Journal of the Association for Information Systems

Volume 18 | Issue 8 Article 1

8-31-2017

Effects of Animation on Attentional Resources of Online Consumers

Muller Y. M. Cheung
Hong Kong University of Science and Technology, mcheung@ust.hk

Weiyin Hong
Hong Kong University of Science and Technology, whong@ust.hk

James Thong
Hong Kong University of Science and Technology, jthong@ust.hk

Follow this and additional works at: https://aisel.aisnet.org/jais

Recommended Citation

Cheung, Muller Y. M.; Hong, Weiyin; and Thong, James (2017) "Effects of Animation on Attentional Resources of Online Consumers," *Journal of the Association for Information Systems*, 18(8), .
DOI: 10.17705/1jais.00464
Available at: https://aisel.aisnet.org/jais/vol18/iss8/1

This material is brought to you by the AIS Journals at AIS Electronic Library (AISeL). It has been accepted for inclusion in Journal of the Association for Information Systems by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Journal of the Association for Information Systems

Research Paper ISSN: 1536-9323

Effects of Animation on Attentional Resources of Online Consumers

Muller Y. M. Cheung
Department of Information Systems, Business Statistics and Operations Management,
School of Business and Management,
Hong Kong University of Science and Technology
mcheung@ust.hk

Weiyin Hong
Department of Information Systems, Business Statistics and Operations Management,
School of Business and Management,
Hong Kong University of Science and Technology
whong@ust.hk

James Y.L. Thong
Department of Information Systems, Business Statistics and Operations Management,
School of Business and Management,
Hong Kong University of Science and Technology
jthong@ust.hk

Abstract:

Websites commonly use animation to capture the attentional resources of online consumers. While prior research has focused on the effects of animation on animated banner ads, limited research has examined the effects of animation on other items on the same webpage. Drawing from psychological theories that the amount of an individual's attentional resources may vary under different conditions, this study focuses on the effects of animation on how individuals allocate attentional resources to both the animated item and the remaining non-animated items. We conducted an eye-tracking experiment to follow online consumers' visual attention while they performed two types of online shopping tasks: browsing and searching tasks. The results showed that a product item that used animation led to increased visual attention to all items on a webpage, which suggests that the amount of attentional resources increases when a webpage includes animation. Meanwhile, animation influenced how individuals allocate their attentional resources such that it increased visual attention on the animated item at the expense of attention on non-animated items on the same webpage. In addition, the type of shopping task moderated animation's effect on how individuals allocate their attentional resources. Specifically, animation's effect on attracting attentional resources to the animated item was stronger when online consumers browsed than when they searched for a specific target item. We discuss the theoretical and practical implications of our findings.

Keywords: Animation, Attentional Resources, Online Consumers, Eye-tracking, Experiment, Website Design, Human-computer Interaction.

Atreyi Kankanhalli was the accepting senior editor. This paper was submitted on April 14, 2015, and went through 2 revisions.

1 Introduction

In 2016, the Internet population reached 3.3 billion (Internet Live Stats, 2016). As the Internet becomes a mass medium with a huge online audience, the design of Internet portals and websites is critical in helping arouse and capture online consumers' attention. One area that particularly needs online consumers' attention is online advertisements, which is the primary source of revenue for many websites. There was an estimated US$49.5 billion spent on online advertising alone in 2014 (PricewaterhouseCoopers, 2015). Animation represents one technology that websites commonly use to attract online consumers' attention, though it also attracts much controversy. Web animation refers to motion of any kind on websites (Zhang, 2000). In the early stages of website development, primarily banner ads used animation. However, many researchers have questioned animation's effectiveness in attracting attention or generating click-through and describe the phenomena as "banner blindness" (i.e., online consumers ignore animated banner ads as if they don't see it at all) (Benway & Lane, 1998; Burke, Hornof, Nilsen, & Gorman, 2005; Dreze & Hussherr, 2003). Even with all the criticisms, our survey of Alexa top 100 global websites shows that about 35 percent of them still use some sort of animation on their websites, and the percentage increases to 81.3 percent if we only look at shopping websites. The newer generation of animation in our survey tends to be more subtle (i.e., non-intrusive) as compared to their earlier applications, and we have started seeing animation being applied to other content (such as titles and pictures of products) than to the banner ads.

Due to the practical significance and the extensive use of animation technologies by websites, researchers in different fields, including IS (e.g., Hong, Thong, & Tam, 2007; Jiang, Lim, & Sun, 2009; Lai, Kuan, Hui, & Liu, 2009; Sun, Lim, Peng, Jiang, & Chen, 2008; Zhang, 2000, 2005; Zorn, Olaru, Veheim, Zhao, & Murphy, 2012), human-computer interaction (e.g., Bayles, 2002; Burke et al., 2005; Hamborg, Bruns, Ollermann, & Kaspar, 2012; Lee, Ahn, & Park, 2015), marketing (e.g., Baltas, 2003; Cho, 2003; Lohtia, Donthu, & Hershberger, 2003; Phillips & Lee ,2005; Sundar & Kim, 2005; Yoo & Kim, 2005), and communications (e.g., Diao & Sundar, 2004; Li & Bukovac, 1999) became interested in this phenomenon. However, while these prior studies have contributed to our understanding of Web animation's effects, we still have much to learn.

First, prior studies (e.g., Diaper & Waelend, 2000; Hong et al., 2007) have mostly focused on how animation affects the time individuals stay on webpages or the time they take to complete online tasks instead of how long they spend specifically on animated items. One can attribute this focus to the scarcity of eye-tracking data. In any case, these prior studies have produced inconsistent findings. For instance, Hong et al. (2007) found that animation increased the time individuals stayed on webpages regardless of whether they searched for a target item or simply browsed without such an item in mind. However, other studies (Burke et al., 2005; Diaper & Waelend, 2000) have found no significant relationship between animation and the time individuals stay on webpages or take to complete online tasks.

Second, prior research has mainly focused on animation's effect on the attention individuals pay to animated items and ignored its effects on the remaining webpage content. One can attribute this focus to the fact that early studies on animation focused only on animated ads (e.g., Benway & Lane, 1998; Lohtia et al., 2003). In the context of e-commerce websites, we need to investigate whether online consumers pay attention to both animated and non-animated items, including other products that the websites offer.

Third, prior studies (e.g., Hong, Thong, & Tam, 2004a; Yoo, Kim, & Stout, 2004) have based their hypotheses about animation's effects on the assumption that individuals have a fixed amount of attentional resources. However, some researchers (Humphreys & Revelle, 1984; Kahneman, 1973) believe that individuals do not have a fixed amount of attentional resources and that it can vary under different conditions. The amount of attentional resources will vary when different types of visual stimuli, such as an animated item, induce different levels of arousal.

Finally, previous studies have typically focused on simple searching tasks (e.g., Bayles, 2002; Burke et al., 2005; Rau, Chen, & Chen, 2006; Rau, Gao, & Liu, 2007); few studies have examined different tasks in the same study (Hong et al., 2007; Jiang et al., 2009; Li and Bukovac, 1999; Pagendarm and Schaumburg, 2001). While some studies have found that animated items have a stronger effect on online consumers who do not have a particular goal in mind (Jiang et al., 2009), other studies have not found any difference (Li & Bukovac, 1999). As a result, there is a lack of consensus on the moderating role of online tasks on animation's effect.

In summary, with this study, we fill the knowledge gaps we identify above by addressing three research questions in the online shopping context:

RQ1: How does animation impact the time individuals spend on viewing webpages?

RQ2: How does animation impact the attention individuals pay to both animated and non-animated items?

RQ3: How does animation's effect on the attention individuals pay to both animated and non-animated items vary across online tasks?

To answer these questions, we leverage cognitive psychology theories and investigate how animation influences the amount of attentional resources that individuals have and how they allocate such resources to animated and non-animated items on the same webpage. To resolve the inconsistent findings of prior research, we investigate whether animation impacts the time individuals spend on viewing webpages and the reasons behind them. We believe that animation has a twofold effect on attentional resources. Apart from increasing the amount of attentional resources (Humphreys & Revelle, 1984; Kahneman, 1973), we expect animation to influence how individuals allocate their attentional resources to animated and non-animated-items. To more comprehensively understand animation's impact on attentional resources, we extend the investigation of attention beyond the animated item to include also the non-animated items on the same webpage. We assess animation's effects on attentional resources across two online tasks: browsing and searching tasks. To complement prior studies that have used memory measures as a surrogate for attention, we use a more direct measure of visual attention with an eye-tracking machine (Poole & Ball, 2006; Rayner, 1998).

With this study, we make three contributions to the existing literature. First, we provide empirical support for Humphreys and Revelle's (1984) and Kahneman's (1973) conception that individuals' amount of attentional resources can vary in different situations, including in an online environment. Second, we investigate animation's effects on both animated and non-animated items and, thus, provide a more complete picture on animation's effects on attentional resources. Third, we investigate animation's effects on attentional resources across different tasks in order to determine the boundary conditions of such effects.

This paper proceeds as follows: in Section 2, we review the literature and elaborate on the identified knowledge gaps. In Section 3, we present the theoretical background of this research and develop the hypotheses. In Section 4, we describe the experiment design. In Section 5, we present the data analysis results. Finally, in Section 6, we discuss the findings, their implications, our study's limitations, and directions for future research.

2 Literature Review

To understand whether and how the use of animation can influence individuals' behavior on webpages, we reviewed the literature on this topic in IS, human-computer interaction, communications, and marketing journals. Table 1 summarizes our review of extant animation studies.

Based on reviewing the animation literature, we identified three major observations about animation's effects on individuals' behavior on the Web. First, prior studies on animation have often used recall as a surrogate for attention. While recall is a convenient surrogate for attention and easy to apply, it has produced inconsistent results (see Table 1). We believe that the discrepancy between recall and attention may explain these inconsistent results. For example, when studying the impacts of Web animation, Yoo et al. (2004) operationalized attention and memory separately such that they measured attention with self-reported items and indexed memory with recall and recognition. Their results revealed support for animation's positive effects on self-reported attention but only partial support for its effects on memory. A possible explanation for the observed discrepancy is that arousal that animation induces (Heo & Sundar, 2000; Lang et al., 2002; Sundar & Kalyanaraman, 2004) influences attention and (short-term) memory differently (Hamilton, Hockey, & Rejman, 1977; Humphreys & Revelle, 1984).

