by visually marking that image's location in the context of the current web page.

ADVERTISEMENTS THAT SHARE PERCEPTUAL OR SEMANTIC FEATURES WITH WEB PAGE CONTENT

Previous research indicates that in some cases, attention to ads appears to be linked to performance disruptions, or distraction effects (Burke et al., 2005 [Experiment 2]; Miarmi & DeBono, 2007; Zhang, 2000), but not in all cases (Burke et al., 2005 [Experiment 1]; Diaper & Waelend, 2000; Helder, under revision; Hong, Thong & Tam, 2004;). An explanation for this contradictory pattern of results has yet to be proposed. One possibility is that attention to ads (and by extension, the likelihood of ad-related distraction effects) can be predicted by the extent to which the ads resemble the target content either perceptually or semantically.

None of the previously reviewed studies systematically varied both the perceptual and semantic similarity of targets and distractors to study the interplay between these two factors. The studies presented in this section were designed to address this shortcoming. Results from a preliminary study are presented, followed by the results of Experiment 1. Experiment 1 was designed to replicate the preliminary study using more diverse material, and a more diverse participant population by including older adults as well as college-aged adults.

Preliminary Study

Predictions

Attention to Advertisements

It is predicted that the current experiment will replicate previous findings in which participants show evidence of attending to ads, even when the ads are task irrelevant. All experiments reported in this dissertation use the results of an unexpected image recognition test as a proxy for attention. It is assumed that for an item to be correctly recognized, it must have been processed, and for it to have been processed, it must have been attended.

In the reported experiments, participants' primary task was an information search task. All target information was text-based, although participants were not informed of this feature of the task environment. In addition to the target text, web pages contained non-ad, semantically related graphics, semantically related ads, and semantically unrelated ads. It is predicted that participants will show evidence of processing all of these content items for meaning, and will guide attention to the items based on the degree to which the image's content matches the target content. Consequently, graphics should be recognized better than related ads, which in turn should be recognized better than unrelated ads.

Even though ads should be visually salient on the web page, as compared to the target text, it is predicted that participants are not likely to show evidence of involuntary attentional capture by these features. If visually salient features are involuntarily capturing attention, no difference should emerge in the recognition rates of graphics, related ads, and unrelated ads. This result, if obtained, would be contrary to the predicted effect of semantic content.

It is, however, predicted that participants may show evidence of contingent attentional capture. Since participants were not informed that the targets of their information search would not be contained in graphics, it is assumed that participants are likely to view semantically related non-ad graphics as potentially task-relevant items. Therefore, when graphics appear on a page, it is possible that participants may include perceptual features common to both graphics and ads in their attentional set. A pattern of results in which ads are more likely to be attended when they appear on a page that contains graphics along with text, than when they appear on a page that only contains other ads and text would be interpreted as supporting the contingent capture hypothesis.

Goal Task Performance

Previous research has found mixed results when it comes to distraction effects from ads—however, if only the results of studies using information searching tasks are considered, virtually no distraction effects from ads have been found (Burke et al., 2005 [Experiment 2, semantic search condition]; Diaper & Waelend, 2000; Helder, under revision). Accordingly, it is predicted that very few, if any, distraction effects on measures of goal task performance will emerge in the current experiment. However, if participants are assumed to use both semantic content and perceptual features to guide attention, it is predicted that participants should be least likely to show distraction effects from ads when viewing pages containing only content-unrelated ads. This prediction is based upon the idea that a page containing only ads should not result in the participant including perceptual features unique to images in the attentional set. Furthermore, semantically unrelated ads are unlikely to be processed beyond the level required to determine their basic meaning. On the other hand, participants are predicted to be most likely to show distraction effects when viewing pages containing a mix of content-related ads and graphics, as the inclusion of graphics should activate an attentional set containing perceptual features common to graphics and ads, while the semantically related content should be considered relevant for further processing.

Materials and Methods

Participants

Ninety-one students enrolled in a psychology course at MSU, ranging in age from 19 to 29 (*M*= 19.36, *CI*=18.76-19.81) participated in the experiment. The experiment was conducted in two phases. The 45 participants (15 males, 30 females) in the first phase of the experiment were tested in a "Uniform" presentation condition , and the 46 participants (7 males and 39 females) in the second phase of the experiment were tested in a "Hybrid" presentation condition.[2]

Design

There were three different types of images used in this experiment: graphics, related ads, and unrelated ads. All "graphics" were non-ad images related to the content of the text. The graphics did not contain additional unique information beyond that provided in the text. Consequently, participants did not need to look at the graphics to successfully complete the task. This control was necessary in order to keep the total amount of task-relevant information on each page constant, regardless of the type of image presented on the page. In addition, this design enabled a comparison to be made between participant responses to graphics and

2 Three participants were tested in the Uniform presentation condition following the conclusion of testing on the Hybrid presentation condition.

ads. All ads used in this experiment were color advertisements containing a mix of text and images. Some of the ads were animated, some were static. "Related ads" were advertisements whose content related to the text, while "unrelated ads" were advertisements whose content was unrelated to the text. As with the graphics, participants did not need to look at either type of ad to successfully complete the task.

Image type was manipulated within subjects. Each participant was presented with one passage in each of four image conditions: Text Only, Graphics Only, Related Ads, and Unrelated Ads. The passage presented in the Text Only condition contained only text and no images. The passage presented in the Graphics Only condition contained text mixed with graphics. These two conditions served as baselines, enabling the comparison of web page viewing behavior with and without graphics to the behavior observed in the ad-present conditions.

Table 1: Image types displayed in each presentation mode in the preliminary study.

		Image Type			
		Text Only	**Graphics Only**	**Related Ads**	**Unrelated Ads**
Presentation	**Uniform**	No graphics or ads	1-4 graphics	1-3 related ads	1-3 unrelated ads
	Hybrid	No graphics or ads	1-4 graphics	1 related ad 1-2 graphics	1 unrelated ad 1-2 graphics

As shown in Table 1, the allocation of images to the Text Only and Graphics only conditions was identical for participants in both phases of the experiment. On the other hand, the allocation of images to the ad-present conditions varied across the two phases. Image type was randomly selected for each participant for each page of a 20 page website. Each participant saw five pages displayed in each of the four image types.

Materials

Web page design and content questions. Participants viewed a 20 page passage on the topic of interpreting health news as reported by mass media channels. Individual pages contained an average of 246 (*SD*=14; *range*=218-274) words. Each page of the passage was displayed with one of the four image types. Individual pages were randomly assigned to image types for each participant. Efforts were made to use styles and coloring consistent with professionally developed websites. A total of 96 images was used across the various website display conditions.

A total of 34 graphics was selected for use in the Graphics Only condition. Pages displayed in this condition contained between one and four graphics, with six pages displaying a single graphic, 13 pages displaying two graphics, and one page displaying four graphics. Each ad-present condition used 31 ads, for a total of 62 ads. Pages displayed in the Related Ads condition contained ads related to health care. Pages displayed in the Unrelated Ads condition contained ads drawn from a variety of different categories. While most of the images a participant saw were presented on only one page, there was one of each type of image that could appear on up to three different pages for an individual participant, depending on the image conditions to which these three pages were assigned for that participant.

The Text Only and Graphics Only pages were identical for participants in the Uniform and the Hybrid presentation conditions. Participants in the Uniform presentation condition viewed each ad-present page of the passage with only related ads or unrelated ads present. In this presentation condition, pages displayed in the Related Ads condition contained between one and three ads, with eight pages displaying a single ad, 11 pages displaying two ads, and one page displaying three ads. The allocation of ads to passage pages in the Unrelated Ads condition mirrored that of the Related Ads condition, to control for the total number of ads per page.

Participants in the Hybrid presentation condition viewed ads mixed with graphics. The Hybrid Related Ads and Unrelated Ads pages were created from the page designs used in the Graphics Only condition, as this was an existing baseline condition. As in the Uniform condition, the allocation of ads to passage pages in the Unrelated Ads condition mirrored that of the Related Ads condition to control for the total number of images per page. On nine of the Graphics Only pages, a single advertisement was added to the existing graphic layout, to increase the total number of images on the page by one. On the remaining 11 pages of the Graphics Only passage, the mix of graphics and ads was created by swapping one of the graphics on the page for an ad, resulting in no change in the total number of images per page.

This method resulted in two changes from the Uniform condition. First, participants in the Hybrid condition saw more images in the passage (Uniform: M= 25.35, SD=1.90; Hybrid: M= 31.51, SD=1.16). Secondly, a greater proportion of the total number of images displayed in the Hybrid condition were graphics than in the Uniform condition (Uniform: 55.05%; Hybrid: 68.26%). The set of ads displayed in the Uniform condition, but removed from the Hybrid condition, were not counterbalanced. Screen shots from the two baseline conditions (Text Only and Graphics Only), and the four ad-present conditions (Uniform: Related Ads and Unrelated Ads; Hybrid: Related Ads and Unrelated Ads) are presented in Appendix A.

The time spent by each participant on each page of the passage was recorded in milliseconds by the computer to enable comparisons in viewing time across conditions. In addition, participants were asked to complete two short answer questions after they finished viewing each of the even numbered passage pages (after page 2, page 4, page 6, etc.). Each question was designed to assess content presented on one of the previous two pages. Questions ranged in difficulty from 11% correct ("*What is the relative difference between $50.00 and $100.00?*"; 100%) to 95% correct ("*What sort of funding does the website www.medlineplus.gov likely receive?* "; government).

Similarly, the set of acceptable answers for individual questions ranged from a single correct answer (ex. "*TRUE or FALSE?: A study that reports effectiveness of a medication using a range is less accurate than a study that reports effectiveness using* *a single number.* "; Accepted: FALSE) to several potentially correct answers (ex. "*List at least two things you should look for in a website to make sure you can trust the health information they are reporting.*"; Accepted: Can you easily see who sponsors the website?; Is the sponsor a Federal agency or a medical school, or is it related to one of these?; Can you find the mission or goal of the sponsor of the website?; Can you see who works for the agency or organization and who is the author? Is there contact information?; Can you tell when the information was written?; Is your privacy protected?; Does the website make claims that seem too good to be true? Are quick, miraculous cures promised?). The author scored each participants' answers for accuracy to provide a measure of content learning. Responses were scored as either correct or incorrect—no partial credit was awarded. Questions that were missing an answer were scored as incorrect.

Memory Test for Images. A memory test containing all 96 images selected for the experiment was considered to be too long. Consequently, the images were divided across four forms to create four different 26-item memory tests, one of which was randomly assigned to each participant. As previously mentioned, three images (one graphic, one related ad, and one unrelated ad) had the potential to be "repeated" during the presentation portion of the experiment. Since the images were included in the design of multiple pages, it was possible (although not certain) that a participant could be exposed to that image multiple times, depending on the image condition under which the pages containing the repeated image were viewed. These three images were included on all four of the memory test forms to make sure that each participant's memory for the image was tested. The remaining images were equally divided across the four test forms. These images were split approximately equally among the three image categories (graphics, related ads, and unrelated ads). In total, three of the four forms contained 9 graphics, 9 related ads, and 9 unrelated ads. The fourth form included 11 graphics, and 7 of each type of ad.

Participants were presented with images displayed one at a time on the computer screen. Participants were asked to decide, for each image, whether they recognized it from the web page viewing task (old), or whether the image was new (new). Although the number of new images on the memory test varied by participant (*M*= 18.01, *SD*=2.19, *range*=11-26), the memory test contained more new images than old images on average. This bias reflected the bias in the overall construction of the experiment.

On average, participants were exposed to approximately 28 images during the web page viewing portion of the experiment, which means that the average participant viewed less than 30% of the possible images. The random assignment of pages to image conditions for each participant meant that the memory test would either need to be custom-created for each participant in order to balance new and old items, or else reflect this overall bias of new/old images. For the purposes of a preliminary study, the latter was judged acceptable. Accuracy in recognizing the images presented on the memory test was recorded. The time taken (in ms) to record each decision was also recorded.

Questionnaires. Participants completed a brief demographic questionnaire generated by the author to assess participants' gender, age, and the number of years of formal schooling they had completed. In addition, participants completed a 15-item vocabulary test (shortened from Zachary, 1986), a computer experience questionnaire (excerpted from a questionnaire used by Kubeck, Miller-Albrecht, and Murphy, 1999; Appendix C) and an Internet experience questionnaire (generated by the author; similar to the one in Appendix D). In addition to providing an overall index of Internet experience, three questions from this questionnaire were used to measure attitude toward Internet ads, and two additional questions were used to measure amount of self-reported distraction from ads.

Procedure

Participants were tested in small groups, ranging from one to six participants at a time. Each participant was seated at his or her own computer station. Participants worked through the experiment independently, although the experimenter monitored their progress and was available for assistance in navigating the web pages.

The experiment began with an informed consent procedure, after which participants were asked to enter their demographic information. They were then given instructions on the website viewing task. Participants were told to do their best "to read the article carefully and to learn the material being presented" as they would "be asked to answer several questions testing [their] comprehension of the material presented in the article." Once participants completed reading the instructions, they were taken to the first page of the website, and began the website viewing task. Participants answered two content questions after every other completed page. Participants were not informed of the question content prior to viewing the passage, and could not return to a previous page once they had left it. After participants had finished viewing the website, they filled out the computer experience questionnaire, the vocabulary test, and the Internet experience questionnaire. All three of these forms were administered via the computer.

The final task in the experiment was the memory test for images. Participants were instructed that they would be shown images on the following screens, and that some of the images would be "advertisements or illustrations that appeared in the article while [they] were reading it." Participants were not told ahead of time that their memory for images displayed in the experiment would be tested, and were encouraged to guess if they were unsure of the correct response to an image. The memory test did not advance to the next image until the participant had indicated a *Yes* or *No* decision. After all testing was completed, participants were provided with a written description of the experiment, and given the opportunity to ask questions about the purpose of the experiment.

Results

Significance testing was carried out with α=.05. Error bars on graphs indicate the 95% confidence interval around the mean.

Manipulation Check

Assignment of participants to presentation condition was blocked. Consequently, the first group of participants tested were assigned to the Uniform condition, and the second group of participants were assigned to the Hybrid condition. To ascertain that these two samples were equivalent, participants in each presentation group were compared on several demographic variables.[3] Summary data on these measures are displayed in Table 2.

Table 2: Means (and 95% confidence interval) on the demographic variables included in the preliminary study.

	Uniform	**Hybrid**	**T-Test**
Age	19.29 (18.76-19.81)	19.43 (18.90-19.97)	*t*(89)<1
Yrs. Education	14.00 (13.53-14.47)	13.69 (13.22-14.16)	*t*(69)<1
Vocabulary [a]	9.30 (8.30-10.29)	9.26 (8.19-10.32)	*t*(66)<1
Computer Exp [b]	38.17 (36.72-39.61)	39.15 (36.99-41.32)	*t*(66)<1
Internet Exp [c]	9.81 (9.31-10.31)	9.32 (8.54-10.10)	*t*(66)=1.06, *p*=n.s.
Ad Attitude [d]	3.00 (2.51-3.49)	2.58 (2.02-3.14)	*t*(66)=1.11, *p*=n.s.
Ad Distraction [e]	5.89 (5.31-6.47)	5.97 (5.20-6.73)	*t*(66)<1

NOTE: (a) Maximum score 15 (b) Most experience=50 (c) Most experience=15 (d) Positivity of attitude towards Internet Ads with most positive=9, most negative=1 (e) Self-report measure of distraction from Internet ads with 2=least distracted, 12=most distracted.

There were no reliable differences on these variables between the participants in

3 Due to the nature of this preliminary study, demographic information was not available for all participants tested.

the two phases of the experiment, indicating that these two samples appear to be equivalent.

Attention to Advertisements

The proportion of incorrectly "recognized" new images (false alarms) and the proportion of correctly recognized old images (hits) were computed, and used as a measure of attention to advertisements. A logistic discrimination index (d_L; derived from signal detection theory) was used to evaluate participants' ability to discriminate between new and old ads. A positive, non-zero d_L value is an indication of memory strength, after controlling for guessing behavior. Based on recommendations by Snodgrass and Corwin (1988), the following formula was used to calculate the discrimination index: $d_L = \mathit{ln}\ \{[H(1\text{-}FA)]/[(1\text{-}H)FA]\}$ where *ln*=natural log, H=proportion of hits, and FA=proportion of false alarms. Hit rates and false alarm rates equal to either 0 or 1 were adjusted by 0.01.

It was expected that graphics would be considered more task-relevant than advertisements, and would consequently be processed more than ads, leading to their increased recognition. Similarly, related ads were expected to be processed more (and recognized more) than unrelated ads. It was also predicted that participants might be more likely to process ads paired with graphics (Hybrid condition) than ads paired with other ads. A 3 (Image Type: graphics, related ads, and unrelated ads) X 2 (Presentation condition: Uniform or Hybrid) repeated measures ANOVA was conducted using the discrimination index to test these hypotheses. In order to control for differences in the actual images presented in each of the presentation conditions, this analysis was conducted using only recognition data from ads appearing in both the Hybrid and the Uniform presentation conditions, and for graphics appearing in the Graphics Only condition (held constant across presentation conditions).

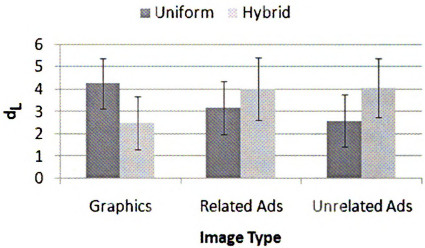

Figure 1: Mean discrimination indices for the images presented in the preliminary study memory test.

Contrary to predictions, there were no significant main effects of image type or presentation condition, *F*s <1. The interaction between image type and presentation condition was not significant, $F(2, 114)=2.81$, $p=.06$, $\eta^2=.05$, as is shown in Figure 1. These values, along with the proportions of hits and false alarms for each image type, are displayed in Table 3.

Table 3: Proportion of hits and false alarms (FAs), and their corresponding discrimination index (d_L) for image recognition in the preliminary study.

		Uniform	Hybrid
Graphics (GO)	**Hits**	.61 (.50-.72)	.45 (.33-.56)
	FAs	.08 (.05-.12)	.15 (.07-.21)
	d_L	4.26 (3.14-5.37)	2.48 (1.29-3.68)
Related Ads	**Hits**	.53 (.41-.64)	.61 (.48-.74)
	FAs	.14 (.09-.20)	.14 (.07-.20)
	d_L	3.17 (1.97-4.37)	4.00 (2.60-5.41)
Graphics (RA)	**Hits**	---	.64 (.52-.76)
	FAs	---	.15 (.07-.22)
	d_L	---	4.61 (3.33-5.90)
Unrelated Ad	**Hits**	.45 (.34-.56)	.54 (.40-.68)
	FAs	.15 (.08-.21)	.08 (.04-.12)
	d_L	2.59 (1.42-3.77)	4.07 (2.76-5.39)
Graphics (UA)	**Hits**	---	.54 (.40-.66)
	FAs	---	.15 (.07-.22)
	d_L	---	3.39 (1.95-4.84)

NOTE: Graphics (GO) denotes graphics presented in the Graphics Only condition, Graphics (RA) denotes graphics presented with related ads in the Hybrid presentation condition, and Graphics (UA) denotes graphics presented with unrelated ads in the Hybrid presentation condition.

An additional analysis of image recognition was conducted on the data from just the participants in the Hybrid condition. As shown in Table 3, there were 5 image conditions in the hybrid condition to account for the mix of ads and graphics appearing in the ad-present conditions. The discrimination indices were compared across these 5 image conditions in this additional analysis to look for differences in the recognition of graphics presented with graphics as opposed to graphics presented with either type of ad. This analysis, however, replicated the null results of the previous analysis, in which there was no main effect for image type. The discrimination indices and proportion hits and false alarms for this analysis are also reported in Table 3.

The time taken for participants to make their decision was also recorded. The average time taken for each participant to reach a correct decision (a hit or a correct rejection) was computed. This average was computed using only the RT's from the first 25 images, as the RT for the final decision reflected both decision time and the time taken to advance to the next task. Outliers on the RT measure (decision times in excess of 30s) were also removed. The decision times were predicted to follow the same basic pattern predicted for the accuracy data, where increased processing of graphics relative to ads was expected to lead to faster reaction times.

The decision times were analyzed using a 3 (Image Type) X 2 (Presentation Condition) repeated measures ANOVA. Mean decision times are reported in Table 4. There was again no significant effect of image type, $F(2, 178)=1.98$, $p=.14$, and no significant effect of presentation condition, $F<1$. The interaction between image type and presentation condition was also not significant, F<1.

Table 4: Mean time in seconds (and 95% confidence interval) taken to make a correct Old/New decision for images in the preliminary study memory test.

	Uniform	**Hybrid**
Graphics (GO)	2.30 (2.01-2.63)	2.37 (2.06-2.67)
Related Ads	2.46 (2.03-2.88)	2.61 (2.19-3.03)
Graphics (RA)	---	2.22 (1.59-2.84)
Unrelated Ads	2.55 (2.16-2.94)	2.47 (2.08-2.85)
Graphics (UA)	---	2.20 (1.83-2.56)

NOTE: Graphics (GO) denotes graphics presented in the Graphics Only condition, Graphics (RA) denotes graphics presented with related ads in the Hybrid presentation condition, and Graphics (UA) denotes graphics presented with unrelated ads in the Hybrid presentation condition.

As with the recognition accuracy data, an additional analysis of the decision times made by the participants in the Hybrid presentation condition is possible. An ANOVA was conducted to compare the 5 different image conditions present for the participants in the Hybrid presentation condition. This analysis also failed to find a main effect of image type or of presentation condition, replicating the results of the original analysis.

Goal Task Performance

Two measures of goal task performance were included in this experiment: web page viewing time and content question accuracy. Previous experiments using similar paradigms have shown few, if any, distraction effects. Consequently, large distraction effects were not expected in this experiment either. However, it was expected that if distraction effects were to emerge, they should be most likely in the conditions in which attention was most likely to be captured by the task irrelevant ads. In particular, it was predicted that attention was most likely to be captured when related ads were presented with graphics in the Hybrid condition.

Web page viewing time. The total time spent per page was averaged across each of the five pages in the four image conditions. A 4 (Image Type) X 2 (Presentation Condition) repeated measures ANOVA was conducted on the measure of time spent viewing the page. The means for time spent viewing web pages are presented by image type and condition in Table 5.

Table 5: Mean time in seconds spent viewing web pages (and 95% confidence interval) in the preliminary study.

	Uniform	**Hybrid**
Text Only	103.77 (85.24-122.31)	90.81 (72.48-109.14)
Graphics Only	96.18 (85.08-107.28)	96.28 (85.30-107.26)
Related Ads	99.04 (85.95-112.12)	105.03 (92.09-117.98)
Unrelated Ads	87.94 (78.66- 97.22)	89.55 (80.37- 98.72)

There was no significant main effect of image type, $F(3, 267)=2.22$, $p=.09$, $\eta^2=.02$. Although this was a small effect size, the pattern of the means observed may support the hypothesis that distraction effects were more likely to occur on pages containing related ads than unrelated ads, as participants spent significantly more time viewing web pages with related ads (M= 102.04; CI=92.83-111.24) than with unrelated ads (M= 88.74; CI=82.22-95.27). The time spent viewing pages containing no images, (M= 97.29; CI=84.26-110.33), and pages containing graphics (M= 96.23; CI=88.42-104.04) were not significantly different from either of the two ad conditions. There were no other significant effects.

Content question accuracy. Multiple-choice content learning questions were administered, and given a score of 0 (either no answer was entered, or an incorrect answer was entered) or 1 (a correct answer). Overall accuracy was computed for each condition. A 4 (Image Type) X 2 (Presentation Condition) repeated measures ANOVA was conducted with the question accuracy data to test for distraction effects related to ads.

Table 6: Mean accuracy (and 95% confidence interval) on content learning questions in the preliminary study.

	Uniform	**Hybrid**
Text Only	.70 (.64-.76)	.74 (.68-.80)
Graphics Only	.69 (.59-.78)	.76 (.67-.85)
Related Ads	.69 (.62-.76)	.71 (.64-.78)
Unrelated Ads	.69 (.61-.77)	.61 (.54-.69)

As can be seen in the means shown in Table 6, there were no significant effects for image condition or for presentation condition, and no significant interaction between the two.

Discussion

The preliminary study was designed to test the hypotheses that participants are likely to select content-related items for further processing, while only minimally processing unrelated items. In addition, it was postulated that participants may be more likely to process irrelevant advertisements when they are presented with seemingly task relevant, graphics. This hypothesis was based on the idea that the inclusion of graphics is likely to activate an attentional set that contains perceptual features unique to images, but shared by both graphics and ads.

Attention to Advertisements

Attention to advertisements was measured by accuracy and decision time on a Yes/No image recognition test. No significant differences were found in the participants' accuracy in recognizing graphics, related ads, or unrelated ads. The interaction between image type and presentation condition was not significant, although the effect size indicated that it accounted for approximately 5% of the variation in image recognition rates.

The pattern of the means indicated that the predicted relationship across image types may have been present for participants in the Uniform presentation condition, who showed the best recognition for graphics, and the worst for unrelated ads. On the other hand, participants in the Hybrid condition may have been better at recognizing the two types of ads than they were at recognizing graphics, and may have recognized more ads in general than the Uniform participants. The time taken to make a correct recognition decision was also analyzed, but no differences were significant. In conclusion, although the recognition data produced means that may have been consistent with the predicted use of semantic content and perceptual features to guide attention, no significant results were found.

Goal Task Performance

Previous research indicates that Internet users do not appear to be particularly susceptible to distraction in the form of ads, at least not while they are engaged in an information search task. Consequently, few distraction effects were predicted for the current experiment. However, it was predicted that the ads that captured the most attention would also be most likely to produce distraction effects. However, no significant differences in recognition rates of the different types of ads was found, and accordingly, no significant differences in performance measures were found.

Limitations

Experiment 1 represents an attempt to produce significant effects supporting the use of these environmental features to guide attention, as well as to address several limitations of the preliminary study. First, the materials used in the preliminary study were somewhat limited. One of these limitations dealt with the distribution of images across the passage, as the number of images per passage page was not held constant. In addition, the passage content (a long article on processing health information) is not necessarily representative of the varied types of information people seek on the Internet. To improve generalizablility, the manipulations of presentation and image type should be carried out on multiple topics. The inclusion of multiple topics may also increase the likelihood that participants are interested in the search content. Exit interviews with 70 of the participants from the preliminary study indicated that on a scale of 1 (Most Interesting) to 9 (Most Boring), participants on average rated the health care informational passage a 6.6. The inclusion of more interesting topics is likely to improve the external validity of this research, as few Internet users are likely to search for information on a topic in which they have no inherent interest.

Another limitation in the materials concerns the content learning questions. Participants were only tested on one piece of information per page, and no significant differences in the content learning measure emerged. Increasing the question density could improve this measure by increasing its sensitivity. In addition, the content learning questions only assessed understanding of the target passage text, and did not allow for assessment of intrusions related to processing advertisements.

Finally, this experiment included only young adults. The Internet is a resource used by adults of all ages, and in recent years, adults aged 50 and over have been the fastest growing age group online. This age group has also been identified as particularly likely to be susceptible to distraction that is semantically related to the goal task (e.g. Connelly et al., 1991). Therefore, it is possible that older adults may show larger distraction effects than younger adults when reading passages that are displayed with Internet ads for products or services related to the passage content.

Experiment 1

Age Differences in Distraction

Older Adults and the Internet

Studies investigating attention and ad processing on the Internet commonly involve only young adults, as they represent the majority of Internet users (Pew Internet and American Life Project, 2007), and are consequently the age group targeted by most web site developers. Over 80% of adults aged 18-29 are using the Internet, while less than 60% of adults over the age of 65 take advantage of this resource. However, these numbers don't tell the whole story. Just as older adults are the fastest growing age demographic in the United States (Wetle, 2002), they are also the fastest growing age group on the Internet. The percent of adults online aged 50 and over grew 53% from 1998 to 2000 (United States Department of Commerce, 2000), and another 47% through 2004 (Fox, 2004).

As a group, older adults spend significant time online, with almost half of the age group logging between 11 and 33 hours each week (Strong, Walker & Rogers, 2002). Furthermore, this group spends more money online than any other age group (Adams, 2003; NUA Internet surveys, 2000; University of Wisconsin-Extension, 2003). Not surprisingly, advertisers have identified older adults as an ideal audience to target in Internet advertising campaigns (Adams, 2003; The Media Audit, 2001). Since older adults are just as likely to encounter irrelevant distraction on the Internet as young adults, it is important to also include this age group in studies that investigate mechanisms involved in controlling distraction on the Internet.

Increased Susceptibility to Distraction

An extensive literature on age differences in cognition indicates that older adults, relative to young adults, often have more difficulty ignoring irrelevant distraction. Hasher and Zacks (Hasher, Lustig, & Zacks, 2007; Hasher & Zacks, 1988; Zacks & Hasher, 1994) have proposed a general processing model to account for age-related differences in attentional abilities. Their framework proposes that attentional ability reflects the ability to control the processing of irrelevant information.

One way in which individuals can control the processing of distracting information is by ignoring the distraction in the first place, which has been termed the "access function" of attention regulation (Hasher et al., 1999, 2007). The access function closely approximates selective attention abilities. According to Hasher and Zacks, declines on complex cognitive tasks can be attributed to the access function of attention regulation becoming less efficient with advanced age, thus allowing irrelevant information to be processed along with task relevant information.

Although age differences in selective attention abilities within Internet environments have not been previously examined in the literature, age differences in selective attention during a reading task have been investigated using the "reading with distraction" task (Connelly et al., 1991; Darowski, Helder, Zacks, Hasher, & Hambrick, 2008; Duchek, Balota, & Thessing, 1998; Dywan & Murphy, 1996; Earles et al., 1997; Salthouse, Atkinson, & Berish, 2003). In this task, participants are asked to read paragraphs that contain embedded distractors. The distractors can be words that are related to the content of the paragraph, words that are unrelated, or strings of Xs. Distractor words are distinguished from target words by the use of a different font style (ex. upright font for distractors and italicized font for target text). Older adults tend to be more disrupted by all types of distractors than younger adults, but the age effects tend to be differentially larger for word distractors—especially those that are related to the text content. Findings from this task indicate that older adults are more likely to show performance decrements when distractors are semantically related to the target text than are young adults.

Factors Attenuating Age Differences in Attention

Although older adults may be more susceptible to distraction than young adults, there is evidence that these age differences are somewhat attenuated when the distraction occurs in predictable locations, or when older adults rely on automatic attentional capture rather than attempting to maintain a goal to ignore the distraction.

For example, when the location of the distractors was fixed in a variation of Connelly et al.'s (1991) reading with distraction task, differences in distraction between old and young adults were no longer observed (Carlson, Hasher, Connelly, & Zacks, 1995). In this study, the reading passage was displayed in columns, with every other column containing distractors. Participants were instructed to read across each row, ignoring the distractor words in the intervening columns. In this experiment, older adults were not differentially susceptible to distraction when compared with young adults.

In another experiment, Carlson et al. (1995) demonstrated that the key to eliminating age differences in distraction was that the location of the distractors was fixed, rather than merely predictable. In this experiment, they again displayed a paragraph divided into columns. However, instead of displaying a full column of content followed by a full column of distractors, the order of content and distractors switched from line to line. Thus, if the first line is arranged in an ABA pattern, where A is content and B is distractors, the second line would be arranged in BAB pattern. When distraction was in this way predictable, yet not fixed, the older adults again showed differential distraction. Therefore, it is possible that since the location of advertisements on a web page remain fixed once the page has loaded, older adults will not show an age-related increase in susceptibility to distraction.

Further support for older adults' ability to use location cues to filter out distractors comes from a study on visual marking (Watson & Maylor, 2002). In this study, both older and younger adults were presented with visual search displays in which one set of stimuli (containing only distractors) appeared onscreen slightly before a second set of stimuli containing distractors as well as a target. Older adults were just as able as young adults to mark the locations of the first set of distractors and exclude those distractors from search when the position of the distractors was stationary. When the distractors were moving, however, older adults were not able to exclude the old distractors from search, although young adults were. Although older adults may not be as able as young adults to apply a location-based filter to moving stimuli, most Internet advertisements appear in one stationary location onscreen, indicating that older adults should be as able as young adults to apply a location-based filter.

Additionally, studies by Kramer and colleagues (Colcombe, Kramer, Irwin, Peterson, Colcombe & Hahn, 2003; Kramer, Hahn, Irwin & Theeuwes, 2000) find evidence that older adults perform comparably in selective attention tasks (as measured by eye movements and RT) when the control of attention is automatic. For example, when the distractor is not perceptually salient, older adults were just as able as young adults to ignore the distractor. However, when the control of attention is voluntary, based on task demands, older adults display more distraction effects than young adults. In the case of attention to Internet advertisements, it is unclear as to whether distinctive visual features of ads such as bright colors and motion are likely to require older adults to intentionally ignore advertisements, or whether some other element of the task such as fixed location of the advertisements, or ease of filtering on the basis of distinctive perceptual features, may contribute to the automatic ignoring of advertisements.

In summary, age differences in attention control abilities could render older adults particularly susceptible to distraction that shares features with the goal task. There is some indication from the reading with distraction task (Connelly et al., 1991) that semantically related (as opposed to perceptually related) features are most likely to cause this age-related deficit. Accordingly, ads that are related to the content of the web page could be expected to produce age differences in distraction effects. On the other hand, older adults have exhibited equivalent performance as young adults when distractors appear in fixed locations (Carlson et al. 1995). Therefore, if the distractor advertisements appear in fixed locations on the page, older adults may be able to screen them out even if they are semantically related to the web page content.

Predictions

The predictions detailed in the presentation of the preliminary study were also valid for Experiment 1. In addition, Experiment 1 added several predications about the role of age differences in attentional control abilities. It was predicted that the older adults may be particularly distracted when a task-irrelevant item is semantically related to target content. In the current experiment, both graphics and related ads were not necessary for the completion of the goal task, but were selected to relate to the target text content. Consequently, it was predicted that older adults may show greater recognition of these types of items (indicative of greater processing) than the young adults. Furthermore, it was predicted that if older adults did demonstrate differential susceptibility to distraction in goal task performance, this was most likely to occur in the graphics and related ads conditions. Finally, given general age-related slowing (e.g., Salthouse, 1996) older adults were expected to show age-related declines in processing speed, resulting in significantly slower reaction times throughout the experiment.

Materials and Methods

Participants

A total of 64 young adults (age 18-22; 29 male) and 64 older adults (age 59-89; 14 male) were tested. The young adult participants were recruited from the psychology department subject pool and compensated with partial course credit. The older adult participants were community-dwelling adults compensated $10.00 an hour for their time. All participants were fluent in English, had completed at minimum a high school degree, and were sufficiently experienced with a computer to be able to control the mouse themselves throughout the experiment. Four young adult participants and three older adult participants reported learning disabilities.[4] Analyses were repeated with learning disabled participants excluded, with no change to the results.

Design

Experiment 1 was a 2 X 4 X 2 mixed design that replicated the design of the preliminary study with the addition of older adults. Consequently, the first quasi-independent variable was age group (young and old). The second independent variable was image type and was manipulated within subjects. The same two ad-absent baseline conditions used in the preliminary study (Text Only and Graphics Only) comprised the first two levels of the image type variable. The second two levels of the image type variable were comprised of the two ad-present

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4 All four young adults were diagnosed with Attention Deficit Disorder, while one older adult was diagnosed with dyslexia and the other two did not report the nature of the learning disability.

experimental conditions used in the preliminary study (Related Ads and Unrelated Ads). Each participant read one 6-page passage in each of the four image conditions. Each passage was on a different topic (Health, Loans, Love and Travel). The third independent variable was ad presentation condition (Uniform and Hybrid), manipulated between subjects as in the preliminary study. As in the previous experiment, the presentation condition affected only pages presented in the ad-present conditions. The allocation of images to display condition is depicted in Table 7 below.

Table 7: Image types displayed in each presentation mode in Experiment 1.

		Image Type			
		Text Only	**Graphics Only**	**Related Ads**	**Unrelated Ads**
Presentation	**Uniform**	No graphics or ads	2 graphics	2 related ads	2 unrelated ads
	Hybrid	No graphics or ads	2 graphics	1 related ad 1 graphic	1 unrelated ad 1 graphic

The order of the passage topics and the image conditions were counterbalanced across 16 forms. Four passage topic orders were created, across which each passage appeared in each possible position (first, second, third, or fourth) one time. Four image condition orders were also created, across which each condition appeared once in each possible position. Then, passage order was crossed with condition order to create 16 forms in which each passage appeared in each condition in each possible order, as shown in Table 8 below.

Table 8: Counterbalancing of passage topics and image type conditions in Experiment 1.

Order	Topic	Form A	Form B	Form C	Form D
1	Health	TO	GO	UA	RA
1	Loan	GO	RA	TO	UA
1	Love	RA	UA	GO	TO
1	Travel	UA	TO	RA	GO
2	Loan	TO	GO	UA	RA
2	Love	GO	RA	TO	UA
2	Travel	RA	UA	GO	TO
2	Health	UA	TO	RA	GO
3	Travel	TO	GO	UA	RA
3	Health	GO	RA	TO	UA
3	Loan	RA	UA	GO	TO
3	Love	UA	TO	RA	GO
4	Love	TO	GO	UA	RA
4	Travel	GO	RA	TO	UA
4	Health	RA	UA	GO	TO
4	Loan	UA	TO	RA	GO

NOTE: TO=Text Only; GO=Graphics Only; RA=Related Ads; UA=Unrelated Ads

Materials

Web page and content questions. Participants viewed four 6-page passages, with approximately 282.96 (*SD*=48.81) words per passage page. The per-page word count included words in the page title, passage outline, and navigational links which were displayed on each of the six pages of the passage. Passages were on four different topics: interpreting health information (health), selecting a student loan

(loan), a travel journal from a cruise to the Caribbean (travel), and the psychology of love and attraction (love). Efforts were made to give each passage topic a unique, but professional appearance and style. Graphics, related ads, and unrelated ads followed the selection criteria used in the preliminary experiment, with the additional stipulation that unrelated ads were selected to be unrelated to the topic of any of the passages. Time taken to read each page, in milliseconds, was recorded by the computer.