Table 1. Literature Review of Animation Studies

Study	Task	Dependent variable: main findings on animation					
		Self-reported data (e.g., recall)			Behavioral data (e.g., click-through rate)		
		Animated	Non-animated	Overall	Animated	Non-animated	Overall
Bayles (2002)	Searching	Ad recall (—); ad recognition (—)					
Benway & Lane (1998) (experiment 2)	Searching	ad recognition (—)					
Burke et al. (2005) (study 1)	Searching			Flashing text banner: perceived workload (↑); animated banners: perceived workload (—)		Flashing text banner: search accuracy (—); animated banners: search accuracy (—)	Flashing text banner: search time (—); animated banners: search time (—)
Burke et al. (2005) (study 2)	Searching	Ad recognition (when correcting for participants' guessing strategies) (↓)			Number of fixations (—)		Less demanding task: search time (↑); more demanding task (—)
Cho (2003)	Browsing				Click-through rate (↑) (when product involvement is low)		
Diao & Sundar (2004)	Browsing	Pop-up ads: ad recall (↑), ad recognition (↓); animated ads: ad recall (—), ad recognition (—)			Pop-up ads: orienting responses (↑); animated ads: orienting responses (—); animated pop-up ads: orienting response (↑)		
Diaper & Waelend (2000)	Searching			Immediate perceived complexity (—)			Search time (—)
Dreze & Husshern (2003) (study 2)	Searching	Ad recall (—); brand recognition (—); brand awareness (—)					
Gao, Koufaris, & Ducoffe (2004)	Searching			Perceived irritation (↑)			
Hamborg et al. (2012)	Searching	Recall (↑); attractiveness (—)			Number of fixations (↑); duration of fixations (—)		
Hong et al. (2004a)	Searching	Animated target products: recall of products (↓); animated non-target products: recall of products (—)	Animated target products: recall of products (↓); animated non-target products: recall of products (↓)	Animated target products: recall of products (↓), focused attention (↓), attitude (—); animated non-target products: recall of products (↓), focused attention (↓), attitude (↓)			Animated target products: response time (—); animated non-target products: response time (↑)
Hong et al. (2007)	Searching and browsing			Focused attention (↓); attitude towards the website (↓)	Possibility of being first clicked (↑); possibility of being clicked in general (↓); possibility of being purchased (—)		Shopping time (↑); number of clicks (↓)
Jiang et al. (2009)	Searching and browsing	Ad recognition (↑)					

Table 1. Literature Review of Animation Studies

Josephson (2005)	Browsing				Number of fixations (—); duration of fixations (—); frequencies participants looked at the banner ads (—)		
Lai, Hui, & Liu (2007)	Browsing	Recall (↑)	Recall (↓)	Perceived hedonic value (↑); perceived utilitarian value (↑)			
Lai et al. (2009)	Browsing	Recall (↑)	Recall (↓)	Perceived hedonic value (↑); perceived utilitarian value (↑)			
Lang, Brose, Wise, & David (2002) (study 3)	Browsing	Recall (↑); recognition (—)			Orienting response (↑)		
Lee et al. (2015)	Browsing	Recognition (—); attitude toward the advertised brand (↑)			Percentage of participants who looked at the banner ads (↓)		
Li & Bukovac (1999)	Searching and browsing	Recall (↑)					Response time (↓)
Pagendarm & Schaumburg (2001)	Searching and browsing	Recall and recognition are higher in browsing than in searching					
Phillips & Lee (2005) (study 2)	Browsing	Attitude toward the character (↑)		Attitude toward the website (↑); perceived social presence (—); perceived entertainment (↑)			
Rau et al. (2006)	Searching	Recall (—); recognition (↑); ad attitude (—); brand attitude (—); purchase decision (—)					
Rau et al. (2007) (study 2)	Searching	Floating animation: recognition (—)		Floating animation: satisfaction (↓)			Floating animation: search time (↑)
Sundar & Kalyanaraman (2004)	Browsing	Recall (—); recognition (—)			Physiological arousal (↑)		
Sundar & Kim (2005)	Browsing	Attitude toward the ads (↑); attitude toward the products (↓)					
Yoo et al. (2004)	Browsing	Self-reported attention (↑); recall (↑); recognition (—); attitude toward the ads (↑); click-through intention (↑)					
Yoo & Kim (2005)	Browsing	Self-reported attention (↑); recall (—); recognition (↑); attitude toward the ads (↑)					
Zhang (2000)	Searching					Task performance (↓)	
Zhang (2005) (studies 2 and 3)	Searching					Task performance (↓)	

Note: "↑" = increase; "↓" = decrease; "—" = no effect; cell is empty if the specific dependent variable was not investigated.

Humphreys and Revelle (1984) suggest that one can explain the inverted-U relationship between arousal and task performance by two different monotonic processes of arousal: sustained information transfer and some function of short-term memory. On the one hand, arousal monotonically increases the amount of attentional resources available for sustained information transfer. On the other hand, arousal negatively affects some function of short-term memory in the sense that it will not improve the short-term memory. Based on Humphreys and Revelle's (1984) argument, it may not be appropriate to use memory data as the surrogate for attention because animation may have different effects on the attentional resources and short-term memory through the induced arousal.

Second, prior research has mainly focused on the effects of the animated item and task performance but generally ignored the effects on the remaining contents on the same webpage (e.g., Benway & Lane, 1998). These studies have usually investigated the effectiveness of an animated banner ad with different measures, including recall and recognition of ads (Lang et al., 2002) and click-through rate (Cho, 2003). When these studies have studied animation in context of searching tasks (Zhang, 2000; Zhang, 2005), they have assessed task performance with common metrics, such as accuracy rate or error rate (Burke et al., 2005), time spent on the task (Hong et al., 2004a) and clicking behavior (Hong et al., 2007). While industry practitioners would like to use animation to increase consumers' memory of an animated item, they do not necessarily intend to do so at the cost of consumers' memory of the non-animated items. For instance, while the operators of online shopping websites intend to increase the attention that consumers allocate to the promoted products by applying animation to them, they may not want to decrease consumers' attention paid to the remaining non-animated products.

Few studies (Hong et al., 2004a; Lai et al., 2007; Lai et al., 2009) have investigated animation's effects on the recall of both animated and non-animated items. However, these studies have generated mixed findings. On the one hand, Lai et al. (2007) and Lai et al. (2009) found that animation improved recall of animated items at the cost of non-animated items. On the other hand, Hong et al. (2004a) found that animation decreased recall of the non-animated items without improving recall of animated items. While we believe that there is a discrepancy between recall and attention, prior research has generally proposed attention to affect how individuals select and process information (Osman & Moore, 1993) and memory (Watt & Welch, 1983). By adding eye-tracking data, we contribute to resolving the mixed findings.

Third, previous studies have typically focused on simple searching tasks (e.g., Bayles, 2002; Bruke et al., 2005; Rau et al., 2007) with few exceptions (Hong et al., 2007; Li & Bukovac, 1999; Pagendarm & Schaumburg, 2001). In e-commerce contexts, Moe (2003) proposes that online consumers use four main visiting strategies: directed buying, hedonic browsing, search/deliberation and knowledge building. Online consumers who engage in search/deliberation or knowledge building are involved in developing purchase intention or information gathering, respectively. These online consumers are not likely to make immediate purchases but may make future ones. In contrast, online consumers who engage in directed buying or hedonic browsing are more likely to make immediate purchases. In directed buying, online consumers have nearly made up their mind to immediately make a purchase. In hedonic browsing, online consumers could make the immediate purchase because of sensory stimulation and other factors. Similar to prior studies (e.g., Phang, Kankanhalli, Ramakrishnan, & Raman, 2010), we do not study all four online store visiting strategies. Instead, we focus on the two strategies that could lead to immediate purchase when online consumers engage in the two most common tasks in a shopping environment: browsing and searching tasks (Bodoff, 2006; McDonald & Chen, 2006). On the one hand, browsing tasks are shopping tasks in which consumers have an interest in making a purchase in a product category but have not made up their minds on which particular product to buy. When consumers do not have a specific product in mind to buy, their purchase decision likely depends on sensory stimulation, such as animation. On the other hand, searching tasks are shopping tasks in which consumers have a specific product in mind to buy. Prior literature suggests that the type of task may have direct effects on attention and memory (Li & Bukovac, 1999) and that the type of task can moderate animation's effects on attention (Hong et al., 2007). The few prior studies that have investigated task types have mainly focused on the type of task's effects on recall. For example, Li and Bukovac (1999) propose that the type of task (seeking information and surfing the Web) impacts how individuals allocate their attention and memory. However, they did not find support for the proposed relationship such that the recall of banner ads was not statistically significant across different types of tasks. In contrast, Pagendarm and Schaumburg (2001) show that types of tasks had significant effect on recall of banner ads such that recall was higher when online consumers engaged in browsing rather than searching tasks. Hong et al. (2007) propose that task type moderates animation's effects on attention. They found partial support for the moderating effects of task type. While they found that animation had a significantly greater negative impact on performance in browsing tasks than in searching tasks, they found that task type did not moderate animation's effects on consumer's perceptions toward using the website.

We follow Underwood and Everatt's (1996) suggestion that one could use visual gaze to reflect how individuals allocate their attention. Prior research has suggested that fixations represent the moment in which individuals acquire and process information (Juse & Carpenter, 1980; Rayner, 1998). A higher number of fixations and a longer total fixation duration imply more visual attention and more processing of the information (Josephson, 2005). Researchers have estimated the minimum fixation duration on a stimulus is around 100-150 milliseconds before individuals process the stimulus (Eriksen & Eriksen, 1971; Spencer, 1969). In order to obtain a holistic view of animation's overall effects on attention, we need to investigate animation's effects on both animated items and non-animated items on the same webpage and measure attention directly with an eye-tracking machine.

3 Theoretical Background and Hypotheses

3.1 Attentional Resources and Arousal

Prior researchers (Kahneman, 1973; Navon & Gopher, 1979) view attention as a pool of general-purpose resources. Individuals can allocate such general-purpose resources, or attentional resources, to concurrent activities based on their attention-allocation mechanisms and the concurrent activities' characteristics. Kahneman (1973) proposes that individuals do not have a fixed amount of human attentional resources (or attention capacity) but that it can change based on the environment and various conditions. While researchers view the amount of attentional resources as limited and that individuals could not engage in infinite number of tasks at one time, they believe that individuals have access to a greater amount of attentional resources (through an increase in the level of arousal) when the difficulty of simultaneous tasks increases.

Anderson (1990, p. 98) describes arousal as a "hypothetical construct representing the sum (in a principal components sense) of a variety of processes that mediate activation, alertness and wakefulness". In general, arousal represents the abstraction of emotional states (such as anger, excitement, etc.) and motivational states (Neiss, 1988). Some researchers prefer arousal to its abstracted elements for simplicity. Compared with its abstracted elements (e.g., emotional states) that can be multidimensional and difficult to measure, researchers have conceptualized arousal as a unidimensional construct that one can readily quantify and measure (Neiss, 1988). Researchers believe arousal to impact multiple aspects that range from subjective judgment (e.g., leader's charisma; Pastor, Mayo, & Shamir, 2007) to objective assessment of task performance (Gellatly & Meyer, 1992; Huber, 1985). Among the possible consequence variables, task performance has received considerable attention from researchers. For example, Yerkes and Dodson (1908) propose an inverted-U hypothesis that asserts a curvilinear relationship between arousal and performance. According to the hypothesized inverted-U relationship, increases in arousal level lead to improvements in task performance until an optimal level of arousal; further increases in arousal level then result in degradation of performance. Humphreys and Revelle (1984) explain this inverted-U relationship by suggesting that arousal has different effects on the amount of attentional resources available for sustained information transfer and short-term memory. Anderson, Revelle, and Lynch (1989) provide additional empirical support for the inverted-U relationship. This theory is consistent with Kahneman's (1973) original conception that an individual's arousal level influences the attentional resources that individuals have available for performing a task.

Several factors and different kinds of experimental manipulations can induce or influence individuals' arousal level. For example, research has found different types of auditory stimuli to induce different levels of arousal (Cohen & Weinstein, 1981; Eysenck, 1982). One can manipulate noise through loud and soft music, and research has found that loud music induces a higher level of arousal. Similar to auditory stimuli, research has shown visual stimuli to have impacts on arousal level (Detenber, Simons, & Bennett, 1998). Prior studies found that images with motion or moving images can induce higher levels of arousal than static images (e.g., Detenber et al., 1998; Simons, Detenber, Roedema, & Reiss, 1999). Detenber et al. (1998) compared the effects of moving and static images extracted from a variety of film and television programs on an individual's arousal level by using self-reported arousal levels and physiological data. The results show that moving images elicit higher levels of arousal than static images. Simons et al. (1999) replicated Detenber et al.'s (1998) study and arrived at the same conclusion that moving images induce higher levels of self-reported arousal and physiological arousal. Their replication study demonstrated the superiority of moving images in inducing higher levels of arousal when the researchers used different types of images (i.e., regardless of whether the images induced positive, negative, or neutral affective response, moving images always induced higher levels of arousal than static images).