The allocation of images to image type conditions followed the method used in the preliminary study, with the modification that every image-present page had exactly two images on it, and each passage page contained unique images. Therefore, a total of 12 graphics, 12 related ads, and 12 unrelated ads were selected for use in each of the four websites, for a total of 144 images used across the various conditions of the experiment. Participants in the Uniform condition were exposed to 12 graphics, 12 related ads, and 12 unrelated ads during the experiment. Participants in the Hybrid condition were exposed to 24 graphics, 6 related ads, and 6 unrelated ads during the experiment. Accordingly, twice as many ads were displayed in the Uniform condition as in the Hybrid condition. The set of 12 ads displayed in the Uniform condition, but removed from the Hybrid condition, were the same for each participant, meaning that they were not counterbalanced.

Half of the ads displayed in the ad-present conditions were animated. Therefore, in the Uniform condition, each page of an ad-present passage contained one animated ad and one static ad. In the Hybrid condition, half of the passage's six pages contained animated ads, while the other half contained static ads. None of the graphics were animated.

Participants answered 12 multiple choice questions per passage to test their learning of the passage content. To provide an even covering of the passage, two questions per passage page were generated. Each question had four answer alternatives. One answer alternative was correct based on the passage text, one was a lure that was incorrect based on the content of the passage text, but corresponded to the content of one of the related advertisements on that page, and two were incorrect distractor answers.

The lure was included as an indicator of related advertisement content processing. If including related ads results in lower content learning scores for one or both groups of participants, it is not possible to determine whether the content of the ads was actually processed, or whether the visual characteristics of the related group of ads coincidentally attracted more attention than the unrelated ads. The inclusion of the lure allowed for an additional test of any potential differences between the related and unrelated ads. Since the lure corresponded to the content of the related ads, an increase in lure selection rates in the Related Ads condition would be interpreted as evidence that ad content is being processed. In addition to the selected answer choice, time taken, in milliseconds, to select an answer choice was also recorded.

Memory test for images. Over the course of the experiment, each participant was exposed to 36 images. Consequently, the memory test consisted of 36 trials, and tested all 36 of the images presented to an individual participant. Each trial contained one previously presented (old) image and one new image. Consequently, participants in the Uniform condition were presented with 12 old graphics, 12 old related ads, and 12 old unrelated ads. Participants in the Hybrid condition were presented with 24 old graphics, 6 old related ads, and 6 old unrelated ads.

New images were undisplayed images selected from the same passage as the old image. For example, if participants viewed the health information passage in the related graphics condition, they would see a related graphic paired with an image presented in one of the ad-present conditions of that passage—in this case, either a health-related ad or a health-unrelated ad. In this way, the new and old images were counterbalanced across participants. The pair of images being tested were shown together onscreen, one pair at a time. Pairs were dynamically selected for each participant, based on the ads displayed to that participant during the experiment. Since some of the topic-related images were old and some were new, simply choosing only topic-related images would not ensure high accuracy on the test. Furthermore, in many cases, participants needed to make a choice between a related graphic and a related ad, rendering a selection strategy based on topic-relevance ineffective.[5] Images from only three of the passages were tested, as the

5 To check for the possibility that participants nevertheless attempted to implement such a strategy, image recognition rates for each type of topic-related image (graphics and related ads) were compared between decisions involving two topic-relevant images and decisions involving a new unrelated ad. There were no significant differences in either the young adult recognition rates, or the older adult recognition rates, indicating that recognition rates of topic-related images should not be inflated by the use of a strategy involving selection of only topic-relevant images.

passage viewed in the Text Only condition was not displayed with any images. Selection accuracy was scored, and time taken, in milliseconds, to classify an image as old or new was also recorded.

Questionnaires. The first questionnaire assessed demographic information, the second assessed computer experience (Appendix C), and the third assessed Internet experience (Appendix D). The demographic questionnaire was designed and generated by the author to record participants' gender, age, handedness, and presence of a learning disability, in addition to the variables used to compare the older and younger participants, such as self-reported health status, and years of education. As in the preliminary study, the computer experience questionnaire was excerpted from one used by Kubeck et al. (1999), while the Internet experience questionnaire was developed by the author.

A measure of attitude toward Internet advertising was computed using the following questions from the Internet Experience questionnaire: *Have you ever purchased an item based on Internet Advertising?* (Y/N); *Do you think Internet advertising works?* (Y/N); *Do you find Internet advertising distracting?* (Y/N); *Do you find Internet advertising to be annoying?* (Y/N). This measure of attitude toward Internet advertising, and an additional question asking participants to indicate whether they believed they were distracted by Internet ads, were only scored for participants who completed all of the questions involved[6], and had at least some experience with the Internet.

At the end of the experiment, participants were asked to fill out an exit questionnaire (Appendix E). The exit questionnaire assessed participants' interest in the passages included in the reading task, their awareness of advertisements during the experiment, and whether they noticed any relationship between the advertisements and the content of the articles.

Measures of processing speed. A common finding in aging research is that older adults tend to perform tasks more slowly than young adults (e.g. Salthouse, 1996). Therefore, it is possible that older adults may perform more slowly than the young adults in the web page viewing task due to age-related slowing, or due to distraction effects. Participants in Experiment 1 completed two speeded comparison tasks, Pattern Comparison and Letter comparison (Babcock & Salthouse, 1990) to enable individual differences (and consequently, age differences) in processing speed to be factored out of the website viewing time measure.

In the pattern comparison task, participants were shown pairs of abstract line drawings and asked to determine as quickly as possible whether the two patterns were the same or different. In the letter comparison task, participants were

6 One young adult participant and 11 older adult participants did not answer all of the items involved in this measure. No reasons for skipping these items were reported, although in the case of the older adults, it seems possible that low levels of Internet experience resulted in uncertainty in their opinions about Internet ads.

shown pairs of nonsense letter strings ranging in length from three to nine letters long, and were asked to determine whether the two strings were the same or different.

In both comparison tasks, participants recorded their decision for each pair by writing an "S" for patterns that were the same, and a "D" for patterns that were different on a line separating each member of the pair. Participants completed two trials of each comparison task, using a different set of stimuli for each trial. Each trial was 30s long.

Reading with distraction task. This task was included as a well-established and reliable measure of susceptibility to distraction (Darowski et al., 2008). In this task, participants read four short narrative passages, each approximately 125 words in length, selected from the materials used by Connelly et al. (1991). Two of these passages were presented in a High Distraction condition in which four words or short phrases that were semantically related to each story's topic were repeated approximately 15 times each. These distractors were randomly interspersed throughout each passage, appearing on average every two to three words for an approximate total of 60 distractors per passage. The remaining two passages were presented in a Low Distraction condition in which the distracting words or phrases from the high distraction condition were replaced by strings of Xs of equivalent length in the same locations within the text.

In both conditions, target text was distinguished from distractors by a font difference. Target text always appeared in an italicized font, while distractors appeared in a regular upright font. Typically, this task is administered by instructing participants to read the target text out loud. However, since most Internet users read Internet content silently, participants in the current experiment were instructed to read the target text to themselves. This methodological change also enabled multiple participants to be tested in group sessions. Participants were instructed to read only the italicized text of each passage, and to ignore the distractors appearing in upright font. When participants had completed reading a passage, they pressed the spacebar key to advance to the next screen.

Each passage was followed by a set of four 6-option multiple choice questions, in which one answer was correct based on the target passage text, and another answer served as a lure, corresponding to a distracting word or phrase in the High Distraction condition. After two short example passages (one in each condition), participants completed one Low Distraction passage, two High Distraction passages, and a fourth Low Distraction passage.

Procedure

Participants were randomly assigned to one of the presentation modes (Uniform or Hybrid), and one of the 16 experimental forms (4 passage orders X 4 image condition orders) prior to arriving at the lab. Participants were tested in small groups, ranging from one to five participants at a time. Upon arrival at the lab, participants were greeted by the experimenter, completed an informed consent procedure, and were seated at a computer. Participants received the following instructions prior to beginning the web page viewing portion of the experiment:

> "In the first task in this experiment, you will be asked to find specific information on web pages You will be searching through several different websites on four different topics to find your answers. When you begin each topic, you will see a list of questions. These are the questions you will be asked after you have finished viewing the website. Once you click the 'View Website' button, you will be directed to the website, and you will not be able to review the content of the questions again. Once you have viewed all of the pages in a particular topic, you will be asked to answer each of the pre-viewed questions by selecting the most appropriate answer choice."

During the web page viewing task, participants worked independently at a pace that was comfortable to them. The experimenter monitored their progress and was available to answer questions about the task procedure or navigating the website. At the beginning of each passage, the 12 content learning questions (without answer choices) were displayed on the screen for participants to familiarize themselves with. When they were ready, they clicked on a hypertext link to advance to the first page of the website viewing task, and continued viewing each page of the passage sequentially. Once a participant had navigated beyond a passage page, he could not return to it again.

When participants completed reading the passage, they were directed to a page where they proceeded to answer each of the previously viewed questions. Questions were answered one at a time. This procedure of reading questions, viewing a passage, and answering questions was completed for each of the four passage topics.

When the content learning questions had been completed for the last passage, the unexpected memory test for images was administered. Participants were instructed to do their best to select the image that they recalled seeing earlier in the experiment by using the mouse to click on the recognized image. If they were unsure as to which image was old, they were instructed to guess. The image test did not advance from one image to the next until a response was made.

Following this test, participants filled out the questionnaires on demographics, computer experience, and Internet experience. While participants filled out these forms, the experimenter interrupted them twice. During the first interruption, participants completed Pattern Comparison. During the second interruption, participants completed Letter Comparison. Once the participants had completed the questionnaires and the speeded comparison tasks, they began the Reading with Distraction task on the computer. The experiment was concluded with the paper/pencil administration of the vocabulary test and the exit questionnaire. After all testing was completed, participants were provided with a written description of the experiment, and given the opportunity to ask questions about the purpose of the study.

Results

Manipulation Checks

Sample selection. The predictions for the current experiment assume that the samples of older and younger participants selected for the Uniform and the Hybrid presentation conditions were equivalent. This assumption was checked by comparing the older and younger adult samples across presentation conditions on several demographic variables. These means are presented in Table 9.

Table 9: Means (and 95% confidence interval) on the demographic measures included in Experiment 1.

	Young Adults		Older Adults	
	Uniform	**Hybrid**	**Uniform**	**Hybrid**
Age	19.31 (18.86-19.76)	19.28 (18.81-19.75)	70.56 (68.29-72.83)	70.88 (68.37-73.39)
Yrs Education	12.81 (12.37-13.25)	12.95 (12.50-13.40)	15.73 (14.71-16.75)	16.37 (15.53-17.21)
Health[a]	3.56* (3.37-3.75)	3.19* (2.94-3.44)	3.16 (2.94-3.38)	3.28 (3.03-3.53)
Vocabulary[b]	9.91 (9.11-10.71)	9.88 (8.87-10.89)	13.69 (13.22-14.16)	13.12 (12.51-13.73)
Computer Exp[c]	41.43 (40.16-42.70)	40.22 (39.08-41.36)	31.79 (29.54-34.04)	32.44 (30.64-34.24)
Internet Exp[d]	16.38 (15.44-17.32)	16.81 (16.10-17.52)	11.41 (9.55-13.27)	12.38 (10.93-13.83)
Ad Attitude[e]	1.64 (1.33-1.95)	1.66 (1.37-1.95)	1.86 (1.55-2.17)	1.46 (1.15-1.77)
Ad Distraction[f]	64.52 (47.39-81.65)	68.25 (56.66-79.84)	87.04 (74.67-99.41)	66.67 (49.51-83.83)
Pattern Comparison[g]	41.56 (39.33-43.79)	41.00 (38.77-43.23)	28.22* (26.26-30.18)	31.31* (29.39-33.23)
Letter Comparison[g]	24.28 (22.81-25.75)	24.09 (22.25-25.93)	18.12 (16.91-19.33)	18.44 (17.10-19.78)

NOTES: (*) denotes difference between presentation conditions is significant (a) Rating based on self-report: 1=worst health; 4=best health (b) Maximum score 15 (c) Most experience=50 (d) Most experience=22 (e) Positivity of attitude towards Internet Ads with most positive=3; most negative=0 (f) Percent of participants claiming that they are distracted by Internet ads (g) Number of correct comparisons completed in 60s.

Overall, there were only two significant differences between presentation condition samples within the same-age group. Young adults in the Uniform condition rated themselves as significantly healthier than the young adults in the Hybrid condition, $t(62)=2.28$, $p=.03$. Older adults in the Uniform condition completed significantly fewer comparisons in the Pattern Comparison task than did the older adults in the Hybrid condition, $t(62)=-2.20$, $p=.03$. Despite these small, isolated differences, the overall pattern indicates equivalence of the groups assigned to the Uniform and Hybrid conditions.

In addition to testing for equivalence across the presentation conditions, the demographic measures were also used to compare the younger and older adult samples. Participants were given a vocabulary test as a means of comparing verbal ability between the two age groups. As is frequently found in aging research, the older adults in this experiment scored significantly higher on the vocabulary test than the younger adults, $t(104)=-9.18$, $p<.01$, indicating stronger verbal ability in the older group. In addition, the older adults had completed significantly more years of education than the younger adults, $t(89)=-8.53$, $p<.01$, although it should be noted that the young adults were current students who had not yet completed their formal education. The two age groups did not differ in terms of their self-rated health status, $t(126)=1.30$. These three variables indicate that the older adults should not be disadvantaged in comparison to the young adults in terms of their verbal abilities, their education level, or their overall health status.

Since previous research has indicated that experience may play a role in participants' ad processing (Bruner & Kumar, 2000; Dahlen, 2001; Raman & Leckenby, 1998), participants' previous computer and Internet experience was assessed. Not surprisingly, the young adults had significantly more experience with computers than the older adults, $t(103.11)=10.19$, $p<.01$. Similarly, the Internet experience questionnaire indicated that the young adults had significantly more experience with the Internet than the older adults, $t(92.60)=6.98$, $p<.01$. Since significant age differences were found in these measures of experience, additional exploratory analyses of the task performance measures were carried out to test the hypothesis that age differences in performance may be due to different experience levels, rather than an actual age-related change in attention abilities.

No age difference was found in attitude toward Internet advertising, $t(114)<1$, p=n.s. Additionally, there was no age difference in participants' Yes/No rating of whether they were distracted by ads, $t(118)<1$, p=n.s. Therefore, despite differences in experience levels, the participants reported similar attitudes toward Internet advertising. Consequently, it was assumed that the perceived relevance or irrelevance of advertisements to the web page viewing task should be equivalent across age groups, and that participants in both age groups should be similarly motivated to attend to ads (or to ignore ads, as the case may be).

Finally, older adults completed significantly fewer comparisons than the young adults on both speeded comparison tasks (Pattern comparison: $t(126)=10.69$, $p<.01$; Letter comparison: $t(126)=7.85$, $p<.01$), indicating that the typical findings of age-related slowing were present in these samples of older and younger adults. In order to control for this age-difference, a speed composite score was created, and used as a covariate in analyses in which age differences in susceptibility to distraction appeared.

Attention to Advertisements

Experiment 1 employed a different type of recognition test than the one used in the preliminary study as a measure of attention to advertisements. Although no significant difference was found in recognition rates of the different types of images in the preliminary study, the overall pattern of the means supported the prediction that recognition would be influenced by the degree to which an image was task relevant. In the current experiment, the adoption of a forced-choice design for the memory test may result in improved sensitivity of the test. Accordingly, it was again predicted that recognition would be best for graphics and worst for unrelated ads. Older adults were predicted to demonstrate proportionately higher recognition rates of graphics and related ads than of unrelated ads, when compared to the pattern of recognition found in young adults.

To test for these effects, each participants' accuracy in choosing old images was computed separately for the three image types: graphics, related ads and unrelated ads. To control for the differences in images presented across the two presentation conditions, accuracy in recognizing graphics was computed using only the recognition of graphics presented in the graphics only condition, and accuracy in recognizing ads was only computed for ads that appeared in both the Hybrid and the Uniform presentation conditions.

A 3 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA was conducted to compare accuracy across conditions. The means used in this analysis are depicted in Figure 2.

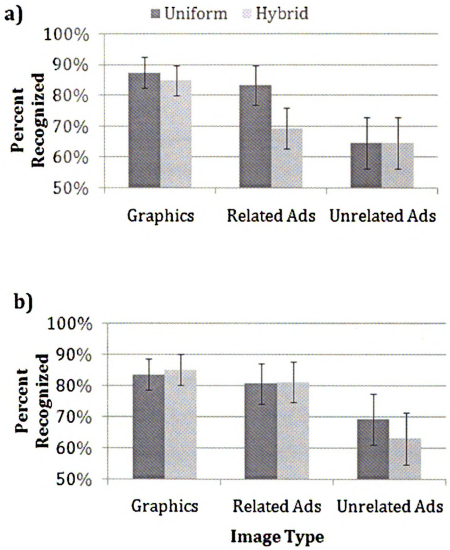

Figure 2: Percent of images recognized by (a) young and (b) older adults in the Experiment 1 image memory test.

A main effect of image type was found in the expected direction, $F(2, 248)=37.46$, $p<.01$, $\eta^2=.23$. Planned comparisons between the accuracy in the three image type conditions indicated that graphics ($M=.85$; $CI=.83$ - .88) were recognized significantly more accurately than related ads ($M=.79$; $CI=.75$ - .82), which in turn were recognized significantly more accurately than unrelated ads ($M=.65$; $CI=.61$ - .70). This finding is consistent with the predictions. No other effects attained significance.

An additional analysis was performed with the data from only the participants in the Hybrid presentation condition. Since participants in this condition viewed graphics presented with other graphics (graphics [GO]), as well as graphics presented with ads (graphics [RA] and,graphics [UA]) a comparison can be made in the recognition rates of graphics paired with ad as opposed to graphics paired with other graphics.

A 5 (Image type: Graphics [GO], Related Ads, Graphics [RA], Unrelated ads, and Graphics [UA]) X 2 (Age Group) repeated measures ANOVA was conducted. There was a main effect for image type, $F(4, 248)=10.64$, $p<.01$, $\eta^2=.15$, as shown in Figure 3. Comparisons between the means indicated that the main effect of image type found previously was replicated. More specifically, Graphics [GO] were recognized significantly more than any other type of image, and unrelated ads were recognized significantly less than any other type of image. Related ads, Graphics [RA], and Graphics [UA] did not differ from each other, and were recognized less than Graphics [GO], but more than unrelated ads. There was no significant main effect for age group, nor was the interaction significant.