3.2 Goal-directed Attention Capture and Stimulus-driven Attention Capture

Hillstrom and Yantis (1994) propose that individuals allocate attentional resources in a visual field in two ways: either through goal-directed attention capture or through stimulus-driven attention capture. These two mechanisms usually work together in guiding individuals' visual attention allocation. Goal-directed attention capture operates in a top-down fashion in that individuals will look for salient features that identify the search target. For example, if individuals know that the search target, the letter "T", is displayed in green among red letters, then any green item will capture their attention. In contrast, stimulus-driven attention capture operates in a bottom-up fashion. It occurs when a salient feature that is independent or irrelevant to an individual's task draws the individual's attention. For instance, when a red apple is placed together with a bunch of bananas, the red apple will capture the individual's attention even though it may not be relevant. Similarly, an animated item captures individuals' attention through stimulus-driven attention capture due to its visual distinctiveness.

3.3 Hypotheses Development

Following Zhang (2000), we define animation as motion of any kind in this paper. In the online context, research has found animation to induce a higher level of arousal (Heo & Sundar, 2000; Lang et al., 2002; Sundar & Kalyanaraman, 2004). For example, Heo and Sundar (2000) compared the usage of animated banner ads and non-animated banner ads on news webpages and found that the animated banner ads elicited or induced a higher level of arousal. Similarly, Lang et al. (2002) found that the animated ads elicited stronger orienting responses (i.e., an organism's immediate response to a change in stimuli, which indicates arousal) than their static counterparts. In our study, we leverage these findings and suggest that animation will induce a higher arousal level and, in turn, increase the amount of individuals' attentional resources (Humphreys & Revelle, 1984). This argument agrees with the empirical evidence that video games that involve more action and motion lead to an increased amount of attentional resources than video games that involve less action and motion (Green & Bavelier, 2003).

Investigating the attentional resources that individuals allocate to webpages can help explain whether individuals stay on the webpages for a longer time because they have an increased amount of attentional resources. Prior studies have found conflicting results on animation's effects on the length of time individuals view webpage content. For example, Hong et al. (2007) found that webpages that used animation increased the length of time individuals stayed on them in both online searching and browsing tasks, but other studies (Burke et al., 2005; Diaper & Waelend, 2000) report no significant relationship between websites that use animation and the length of time individuals stayed on them.

Several studies have shown that animation induces higher levels of arousal (Heo & Sundar, 2000; Lang et al., 2002; Sundar & Kalyanaraman, 2004) such that higher levels of arousal increase the amount of attentional resources available to an individual (Humphreys & Revelle, 1984; Kahneman, 1973). As a result, individuals have an increased amount of attentional resources to allocate to webpage content. Lavie (1995) suggests that whether individuals allocate their attentional resources to certain stimuli depends on the amount of remaining attentional resources. When individuals perform a certain task that will not exhaust all their available attentional resources, then they will allocate their remaining attentional resources to certain stimuli involuntarily. In the online context, animation induces higher levels of arousal of individuals that, in turn, increases the amount of attentional resources. When individuals have a higher amount of attentional resources, they would have more attentional resources to allocate to the webpages and spend longer time viewing the webpages. As we discuss above, little research has examined animation's effects on both animated items and non-animated items (Hong et al., 2004a; Lai et al., 2007; Lai et al., 2009). These prior studies have used memory (measured as recall) as the dependent variable and found that individuals correctly recalled fewer non-animated items when animation was present. The results agree with Humphreys and Revelle's (1984) proposed negative relationship between arousal level and short-term memory and positive relationship between arousal level and amount of attentional resources. Due to an increased amount of attentional resources, individuals will have more attentional resources to allocate to the content that they view. Applying this notion to the context of online shopping, individuals will have more attentional resources to allocate to all items (i.e., both animated and non-animated items) on the same webpage and view the webpage's content for a longer time. Therefore, we propose the following hypotheses:

H1: Animation's presence on a webpage increases the length of time individuals view the webpage's content.

H2: Animation's presence on a webpage increases the amount of attentional resources that individuals allocate to all items on the webpage (i.e., the animated and non-animated items).

Previous studies show that animation helped to attract individuals' attention to animated items (Yoo et al., 2004; Yoo & Kim, 2005). They asked individuals to rate their attention paid to the banner ads. Individuals reported that they paid more attention to the animated banner ads than to the static non-animated banner ads. Animated items' attention capturing/grabbing capabilities could be attributed to their visual distinctiveness. Distinguishing themselves from other components on the same webpage, the animated items attract attention due to their visual distinctiveness (Gati & Tversky, 1987; Nairne, Neath, Serra, & Byun, 1997). By relaxing the assumption of fixed amount of attentional resources, we believe that animation has two effects on the attention that individuals allocate to animated and non-animated items. Apart from inducing higher levels of arousal and increasing the amount of attentional resources, animation affects how individuals allocate attentional resources to animated and non-animated items. Visual search theories propose that movement is unique in the way that the human visual system can effortlessly register it (James, 1950). For example, a natural way to capture someone's attention is to wave one's arms. There is also neuro-anatomical evidence that the visual system tends to segregate motion information from color and orientation information, which makes the former more powerful in attracting attention (Girelli & Luck, 1997).

Animation, which refers to motion of any kind, is powerful in grabbing individuals' attentional resources in the online context (Zhang, 2000). Hence, we propose that webpages that use animation will cause individuals to allocate a higher proportion of their attentional resources to the animated item and, at the same time, allocate a lower proportion of attentional resources to the non-animated items.

H3a: Animation's presence on a webpage increases the proportion of attentional resources that individuals allocate to the animated item.

H3b: Animation's presence on a webpage decreases the proportion of attentional resources that individuals allocate to non-animated items[1].

We expect goal-directed attention capture to dominate when individuals engage in searching tasks. Under the searching task condition, individuals have specific targets in mind. They will allocate attentional resources to salient features that can help them identify the search targets. Compared to the situation where individuals do not have a specific target in mind, a particular item that uses animation may be less effective in grabbing individuals' attentional resources when they have a specific search target in mind. When individuals engage in browsing tasks, stimulus-driven attention capture dominates and the animated item would be effective in grabbing attentional resources. As a result, individuals would allocate a higher proportion of their attentional resources to the animated item and a lower proportion to non-animated items. In contrast, when individuals engage in searching tasks, goal-directed attention capture would dominate and the animated item would capture attention less effectively. Individuals would no longer allocate a higher proportion of their attentional resources to the animated item; instead, they make available a greater proportion of their attentional resources for non-animated items.

We expect that individuals will allocate a higher proportion of their attentional resources to the animated item on a webpage and that they will have a lower proportion of attentional resources available for non-animated items when they browse than when they search for a particular target item. Under the browsing task condition, animation is more effective in grabbing individuals' attentional resources. While animation leads to an increased amount of attentional resources through arousal, individuals will allocate a higher proportion of their attentional resources to the animated item, which leaves a lower proportion for the remaining non-animated items. The three studies that have investigated animation's effects on non-animated items (Hong et al., 2004a; Lai et al., 2007; Lai et al., 2009) found a tradeoff in memory performance between animated and non-animated items under the browsing task condition (Lai et al., 2007; Lai et al., 2009) but not under the searching task condition (Hong et al., 2004a). With animation, individuals better recalled the animated item at the cost of the non-animated items when they browsed a website without any specific target item in

[1] Note that, in the context of our study, users may allocate their attentional resources to three types of items on a webpage: 1) an animated product item, 2) non-animated product items, and 3) non-animated non-product items (e.g., blank space, menu bar, tool bar, etc.). Thus, H3a and H3b are not two sides of the same hypothesis.

mind (Lai et al., 2007; Lai et al., 2009). However, this tradeoff in performance was not present when individuals searched for a specific target item on a website (Hong et al., 2004a).

Based on the above discussion, we posit that task type will moderate animation's effects on the proportion of attentional resources that individuals allocate to both animated and non-animated items and that animation leads to an increased amount of attentional resources through arousal. Task type moderates the animated item's attention-grabbing capabilities such that individuals allocate a higher proportion of their attentional resources to the animated item and a lower proportion of attentional resources to non-animated items when they perform browsing rather than searching tasks.

H4a: Task type moderates animation's effects on the proportion of attentional resources that individuals allocate to the animated item such that they allocate a higher proportion of their attentional resources to the animated item when they perform browsing rather than searching tasks.

H4b: Task type moderates animation's effects on the proportion of attentional resources that individuals allocate to non-animated items such that they allocate a lower proportion of their attentional resources to non-animated items when they perform browsing rather than searching tasks.

4 Research Methodology

4.1 Experiment Participants

We used the experiment methodology so we could manipulate the independent variables and test the causal relationships (Chan, Wei, & Siau, 1993; Goswami, Chan, & Kim, 2008; Sheng, Nah, & Siau, 2008; Sia, Tan, & Wei, 2002). We recruited 63 undergraduate students from a public university in Hong Kong for this experiment. As incentives, we paid them US$15 to complete the whole experiment. We recruited the participants through an advertisement placed on the university's electronic notice board. Due to difficulties in calibrating their eye movements, we dropped three participants from the final sample. In the end, we recorded comprehensive eye-movement data for the remaining 60 participants (30 participants for each task condition). Further, 33 participants were female and 27 participants were male. They were between 19 and 22 years' old (20.42 years' old on average). On average, the participants had 8.27 years' experience with using the Internet. As future young professionals and part of the age group that is more likely to engage in online shopping activities (eMarketer, 2013), our participants belonged to a homogenous group, which meant we could control for endogeneity. Thus, we believe that these participants constituted an appropriate sample to test our hypotheses.

4.2 Experiment Design and Independent Variables

We employed a 2x2 mixed design with animation as a within-subject factor and task as a between-subject factor. We randomly assigned participants to either browsing or searching tasks. The within-subject factor (i.e., animation) had two levels: with animation and without animation (the control condition).

To improve the internal validity of the experiment and minimize the influence of extraneous factors, we carefully selected the materials for the experiments. We developed a hypothetical online shopping website to control for the potential bias that may result from participants' familiarity with popular websites. We chose the context of online grocery shopping given that that most people are likely familiar with grocery products[2]. We conducted a pretest to identify product categories (out of 15) that our participants found equally familiar (Brucks, 1985). We chose six product categories[3] for their similar level of familiarity to our participants so that we controlled for any potential participants' bias towards specific product categories. After the pretest, we selected fictitious or foreign product brand names to eliminate potential effects from familiar brand names (Dodds, Monroe, & Grewal, 1991) or brand equity (Xu, Thong, & Venkatesh, 2014). Following the practice in marketing research, we controlled price at ±5 percent in each product category (Dodds et al., 1991). As a result, we prepared six products with similar prices but unfamiliar brand names for each grocery product category.

[2] As a result, we could control subjects' familiarity with the products. If we had asked the subjects to shop for a digital camera online, the subjects' perception and allocation of attention to a particular camera would depend on their familiarity with that digital camera.
[3] Bottled water, chocolate, toothpaste, biscuits, box of tissues, and bottled fruit juice.

We developed a hypothetical website (with HTML, ASP and Adobe Flash) specifically for the experiment. A server in the same local area network as the PC we provided to the participants hosted the website. This setup helped to avoid unnecessary time delay in loading the webpages and ensured consistent access speed for all participants (Hong, Thong, & Tam, 2004b). The experiment website comprised an introduction webpage, instruction webpages that presented the cover stories for either the browsing task or the searching task, webpages that presented a training shopping trip, and webpages that presented the six main shopping trips. The six shopping trips presented six different product categories; each participant went through all six shopping trips. We randomized the order in which these product categories appeared for each participant. Each shopping trip presented participants with six different products under the same product category in a random order (see Figure 1). When participants clicked on the title of a product, they would proceed to a webpage that showed detailed information of the selected product (see Figure 2). After reading that webpage, participants could choose to return to the webpage that showed the six products or to buy the selected product and proceed to the next shopping trip.

We manipulated the task factor in the instruction webpages. We told participants who we assigned to the searching task to shop for a target product in each of the six shopping trips (and product categories). We randomly chose the target product for each shopping trip. In contrast, we told participants who we assigned the browsing task to shop for a product in each of the six shopping trips and to base their shopping decisions on their own preferences.

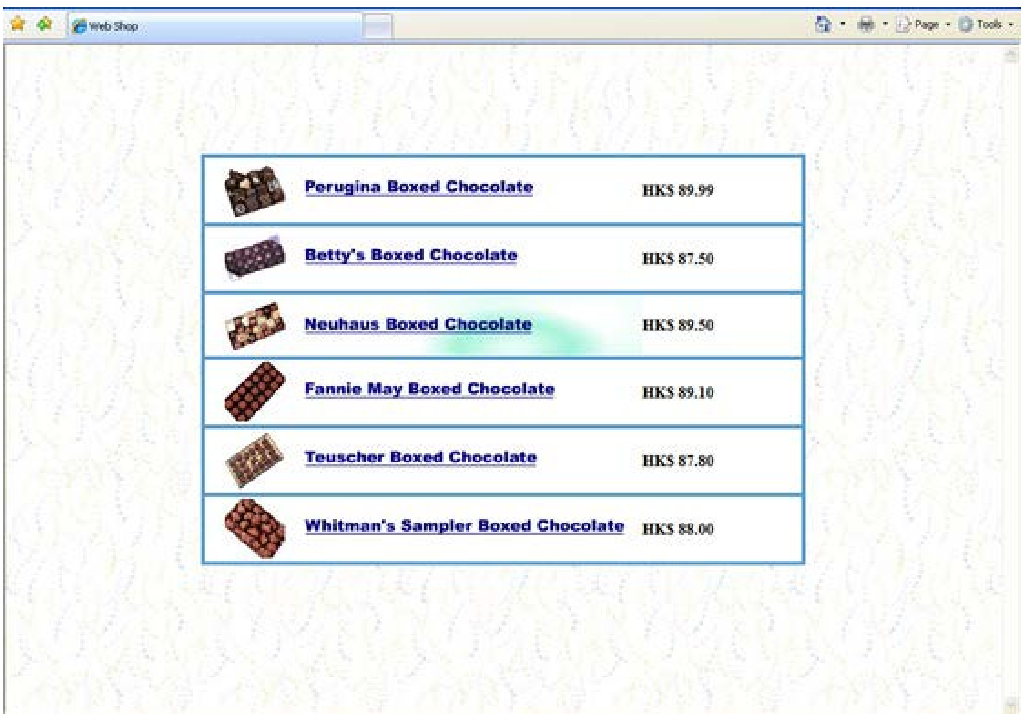

Figure 1. Snapshot of a Shopping Webpage

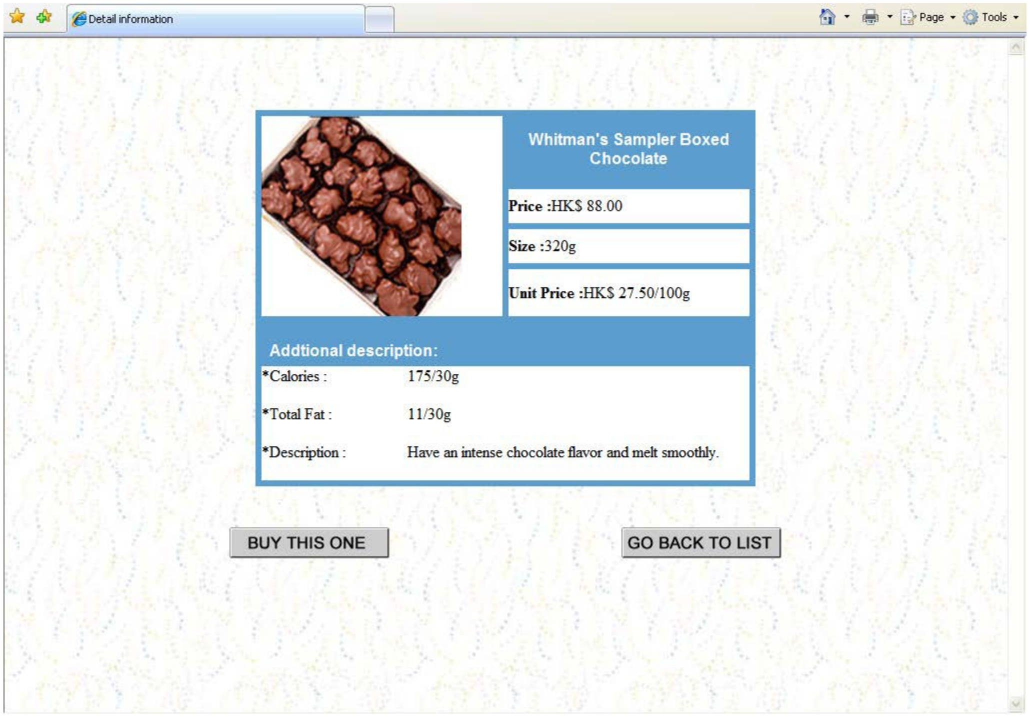

Figure 2. Snapshot of a Product Webpage

Each participant viewed three shopping trips with animated product titles and three shopping trips without any animation. In each shopping trip with the animation condition, to manipulate the animation factor, we randomly applied animation to the title of one of the six products[4]. For the searching task condition, we excluded the search target from being animated. This approach is consistent with prior studies that have applied animation as a visual distraction (Hong et al., 2007; Yoo & Kim, 2005). We designed the animated product title (water waves that moved in the title background) using Adobe Flash. In our context, we focused on seeing whether animation would increase individuals' overall attention to the product, including its image, title, and price. This aspect would increase our study's practical relevance because it is quite common to see websites apply animation to part of a product portfolio to increase the likelihood of attracting attention to the entire product's presentation. We followed existing industry practice and used an animation that does not irritate or intrude. A group of five undergraduate students took part in a pilot test in which they browsed the experiment website and evaluated whether or not the applied animation was irritating or intrusive. Stronger animations are likely to have stronger effects but can also cause a significant degree of irritation to online consumers (Gao et al., 2004), which limits animation's practical value. A review of the literature on ad intrusiveness or annoyance suggests that the intrusiveness of an animated ad may lead to avoidance behaviors and even website abandonment (Goldstein, McAfee, & Suri, 2013; Yoo & Kim, 2005). This result coincides with the finding from our survey of Alexa top 100 websites: we found that these websites used subtle as compared to more intrusive animation.

4.3 Dependent Variables

In this study, we used number of fixations and fixation duration to measure visual attention (Rayner, 1998). We also measured the time spent on a shopping trip, which refers to the duration of time participants spent on viewing the webpage before making their purchase decision in each shopping trip. For each participant, we measured this dependent variable in seconds by taking the average of the time spent on shopping trips with animated content and the average of the time spent on shopping trips without animated content. We measured the number of fixations and the total duration of fixations when participants' eyes fixated on the products. We followed previous research (Eriksen & Eriksen, 1971;

[4] In this study, we manipulated animation as moving water waves applied to the product titles. We did not apply animation on the product images because product images have different angles and colors, which could have potential confound with the animation. We kept the product titles in the same font style, font size, font color, and with similar length for all products to minimize any potential interaction between the product title and the animation.

Nakamura & Kondo, 2007; Spencer, 1969) and defined the eyemarks' staying in the same position for 0.1 seconds or more to be fixations. To test Hypotheses 3a, 3b, 4a, and 4b, we further derived two fixation measures: the percentage of the total number of fixations on animated (non-animated) items (% fixation count = total number of fixations on animated (non-animated) items/total number of fixations on the webpage) and the percentage of the total fixation duration on animated (non-animated) items (% fixation duration = total fixation duration on animated (non-animated) items/total fixation duration on the webpage). These two measures described the proportions of attentional resources that participants allocated to the animated item and non-animated items respectively.

4.4 Experiment Task and Procedure

We used an ASL 504 eyetracker to capture participants' eye movements during the experiment. This eyetracker deployed a camera that recorded at a rate of 60Hz. We used the official program that ASL provides, the E5000 User Interface Program, to control the eyetracker and capture the eye-tracking data. At the start of the experiment, the participants completed a calibration process with the eyetracker. After we calibrated the eye-tracking machine with each participant, we directed them to the instruction webpage on the experiment website. We reminded participants to follow the given instructions carefully. Before undertaking the six shopping trips, the participants first went through a training trip so that they could familiarize themselves with the user interface of the experiment website. At the end of the shopping trips, the participants completed an online questionnaire about their demographic data.

5 Data Analysis and Results

5.1 Manipulation and Control Checks

Prior to testing the hypotheses, we performed manipulation checks. First, we checked whether we successfully randomly assigned participants to task conditions. A multivariate analysis of variance (MANOVA) test showed that there were no significant differences in age ($F = 0.166$, $p = 0.685$), gender ($F = 2.044$, $p = 0.158$), and Internet experience ($F = 0.126$, $p = 0.724$) between the participants performing browsing tasks (n=30) versus searching tasks (n = 30). As such, the random assignment of participants to the two between-subject tasks was successful.

We proceeded to check whether the participants found the animation manipulations to be irritating. As we mention above, we carefully designed the animation to ensure that the animation was not intrusive to the participants. When asked how annoying the animation was, the participants reported an average rating of 3.06 on a seven-point Likert scale. The moderate rating gave us confidence that the manipulation of animation did not cause unnecessary irritation to the participants.

5.2 Hypotheses Testing

Figure 3 illustrates how we analyzed the data to test the hypotheses. To test H1 and H2, we compared NS (non-animated searching group) and NB (non-animated browsing group) with AS (animated searching group) and AB (animated browsing group). A repeated measures ANOVA revealed a significant difference in the average time participants spent on shopping trips when animation was present (AS+AB) versus when animation was not present (NS+NB). The participants spent significantly longer time on viewing the webpages with animation than on webpages without animation ($F = 10.207$, $p = 0.002$). The average time participants spent on a shopping trip was 29.309 seconds in the presence of animation and 25.489 seconds when animation was not present. As such, we found support for H1.

Table 2 presents the descriptive statistics and hypothesis testing results for H2. To test H2, we assessed the impact of animation on the attentional resources that individuals allocated to all items (both animated item and non-animated items) on the webpages. We aggregated the fixations data by taking averages of the number and duration of fixations on product items for shopping trips when animation was present (AS+AB) and for shopping trips when animation was not present (NS+NB). As Table 2 shows, a fixation duration score of 0.850 with number of fixations= 3.475, means that, on average, participants fixated at a particular product item for 3.475 times for 0.850 seconds for the shopping trips when animation was not present (NS+NB). A repeated measures MANOVA showed a significant result for animation ($F = 6.698$, $p = 0.002$). We then proceeded with tests of univariate ANOVAs. Specifically, animation significantly increased the number of fixations on all product items: from 3.475 to 3.880 ($F = 4.383$, $p = 0.041$). The fixation duration that participants spent on all product items on the same webpage also increased from

0.850 to 0.997 second (F = 7.629, p = 0.008) when an item was animated. Hence, we found support for H2: animation's presence increased individuals' attentional resources to all product items on a webpage.