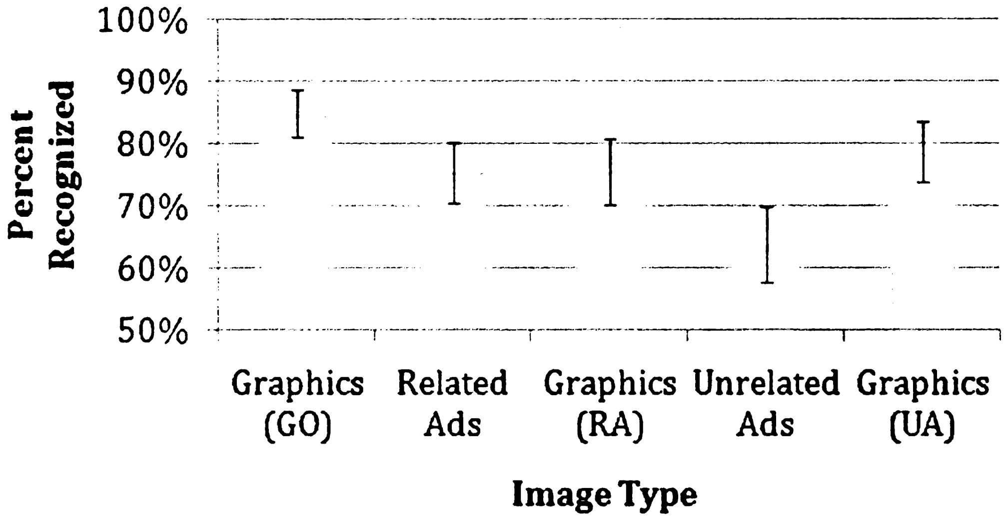

Figure 3: Percent of images recognized by participants in the Hybrid presentation condition on the Experiment 1 image memory test.

Finally, it was hypothesized that a participant's interest in the topic of the passage could influence the degree to which he/she attended to semantically related images. In order to investigate this possibility, participants' recognition rates were computed separately for related images in each topic. These topics were then ordered according to the rank provided by each participant (1=most interesting, 4=least interesting). Paired t-tests for related image recognition rates for each rank were conducted. Critically, a significant difference between the recognition of related images in the most interesting topic and the least interesting topics emerged, $t(18)=3.40$, $p<.05$. This finding indicated that more related images were recognized when a participant was interested in the passage, (M = .81; CI = .74-.88) than when a participant was not interested in the passage topic, (*M* = .67; *CI* = .59-.74). In addition, a significant difference also emerged between the second most interesting passage (*M* = .83, *CI* = .76-.90) and the least interesting passage (*M* = .75, *CI* = .65-.84), $t(16)=2.20$, $p<.05$. Although interest is not one of the main features being investigated in this study, this finding indicates that this feature merits further investigation in future work, as it may also be key to guiding attention.

The average time taken for each participant to reach a correct decision was also computed. These decision times were predicted to follow the same pattern found in the preliminary study, in which participants showed a trend to be faster making decisions on graphics than on ads. In addition, it was also predicted that older adults would take longer to make their decisions than young adults. These predictions were tested using a 3 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA. The overall results on this measure are shown in Figure 4. The predicted main effects of image type, $F(2, 248)=27.52$, $p<.01$, $\eta^2=.18$, and age group, $F(1, 124)=47.63$, $p<.01$, $\eta^2=.23$, emerged. Decisions were made significantly faster for graphics (*M*= 3.90; *CI*=3.44-4.35) than for either type of ad, which did not differ from each other (related ads: *M*= 4.82; *CI*=4.31-5.32; unrelated ads: *M*= 5.20; *CI*=4.70-5.69).

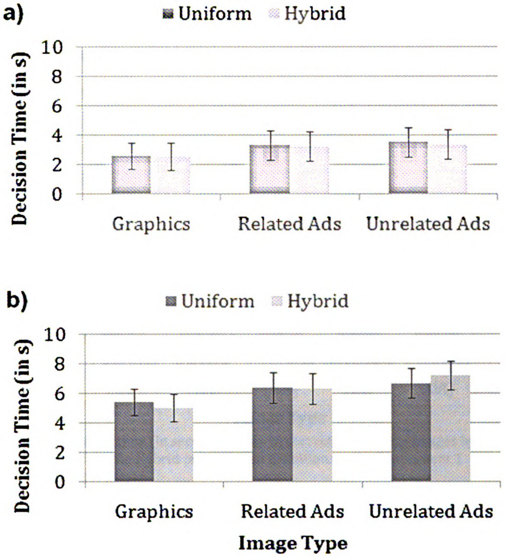

Figure 4: Mean time (in seconds) taken for (a) young adults and (b) older adults to make a correct decision in the Experiment 1 image memory test.

Older adults took significantly longer to make a decision on all three types of images (M= 6.17; CI=5.55-6.79) than did the younger adults (M= 3.10; 2.48-3.73). The interactions between age group and image type, and age group and presentation condition, were not significant.

An additional 5 (Image Type) X 2 (Age Group) repeated measures ANOVA was conducted to compare the time taken to make decision for all image types in the Hybrid condition. These means as shown in Figure 5.

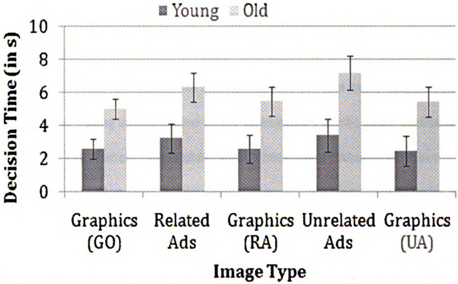

Figure 5: Mean time (in seconds) taken to correctly recognize images by participants in the Hybrid presentation condition on the Experiment 1 image memory test.

There was a significant main effect of image type, $F(4, 248)=8.87$, $p=.01$, $\eta^2=.12$, and a significant main effect of age group, $F(1, 62)=40.78$, $p<.01$, $\eta^2=.40$. The pattern of these main effects replicated the pattern found in the original analysis. In this case, there was no significant differences in the time taken to make a decision on a graphic based on whether the graphic had originally been presented with other graphics or with ads. Therefore, decisions on all graphics (graphics [GO], graphics [RA], and graphics [UA]) were significantly faster than decisions on related or unrelated ads. The interaction between age group and image type was not significant, $F(4, 248)=1.27$, $p=.28$.

Goal Task Performance

Four measures of goal task performance were included in this experiment: web page viewing time, content question accuracy, time taken to answer the content questions, and rate of lure selection. As the preliminary experiment replicated previous findings of little or no distraction effects in response to the inclusion of ads on web pages, few distraction effects were predicted for this experiment. However, in addition to the young adults tested in the preliminary study, older adults were included in this experiment. Since older adults have been found to be more susceptible to distraction than young adults on a variety of laboratory tasks, it seemed possible that the older adults in this experiment could show distraction effects where the young adults in the preliminary study did not. In particular, it was expected that older adults may have more difficulty ignoring relevant ads than irrelevant ads. In addition, it was expected that older adults would take longer than the young adults to complete tasks, as indicated by elevated reaction times.

Web page viewing time. Average time spent per page was computed for each image condition, and used to detect whether participants spent longer on the web page viewing task when ads were present. A 4 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA was conducted to compare the average web page viewing times. There was a significant main effect of image condition, $F(3, 372)=5.36$, $p<.01$, $\eta^2=.04$, however, this effect was in an unexpected direction. The means indicated that participants spent significantly less time on websites displayed in the related ads condition (*M*= 68.28; *CI* =64.53 – 72.03) than those displayed in any of the other conditions (Text Only: *M*= 72.80; *CI*=69.00 - 76.59; Graphics Only: *M*= 73.86; *CI*=69.29 – 78.43; Unrelated Ads: *M*= 72.84; *CI*=68.66 – 77.02). The mean time spent viewing pages containing graphics or unrelated ads did not differ. Means on this measure are shown in Table 10.

Table 10: Mean time (and 95% confidence interval) in seconds spent viewing web pages in Experiment 1.

	Younger Adults		**Older Adults**	
	Uniform	**Hybrid**	**Uniform**	**Hybrid**
Text Only	59.93	55.14	89.27	86.84
	(52.34-67.53)	(47.54-62.73)	(81.68-96.86)	(79.25-94.44)
Graphics Only	60.35	57.46	91.74	85.90
	(51.21-69.49)	(48.32-66.60)	(82.60-100.89)	(76.75-95.04)
Related Ads	52.46	53.91	88.43	78.31
	(44.96-59.96)	(46.41-61.41)	(80.93-95.93)	(70.81-85.81)
Unrelated Ads	57.83	58.17	92.75	82.63
	(49.46-66.19)	(49.81-66.54)	(84.38-101.11)	(74.26-90.99)

There was also a significant effect of age group, $F(1, 124)=66.56$, $p<.01$, $\eta^2=.35$, indicating that older adults (*M*= 86.98; *CI*=81.82 – 92.14) spent more time per page than did young adults (*M*= 56.91; *CI*=51.75 – 62.07). This finding was consistent with predictions. No other comparisons obtained significance.

The analysis of page viewing time in Experiment 1 does not replicate the preliminary findings of a marginally significant effect of image type where pages with related ads were viewed somewhat longer than pages in the other image conditions. In fact, the pattern of results in this experiment is in the opposite direction. To further explore this unexpected result, additional analyses investigating possible practice effects were conducted.

The current experiment presented image conditions blocked by passage topic, while the preliminary study presented image conditions randomized by page. Therefore, it could be that influence of related ads on web page viewing time changes from page to page of a blocked passage. To explore this possibility, a 4 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA was conducted on page viewing times from only the first page in a passage, instead of on the average page viewing time in the passage. In this analysis, the main effect for image type was only marginally significant, $F(3, 372)=2.33$, $p=.07$, $\eta^2=.02$. However, the pattern of results was the same, in which pages in the Related Ads condition ($M=72.03$; $CI=66.79\text{-}77.28$) were viewed for significantly less time than pages presented in the Text Only ($M=79.17$; $CI=74.14\text{-}84.20$) or the Unrelated Ads ($M=78.66$; $CI=72.52\text{-}84.80$) conditions. Pages in the Graphics Only condition ($M=77.88$; $CI=71.82\text{-}83.94$) were not significantly different from any of the other image conditions. Since the pattern of results from the first pages of the passages replicates the overall pattern of results, it seems unlikely that practice effects across individual pages of a passage masked early distraction effects.

An alternative possibility is that practice effects could have emerged after the first passage was completed. To investigate this, a 4 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) ANOVA was conducted using the average page viewing times from only the first passage encountered by participants. It is important to note that in this case, image type becomes a between subjects variable, since each participant viewed the first passage in only one of the possible image type conditions. This analysis found only a main effect for age group, $F(1, 112)=56.80$, $p<.01$, $\eta^2=.34$. None of the other effects obtained significance.

Content learning questions. Mean accuracy on the content learning questions was computed and compared in a 4 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA . These data are shown by age group and condition in Table 11. As in the preliminary study, no significant distraction effects emerged in this measure of goal task performance. Furthermore, older adults performed just as well on this measure as young adults.

Table 11: Mean accuracy (and 95% confidence interval) on content learning question in Experiment 1.

	Younger Adults		Older Adults	
	Uniform	**Hybrid**	**Uniform**	**Hybrid**
Text Only	.87	.84	.85	.89
	(.83-.92)	(.79-.88)	(.81-.90)	(.84-.94)
Graphics Only	.86	.85	.83	.87
	(.81-.91)	(.80-.90)	(.78-.88)	(.82-.92)
Related Ads	.87	.87	.84	.88
	(.83-.92)	(.83-.91)	(.80-.88)	(.83-.92)
Unrelated Ads	.85	.84	.83	.88
	(.80-.90)	(.79-.89)	(.78-.88)	(.82-.92)

In addition to scoring the content learning questions for accuracy, the time taken for participants to select a correct answer was also recorded, and separate averages were computed for age groups, image types, and presentation conditions. The 4 (Image Type) X 2 (Presentation Condition) X 2 (Age Group) repeated measures ANOVA found only the predicted main effect for age group, $F(1, 124)=72.71$, $p<.01$, $\eta^2=.37$, indicating that older adults (M= 16.89; CI=15.78-17.99) take longer than young adults (M= 10.15; CI=9.04-11.26) to answer the questions. No other comparisons attained significance.

Lure selection. Finally, the content learning questions each contained a lure choice that corresponded to the content of one of the related ads. Therefore, if participants were choosing the lures due to confusion between the target text content and the distractor ads' content, lure selection rates should be elevated in the related ads condition. However, the rate of lure selection was extremely low (occurring 3% or less of the time), and there were no cases in which the lure selection in the Related Ads condition was significantly higher than the lure selection rate in the Text Only, Graphics Only, or Unrelated Ads conditions (all $ts<2$, $ps>.05$). As a result, the data from this measure was considered uninformative and was not examined further.

Reading With Distraction Task

The reading with distraction task was included as an independent measure of susceptibility to distraction. Since the participants were randomly assigned to the Uniform and the Hybrid manipulation conditions, there was no reason to predict a difference between the two presentation conditions on any of the reading with distraction measures. Nevertheless, independent samples t-tests for older and younger adults assigned to the Uniform and the Hybrid conditions were conducted to verify that there were no significant differences between the two presentation conditions. The two presentation groups were equivalent on measures of reaction time, and accuracy for both the low and the high distraction conditions (all $ts<2$, $ps>.05$). Consequently, presentation condition was excluded as an independent variable in the following analyses.

The reading with distraction task was selected for its reliability in detecting age differences in susceptibility to distraction (Darowski et al., 2008). The older adults tested in this study did not show any increase in susceptibility to distraction from Internet ads relative to their younger counterparts on the website viewing task. This finding could indicate that older adults in general are just as able to ignore Internet ads as young adults. However, it is also possible that the sample of older adults selected for this study are higher performing, and consequently, less susceptible to distraction than their average age-matched peer. If this is the case, the typical interaction between age and distraction type should not emerge in the reading with distraction task.

Reading time. A 2 (Distraction type: High or Low) X 2 (Age Group) repeated measures ANOVA was conducted on the reading time means shown in Figure 6.

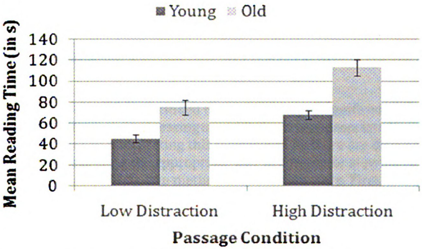

Figure 6: Mean reading time in the Experiment 1 reading with distraction task.

This analysis found a significant main effect for age, $F(1, 126)=77.55$, $p<.01$,

η^2=.38, and a significant effect of distractor type, $F(1, 126)$=422.99, p<.01, η^2=.77. However, both of these main effects were qualified by the predicted interaction between age and distraction type, $F(1, 126)$=19.40, p<.01, η^2=.13. This interaction, indicated that the older adults were more slowed by the high distraction passage than were the young adults. This finding replicates the pattern of results typically reported in this task, in which older adults are more susceptible to distraction than the young adults.[7]

Content learning questions. Accuracy on the content learning questions was computed, and compared in a 2 (Distraction type) X 2 (Age Group) repeated measures ANOVA. There was a significant age group effect, $F(1, 126)$=9.91, p<.01, η^2=.07, in which older adults (M= .75; CI=.72-.78) were less accurate than young adults (M= .81; CI=.78-.84). There was also a significant main effect for distraction type, $F(1, 126)$=97.63, p<.01, η^2=.44, indicating that participants were less accurate in the high distraction passages (M= .70, CI=.67-.73) than in the low distraction

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7 Since the older adults included in this study were significantly slower than the young adults on the processing speed tasks, it is appropriate to correct for slowing prior to interpreting this interaction. As there are disputes in the literature regarding the appropriate way to correct for slowing (e.g. Speiler, Balota & Faust, 2000), two method of correction were. First, this analysis was repeated using a speed composite score [($Z_{\text{Pattern Comparison}} + Z_{\text{Letter Comparison}}$) / 2] as a covariate, with no change to the overall pattern of results. Secondly, standardized distraction effects [($M_{\text{High Distraction}} - M_{\text{Low Distraction}}$) / $M_{\text{Low Distraction}}$] were compared between age groups. In contrast to the results of the first analysis, this method resulted in no significant difference between age groups, $t(128)$=-.08, p=n.s. Nevertheless, I have chosen to present this interaction as significant, believing that the covariate method of correcting for generalized slowing may be a better method as it utilizes an independent measure of processing speed.

passages (*M*= .87; *CI*=.85-.89). The interaction between distraction type and age group, however, was not significant, indicating that older adults' accuracy was not differentially affected by distraction when compared to younger adults' accuracy.

Predicting distraction control in the web viewing task. Although no overall performance decrements (defined as longer viewing times or lower accuracy) on the website viewing task were observed in the presence of advertisements, it is possible that some individuals who are particularly susceptible to distraction may have demonstrated decrements. In order to explore this possibility, a measure of susceptibility to distraction was created for each participant by subtracting the time taken to read Low Distraction passages from the time taken to read High Distraction passages. Larger differences between the two distraction conditions generated higher scores on this measure, signifying greater susceptibility to distraction (Darowski et al., 2008). Within each age group, participants were ranked by their susceptibility to distraction scores. The third with the lowest scores were termed Low distractible, the middle third were termed Middle distractible, and the third with the highest scores were termed High distractible.

For each age group, a 3 (Susceptibility to Distraction: Low, Middle, High) X 4 (Image Type) X 2 (Presentation Condition) repeated measures ANOVA was conducted on the measure of time spent viewing web pages. The analysis of the young adults' data replicated the main effect of image type found earlier, $F(3, 174)=5.95$, $p<.01$, $\eta^2=.09$. No other significant effects were found in the young adults analysis, nor in the older adult analysis. A similar analysis was conducted on the measure of content question accuracy for each age group, but no significant effects were found. This pattern of results seems to indicate that susceptibility to distraction on the Reading with Distraction task does not predict performance on the website viewing task.[8]

Even if susceptibility to distraction did not predict performance on the web page viewing task, the possibility remains that participants who were more susceptible to distraction may have processed more images, as measured by image recognition accuracy. To test this possibility, a 3 (Susceptibility to Distraction) X 3 (Image Type) X 2 (Presentation Condition) repeated measures ANOVA was conducted on the image recognition data for each age group. This analysis replicated the main effect of image type in both the young adult data, $F(2, 116)=22.02$, $p<..01$, $\eta^2=.28$, and the older adult data, $F(2, 116)=15.46$, $p<..01$, $\eta^2=.21$. No other differences were significant. In conclusion, then, distraction scores on the Reading with Distraction task, although reliable, do not appear to predict the degree to which participants will attend to Internet advertisements.