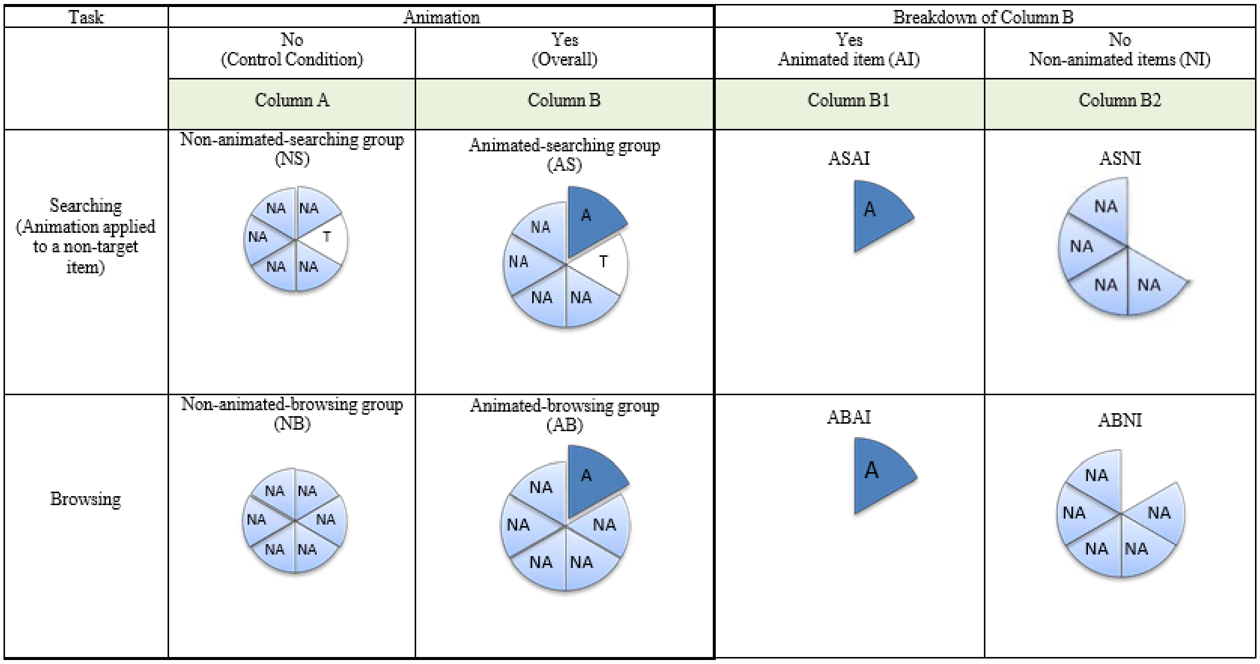

Figure 3. Illustration of Comparisons for Hypothesis Testing[5]

Table 2. Effects of Animation on the Attentional Resources Allocated to all Items

Independent variable	MANOVA	Dependent variable	Condition	Mean	Standard deviation	*F*	*p*
Animation	F = 6.698, p = 0.002**	No. of fixations	No animation (NS+NB)	3.475#	2.412	4.383	0.041*
			Animation (AS+AB)	3.880	2.577		
		Fixation duration (in seconds)	No animation (NS+NB)	0.850#	0.611	7.629	0.008**
			Animation (AS+AB)	0.997	0.682		

Note: * p < 0.05, ** p < 0.01.
The average number of fixations and the average fixation duration on all items in the control condition.

To test H3a, H3b, H4a, and H4b, we divided the product items on the webpages with animation into two subgroups: one animated product item (ABAI) and five non-animated product items (ABNI) for the browsing task condition and one animated product item (ASAI) and four non-animated product items (ASNI), after excluding the search target, for the searching task condition. Specifically, to assess whether the presence of animation increased (decreased) the *proportion* of attentional resources that individuals allocated to the animated items (non-animated items), we checked whether the *average percentage* of the total number of fixations and the *average percentage* of the total fixation duration on animated items (non-animated items) were higher (lower) when animation was present on the webpages (the animation condition) than when animation was not present on the webpages (the control condition).

To test H3a and H4a, we compared the average percentages of total number of fixations and total fixation duration on the animated item in the animation condition (ASAI+ABAI) with the average percentages of

[5] The size of the pie and its components indicate the amount of attentional resources. To test hypotheses H3a, H3b, H4a, and H4b, we divided column B into Column B1 and Column B2. "A" stands for the animated item, "NA" stands for the non-animated items, and "T" stands for the search target item.

total number of fixations and total fixation duration on the product items in the control condition (NS+NB). For the webpages with animation present, we extracted the animated product items and calculated the average percentages of total number of fixations and total fixation duration on the animated item for browsing and searching tasks, respectively. For the webpages without animation present (control condition), we included all six product items and took the average percentages of total number of fixations and total fixation duration on the six product items[6]. Table 3 presents the descriptive statistics and hypotheses-testing results for H3a and H4a.

H3a states that animation's presence on a webpage increases the proportion of attentional resources that individuals allocate to the animated item. We performed a repeated measures MANOVA and found a significant main effect for animation (F = 3.796, p = 0.028). Compared with the product items on the webpages without animation (NS+NB), we found the average percentage of number of fixations on the animated item (ASAI+ABAI) to be significantly greater (mean = 16.788%, F = 7.475, p = 0.008), and the average percentage of total duration of fixations was also significantly greater (mean = 17.064%, F = 7.061, p = 0.01). Hence, we found support for H3a.

Table 3. Animation's Effects on the Attentional Resources that Individuals Allocate to the Animated Item

Independent variable	MANOVA	Dependent variable	Condition	Mean	Standard deviation	*F*	*p*
Animation	F = 3.796 p = 0.028*	% no. of fixations	No animation (NS+NB)	14.731[##]	1.420	7.475	0.008**
			Animation (ASAI+ABAI)	16.788	6.374		
		% fixation duration	No animation (NS+NB)	14.786[##]	1.583	7.061	0.01**
			Animation (ASAI+ABAI)	17.064	7.432		
Task x animation	F = 4.815 p = 0.012*	% no. of fixations	No animation + browsing (NB)	14.495[##]	1.177	8.820	0.004**
			No animation + searching (NS)	14.967[##]	1.613		
			Animation + browsing (ABAI)	18.785	5.334		
			Animation + searching (ASAI)	14.790	6.778		
		% fixation duration	No animation + browsing (NB)	14.548[##]	1.080	9.559	0.003**
			No animation + searching (NS)	15.024[##]	1.953		
			Animation + browsing (ABAI)	19.477	6.098		
			Animation + searching (ASAI)	14.652	7.947		

Note: * p < 0.05, ** p < 0.01.
[##] The average percentage of the total number of fixations and the average percentage of the total fixation duration on the non-animated items in the control condition.

H4a states that the task condition moderates animation's effects on the proportion of attentional resources that individuals allocate to the animated item such that they allocate a higher proportion of their attentional resources to the animated item when they perform browsing rather than searching tasks ((ASAI vs. NS) vs. (ABAI vs. NB)). A repeated measures MANOVA found a significant interaction effect for task and

[6] Ideally, when testing H3a, we should have compared attention to a specific product item with and without animation. However, that would require a subject to shop for the same set of products twice in the experiment (once with the specific item animated and once without animating that item), which was not viable in our current experiment design. Hence, we used the best possible surrogate measure by comparing attention to the animated item with attention to the average of all items without animation. We acknowledge this limitation and encourage future research to resolve this issue by using a between-subject design.

animation (F = 4.815, p = 0.012). The results of ANOVAs revealed significant effects for task x animation on the average percentage of number of fixations (F = 8.820, p = 0.004) and the average percentage of duration of fixations (F = 9.559, p = 0.003). When participants engaged in browsing tasks, the incremental average percentage of number of fixations on animated items (ABAI-NB; 18.785%- 14.495% = 4.29%) was greater than when participants were performing searching tasks (ASAI-NS; 14.790%-14.967% = -0.177%). Similarly, the incremental average percentage of duration of fixations on animated items was greater in browsing tasks (ABAI-NB; 19.477%-14.584% = 4.893%) than in searching tasks (ASAI-NS; 14.652%-15.024% = -0.372%). Therefore, we found support for H4a. Figure 4 presents the plots of task x animation on the percentage of number of fixations and the percentage of duration of fixations.

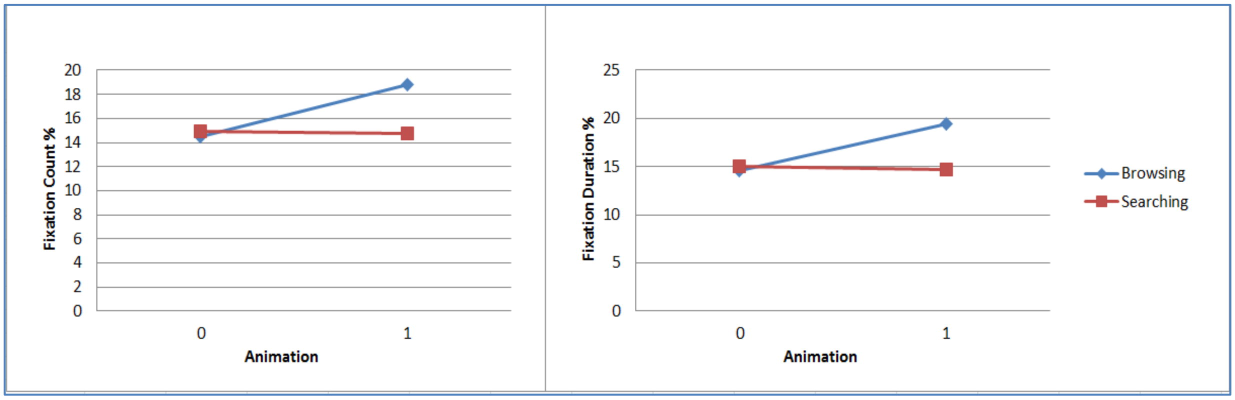

Figure 4. Interaction Plots for Animated Items

Table 4 presents the descriptive statistics and hypotheses-testing results for H3b and H4b. To test H3b and H4b, we compared the average percentages of total number of fixations and total fixation duration on the non-animated items in the animation condition (ABNI+ASNI) with the average percentages of total number of fixations and total fixation duration on the product items in the control condition (NS+NB). We excluded the animated item from data analysis. To avoid an unnecessary confounding effect, we excluded the target product items in the searching task in the subsequent analysis. H3b states that animation's presence on a webpage decreases the proportion of attentional resources that individuals allocate to the non-animated items. The repeated measures MANOVA revealed a significant result for animation (F = 4.917, p < 0.011).

When a webpage had no animation, the average percentage of number of fixations on the non-animated items was significantly greater (mean = 14.731%, F = 9.534, p = 0.003); also, the average percentage of total duration of fixations was significantly greater (mean = 14.786%, F = 6.716, p < 0.012). Therefore, we found support for H3b[7].

H4b states that task type moderates animation's effects on the proportion of attentional resources that individuals allocate to non-animated items such that they allocate a lower proportion of their attentional resources to non-animated items when they perform browsing rather than searching tasks.((ASNI vs. NS) vs. (ABNI vs. NB)). The repeated measures MANOVA revealed a non-significant effect for task x animation interaction (F = 0.454, p = 0.583). The results of univariate ANOVAs showed non-significant effects for the interactions with the average percentage of number of fixations (F = 0.007, p = 0.935) and the average percentage of duration of fixations (F = 0.228, p = 0.635). Hence, we did not find support for H4b. Table 5 summarizes the hypotheses-testing results[8].

[7] Note that H3b is not a reverse statement of H3a (see the way we measured fixation data). Specifically, when measuring fixation on animated/non-animated items on a webpage and computing the average percentages of fixation, we used fixation on animated/non-animated items divided by total fixation on the webpage, which also includes fixation on non-animated non-product items (e.g., blank space, menu bar, tool bar, etc.). Hence, adding fixation on animated items and fixation on non-animated items does not equal to the total fixations on the webpage.

[8] Note that, when calculating the fixation data on animated/non-animated item, we included fixations on the whole product area, which includes the product image, the product title, and the price. We considered the whole product area as a better representation of the total attention that animation drew to a product or the total attention that a non-animated product received. Nevertheless, we conducted additional analysis in which we limited the fixation data to only the product title and found similar results for H2 to H4 (H2: F=12.974, p = 0.001 for no. of fixation and F = 19.629, p < 0.001 for fixation duration; H3a: F = 48.823, p < 0.001 for % no. of fixations and F = 38.263, p < 0.001 for % fixation duration; H3b: F = 5.540, p = 0.022 for % no. of fixations and F = 7.368, p = 0.009

Table 4. Animation's Effects on the Attentional Resources that Individuals Allocate to the Non-animated Items

Independent variable	MANOVA	Dependent variable	Condition	Mean	Standard deviation	*F*	*p*
Animation	F = 4.917 p = 0.011*	% no. of fixations	No animation (NS+NB)	14.731##	1.420	9.534	0.003**
			Animation (ASNI + ABNI)	13.814	1.888		
		% fixation duration	No animation (NS+NB)	14.786##	1.583	6.716	0.012*
			Animation (ASNI + ABNI)	13.886	2.066		
Task x animation	F = 0.454 p = 0.583	% no. of fixations	No animation + browsing (NB)	14.495##	1.177	0.007	0.935
			No animation + searching (NS)	14.967##	1.613		
			Animation + browsing (ABNI)	13.553	1.288		
			Animation + searching (ASNI)	14.075	2.336		
		% fixation duration	No animation + browsing (NB)	14.548##	1.080	0.228	0.635
			No animation + searching (NS)	15.024##	1.953		
			Animation + browsing (ABNI)	13.482	1.394		
			Animation + searching (ASNI)	14.290	2.531		

Note: * p < 0.05, ** p < 0.01.
The average percentage of the total number of fixations and the average percentage of the total fixation duration on the non-animated items in the control condition.

for % fixation duration; H4a: F = 5.392, p = 0.024 for % no. of fixations and F = 4.538, p = 0.037 for % fixation duration; H4b: F = 1.279, p = 0.263 for % no. of fixations and F = 0.372, p = 0.544 for % fixation duration).

Table 5. Summary of Hypotheses Testing

Hypotheses	Assessment	Results
H1: Animation's presence on a webpage increases the length of time individuals view the webpage's content.	(AS+AB) vs. (NS+NB)	Supported
H2: Animation's presence on a webpage increases the amount of attentional resources that individuals allocate to all items on the webpage (i.e., the animated and non-animated items).	(AS+AB) vs. (NS+NB)	Supported
H3a: Animation's presence on a webpage increases the proportion of attentional resources that individuals allocate to the animated item.	(ASAI+ABAI) vs. (NS+NB)	Supported
H3b: Animation's presence on a webpage decreases the proportion of attentional resources that individuals allocate to non-animated items.	(ABNI+ASNI) vs. (NS+NB)	Supported
H4a: Task type moderates animation's effects on the proportion of attentional resources that individuals allocate to the animated item such that they allocate a higher proportion of their attentional resources to the animated item when they perform browsing rather than searching tasks.	(ASAI vs. NS) vs. (ABAI vs. NB)	Supported
H4b: Task type moderates animation's effects on the proportion of attentional resources that individuals allocate to non-animated items such that they allocate a lower proportion of their attentional resources to non-animated items when they perform browsing rather than searching tasks.	(ASNI vs. NS) vs. (ABNI vs. NB)	Rejected

5.3 Additional Analysis

To untangle the relationship between recall and attention measures, we collected additional data on how well our participants recalled products and analyzed its relationship with fixation data that we report in Section 5.2 earlier. We measured recall based on whether the participants could recall the product titles that had appeared on the experiment website. For each product category, we presented the participants with 12 brand names (six valid brands and six invalid brands) and asked them to identify the brand names that they had previously seen during their shopping trips. We calculated recall as the average number of correct identifications of product titles in each product category. First, we used recall as the dependent variable (instead of fixation data) and tested H2 to H4 again. The results showed non-significant effects on all hypotheses (H2: $F = 1.206$, $p = 0.277$; H3a: $F = 0.048$, $p = 0.827$; H3b: $F = 2.205$, $p = 0.143$; H4a: $F = 2.446$, $p = 0.123$; H4b: $F = 0.003$, $p = 0.956$). So, if we did not have the eye-tracking data and only had recall to indicate attention, we would have reached the conclusion that animation had no effect on the overall attention to the webpage and no effect on attention to the animated or non-animated items. Second, using recall as the dependent variable, we examined whether fixation data was related to recall. The logistic regression showed that fixation count had a significant positive relationship with recall ($\beta = 0.226$, $p < 0.001$), while fixation duration had a significant negative relationship with recall ($\beta = -0.374$, $p = 0.047$). Together, the results of additional analyses show that animation may have an effect on recall through fixation data but fixation data is a more direct and reliable measure of attention than recall.

6 Discussion and Implications

6.1 Theoretical Implications

This study provides empirical support for Humphreys and Revelle's (1984) conception that the amount of individuals' attentional resources can vary in different situations and especially in the online environment. When a webpage features animation, online consumers view the webpage for a longer duration and increase the attentional resources they allocate to all items (animated and non-animated items) on it. Animation increases the amount of attentional resources by inducing arousal as Humphreys and Revelle (1984) suggest.

Prior studies (e.g., Rau et al., 2007) on Web animation have typically assumed that individuals have a fixed amount of attentional resources. Although Kahneman's (1973) original conception allows for variation in the amount of attentional resources that individuals possess, other researchers (e.g., Navon & Gopher, 1979) have assumed that individuals have a fixed amount of attentional resources. Most prior studies on animation that reference attention theories have typically assumed a fixed amount of attentional resources and focused on animation's attention capturing-capabilities. Our study extends prior studies by showing that animation can 1) increase the amount of attentional resources that individuals can allocate to all items and 2) cause them to allocate a higher proportion of their attentional resources to the animated item. Our study helps explain the inconsistent findings in prior studies that have assumed that individuals have a fixed amount of attentional resources and provides a more thorough understanding of animation's effects on attention.

Web animation is a double-edged sword in the sense that it increases the proportion of attentional resources that individuals allocate to the animated item at the expense of the proportion of attentional resources they allocate to non-animated items. This finding is consistent with Lai et al.'s (2007, 2009) results. Interestingly, both we and Lai et al. (2007, 2009) tested animated content that did not fall outside the main content area such as with a typical banner ad on the top or to the right of a webpage (Resnick & Albert, 2014). Instead, the animated content was either part of the main content or overlapped with it. Comparing this design to other designs in studies that found animation had no significant effects on fixation data (Burke et al., 2005; Dreze & Hussherr, 2003), recall (Bayles, 2002; Burke et al., 2005), or click-through rate (Robinson et al., 2007), we noticed those studies typically applied animation to an outlined rectangular area (i.e., banner ads) that stayed independently either on top or to the right of the main content area. Our result also differed from those that Hong et al. (2004a) found: these authors used a similar website design (i.e., product titles in the main content area used animation), but the product titles had flashing animation compared to the more subtle moving water waves we used. As a result, Hong et al. (2004a) found that animation's presence decreased how well individuals could recall the non-animated items without improving how well they could recall the animated items, while we found that animation's presence increased individuals' attention to animated items at the cost of non-animated items. Overall, these results are consistent with Resnick and Albert (2014) in the sense that the so-called "banner blindness" may occur due to the location of the ad and the animation's intrusiveness. Our findings show that subtle animation applied to the main content of a webpage may help to avoid "banner blindness" and lead to better attention to the animated item.

In addition, we found that animation was more effective in capturing individuals' attention when they performed browsing tasks than searching tasks. Specifically, the increases in average percentages of both the number of fixations and the duration of fixations on animated items were greater in browsing tasks than in searching tasks. Cognitive psychology theories suggest that visual stimuli with visual distinctiveness capture attention through stimulus-driven attention capture. Our results provide support for this conjecture by showing that animation was more effective in attracting attention when individuals performed browsing tasks and stimulus-driven attention capture dominated.

We also found that, while task type did moderate the proportion of attentional resources that individuals allocated to animated items, it did not moderate the proportion of attentional resources they allocated to the non-animated items. Contrary to our prediction, we did not find a significant decrease in the proportion of attentional resources individuals allocated to the non-animated items together with the significant increase in the proportion of attentional resources they allocated to the animated items in the browsing tasks condition. As for why, in the browsing tasks condition, individuals may not necessarily have taken the additional proportion of attentional resources on animated items from the attentional resources they allocated to the non-animated items but from the attentional resources they allocated to other parts of webpages. The two studies we identified that have investigated animation's effects on individuals across browsing and searching tasks used different dependent variables with inconsistent results. While Li and Bukovac (1999) found the recall of banner ads was higher for the animated banner ads than the static banner ads, they did not find animation's effect to differ across browsing and searching tasks. Hong et al. (2007) demonstrated that task type partially moderated animation's effects on individuals' self-reported attention. While they show animation to have had a significantly greater negative impact on performance in browsing task than in searching task, they did not find task type to moderate animation's effects on consumers' perceptions toward using the website. Our study differs from these two identified studies by shifting the focus from recall and self-reported attention to the visual attention. Considering the results of our study and prior studies together, we suggest that there is a discrepancy between recall, self-reported attention, and visual attention.

Researchers should be careful in selecting dependent variables and be cautious about generalizing the findings to closely related but different factors. In particular, our study complements prior studies by showing that task type (browsing versus searching tasks) moderated how animation affected the allocation of visual attention to animated items but not to non-animated items.

We also answer researchers' call for research that uses eye-tracking machines to study animation (Rau et al., 2007). Compared with recall, which is a convenient measure of attention, eye-tracking data serves as a direct measure of attention and captures individuals' immediate response to animation.

Our results show that, while recall was significantly related to fixation counts and fixation durations as expected (i.e., consumers need to see to remember), we failed to find a direct significant effect of animation on recall. This finding may help to explain the mixed findings on recall reported in prior animation studies (e.g., Hong et al., 2004a; Lang et al., 2002; Sundar & Kalyanaraman, 2004). Because downstream attention measures, such as recall, are subject to many other factors, such as encoding of the information and retrieval of the information, researchers who do not find significant difference on recall should not jump to the conclusion that a particular design feature has no effect. Moreover, while it is tempting to say that recall is ultimately what matters to online marketers, prior marketing research has also suggested that, even if a consumer does not remember seeing an ad for a product, being exposed to such an ad can still affect their evaluation of the product (Janiszewski, 1993). Our results show that this phenomenon may have happened because individuals did fixate on the ads but they did not register them in their short-term memory. This result is also similar to that of Yoo et al. (2004): these authors measured attention and memory separately and found that animation did not have consistent effects on attention and memory. By using a direct measure of visual attention, we gain new insights into animation's immediate effects on online consumers' attention.

6.2 Limitations and Future Research

This research has several limitations. Following prior studies (e.g., Lai et al., 2009), we used a hypothetical experiment website instead of a field experiment with popular retail websites (e.g., Amazon). Internal validity is the main strength of laboratory experiments. We designed a hypothetical experiment website to rule out the many potential exogenous interface variables (e.g., flashing buttons) that may interact with the manipulation of animation in the study. Future research can seek partnerships with popular retail websites to conduct field experiments, but they must be able to control for the exogenous variables. Our using student participants may limit our findings' generalizability (Compeau, Marcolin, Kelley, & Higgins, 2012). Before generalizing the results to other types of individuals, research must replicate this study using such subjects. In our study, experiment participants needed to complete the experiment with an eye-tracking machine. In order to avoid sensitizing the participants, we did not use special machines to assess arousal levels while we tracked their eye movements. Future research can assess animation's effects on arousal with more direct measurements of arousal, such as heart rate (e.g., Gellatly & Meyer, 1992; Pastor & Mayo, 2007), skin conductance level (e.g., Lang et al., 2002), and electroencephalography (EEG) measures (e.g., Gregor, Lin, Gedeon, Amir, & Zhu, 2014). Doing so may enhance our understanding of animation's effects on arousal and provide a more complete picture of the relationships among animation, arousal, attention, and task.