Role of Experience

Other researchers (Bruner & Kumar, 2000; Dahlen, 2001; Raman & Leckenby,

8 In addition, the correlation between performance on the information searching task and the residuals from the reading with distraction task were examined, with no significant relationship found. Two difference scores were used as measures of information searching performance: Time spent viewing RA pages minus time spent viewing TO pages and accuracy on TO pages minus accuracy on RA pages. The residuals did significantly correlate with the raw measures of web page viewing time in all four image type conditions. However, this effect was attributed to the influence of reading speed, rather than distractor interference.

1998) have found that experience with the Internet appears to modulate the impact of Internet ads. Although the older adults tested in this experiment had significantly less experience with the Internet than did the young adults, the majority of the older adult sample had previous experience with the Internet. If any experience with the Internet is sufficient for enabling participants to efficiently control attention in this environment, then a comparison between older adults with virtually no previous Internet experience and older adults with substantial previous Internet experience should reveal a difference in distraction control abilities.

In order to investigate this possibility, 7 participants who reported little to no experience with the Internet on the Internet experience questionnaire (0-3 points; M=1.14) were age-matched to 7 participants reporting more extensive experience with the Internet (12-17 points; M=15.28). The two groups were not significantly different in age, $t(12)<1$, but were significantly different on the selection variable, Internet experience, $t(12)=-18.60$, $p<.01$. The high Internet experience group also had significantly more education(High: $M=17.00$; Low: $M=14.16$, $t(11)=-2.48$, $p=.03$), and were significantly faster on the speeded comparison tasks, as measured by the speed composite score (High: $M=-0.78$; Low: $M=-1.50$; $t(12)=-2.54$, $p=.03$).

There was a significant main effect of Internet experience on content question accuracy, $F(1,12)=5.79$, $p=.03$, $\eta^2=.32$, indicating that the High Internet experience group ($M=.89$; $CI=.82-.95$) outperformed the Low Internet experience group ($M=.78$; $CI=.72-.85$). However, as the High Internet experience group had significantly more education, this finding could reflect differences in reading skill as opposed to differences in susceptibility to distraction.

In order to determine whether the Low Internet group was specifically disadvantaged in ad-present passages, separate t-tests were conducted to compare the groups on passages in each of the image conditions. Significant differences between the groups on content accuracy in the two ad-present conditions (Related Ads: $t(12)=-2.22$, $p=.05$; Unrelated Ads: $t(12)=-2.27$, $p=.04$) indicating that the group with High Internet experience (Related Ads: $M=.89$; Unrelated Ads: $M=.92$) was significantly more accurate on the ad-present passages than the Low Internet experience group (Related Ads: $M=.80$; Unrelated Ads: $M=.70$). There was no significant difference between the two groups' accuracies for the graphics pages, $t(12)=-.59$ or the text only pages, $t(12)=-1.27$. It is possible that this pattern of results indicates that participants with little Internet experience are more disrupted by the presence of advertisements than individuals with substantial Internet experience.

However, there is an alternative explanation for this pattern of results that cannot be ruled out. These samples were selected on the basis of their Internet experience scores, and were not selected to be evenly distributed across the 16 different experimental forms. Consequently, the counterbalancing of passage topics across presentation conditions is not likely to be complete in such a small sample. Consequently, the difference between the two Internet experience groups on the ad-present passages could be a materials effect. Analyses of overall accuracy for each of the four passage topics (using the full data set of participants) indicates that the content learning questions were of varying difficulty (Health: *M*= 81%; Loan: *M*= 89%; Love: *M*= 82%; Travel: *M*= 92%), which could have resulted in the accuracy differences displayed in this small sample.

Discussion

Experiment 1 was designed to replicate the preliminary study, which produced some (albeit non-significant) indication in the measure of image recognition, and in the measure of web page viewing time, that participants may be using semantic and perceptual features to enable attentional filtering of ads. In particular, Experiment 1 was predicted to show that images related to the content of the goal task were significantly more likely to be processed, and consequently, were more likely to result in distraction effects when present. Furthermore, it was predicted that ads may be more likely to be processed when presented along with graphics, than when presented with other ads. In addition, Experiment 1 extended the findings from the preliminary study by testing older adults as well as young adults. Older adults were primarily predicted to show age differences when images were related to the target content, as was the case with the graphics and related ads.

Attention to Advertisements

Attention to advertisements was measured by accuracy and decision time on a two alternative forced choice recognition test. A significant difference was found in the participants' accuracy in recognizing different types of images, where graphics presented in the Graphics Only condition were better recognized than related ads, which in turn were better recognized than unrelated ads. A similar pattern was found in the time taken to make a correct decision, where decisions on graphics were made significantly faster than decisions on either type of ad. These findings were consistent with predictions, and as such, are interpreted as an indication that participants were utilizing semantic filters.

In addition, the pattern of image recognition seems to support the idea that distinctive perceptual features are not likely to result in attention capture when they are not part of the current attentional set. If attention to images was controlled only by the presence of visually salient features, both types of ads should have resulted in higher recognition rates than the graphics, as half of the ads were animated and none of the graphics were animated.

It was also predicted that older adults may have more difficulty than young adults in filtering out images that were semantically related to the target content. Although older adults took significantly longer to make a decision in the image recognition test, there were no significant differences in the overall pattern of recognition results between the two age groups.

It was also predicted that recognition of ads would increase when the ads were presented with graphics as opposed to with other ads, thereby supporting the hypothesis that participants may be more likely to use perceptual features to guide attention when they are consistent with the current attentional set. Unfortunately, there was no evidence of this type of an effect in the current experiment, as no significant differences between presentation conditions emerged in either the recognition accuracy or recognition speed data.

In conclusion, the current study only found support for the use of semantic filters. Participants appear to be more likely to attend to images in general, and ads in specific, when they are semantically related to the target content. The finding that graphics were better recognized than related ads can be viewed as an indication that participants judged the graphics to be more task relevant than the related ads, even though neither type of image contained information needed for the completion of the goal task. Although it is likely that this effect truly reflects the influence of semantic content, the lack of image counterbalancing across conditions leaves open the possibility that this pattern of results could be caused by a materials effect in the selection of images. In order to test this possibility, it is important to design future experiments in such a way as to enable complete counterbalancing of images across conditions.

Goal Task Performance

Goal task performance in the current study was measured by the average time spent per passage page, as well as by several measures of content learning (speed and accuracy in answering content questions and selection rate of lure choices). It was predicted that, if observed, distraction effects would most likely occur in the Related Ads condition. It was also predicted that older adults would be somewhat more likely than younger adults to show distraction effects in this condition. However, both the current study and the preliminary study supported the results of earlier research (Helder, under revision) that failed to find substantial distraction effects from the inclusion of Internet ads in an information search task.

The preliminary study found a possible distraction effect in the measure of web page viewing time, as participants in this experiment appeared to spend somewhat more time viewing web pages in the Related Ads condition than they spent viewing pages in any of the other conditions. However, Experiment 1 failed to replicate this finding, and in fact produced a significant result in the opposite direction, indicating that overall, participants spent significantly less time on pages in the Related Ads condition than on pages in any of the other conditions. The reversal in the pattern of results between the preliminary study and Experiment 1 was explored by testing for practice effects across the individual pages in a passage, and across subsequent passages in Experiment 1. No evidence of practice effects across individual pages in a passage, nor across the four passages, were found. Consequently, practice effects do not seem to be a likely explanation for this pattern of results.

A more likely explanation involves a materials effect, as alluded to in conjunction with the results of the recognition test. Very few of the images used in the preliminary study were also used in Experiment 1. Therefore, the selection of images of differing visual salience and intrinsic interest across experiments could account for the different pattern of viewing times. Furthermore, just as the images were not held constant across experiments, the images used in the different image conditions were not counterbalanced. An image that served as a related ad in the health passage in Experiment 1 did not serve as an unrelated ad in the other passages. Consequently, the images selected to serve as related ads in Experiment 1 may have been less interesting or less salient than the images selected as graphics and as unrelated ads, resulting in a decrease in page viewing time in the related ads condition. However, it is interesting to note that if this overall decrease in Related Ads page viewing time resulted from a decrease in time spent viewing the actual ads, this reduction did not translate into a reduced recognition rate of related ads.

The preliminary study evaluated content learning using short-answer format questions, with a question density of one question per page. No significant differences between any of the conditions were found. Efforts were made to improve the measure of content learning in Experiment 1. Participants answered 4-alternative multiple choice questions, with a question density of two questions per page. In addition, the answer set for each question contained a lure that corresponded to information contained in one of the related ads displayed on that page of content. This addition was included as a means of measuring the degree to which ad content had been processed. Finally, time taken to select a correct answer was also recorded. Despite these efforts to improve the measure of content learning in Experiment 1, no significant differences were observed in the content learning accuracy, reaction time, or lure selection measures for either young or older adults.

Age Differences

As with previous studies including both young and older adults, it was predicted that older adults could be more susceptible to distraction from advertisements. No support for this prediction was found in Experiment 1. The volunteer nature of the older adult sample, however, could be be associated with better than average distraction control abilities. The Reading with Distraction task (Connelly et al., 1991) was used to test for age differences in susceptibility to distraction. The typical interaction between distraction type and age group emerged on this measure, indicating that the older adults' ability to ignore distraction in the form of Internet ads did not appear to be associated with age atypical abilities to control distraction on this task. An additional exploratory analysis of performance based on Internet experience was conducted, but no conclusive evidence of an experience effect emerged.

Conclusion

The null results obtained on measures of goal task performance are similar to those obtained in previous experiments (Helder, under revision), and appear to support the prediction that Internet users are not disadvantaged in their search for information when ads appear with target informational content. Nevertheless, participants did display reliable recognition of ads in general, even when exposure to the ads was incidental, and not relevant for task completion. Consequently, this set of experiments can be viewed as providing encouraging results for both Internet advertisers, and Internet users.

The data from the image recognition test indicates that Internet users are likely to attend to ads enough to facilitate their later recognition. Furthermore, ads are equally likely to be recognized whether they appear in competition with other ads, or when they appear paired with graphics. Finally, it appears that advertisers would be wise to choose to advertise primarily on websites that are related to the product or service being advertised, particularly since Internet users seem to be more likely to process images when they are related to a topic they find intrinsically interesting.

On the other hand, Internet users do not appear to show signs of consistent significant performance decrements in an information search task, as measured by search speed and accuracy, when ads appear alongside the target information. Given the results of reliable ad recognition, this finding indicates that participants are able to allocate attention to ads, without impairing their ability to attend to the information search task. This finding is especially encouraging for older adults, who have been found to be differentially susceptible to distraction on a large number of laboratory tasks. Experiment 1's finding of no significant age differences in distraction control abilities in an Internet environment, rife with distractors, could indicate that older adults may be better able to control distraction in real world tasks than in laboratory tasks.

However, there is a caveat to this interpretation. Participants in the current study were engaged in a highly focused, well-constrained information search task. Participants in this experiment may have more focused, and possibly more motivated, to complete the task as quickly as possible than the average real world Internet searcher. Consequently, although distraction effects did not emerge in this experiment, it is possible that Internet users carrying out self-directed searches outside the lab may be more susceptible to distraction from Internet ads.

THE INFLUENCE OF LOCATION-BASED ATTENTIONAL FILTERS ON ATTENTION TO INTERNET ADVERTISEMENTS

The location of items onscreen may be key to enabling participants to direct attention to target content and away from irrelevant ads. It is predicted that Internet users may utilize spatial cues to help guide attention in this manner, similar to the way participants in visual marking paradigms are able to use item location reduce the processing of items previously determined to be distractors. The use of spatial cues is likely to be in conjunction with processing items for semantic content, as the relevance of individual items for task performance needs to first be determined prior to the marking of distractors. In particular, once the page loads, participants could quickly process the page layout, and determine whether each image is task-relevant or task-irrelevant. Participants could then mark the location of the irrelevant images, such as ads, on the page and avoid re-processing them as they focus on processing relevant page content.

The initial attention directed toward the ads as they are processed for relevance, then marked for location, could account for previous findings that some ads may be better recognized than others. It could be that ads that hold interest for the person, whether that is intrinsic interest, or interest stemming from the particular task demands at hand, may undergo a greater degree of processing. This hypotheses was supported in the results of Experiment 1's image recognition test. The efficiency with which spatial cues can be used to guide attention could account for the lack of distraction effects on measures of reading performance in the preliminary study and Experiment 1.

To test this hypothesis, this experiment introduces a secondary task designed to interfere with participant's abilities to limit processing in regions of the screen determined to hold task irrelevant items. This was done by incorporating a secondary task that presented stimuli at various locations onscreen, sometimes coinciding with the location of primary task relevant items, and sometimes not. The need to complete this secondary task is likely to result in fewer attentional resources being available in the primary information search task. Consequently, performance decrements on the web page viewing task are likely to be observed simply due to the dual task nature of this condition, and not necessarily due to any task-specific interference with a location-based filter. To control for this influence, a second dual task condition was used in which participants are involved in a similar secondary task, but the stimuli appeared in just one fixed location onscreen. Performance in these two dual-task conditions was compared to performance in a no dual task baseline condition.

Predictions

As in Experiment 1, it was predicted that evidence of attention to ads in general would emerge on the recognition test. More specifically, it was predicted that participants in this experiment would show evidence of using spatial cues to guide attention. Participants completing a secondary task in which stimuli appeared in multiple (variable) onscreen locations were expected to be less able to limit processing in regions of the screen containing irrelevant images. Consequently, they were predicted to show an increase in recognition of images in general, due to increased processing of irrelevant images. On the other hand, it was predicted that participants would be least likely to process images in a dual task condition in which stimuli appeared in only one (fixed) location onscreen. The rationale behind this prediction is that participants engaged in a secondary task should have fewer attentional resources available for processing images. This decrease in available attention, coupled with a dual task condition which should not interfere with location cuing, was expected to lead to lower image recognition rates. Image recognition for participants in the no dual task baseline condition was expected to fall between the two dual task conditions.

In addition, participants were predicted to again show evidence of guiding attention based on the semantic relatedness of an object to the target content, with attention to semantically related graphics and ads being greater than attention to unrelated ads. A possible interaction between location cues and semantic content is predicted as well, in which the recognition of unrelated ads increases more substantially than the recognition of graphics or related ads under dual task conditions. This dual task effect is not predicted to occur when secondary task simuli appear in only one (fixed) location onscreen.

It is also predicted that the introduction of a secondary task will result in decrements in performance of the primary search task, as measured by search speed and search accuracy, as it will result in less attentional resources being available for the primary task. Furthermore, these decrements are expected to increase as the difficulty of the secondary task increases. Therefore, greater distraction effects are expected in the variable location condition of the dual task than in the fixed location condition.

Materials and Methods

Participants

The participants in Experiment 2 included the young adults tested in the Hybrid condition of Experiment 1 plus 64 more young adults from the same source(the psychology department subject pool), for a total of 96 young adult participants (age 18-23; 29 males and one participant who chose not to report gender). Testing on Experiment 1 and Experiment 2 occurred concurrently, and participants were randomly assigned to experiments to reduce the likelihood that selection biases would occur between the participants used in the baseline group and in the two dual task groups. As in Experiment 1, all participants were fluent in English and had completed at minimum a high school degree. Six participants reported learning disabilities .[9] Analyses were repeated with learning disabled participants excluded, with no change to the results.

Design

Experiment 2 was designed to replicate the Hybrid presentation condition of Experiment 1, with the addition of two dual task conditions. Consequently, the data from the 32 young adult participants in the Hybrid presentation condition of

9 Five diagnoses were for Attention Deficit Disorder or Attention Deficit-Hyperactivity Disorder, one was of Obsessive Compulsive Disorder, and one was for Dyslexia.

Experiment 1 were included as a no dual task baseline in this experiment to conserve participant testing time and resources. The 64 additional subjects were tested in two conditions involving a dual task. With the exception of this dual task, the materials and procedures for these two additional groups of participants were exactly the same as those used for Experiment 1.

Considering all three groups, Experiment 2 had a 4 X 3 mixed design. The first independent variable was image type (Text Only, Graphics Only, Related Ads, and Unrelated Ads) and was manipulated within subjects. Each participant read one passage in each of these four image conditions, with the order of the passage topics and image conditions counterbalanced as in Experiment 1. The second independent variable was the dual task condition with the following three levels: None, Fixed, and Variable. The dual task conditions were manipulated between subjects.

Materials

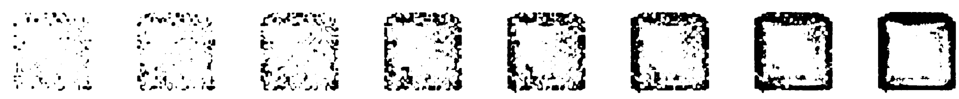
The same passages used in the Hybrid presentation condition from Experiment 1 were used in Experiment 2. The time spent viewing each page was recorded. The content learning questions used in Experiment 2 were also identical to those used in Experiment 1. Overall accuracy on the content learning questions, rate of lure selection, and the the time taken to answer each question were recorded and used to compare content learning across conditions.

The images used in Experiment 2 were the same as those used in the Hybrid presentation condition in Experiment 1. Participants viewed the four websites in one of three dual task conditions: None, Fixed, and Variable. As mentioned before, the task in the None dual task condition was the same task used in the Hybrid presentation condition in Experiment 1, and as such, used the data from the young adults in this condition in Experiment 1. The Fixed and Variable dual task conditions required participants to carry out a secondary task while they were engaged in the website viewing task. In these conditions, participants were given the secondary task of "collecting gems" as quickly as possible when a gem icon appeared on the screen.

Gems were represented by six different gem icons. Each gem icon was contained within an invisible 40 x 40 pixel square. The gems were different colors and different shapes. The pairing between color and shape remained constant throughout the experiment. Gray-scale images of the gems are depicted in Figure 7 below, with the actual gem color indicated in the text below the gem.

Figure 7: The six gem shapes and colors used in the dual task component of Experiment 2.

Each gem was an animated file that appeared onscreen gradually by randomly adding pixels to the gem until the image was complete. This animation involved 55 frames, each of which lasted 150ms. Consequently, gems took 8100ms to go from no visible icon to a complete icon. This transition is shown at approximately 1s timestamps in Figure 8.



0 1050 1950 3000 4050 4950 6000 7050 8100

Figure 8: Representation of the gem materialization animation sequence in Experiment 2, with timestamps (in ms) below each image.

The background of the gem was transparent, allowing the background of the web page to show through until blocked by a gem-pixel. This procedure reduced the likelihood that the abrupt onset of the gem image could result in automatic attention capture. Instead, it was assumed that participants would have to maintain attention to areas of the screen in which the gems could appear.

For each of the four passage topics, four potential gem locations were identified. These gem locations were selected to be distributed across the area of the screen in which content and images appeared, as shown in Figure 9. The same set of four gem positions was used throughout a passage, but varied across passages. Within each image-present condition of a passage (Graphics Only, Related Ads and Unrelated Ads), six of the images could potentially have a gem land on it, and six images were never landed on by a gem. Efforts were made to select gem locations that would enable a gem to potentially land on an image on every page of a passage, but this was not always possible. There was one page in the loan passage, and two pages in the love passage in which none of the images aligned with any of the possible gem positions.

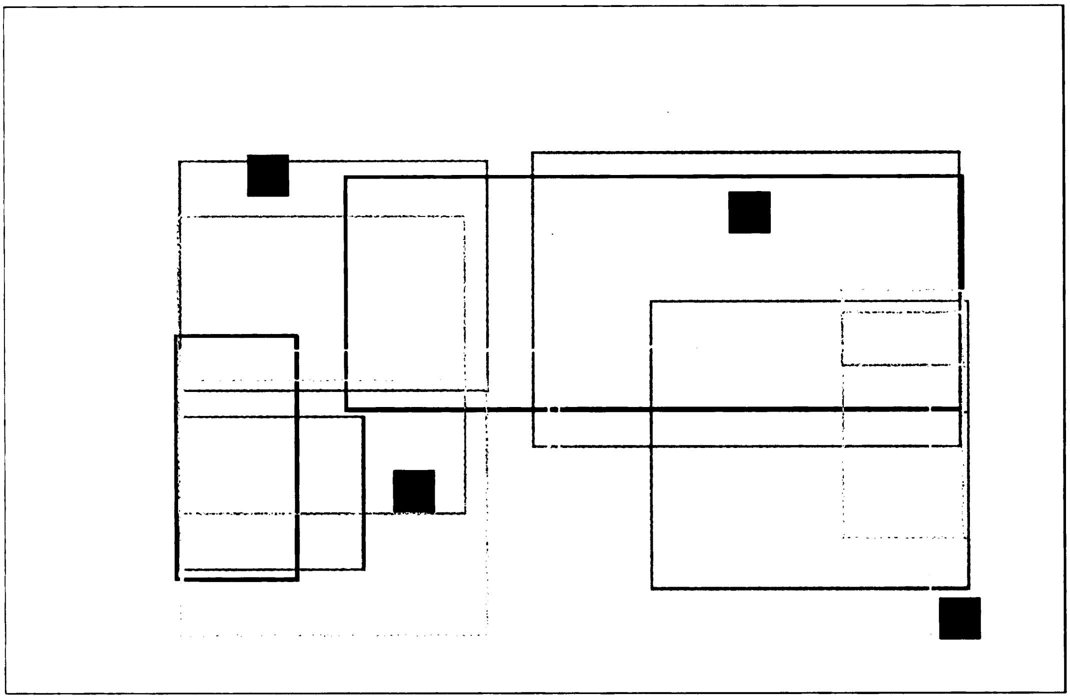


Figure 9: Page layout indicating image positions (open squares) and gem locations (filled squares) for all six pages of the Health Information passage.

To collect the gems, participants pressed the zero (0) key on the number pad of the keyboard, indicating that the gem was perceived. Participants were instructed to press the key as soon as they saw a gem onscreen Once the zero key was pressed to indicate that the gem has been perceived, it disappeared from the screen. Participants were encouraged to collect gems quickly by providing them with feedback on their average gem collection speed at the end of each passage. Each trial (marked by the loading of a new web page) began without a gem onscreen. The first gem began appearing 4-7s after the page had completed loading. The interval between the offset of one gem and the onset of the next gem varied between 4000 and 6999ms, averaging 5482ms (*SD*=863ms).

In the Fixed condition, all gems appeared in the same location on the screen for an entire passage, resulting in a dual-task condition in which the location of secondary task stimuli was predictable. Since the location of the gems in this condition was predictable, allocating attention to the gem collecting task in this condition was not predicted to interfere with spatial location cues. In the Variable condition, the location in which the gems appeared onscreen was randomly selected from the set of four possible locations for each passage. Because gems were likely to appear in several onscreen locations in this condition, allocating attention to the gem collecting task was predicted to interfere with participants' ability to direct attention according to spatial location cues.

The total number of gems collected on each page, and the time taken to collect each gem, was recorded for each participant. These measures were used as indicators of the difficulty of the two dual task conditions, as well as of participant's involvement in the secondary task.

The remaining materials used in the experiment—the memory test for images displayed in the experiment, the questionnaires, the processing speed tasks, and the reading with distraction task—were identical to the ones used in Experiment 1.

Procedure

The procedure for Experiment 2 followed the same task order as the procedure in Experiment 1. However, participants who completed the experiment in either the Fixed or the Variable dual task conditions completed a brief gem-collection practice immediately after listening to the website viewing task instructions. The practice entailed collecting five gems displayed one at a time, using the same timing parameters as the experimental conditions. The average collection speed for the five practice gems was reported, and participants were encouraged to try to maintain a similar collection speed throughout the experiment. After completing the gem collection practice, participants continued to follow the procedure of Experiment 1 by previewing a list of 12 content questions, and viewing the first passage. Participants in the Fixed and the Variable dual task conditions needed to monitor the screen for the appearance of gems while viewing the web page.

Results

Manipulation Checks

Participants

Participants were given the same 15-item vocabulary test, demographic questionnaire, processing speed tasks, computer experience questionnaire, and Internet experience questionnaire as participants in Experiment 1. The means on these demographic measures, separated by dual task group, are presented in Table 12. These measures were used to establish that the three dual task groups were equivalent. No significant differences between any of the dual task groups were found on any of the demographics measures, *F*s between 0.11 and 2.23, *p*s>.11.

Table 12: Scores on the demographic measures included in Experiment 2.

	None	Fixed	Variable
Age	19.28 (19.79-19.77)	19.77 (19.28-20.27)	19.22 (18.74-19.70)
Yrs Education	12.95 (12.48-13.42)	13.31 (12.83-13.79)	12.62 (12.17-13.08)
Health[a]	3.19 (2.92-3.45)	3.34 (3.13-3.56)	3.47 (3.26-3.67)
Vocabulary[b]	9.88 (8.82-10.93)	9.56 (8.65-10.48)	9.66 (8.71-10.60)
Computer Exp[c]	40.22 (39.03-41.41)	39.65 (38.66-40.64)	39.11 (37.92-40.30)
Internet Exp[d]	16.81 (16.07-17.55)	16.03 (15.22-16.84)	16.22 (15.46-16.98)
Ad Attitude[e]	1.66 (1.36-1.95)	1.82 (1.49-2.13)	1.75 (1.42-2.08)
Ad Distraction[f]	71.88 (55.41-88.34)	78.13 (62.98-93.27)	68.75 (51.77-85.73)
Pattern Comparison[g]	41.00 (38.67-43.32)	41.78 (39.40-44.16)	40.53 (38.41-42.65)
Letter Comparison[g]	24.09 (22.18-26.00)	24.44 (23.40-27.48)	25.19 (23.45-26.93)

NOTES: (a) Rating based on self-report: 1=worst health; 4=best health (b) Maximum score 15 (c) Most experience=50 (d) Most experience=22 (e) Positivity of attitude towards Internet Ads with most positive=3; most negative=0 (f) Percent of participants claiming that they are distracted by Internet ads (g) Number of correct comparisons completed in 60s.

Dual Task Performance

For the gem collecting task to have the potential to impact performance, participants must consistently attend to both the primary web-viewing task and the gem collecting task. The total number of gems collected per passage by participants, as well as their reaction time in collecting the gems were used as indicators of attention to the gem collection task.

On average, participants collected one gem every 9.90s (*CI*=9.48-10.49s) while viewing a web page, with the average collection rate ranging from one gem every 7.50s to one gem every 19.82s across participants. The gem collection rate indicates that participants were attending to the gem collection task appropriately. The average gem collection time across participants and conditions was 2.37s (*CI*=2.17-2.58s). Since gems took approximately 8s to fully materialize, this collection speed indicates that participants were vigilant and quick to respond to gems.

The number of gems collected, and the speed with which they were collected, can also be used to test the difficulty of the two dual task conditions. It was assumed that the Variable condition of the gem collection task would be more difficult than the Fixed condition. This was tested by comparing the number of gems collected per page in a 4 (Image Type) X 2 (Dual Task) repeated measures ANOVA. The means used in this comparison are reported in Table 13. The predicted main effect of dual task emerged, $F(1, 62)=7.04$, $p=.01$, $\eta^2=.10$, indicating that significantly more gems were collected per page in the fixed condition ($M=7.34$; $CI=6.57$-8.12) than in the variable condition (*M*=5.89; *CI*=5.11-6.66). There was no significant main effect of image type on the number of gems collected per page, although the direction of the means indicates that the more gems were collected on Text Only pages (*M*=6.80; *CI*=6.13-7.46), than on Unrelated Ads pages (*M*=6.42; *CI*=5.84-7.01). The interaction was also not significant.

Table 13: Average number of gems collected per page in Experiment 2.

	Fixed	**Variable**
Text Only	7.48 (6.54-8.42)	6.11 (5.17-7.05)
Graphics Only	7.62 (6.60-8.65)	5.85 (4.83-6.88)
Related Ads	6.92 (6.09-7.75)	6.08 (5.25-6.91)
Unrelated Ads	7.34 (6.51-8.17)	5.51 (4.67-6.34)

The average time taken to collect a gem was also compared in a 4 (Image Type) X 2 (Dual Task) repeated measures ANOVA. The predicted dual task effect emerged on this measure as well, $F(1,62)=30.55$, $p<.01$, $\eta^2=.33$, indicating that participants in the Variable location condition took significantly longer to collect gems than did participants in the Fixed location condition. A main effect of image type was also found, $F(3,186)=18.92$, $p<.01$, $\eta^2=.23$. However, these main effects were qualified by a significant interaction between image type and dual task condition, $F(3,186)=3.12$, $p=.03$, $\eta^2=.05$. As shown in Figure 10 below, the interaction indicated that the dual task condition was more influential on gem collection speed when there were images onscreen, than in the Text Only condition. In summary, these measures support the prediction that the Variable location condition should be more difficult than the Fixed location condition.

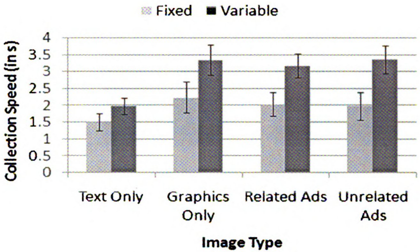


Figure 10: Average RT (in seconds) to collect gems in Experiment 2.

Reading with Distraction Task

The Reading with Distraction task was also included in Experiment 2. In Experiment 1 it served as a manipulation check to make sure that the older adults displayed the expected age-related increase in susceptibility to distraction. Similarly, in this experiment, scores on the reading with distraction task can be used as a manipulation check to ensure that there were no significant differences in distractibility between the three randomly assigned dual-task groups. A 2 (Distraction Level) X 3 (Dual Task) repeated measures ANOVA was conducted to compare the three dual task groups on the difference scores for passage reading time. The main effect of dual task, as predicted, was not significant. There was a significant main effect of distraction level, $F(1,93)=337.08$, $p<.01$, $\eta^2=.78$, indicating that high distraction passages were read more slowly than low distraction passages.

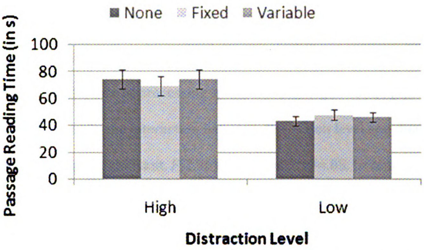


Figure 11: Mean passage reading time (in seconds) on the reading with distraction task in Experiment 2.

Critically, however, there was a significant interaction between distraction level and dual task, $F(2,93)=3.71$, $p=.03$, $\eta^2=.07$. As shown in Figure 11, this interaction was due to the participants in the Fixed condition being somewhat less affected by the high distraction condition than participants in the other two conditions. In other words, this finding seems to indicate that the participants assigned to the Fixed location condition may be somewhat less susceptible to distraction than the participants assigned to the other dual task conditions. This selection bias is somewhat problematic, as the predicted effect of the dual task manipulation is that the participants in the Fixed location condition are less likely to show distraction effects than participants in the Variable location condition.

In order to further explore the cause of this difference, the 2 (Distraction level) X 3 (Dual Task) repeated measures ANOVA was repeated, with the participants' processing speed composite score included as a covariate to control for individual differences in processing speed. There was again a significant effect of distraction level, $F(1,106)=415.43$, $p<.01$, $\eta^2=.80$, and no significant effect of dual task. However, the influence of processing speed was also significant, $F(1,106)=7.59$, $p<.01$, $\eta^2=.07$. As a result, the interaction between distraction level and dual task condition was no longer significant, $F(2,90)=2.67$, $p=.07$, $\eta^2=.05$. In conclusion, the results of this analysis indicate that the three dual task groups should be approximatley equivalent in their susceptibility to distraction, as measured by the Reading with Distraction task, once individual differences in processing speed have been controlled.

Attention to Advertisements

It was predicted that overall, recognition rates would reflect the influence of semantic content, replicating Experiment 1. In addition, it was predicted that the use of location cues would be most difficult in the Variable location dual task condition, in which participants needed to monitor several locations onscreen in order to efficiently collect gems. This predicted difficulty in using location cues was expected to manifest in elevated image recognition rates in the Variable location condition.

A 3 (Image Type: Graphics [GO], Related Ads, and Unrelated Ads) X 3 (Dual Task) repeated measures ANOVA was conducted to test these hypotheses. A main effect of image type was found, $F(2, 186)=26.74$, $p<.01$, $\eta^2=.22$. The direction of this effect was consistent with the predictions. Graphics presented with other graphics in the Graphics Only condition (*M*=.85, *CI*=.83-.88) were recognized significantly better than related ads. In turn, related ads (*M*=.73; *CI*=.68-.77) were recognized significantly more than unrelated ads (*M*=.65; *CI*=.60-.70).[10]

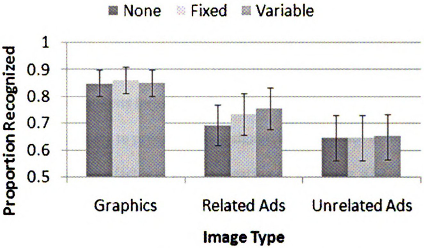


Figure 12: Proportion of images recognized in the Experiment 2 image memory test.

Contrary to predictions, there was no effect of dual task condition on image recognition, $F<1$. There was also no significant interaction between image type and dual task condition, $\eta^2 = .03$. Although the interaction was not significant, it is worth noting that the general pattern of the means provided some indication that the dual task manipulation may have had more influence on the recognition rate of related ads than on the recognition of either graphics or unrelated ads. This pattern is shown in Figure 12.

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10 There was no significant difference between recognition of graphics presented with related ads (*M*=.74; *CI*=.70-.79) and graphics presented with unrelated ads (*M*=.77; *CI*=.73-.81), although both types of graphics were recognized significantly more than unrelated ads, and significantly less than graphics presented with other graphics.

It was predicted that recognition should increase when the locations of gems were likely to draw attention to images. Although this effect did not emerge in the overall data, it is still possible that recognition of specific images on which gems appeared may be better than the recognition of images on which gems did not appear. To test this prediction, overall recognition rates of images on which gems appeared were compared to overall recognition of images on which no gems appeared. This analysis included only participants in the gem-present dual task conditions. Contrary to predictions, no significant difference in image recognition rates was found as a factor of gems appearing on an image, $t(62)=.27$, p=n.s. (Images on which gems appeared: $M=.76$, $CI=.70-.82$; Images on which no gems appeared: $M=.76$, $CI=.74-.79$).

The average time taken for each participant to reach a correct decision was also computed. The pattern of decision time results was predicted to replicate those found in Experiment 1, in which participants were faster to make decisions for graphics than for ads. In addition, it was predicted that if participants in the Fixed location dual task condition were least likely to process images, these participants might take the longest time to make their decisions.

To test these hypotheses, the correct decision times were analyzed using a 3 (Image Type) X 3 (Dual task) repeated measures ANOVA. The predicted main effect of image type emerged, $F(2, 184)=21.27$, $p<.01$, $\eta^2=.19$.[11] Planned comparisons

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11 One participant in the Variable location condition failed to correctly recognize any of the unrelated ads, and was thus excluded from this analysis.

indicated that participants were significantly faster to recognize graphics (*M*= 2.45, *CI*=2.27-2.63) than either of the two types of ads.[12] The time taken to recognize related ads (*M*= 2.96, *CI* =2.77-3.14) and unrelated ads (*M*= 3.09, *CI*=2.86-3.33) did not differ from each other. The main effect for dual task, and the interaction between image type and dual task did not obtain significance (*F*s<1.5). These results are depicted in Figure 13.

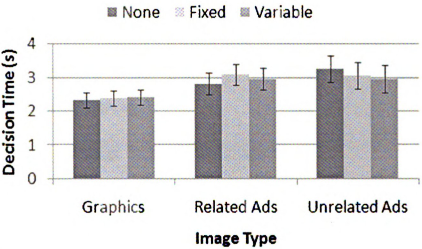

Figure 13: Time taken (in seconds) to make a correct decision on the image memory test in Experiment 2.

Goal Task Performance

As in Experiment 1, four measures of goal task performance were included: web page viewing time, content question accuracy, time taken to answer the content

12 Participants were also significantly faster to recognize graphics presented with ads (Graphics [RA]: *M*=2.35, *CI*=2.19-2.51; Graphics [UA]: *M*=2.30, *CI*: 2.11-2.49) than to recognize either type of ads.

questions, and rate of lure selection. Once again, few distraction effects were predicted for this experiment. However, it was predicted that distraction effects would be most likely to emerge in the Variable location dual task condition, and in particular, when related ads were onscreen.

Web Page Viewing Time

Average time spent per page was computed for each image type, and used to detect whether participants spent longer on the web page viewing task when ads were present. A 4 (Image Type) X 3 (Dual Task) repeated measures ANOVA was conducted to compare the average web page viewing times. The overall pattern of results is depicted in Figure 14.

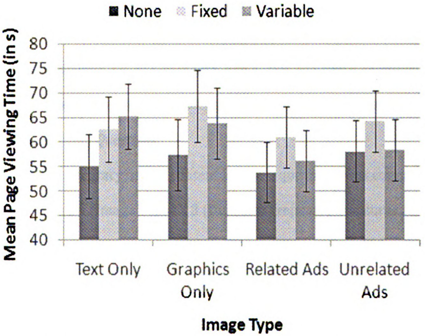

Figure 14: Mean time (in seconds) spent viewing website pages in Experiment 2.