Further, future research could investigate animation's effects on memory capacity and attentional resources under different types of websites and tasks. In this study, we used a relatively common but simple task: online shopping. Because we limited the numbers of product categories and possible selection, the task complexity was relatively low. This setup allows consumers to expand the amount of their attentional resource when needed (i.e., when animation is present). A more complex task could exhaust the attentional resources and leave less room for expansion. As such, we need future research to test the boundary conditions of animation effects under more complex tasks on different types of websites. Note that we did not directly measure the limit of the amount of attentional resources in our study. Future research that directly measures the amount of attentional resources and use more complex tasks may allow researchers to gain more insights into the effects of animation.

Lastly, future research can extend the generalizability of our study by investigating animation's effects on individuals in different regions/cultures. Prior studies (e.g., Kankanhalli, Tan, Wei, & Holmes, 2004) have shown that individuals' perceptions and behaviors may depend on cultural settings.

6.3 Practical Implications

A review of the top-100 websites rated by Alexa shows that 81.3 percent of shopping websites used some sort of animation and that this animation featured three characteristics. First, they tended to use non-intrusive and much more subtle animation technologies than their counterparts say about a decade ago. For example, many websites used a type of animation similar to the transition effect of a PowerPoint slide show such that a particular ad would stay still for a few seconds before another ad clicked in and replaced it. This motion continued until consumers moved away from the webpage. Practitioners have also noticed that "animation is a powerful instrument that in the majority of cases can save the day"; however, as Birch (2015) notes, "finding an optimal balance that won't overpower users is the key to success". A review of studies on “banner blindness” also suggests that an animated ad’s intrusiveness may lead to avoidance behavior. We followed the current trend and tested subtle animation in our study. We found positive results in the sense that subtle animation can still grab consumers’ attention and lead to a longer viewing time not only on the animated items but also to other items on the same webpage; hence, we shed light on tackling “banner blindness”.

Second, in reviewing the Alexa top-100 websites, we also found they tended to apply animation technologies to standalone ads either on the top or to the right of the main content area (also see Resnick & Albert, 2014). After reviewing studies on banner blindness, we believe that this tendency might be another leading cause for the so-called “banner blindness”. As expected, when we applied a subtle animation to the main content area, we successfully avoided “banner blindness”. Based on this encouraging result, practitioners may consider highlighting the products they want to promote inside the product-listing area (instead of framing it as an ad outside the product listing area). In fact, we have started to see some shopping websites do exactly that. For example, flipkart.com and jd.com use a colorful background to highlight some important product features for a selected number of products on the listing page; other websites change the background color of a product title or change the size of the product when consumers move their mouse over any part of the product area (e.g., Taobao.com; Alibaba.com; rakuten.co.jp). We took this feature a step further by applying a subtle animation because researchers (e.g., Folk, Remington, & Johnston, 1992) believe that animation has a stronger attention-attracting ability than static features, such as color.

Third, in reviewing the Alexa top-100 websites, we found that most websites applied animation to graphics instead of text possibly because earlier applications of animation on texts, such as flashing, enlarged, or moving text, were too intrusive and did not generate good results (Bayles, 2002; Benway & Lane, 1998; Hong et al., 2004a). Nevertheless, we found two websites that still used enlarging texts in their ads to grab attention (xinhuanet.com and pixnet.net) and one that used rolling text (naver.com). In our study, we tested a novel form of animation that one can apply to text without such intrusive features and obtained positive results. However, applying such an animation on one product may decrease the proportion of attention that individuals give to other products. Fortunately, the descriptive statistics in Table 3 show that the magnitude of such a decrease was relatively small with our participants. Hence, practitioners need to decide if this is a tradeoff that they are willing to make (i.e., inducing more attention to certain products under promotion at a (albeit small) cost to other products).

In short, our study highlights animation’s attention-capturing capabilities when it appears on certain places on a webpage and when it is not intrusive. Our results show that online consumers have the tendency to allocate a higher proportion of their attentional resources to animated items—particularly when browsing product categories without specific target items to purchase in mind. This situation is exactly the type of situation when online retailers may want to exercise more influence over their consumers by highlighting the products they would like to promote or recommend to online consumers.

Proper use of a subtle animation can also induce online consumers to view the overall content of a webpage for a longer duration. This finding encourages online retailers to use subtle animation on their websites to enhance online consumers’ shopping experience and retain them for a longer period, which may eventually lead to a higher probability that they will make a purchase.

7 Conclusion

We investigated animation’s effects on the duration of time that online consumers spent viewing a webpage and how they allocated their attentional resources to both animated and non-animated items. Animation increased the duration that consumers spent on viewing the webpage and also the attentional resources that they allocated to its content. While animation’s effect on the proportion of attentional resources that online consumers allocated to the animated item varied across online tasks, its effect on the proportion of attentional resources that they allocated to the non-animated items did not differ significantly across online tasks. Online consumers allocated a higher proportion of their attentional resources to an animated item when they browsed the website than when they searched for a specific target product. The eye-tracking results complement prior studies that focus on animation’s effects on attention and cognitive behavior of online consumers.

Acknowledgements

We thank the Senior Editor, Atreyi Kankanhalli, and the anonymous review panel for their many helpful suggestions. This project was partially funded by the Endowed Michael Jebsen Professorship at Hong Kong University of Science and Technology.

References

Anderson, K. J. (1990). Arousal and the inverted U hypothesis: A critique of Neiss's "reconceptualizing arousal". *Psychological Bulletin, 107*(1), 96-100.

Anderson, K. J., Revelle, W., & Lynch, M. J. (1989). Caffeine, impulsivity, and memory scanning: A comparison of two explanations for the Yerkes–Dodson effect. *Motivation and Emotion, 13*(1), 1-20.

Baltas, G. (2003). Determinants of internet advertising effectiveness: An empirical study. *International Journal of Market Research*, *45*(4), 505-513.

Bayles, M. E. (2002). Designing online banner advertisements: Should we animate? *Proceedings of CHI 2002 ACM Conference on Human Factors in Computer Systems* (pp. 363-366). NY: ACM Press.

Benway, J. P., & Lane, D. M. (1998). Banner blindness: Web searchers often miss "obvious" links. *Internetworking*, *1*(3).

Bodoff, D. (2006). Relevance for browsing, relevance for searching. *Journal of the American Society for Information Science and Technology, 57*(1), 69-86.

Birch, N. (2015). 10 of the best types of Web animation so far. *Onextrapixel.* Retrieved from http://www.onextrapixel.com/2015/07/10/10-of-the-best-types-of-web-animation-so-far/

Brucks, M. (1985). The effects of product class knowledge on information search behavior. *Journal of Consumer Research, 12*(1), 1-16.

Burke, M., Hornof, A., Nilsen, E., & Gorman, N. (2005). High-cost banner blindness: Ads increase perceived workload, hinder visual search, and are forgotten. *ACM Transactions on Computer-Human Interaction, 12*(4), 423-445.

Chan, H. C., Wei, K. K., & Siau, K. L. (1993). User-database interface: The effect of abstraction levels on query performance. *MIS Quarterly, 17*(4), 441-464.

Cho, C. H. (2003). The effectiveness of banner advertisements: Involvement and click-through. *Journalism and Mass Communication Quarterly, 80*(3), 623-645.

Cohen, S., & Weinstein, N. (1981). Nonauditory effects of noise on behavior and health. *Journal of Social Issues, 37*(1), 36-70.

Compeau, D., Marcolin, B., Kelley, H., & Higgins, C. A. (2012). Generalizability of information systems research using student subjects—a reflection on our practices and recommendations for future research. *Information Systems Research, 23*(4), 1093-1109.

Detenber, B., Simons, R., & Bennett, G. (1998). Roll'em!: The effects of picture motion on emotional responses. *Journal of Broadcasting & Electronic Media*, *42*(1), 113-127.

Diao, F., & Sundar, S. S. (2004). Orienting response and memory for Web advertisements: Exploring effects of pop-up window and animation. *Communication Research*, *31*(5), 537-567.

Diaper, D., & Waelend, P. (2000). World Wide Web working whilst ignoring graphics: Good news for web page designers. *Interacting with Computers*, *13*(2), 163-181.

Dodds, W. B., Monroe, K. B., & Grewal, D. (1991). Effects of price, brand, and store information on buyers' product evaluations. *Journal of Marketing Research*, *28*(3), 307-319.

Dreze, X., & Hussherr, F. (2003). Internet advertising: Is anybody watching? *Journal of Interactive Marketing*, *17*(4), 8-22.

eMarketer. (2013). How millennials shop online: Spending more than 1 hour per day on retail sites is fairly common. *eMarketer.* Retrieved from http://www.emarketer.com/Article/How-Millennials-Shop-Online/1010031

Eriksen, C. W., & Eriksen, B. A. (1971). Visual perceptual processing rates and backward and forward masking. *Journal of Experimental Psychology*, *89*(2), 306-313.

Eysenck, M.W. (1982). *Attention and arousal: Cognition and performance*. Berlin: Springer.

Folk, C. L., Remington, R. W., & Johnston, J. C. (1992). Involuntary covert orienting is contingent on attentional control settings. *Journal of Experimental Psychology: Human Perception & Performance*, *18*(4), 1030-1044.

Gao, Y., Koufaris, M., & Ducoffe, R. H. (2004). An experimental study of the effects of promotional techniques in Web-based commerce. *Journal of Electronic Commerce in Organization, 2*(3), 1-20.

Gati, I., & Tversky, A. (1987). Recall of common and distinctive features of verbal and pictorial stimuli. *Memory and Cognition, 15*(2), 97-100.

Gellatly, I. R., & Meyer, J. P. (1992). The effects of goal difficulty on physiological arousal, cognition, and task performance. *Journal of Applied Psychology, 77*(5), 694-704.

Girelli, M., & Luck, S. J. (1997). Are the same attentional mechanisms used to detect visual search targets defined by color, orientation, and motion? *Journal of Cognitive Neuroscience, 9*(2), 238-253.

Goldstein, D. G., McAfee, R. P., & Suri, S. (2013). The cost of annoying ads. In *Proceedings of the 22nd International World Wide Web Conference* (pp. 459-470).

Goswami, S., Chan, H. C., & Kim, H. W. (2008). The role of visualization tools in spreadsheet error correction from a cognitive fit perspective. *Journal of the Association for Information Systems, 9*(6), Article 16.

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature, 423*(6939), 534-537.

Gregor, S., Lin, A. C. H., Gedeon, T., Amir, R., & Zhu, D. (2014). Neuroscience and a nomological network for the understanding and assessment of emotions in information systems research. *Journal of Management Information Systems, 30*(4), 13-48.

Hamborg, K.-C., Bruns, M., Ollermann, F., & Kaspar, K. (2012). The effect of banner animation on fixation behavior and recall performance in search tasks. *Computers in Human Behavior, 28*(2), 576-582.

Hamilton, P., Hockey, R., & Rejman, M. (1977). The place of the concept of activation in human information processing theory: An integrative approach. In S. Dornic (ed.), *Attention and performance VI* (pp. 463-486). London: Academic Press.

Heo, N., & Sundar, S. S. (2000). *Emotional responses to Web advertising: The effects of animation, position, and product involvement on physiological arousal*. Paper presented at the Advertising Division of the Annual Convention of the Association for Education and Journalism and Mass Communication, Phoenix, AZ.

Hillstrom, A. P., & Yantis, S. (1994). Visual motion and attentional capture. *Perception & Psychophysics, 55*(4), 399-411.

Hong, W., Thong, J. Y. L., & Tam, K. Y. (2004a). Does animation attract online consumers' attention? The effects of flash on information search performance and perceptions. *Information Systems Research, 15*(1), 60-86.

Hong, W., Thong, J. Y. L., & Tam, K. Y. (2004b). The effects of information format and shopping task on consumers' online shopping behavior: A cognitive fit perspective. *Journal of Management Information Systems, 21*(3), 151-188.

Hong, W., Thong, J. Y. L., & Tam, K. Y. (2007). How do Web users respond to non-banner-ads animation? The effects of task type and user experience. *Journal of the American Society for Information Science and Technology*, *58*(10), 1467-1482.

Huber, V. L. (1985). Effects of task difficulty, goal setting, and strategy on performance of a heuristic task. *Journal of Applied Psychology, 70*(3), 492-504.

Humphreys, M. S., & Revelle, W. (1984). Personality, motivation, and performance: A theory of the relationship between individual differences and information processing. *Psychological Review, 91*(2), 153-184.

Internet Live Stats. (2016). *Internet users*. Retrieved from http://www.internetlivestats.com/internet-users/

James, W. (1950). *The principles of psychology (Vol. 1).* New York: Holt.

Janiszewski, C. (1993). Preattentive mere exposure effects. *Journal of Consumer Research*, *20*(3), 376-392.

Jiang, C., Lim, K. H., & Sun, Y. (2009). Exploring effective advertising strategies: The roles of formats, content relevance and shopping tasks on ad recognition. In *Proceedings of the International Conference of Information Systems.*

Josephson, S. (2005). Eye tracking methodology and the Internet. In K. Smith, S. Moriarty, G. Barbatsis, & K. Kenney (eds.), *Handbook of visual communication: Theory, methods, and media* (pp. 63-80). Mahwah, NJ: Lawrence Erlbaum Associates.

Juse, M., & Carpenter, P. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review, 87*(4), 329-354

Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice-Hall.

Kankanhalli, A., Tan, B. C. Y., Wei, K. K., & Holmes, M. C. (2004). Cross-cultural differences and information systems developer values. *Decision Support Systems, 38*(2), 183-195.

Lai, Y.-L., Hui, K. L., & Liu, N. (2007). To animate or not to animate? The effects of animation on recall, product perceptions and attitude. In *Proceedings of the Pacific Asia Conference on Information Systems.*

Lai, Y.-L., Kuan, K. K. Y., Hui, K. L., & Liu, N. (2009). The effects of moving animation on recall, hedonic and utilitarian perceptions, and attitude. *IEEE Transactions on Engineering Management, 56*(3), 468-477.

Lang, A., Brose, J., Wise, K., & David, P. (2002). Captured by the World Wide Web: Orienting to structural and content features of computer-presented information. *Communication Research, 29*(3), 215-245.

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology: Human Perception and Performance, 21*(3), 451-468.

Lee, J., Ahn, J.-H., & Park, B. (2015). The effect of repetition in Internet banner ads and the moderating role of animation. *Computers in Human Behavior, 46*, 202-209.

Li, H., & Bukovac, L. (1999). Cognitive impact of banner ad characteristics: An experimental study. *Journalism and Mass Communication Quarterly, 76*(2), 341-353.

Lohtia, R., Donthu, N., & Hershberger, E. K. (2003). The impact of content and design elements on banner advertising click-through rates. *Journal of Advertising Research, 43*(4), 410-418.

McDonald, D. M., & Chen, H. (2006). Summary in context: Searching versus browsing. *ACM Transactions on Information Systems, 24*(1), 111-141.

Moe, W. W. (2003). Buying, searching, or browsing: Differentiating between online shoppers using in-store navigational clickstreams. *Journal of Consumer Psychology, 13*(1/2), 29-40.

Nairne, J. S., Neath, I., Serra, M., & Byun, E. (1997). Positional distinctiveness and the ratio rule in free recall. *Journal of Memory and Language, 37*(2), 155-166.

Nakamura, M., & Kondo, T. (2007). Characterization of distribution pattern of eye fixation pauses in observation of knotty wood panel images. *Journal of Physiological Anthropology, 26*(2), 129-133.

Navon, D., & Gopher, D. (1979). On the economy of the human information processing system. *Psychological Review*, *86*(3), 214-255.

Neiss, R. (1988). Reconceptualizing arousal: Psychobiological states in motor performance. *Psychological Bulletin, 103*(3), 345-366.

Osman, A., & Moore, C. M. (1993). The locus of dual-task interference: Psychological refractory effects on movement-related brain potentials. *Journal of Experimental Psychology: Human Perception and Performance, 19*(6), 1292-1312.

Pagendarm, M., & Schaumburg, H. (2001). Why are users banner-blind? The impact of navigation style on the perception of Web banners. *Journal of Digital Information, 2*(1).

Pastor, J. C., Mayo, M., & Shamir, B. (2007). Adding fuel to fire: The impact of followers' arousal on ratings of charisma. *Journal of Applied Psychology, 92*(6), 1584-1596.

Phang, C. W., Kankanhalli, A., Ramakrishnan, K., & Raman, K. S. (2010). Customers' preference of online store visit strategies: An investigation of demographic variables. *European Journal of Information Systems, 19*(3), 344-358.

Phillips, B., & Lee, W. (2005). Interactive animation: Exploring spokes-characters on the Internet. *Journal of Current Issues & Research in Advertising*, *27*(1), 1-17.

Poole, A., & Ball, L. J. (2006). Eye tracking in human-computer interaction and usability research: Current status and future prospects. In C. Ghaoui (Ed.), *Encyclopedia of human-computer interaction.* Pennsylvania: Idea Group.

PricewaterhouseCoopers. (2015). *IAB Internet advertising revenue report, FY 2014*. Retrieved from http://www.iab.net/media/file/PwC_IAB_Webinar_Presentation_FY2014_PWC.pdf

Rau, P., Chen, J., & Chen, D. (2006). A study of presentations of mobile web banners for location-based information and entertainment information websites. *Behaviour & Information Technology, 25*(3), 253- 261.

Rau, P. L., Gao, Q., & Liu, J. (2007). The effect of rich web portal design and floating animations on visual search. *International Journal of Human-Computer Interaction, 22*(3), 195-216.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*(3), 372-422.

Resnick, M., & Albert, W. (2014). The impact of advertising location and user task on the emergence of banner ad blindness: An eyetracking study. *International Journal of Human-Computer Interaction, 30*(3), 206- 219.

Robinson, H., Wysocka, A., & Hand, C. (2007). Internet advertising effectiveness: The effect of design on click- through rates for banner ads. *International Journal of Advertising, 26*(4), 527-541.

Sheng, H., Nah, F. F.-H., & Siau, K. (2008). An experimental study on ubiquitous commerce adoption: Impact of personalization and privacy concerns. *Journal of the Association for Information Systems, 9*(6), 344-376.

Sia, C. L., Tan, B. C. Y., & Wei, K. K. (2002). Group polarization and computer-mediated communication: Effects of communication cues, social presence, and anonymity. *Information Systems Research, 13*(1), 70-90.

Simons, R. F., Detenber, B. H., Roedema, T. M., & Reiss, J. E. (1999). Emotion processing in three systems: The medium and the message. *Psychophysiology, 36*(5), 619-627.

Spencer, T. J. (1969). Some effects of different masking stimuli on iconic storage. *Journal of Experimental Psychology*, *81*(1), 132-140.

Sun, Y., Lim, K. H., Peng, J. Z., Jiang, C., & Chen, X. (2008). Why and when will banner blindness occur? An analysis based on the dual processing theory. In *Proceedings of the Americas Conference on Information Systems.*

Sundar, S. S., & Kalyanaraman, S. (2004). Arousal, memory, and impression-formation effects of animation speed in web advertising. *Journal of Advertising, 33*(1), 7-17.

Sundar, S. S., & Kim, J. (2005). Interactivity and persuasion: Influencing attitudes with information and involvement. *Journal of Interactive Advertising, 5*(2), 5-18.

Underwood, G., & Everatt, J. (1996). Automatic and controlled information processing: The role of attention in the processing of novelty. In O. Neumann & A. F. Sanders (Eds.), *Handbook of perception and action* (pp. 185-227)*.* London: Academic Press.

Watt, J. H., & Welch, A. J. (1983). Effects of static and dynamic complexity on children's attention and recall of televised instruction. In J. Bryant & D. R. Anderson (Eds.), *Children's understanding of television* (pp. 69-102)*.* New York: Academic Press.

Xu, X., Thong, J. Y. L., & Venkatesh, V. (2014). Effects of ICT service innovation and complementary strategies on brand equity and customer loyalty in a consumer technology market. *Information Systems Research, 25*(4), 710-729.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*(5), 459-482.

Yoo, C. Y., & Kim, K. (2005). Processing of animation in online banner advertising: The role of cognitive and emotional responses. *Journal of Interactive Marketing, 19*(4), 18-34.

Yoo, C. Y., Kim, K., & Stout, P. A. (2004). Assessing the effects of animation in online banner advertising: Hierarchy of effects model. *Journal of Interactive Advertising, 4*(2), 49-60.

Zhang, P. (2000). The effects of animation on information seeking performance on the World Wide Web: Securing attention or interfering with primary tasks? *Journal of the Association for Information Systems, 1*(1), 1-30.

Zhang, P. (2005). Animation's impact and implications for website design and online advertising: A series of studies. In D. Galletta & P. Zhang (Eds.), *HCI in MIS: Applications* (pp. 1-49). New York: M.E. Sharpe.

Zorn, S., Olaru, D., Veheim, T., Zhao, S., & Murphy, J. (2012). Impact of animation and language on banner click-through rates. *Journal of Electronic Commerce Research, 13*(2), 173-183.

About the Authors

Muller Y. M. Cheung is a Visiting Scholar of Information Systems in the Department of Information Systems, Business Statistics and Operations Management (ISOM), School of Business and Management, Hong Kong University of Science and Technology. He received his PhD in Information Systems from the Hong Kong University of Science and Technology. His research interests include human-computer interaction, technology adoption, information security, and crowdsourcing.

Weiyin Hong is an Adjunct Associate Professor of information Systems in the Department of Information Systems, Business Statistics and Operations Management (ISOM), School of Business and Management, Hong Kong University of Science and Technology. She is also an Emeritus Associate Professor in the Department of Management Information Systems at the University of Nevada, Las Vegas. She received her PhD in Information Systems from the Hong Kong University of Science and Technology and her BSc. in MIS from Fudan University. Her research interests include human-computer interaction, user acceptance of emerging technologies, and information privacy concerns. Her work has appeared in *MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, International Journal of Human-Computer Studies, Communications of the ACM, Information & Management*, and *Journal of the American Society for Information Science and Technology*, among others.

James Y. L. Thong is the Michael Jebsen Professor of Business, Chair Professor of Information Systems, and Head of the Department of Information Systems, Business Statistics and Operations Management (ISOM), School of Business and Management, Hong Kong University of Science and Technology. He received his PhD in Information Systems from the National University of Singapore. His research on technology adoption and implementation, e-government, human–computer interaction, information privacy, software piracy, and IT in small business has appeared in *Information Systems Research, MIS Quarterly, Journal of Management Information Systems*, and *Journal of the Association for Information Systems*, among others. Previously, he served as an associate editor for *Information Systems Research* and *MIS Quarterly*, and received the “2011 *ISR* Best Associate Editor Award”. He is currently an AIS Fellow and Senior Editor for *MIS Quarterly*.

Copyright © 2017 by the Association for Information Systems. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and full citation on the first page. Copyright for components of this work owned by others than the Association for Information Systems must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists requires prior specific permission and/or fee. Request permission to publish from: AIS Administrative Office, P.O. Box 2712 Atlanta, GA, 30301-2712 Attn: Reprints or via e-mail from publications@aisnet.org.