There was a significant main effect of image condition, $F(3, 279)=4.66$, $p<.01$, $\eta^2=.05$, indicating that passages with related ads (M= 57.07; CI=53.48-60.66) are viewed significantly less than passages in any of the other image conditions (Text Only: M=61.01, CI=57.22-64.81; Graphics Only: M= 62.89; CI=58.69-67.09; Unrelated ads: M= 60.30; CI=56.70-63.89). This effect replicated the findings of Experiment 1, although it was not anticipated in the predictions developed for the preliminary study.

The dual task conditions were predicted to result in an increase in time spent on task, as attention should be divided between the information gathering task and the gem collecting task. Inspection of the means shows that in general, participants engaged in the gem collection task to took longer than participants not engaged in a secondary task, as shown in Figure 14. However, there was no significant main effect for dual task condition, $F(2,93)=1.83$, p=n.s., nor was there a significant interaction between image type and dual task condition, $F(6,279)=1.59$, p=n.s.

Content Learning Questions

Mean accuracy on the content learning questions was computed and compared in a 4 (Image Type) X 3 (Dual task) repeated measures ANOVA. As in the previous experiments, no significant differences were found (the main effect for image and the interaction between image and dual task produced Fs<1). Means on this measure are shown in Table 14.

Table 14: Mean proportion correct on content learning questions in Experiment 2.

	None	Fixed	Variable
Text Only	0.84 (0.79-0.89)	0.82 (0.77-0.87)	0.79 (0.74-0.84)
Graphics Only	0.85 (0.8-0.91)	0.83 (0.77-0.88)	0.78 (0.72-0.84)
Related Ads	0.87 (0.82-0.92)	0.80 (0.75-0.85)	0.80 (0.75-0.85)
Unrelated Ads	0.84 (0.78-0.9)	0.78 (0.72-0.85)	0.79 (0.72-0.85)

In addition to scoring the content learning questions for accuracy, the time taken for partcipants to select a correct answer was also recorded, and separate averages were computed for image types and dual task conditions. A 4 (Image Type) X 3 (Dual Task) repeated measures ANOVA was conducted on the content question RT measure, with no significant differences between any of the conditions. These means are shown in table 15.

Table 15: Mean time (in seconds) taken to select a correct answer on the content learning questions in Experiment 2.

	None	Fixed	Variable
Text Only	10.31 (8.81-11.80)	11.28 (9.78-12.77)	11.15 (9.66-12.65)
Graphics Only	10.01 (8.62-11.39)	10.89 (9.50-12.28)	10.68 (9.29-12.07)
Related Ads	9.74 (8.42-11.05)	10.95 (9.64-12.27)	10.21 (8.90-11.52)
Unrelated Ads	10.57 (8.81-12.32)	11.53 (9.78-13.29)	10.70 (8.94-12.45)

Finally, the content learning questions each contained a lure choice that corresponded to the content of one of the related ads. Therefore, if participants were choosing the lures due to confusion between the target text content and the content of distractor ads, lure selection rates should be elevated in the Related Ads condition. However, as in Experiment 1, the rate of lure selection was extremely low (less than 4% of the time), and there were no cases in which the lure selection in the Related Ads condition was significantly higher than the lure selection rate in the other three conditions. As a result, data from this measure was considered uninformative and was not considered further.

Discussion

Experiment 2 introduced a secondary gem-collection task, which participants completed in conjunction with the Hybrid presentation web page viewing task from Experiment 1. This secondary task was designed to interfere with participants' abilities to selectively attend to only regions of the screen containing task-relevant images or content, and to enable investigate whether participants may utilize spatial cues in conjunction with processing items for semantic content.

Attention to Advertisements

It was predicted that the memory test results would replicate the results from Experiment 1 in which recognition of graphics was best, followed by recognition of related ads and then unrelated ads. This prediction was supported in both the recognition accuracy and the recognition speed data. Central to the design of Experiment 2, however, was the dual task manipulation. The Variable location condition of the dual task was predicted to interfere with participants' abilities to restrict processing to relevant regions of the screen. Consequently, participants in this condition were predicted to show higher recognition rates than participants in the no dual task baseline, indicative of greater image processing. On the other hand, it was thought that the Fixed location condition of the dual task would result in the participants having fewer attentional resources available to allocate to the processing of ads, resulting in lower recognition rates in this condition, compared to the baseline.

Unfortunately, no influence of dual task condition was found on either the recognition accuracy or the recognition speed data. It is, however, worth noting that the recognition rates of related ads may have increased slightly from the None dual task condition to the Fixed location condition to the Variable location condition, while the recognition rates of graphics and of unrelated ads remained fairly stable across dual task conditions. This finding, although not statistically significant, may indicate that the related ads were more likely to benefit from participants' inability to confine their attention to specific content-relevant regions of the page.

The results of Experiment 1, interpreted as evidence of semantic content guiding processing, showed that related ads were more likely to be recognized than unrelated ads. If attention is guided to regions of the screen based on the semantic content of items, then participants were predicted to use spatial cues to avoid returning attention to semantically unrelated items. In other words, the disruption to the use of spatial cues caused by the secondary task was expected to most benefit the recognition rate of unrelated ads, since these ads were expected to be marked as distractors and subsequently ignored, while related ads were expected to be marked for further processing.

Since the gems did not appear on each image presented in the experiment, it is possible that the influence of the dual task would only emerge in the recognition rates of images on which gems appeared. Accordingly, this analysis was conducted. Although the recognition rates for images presented in a dual task condition on which a gem actually appeared was numerically higher than for images on which no gems appeared, this difference was not significant. In conclusion, there was little evidence in the image recognition data that the introduction of this dual task resulted in any measurable change in image processing.

Goal Task Performance

The current study used the same measures as Experiment 1 to evaluate goal task performance. It was predicted that distraction effects (previously unobserved in similar paradigms) were likely to occur in both of the dual task conditions, in which fewer attentional resources should be available for the primary information search task. Distraction effects in these two conditions were predicted to be attributable to the influence of that secondary task, rather than the influence of ads as distractors.

In keeping with the findings of Experiment 1, no decrements in goal task performance were observed across the different image type conditions. In fact, the measure of website viewing time indicated that the pages presented in the Related Ads condition were actually viewed for significantly less time than the pages presented in any of the other image conditions. This result replicates the unexpected pattern of results obtained in Experiment 1, and as previously noted, could reflect a materials effect as the same materials were used in both Experiment 1 and Experiment 2.

Contrary to predictions, no influence of the secondary gem collection task was found, as no performance decrements were observed across dual task conditions. Unfortunately, the failure to find a secondary task effect in this experiment may indicate that the goal task performance measures are not sufficiently sensitive to detect changes in search performance, as there is a substantial body of evidence pointing to dual task effects on measures of accuracy and RT. This difficulty with the design of the current experiments will be discussed in more detail in the general discussion section.

Conclusions

In summary, the recognition data in the current experiment supported the findings in Experiment 1 of semantic filters, but none of the predicted dual task effects were found. In addition, no distraction effects from the type of images included on the web pages were observed, although pages were viewed significantly less in the Related Ads condition than in any of the other image conditions. As was the case in Experiment 1, these results may be attributed to a materials effect.

Surprisingly, the introduction of a secondary task did not result in any observable changes in goal task performance, or in the measure of attention to ads. On the one hand, this may be due to using global measure of time spent on page, and content accuracy, rather than more fine-grained measures such as eyetracking. On the other hand, if performance changes in the information search task performance cannot be detected using these global measures, it is unlikely that Internet users would be able to detect appreciable differences in their ability to carry out their goal task when Internet ads were present onscreen.

As such, this experiment again provides support for the idea that Internet users are not likely to be at a disadvantage when it comes to completing tasks online in the presence of ads. Furthermore, the non-significant influence of a secondary task supports the idea that Internet users may be able to carry out a secondary task, such as chatting online, with few repercussions to primary task performance. However, the participants in this experiment were all college students, an age group that arguably has the most experience dividing their attention across multiple online tasks. A follow-up study testing the generalizability of these findings with a group of older adults seems appropriate prior to making a strong case for unimpaired primary task performance in conjunction with a secondary task. In addition, as mentioned in the Experiment 1 discussion, the possibility also exists that distraction effects may emerge in search performance when participants are engaged in less constrained, self-directed searches outside of a laboratory environment.

GENERAL DISCUSSION

Summary of Experimental Results

The aim of this work was to investigate mechanisms enabling Internet users to control their attention on the Internet and avoid unwanted processing of distractor stimuli, such as task irrelevant advertisements. Based on a review of previous research on attentional control mechanisms, it was hypothesized that Internet users should be particularly likely to use perceptual features, semantic content, and spatial location cues to guide their attention on the Internet.

A preliminary study, and Experiment 1, explored the relative influences of distinctive perceptual features and semantic content on attention to ads and on search task performance. Experiment 2 was designed to explore the relative influences of semantic content and location cues on attention control abilities during an information searching task. As in previous studies (Helder, under revision), ad recognition rates were used as a measurement of attention to ads in all the reported experiments. Measures of goal task performance involved the time taken to complete the information searching task, and the accuracy with which the target information was obtained from the experimental web pages.

Role of Perceptual Features

It was predicted that participants would show evidence of using distinctive perceptual features to guide attention in the preliminary study, and in Experiment 1. In particular, it was predicted that distinctive perceptual features would be likely to capture attention when they shared features with the current attentional set, supporting a contingent capture hypothesis rather than an involuntary capture hypothesis. This effect was predicted to take the form of increased recognition of ads presented with graphics in the Hybrid presentation condition, as compared to the recognition rates of ads presented with other ads in the Uniform presentation condition. This prediction was based on the idea that when graphics appeared on the web page, the attentional set should contain perceptual features unique to images, but shared by both graphics and ads. On the other hand, when only ads were presented onscreen, none of the images should be considered task relevant, and thus the attentional set should not contain perceptual features unique to images. However, the difference in recognition rates between the two presentation conditions in both the preliminary study and in Experiment 1 did not reach significance. Consequently, no consistent evidence supporting the use of perceptual features to capture attention

Although support for a contingent attentional capture hypothesis was not obtained, support for an involuntary attentional capture hypothesis was also not obtained. According to this hypothesis, distinctive and visually salient features should capture attention regardless of their consistency with the current attentional set. In general, images should be more visually salient than text, due to their use of bright colors and large size. Furthermore, animated ads should be more visually salient than static graphics, and there should be no difference in salience between related and unrelated ads. Therefore, the contingent attentional capture hypothesis would predict that recognition would be best (and equivalent) for the two types of ads, followed by graphics. This pattern of results was not observed.

Although these experiments did not support the hypothesis that perceptual features are involved in controlling attention in an Internet environment, this possibility cannot be completely ruled out. The manipulation of perceptual relatedness in these experiments was confounded with the manipulation of semantic relatedness. In these experiments, it was assumed that the appearance of semantically related graphics on a web page would alter the characteristics of attentional set, resulting in an attentional set that contained perceptual features common to both graphics and ads. However, it is not certain that the graphics were treated as task relevant by participants, and consequently, the attentional set may not have ever contained perceptual features common to both ads and graphics. A stronger test of the role of perceptual features would involve a direct manipulation of the primary t ask to ensure that perceptual features common to ads and a target stimulus are contained in the attentional set.

Influence of Semantic Content

It was predicted that participants would show evidence of using semantic content to guide attention to items. Overall, this prediction was supported. Although the preliminary study did not find a significant effect of semantic content on image recognition rates, both Experiment 1 and 2 did. In both of these experiments, graphics were better recognized than related ads, which in turn were better recognized than unrelated ads. These findings were interpreted as support for the participants' use of semantic filters to control the processing of potentially task irrelevant images.

Previous studies (Helder, under revision) have failed to produce any reliable distraction effects from ads on the measures of goal task performance. However, these studies only included ads that were unrelated to the web content used in the information search task. Consequently, it was predicted that participants in the experiments included in the current study may show distraction effects when ads displayed were related to the target content.

None of the experiments reported herein found any evidence of ad-related distraction effects. Unexpectedly, Experiment 1 and Experiment 2 produced results in the opposite direction in the web page viewing time measure. In these experiments, participants were significantly *faster* to process Related Ads pages than pages in any other image condition (which did not differ from each other). This finding was not expected, and is difficult to interpret. Faster processing of web pages containing related ads could be indicative of a facilitation effect, in which the presence of ads actually aids the participant in searching for information on the page. This explanation seems unlikely, as there does not seem to be any reason to assume that content-related ads would benefit processing any more than content-related graphics.

Another possibility is that images were processed less when they were related ads than when they were related graphics. This explanation can account for the finding that participants spent longer on the pages displayed in the Graphics Only condition—however, it seems to break down when it comes to accounting for the results obtained in the Unrelated Ads condition. If the reduced viewing time in the Related Ads condition reflects a reduction in image processing, then the finding that processing time for pages in the Unrelated Ads condition did not differ from processing time of pages in the Graphics Only condition would imply that unrelated ads were attended similarly to graphics. Yet the recognition tests in both Experiment 1 and Experiment 2 show that recognition of unrelated ads is significantly lower than both graphics and related ads.

A final explanation involves a materials effect, as proposed previously in the individual experiment discussions. One of the difficulties in attempting to conduct "practically relevant research" (Czaja & Sharit, 2003) is balancing the need to replicate real world conditions with the need to exert experimental control. In the current study, the unrelated ads were selected based on their dimensions and ability to fit in the same area of the page occupied by a graphic or a related ad in the other conditions, thus controlling for image size and position across image conditions. This decision was made at the expense of counterbalancing the ads by using ads that were considered a related ad in one passage and an unrelated ad in another passage. It was thought that the resulting greater variety of categories represented by the unrelated ads was more similar to the variety of ads Internet users were likely to encounter during a real world web search. Nevertheless, since the images were not counterbalanced across conditions, there is no way to determine where the influence of individual images ends and where the influence of the image's semantic content begins. Therefore, the results of these experiments would benefit from an additional study in which the semantically related and unrelated ads were counterbalanced. This experiment would also improve the strength of the interpretation of the recognition test results, as image recognition rates are also susceptible to materials effects when counterbalancing is not complete.

Influence of Spatial Location

Although Experiment 1 showed evidence that attention toward ads appears to be influenced by the extent to which an ad's content resembles the target content, no consistent distraction effects were found in this experiment. These findings, along with previous research (Helder, under revision), have been interpreted as indication that the majority of attentional resources are allocated toward processing target content, rather than advertisements. Experiment 2 was designed to explore whether participants may be utilizing both semantic content and spatial location to guide attention and avoid distraction effects. It was hypothesized that in order to successfully complete the task, participants would need to process all web page images for content. However, to conserve attentional resources, it was predicted that participants may employ a visual marking strategy to enable them to avoid subsequent processing of images deemed to be task irrelevant.

To test this hypothesis, a secondary task was designed to interfere with participants' abilities to inhibit subsequent processing of screen regions containing irrelevant images. Specifically, participants were asked to "collect gems" that appeared onscreen as quickly as they could. This secondary task was performed concurrently with the primary information searching task. The key dual task condition involved the presentation of gems in variable locations on the web page. Since the location of the gems could not be predicted by participants in advance, it was assumed that participants would have to remain vigilant to the entire area of the screen, rather than avoiding returning to locations previously determined to contain task irrelevant images.

It was predicted that interference from this dual task condition would result in increased recognition of images, as well as an overall decrease in information search task performance. A second dual task condition, in which the location of the gem was fixed (and consequently predictable) was included in order to compare differences in search task performance due to the inclusion of a secondary task, and those due to the inability of participants to use location cues to guide attention.

Unfortunately, no significant dual task effects emerged. Not only did image recognition rates not differ across between the baseline and the dual task conditions, a separate analysis comparing the recognition rates of images on which a gem had actually appeared to the recognition rates of images on which no gem appeared failed to find any significant differences. Furthermore, goal task performance remained constant across the dual task conditions, indicating that there was no difference in page viewing time or in content learning in the dual task conditions as compared to a baseline (no dual task) condition.

This null effect is disappointing on multiple accounts. Central to the motivation for this study, it is disappointing to find no evidence for location-based filters. However, it is more disappointing to find no general dual task effect, as this calls into question both the effectiveness of the dual task manipulation, as well as the sensitivity of the performance measures.

In order for the dual task to have influenced participants' abilities to set location-based filters, participants needed to be engaged in the dual task. If participants were not dividing their attention between the secondary gem collection task and the primary search task in Experiment 2, it would not be surprising to find no results from the dual task manipulation. However, measures of gem collection performance indicated that participants appeared to be attending to the secondary task in addition to the primary search task. Participants on average collected more than five gems per passage page, indicating that gem collection was ongoing while participants were viewing a page. Even more indicative of attention to this secondary task is the finding that the average time taken to collect a gem was less than 3s. As gems were animated to appear gradually over the course of 8s, this finding indicates that the majority of gems were collected before they had fully materialized. Consequently, it does not seem likely that the failure to find dual task effects can be attributed to a lack of attention directed to the secondary task.

The explanation that remains, then, is that the measures of goal task performance were not sufficiently sensitive to detect performance differences between the baseline and dual task conditions. As in Experiment 1, performance in Experiment 2 was measured primarily in terms of average time spent viewing each web page, and average accuracy in answering content learning questions, although the time taken to answer content learning questions correctly, and the proportion of lures selected were also recorded and analyzed. In comparison to experiments that have measured performance using more fine grained methods, such as reaction time in a simple search task, or tracking of eye movements, these measures are global, and subject to more variability both within and across individual participants.

In order to address this particular methodological problem, it is recommended that future research be conducted in which external validity is sacrificed for increased sensitivity of goal task performance. One way of achieving this would be to substantially reduce the amount of information presented on each web page, and refine the task to more closely resemble a visual search task than an information search task. In particular, the methodology used by Burke et al. (2005) in their headline visual search task could be adapted to investigate the influence of semantic and location-based filters.

Conclusions

The current study finds evidence for the use of semantic filters, but not for the use of perceptual or location-based filters in controlling attention in Internet environments. Although no evidence for perceptual or location-based filters was found, it is possible that these mechanisms may still play a role in guiding selective attention on the Internet. Future experiments designed to address methodological issues present in the current study are required before any definitive conclusions can be made about the presence or absence of these mechanisms. Nevertheless, consistent with previous research, this study offers good news to both advertisers and Internet users.

Implications for Advertisers

It was expected that participants would show reliable overall recognition of advertisements presented during the experiment—even though participants were not aware that their memory for advertisements would be tested. This overall effect was observed in the current study, as well as in previous studies (Helder, under revision). Accordingly, this represents good news for advertisers whose goal is to obtain the attention of potential consumers on the Internet. Of note is the fact that the current experiments find reliable recognition of a fairly large number of advertisements by participants, as compared to some studies in the advertising literature that test recognition of just a few advertisements (Raman & Leckenby, 1998; Yoo & Kim, 2005). Experiment 1 presented participants with either 12 or 24 ads (Hybrid and Uniform conditions, respectively) and Experiment 2 presented participants with 12 ads. In addition, graphics were presented in the experiment, which likely resulted in competition for attention to advertisements—yet recognition rates were still quite good.

Another implication of this study, relevant to Internet advertisers, is the finding that the semantic content of an ad can influence the amount of attention (and consequently, the rate of later ad recognition) directed to an ad. This finding supports the recent trend for Internet advertisers to focus their marketing efforts around key word searches (Li & Leckenby, 2007). Advertisements that are closely matched to the interests and current goals of an Internet user are likely to pay off with increased attention directed toward the advertisements.

The final implication of this study for advertisers is that reliable recognition of ads can be achieved without resorting to forced exposure techniques. All ads used in these experiments were non-interactive banner ads. Target web content was never obscured by an ad, and participants were never required to click on or otherwise interact with an ad to complete their goal task. The implication of these findings is that creating progressively more intrusive advertisements may not be necessary in order to gain Internet users' attention.

Implications for Internet Users

A recent review of Internet advertising effectiveness notes that the majority of Internet users who choose to block advertising base their choice on the belief that the advertisements impede their ability to carry out a goal task on the Internet (Cho & Cheon, 2004). This belief is echoed in the participants tested in these experiments, the majority of whom believe that they are distracted by Internet advertisements to some degree. Nevertheless, these experiments did not produce any significant differences in the measures of search task performance. Participants in this study did not spend significantly longer per web page when ads are present, nor were they significantly less able to gather the information they sought.

Although these performance measures may not be the most sensitive used in the literature on attention and distraction, they are representative of the measures that are likely to be most important to the average Internet users. Internet users are not likely to be aware of whether the pattern of their eye fixations varies between web pages with and without ads, but they are likely to be aware of (and frustrated by) an inability to direct their attention as needed to obtain the sought-after information. The present research indicates that there are no real decrements likely to be observed on goal task performance, when measured globally. Therefore, although Internet users may continue to feel as though their attention is co-opted and coerced by advertisements, the data indicate otherwise.

APPENDIX A: SCREEN SHOTS FROM THE PRELIMINARY EXPERIMENT

Baseline Conditions

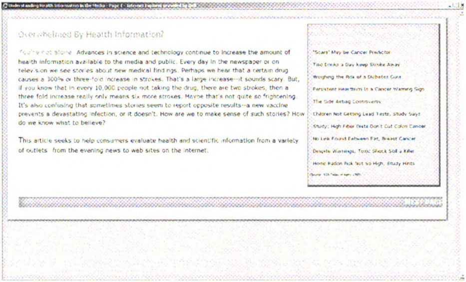

Figure A1: Screen shot of the first page displayed in the text only condition.

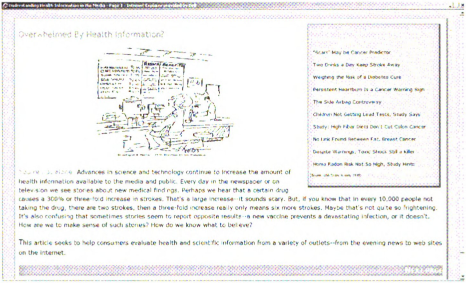

Figure A2: Screen shot of the first page displayed in the graphics only condition.

Ad Conditions in the Uniform Presentation Condition

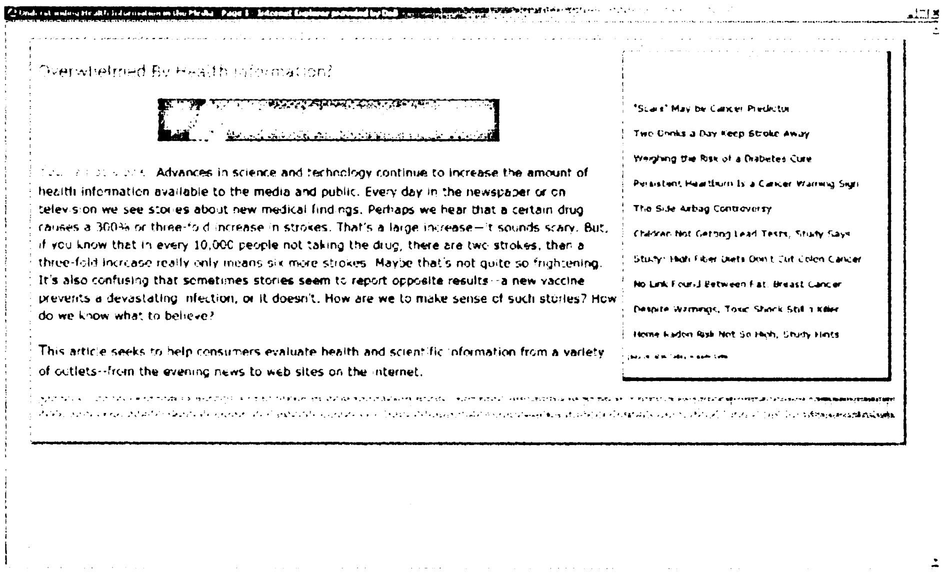

Figure A3: Screen shot of the first page displayed in the related ads condition.

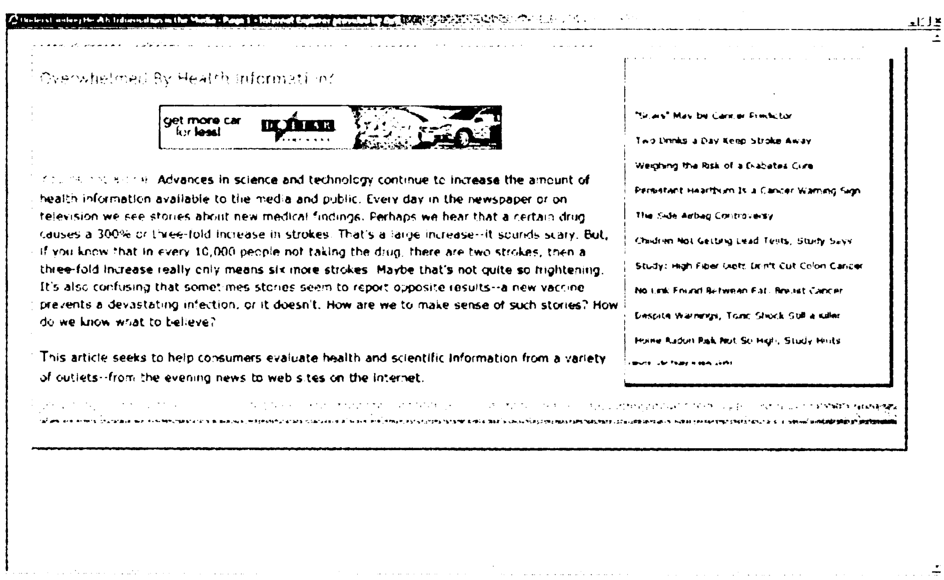

Figure A4: Screen shot of the first page displayed in the unrelated ads condition.

Ad Conditions in the Hybrid Presentation Mode

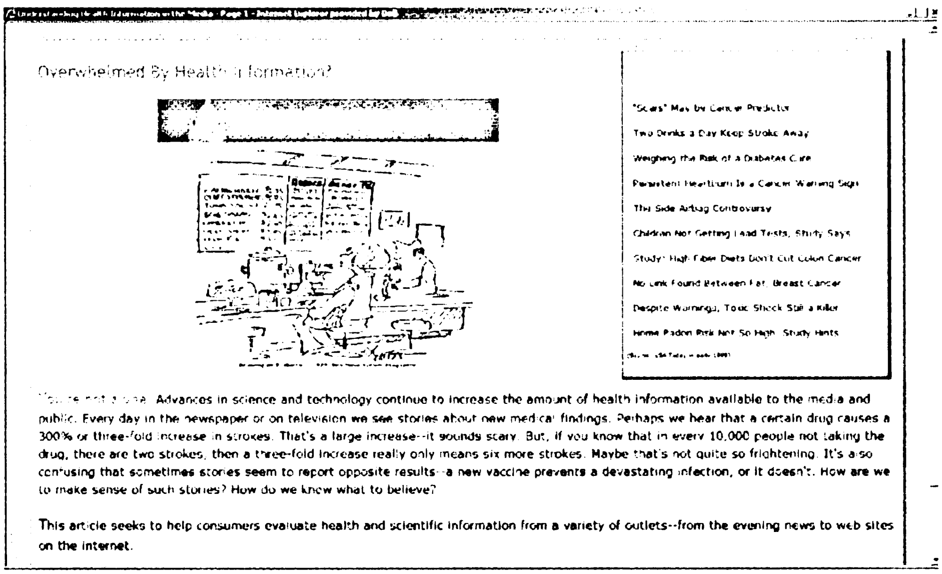

Figure A5: Screen shot of the first page displayed in the related ads condition.

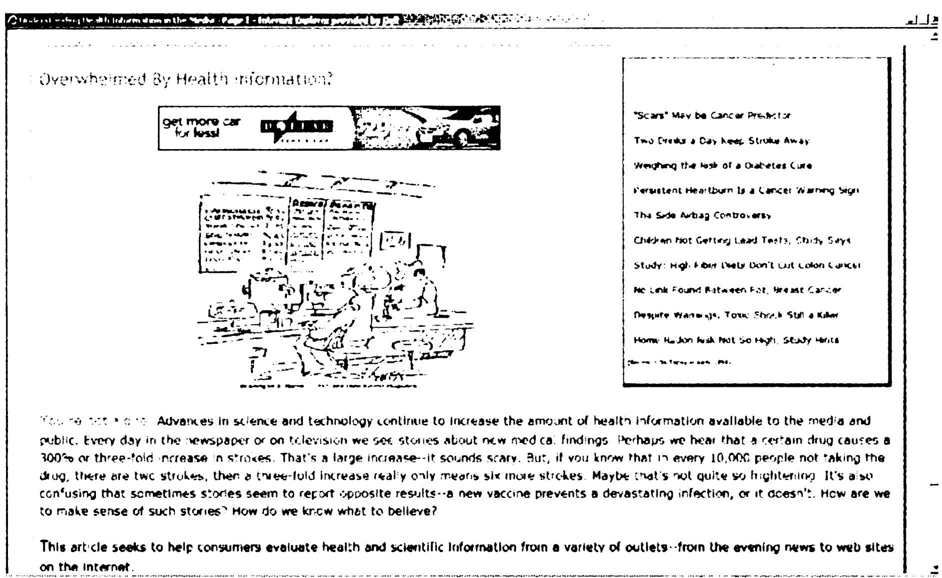

Figure A6: Screen shot of the first page displayed in the unrelated ads condition.

APPENDIX B: SCREEN SHOTS FROM EXPERIMENTS 1 & 2

Baseline Conditions

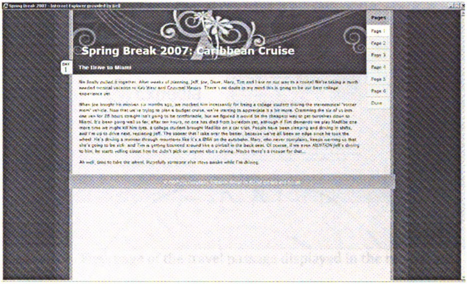

Figure B1: First page of the travel passage displayed in the text only condition.

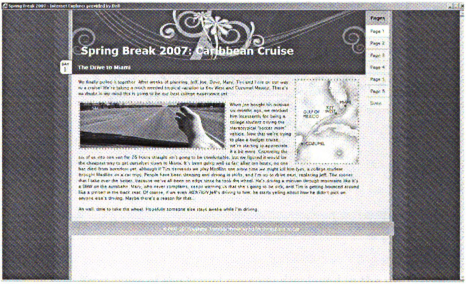

Figure B2: First page of the travel passage displayed in the graphics only condition.

Ad Conditions in Uniform Presentation Mode

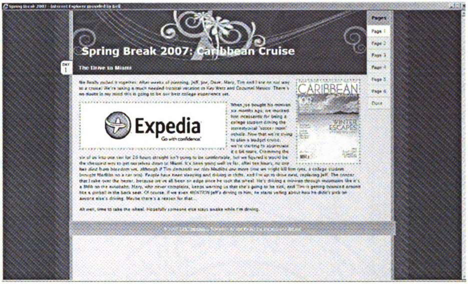

Figure B3: First page of the travel passage displayed in the related ads condition.

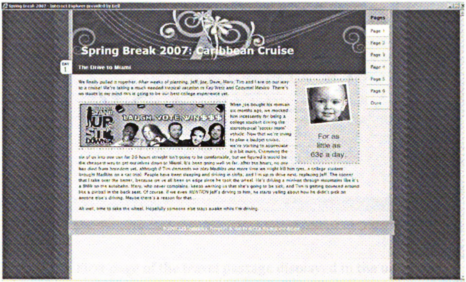

Figure B4: First page of the travel passage displayed in the unrelated ads condition.

Ad Conditions in Hybrid Presentation Mode

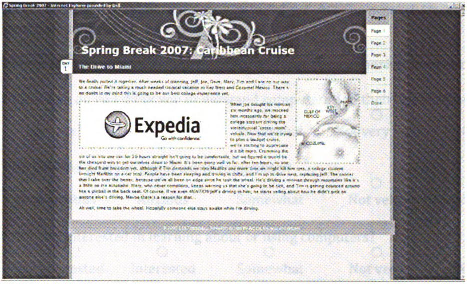

Figure B5: First page of the travel passage displayed in the related ads condition.

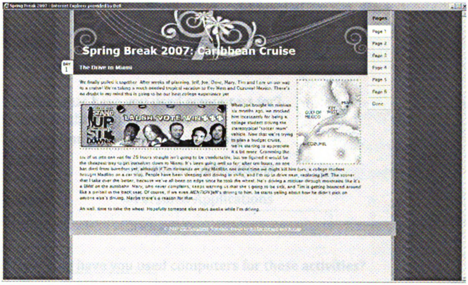

Figure B6: First page of the travel passage displayed in the unrelated ads condition.

APPENDIX C: COMPUTER EXPERIMCE QUESTIONNAIRE

NOTE: Based on a questionnaire used by Kubeck, Miller-Albrecht, and Murphy (1999). Items original to that questionnaire are indicated using an asterisk (*). All other items have been updated by the author.

Please answer the following questions about your experience with computers.

* How well do you think you understand computers and their applications?

O	O	O	O	O
Very well	Well	Somewhat	Not very well	Not at all

* Do you feel anxious about using computers?

O	O	O	O	O
Very anxious	Anxious	Somewhat	Not very	Not at all

* Are you interested in learning about or using computers?

O	O	O	O	O
Very interested	Interested	Somewhat	Not very	Not at all

* How difficult or easy do you feel it would be for you to learn to use computers (or how difficult or easy was it for you to learn to use computers)?

O	O	O	O	O
Very hard	Hard	Somewhat	Easy	Very easy

* Have you used a computer before?

OYes ONo

* If YES, what have you used computers for?
(Check all that apply)

☐Entertainment	☐Word Processing
☐Library Research	☐Business Applications
☐Email	☐Personal Applications
☐Internet	☐Other: ______

* How long have you used computers for these activities?

______ Years

* Do you know how to use a mouse?

OYes OSo-so ONo

* How often do you use computers?

O	O	O	O	O
Daily	Weekly	Several times a month	Once a month	Rarely, if at all

* Do you own a computer?

OYes ONo

* Have you taken any courses using computers?

OYes ONo If yes, please describe:

* How comfortable are you with using a computer?

O	O	O	O	O
Very Comfortable	Comfortable	Somewhat	Not very	Not at all

* When you want to find information about a topic, what KINDS or TYPES of sources do you typically use? Please rate the following in order of frequency/importance. Where do you typically look FIRST, SECOND, etc.

Ask an Expert
Newspaper
Internet
Library
Encyclopedia
Magazines
Books
Databases
Scientific Journals
Television
Ask a friend/relative
Other:

Please specify "other", if selected:

When you have completed this form, please click the button below.

Record My Answers

APPENDIX D: INTERNET EXPERIENCE QUESTIONNAIRE

Please answer the following questions about your experience with the Internet.

* If you had to briefly define the following terms to someone who had never heard of them, what would you say? In one or two sentences, describe what you know about:

1. the Internet:
2. being online:
3. e-mail:
4. the world wide web:
5. using online search engines:

How often do you use the Internet?

○	○	○	○	○
Daily	Weekly	Several times a month	Once a month	Rarely, if at all

If you are a daily Internet user, approximately how many hours do you estimate you spend online a day?

○	○	○	○	○
Not Applicable	Less than 1 hour	Between 1 and 2 hours	Between 2 and 4 hours	More than 4 hours

If you are an Internet user, approximately how many years have you been using the Internet?

○	○	○	○	○
Not Applicable	Less than 1 year	More than 1 year, less than 5 years	More than 5 years, less than 10 years	More than 10 years

Are there specific Internet websites that you tend to visit on a regular basis?
○Yes ○No

If so, what types of sites do you read on a regular basis?

(Check all that apply)

☐Hometown News	☐National News
☐Sports	☐Weather
☐Personal web pages/Blogs	☐Social networking (Ex: Myspace, Facebook)
☐Online Games	☐Email
☐Portal page (Ex: yahoo.com, msn.com)	☐Other:

Have you ever purchased a product based on an Internet advertisement?
○Yes ○No

Do you think Internet advertising works?
○Yes ○No Why or why not?

Do you find advertisements on the Internet to be distracting?
○Yes ○No Why or why not?

Do you find advertisements on the Internet to be annoying?
○Yes ○No Why or why not?

Do you pay attention to advertisements on the Internet?
○Yes ○No Why or why not?

In your opinion, what makes (or could be done to make) Internet advertisements ...

1. eye catching?:
2. appealing?:
3. memorable?:
4. distinctive?:

When you have completed this form, please click the button below.

Record My Answers

APPENDIX E: EXIT QUESTIONNAIRE

Internet Searching 2008: Exit Questionnaire

1. **Please rank the following topics that you read a passage on in order from most interesting (1) to least interesting (4):**
   _______ Understanding Health Information in the Media
   _______ Student Loans: What You Need to Know
   _______ The Psychology of Love and Attraction
   _______ Spring Break 2007: Caribbean Cruise

2. **For each of the following four topics, please indicate on a scale of 1 (Extremely Interesting) to 7 (Extremely Boring) how interesting you found the topic to be:**
   a. Understanding Health Information in the Media
   b. Student Loans: What You Need to Know
   c. The Psychology of Love and Attraction
   d. Spring Break 2007: Caribbean Cruise

(The following rating scale was duplicated for each of the four passages.)

1	2	3	4	5	6	7
Extremely Interesting	Very Interesting	Interesting	Neither Interesting nor Boring	Boring	Very Boring	Extremely Boring

3. Did you pay attention to the images presented on the websites? YES NO
4. Did you pay more attention to certain types of images than others? YES NO
   a. If so, which types?

5. Did you pay attention to the advertisements presented on the websites? YES NO
6. Did you pay more attention to certain types of advertisements than others?
   a. YES NO
   b. If so, which types?

7. Did you notice any relationship between the advertisements presented in this experiment and the content of any of the passages? YES NO
   a. If so, describe the relationship you noticed.

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