



Do not allow pop-up ads to appear too early internet users' browsing behaviour to pop-up ads

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ABSTRACT

This study examines the timing of pop-up advertising appearance and its effect on perceived intrusiveness, advertising irritation and advertising avoidance. Experiment was designed to build a virtual Internet environment (including the main content on the webpage and a pop-up ad) and to manipulate the timing of the pop-up advertising appearance. Participants were invited to participate in two experiments, and then assigned to a specific target browsing task; their advertising browsing activities during the task were measured. In order to measure their cognitive advertising avoidance, an eye-tracking device was utilised to gain objective and accurate psychological information. Results showed that earlier pop-up advertising appearances are associated with a lower consumer fixation count and fixation length; in contrast, pop-up advertising that appears later is associated with a higher fixation count and fixation length. This study attempts to gain more objective and accurate psychological data by using an eye-tracking device to collect information about eye movements associated with the appearance of pop-up advertising to better analyse consumer behaviours towards them. These results offer insights to Internet advertisers and Internet platform companies on how to provide more efficient Internet advertising.

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1. Introduction

Over the past decade, the number of Internet users has increased rapidly for a multitude of purposes related to entertainment, work, social contact and shopping. In response, advertisers that have relied on traditional media such as newspapers, television or radio have been shifting to Internet advertising, causing the Internet advertising industry to develop rapidly (Snyder and Garcia-Garcia 2016; Zha, Li, and Yan 2015). In addition, information richness associated with Internet advertising is higher than in traditional media: online advertising can be done in various ways, and new forms are consistently evolving (Chiu, Lo, and Hsieh 2017; Duffett 2015; Namin, Hamilton, and Rohm 2020).

Even though pop-up advertising are associated with greater levels of consumer attention and a higher click-through rate, they also can result in negative consumer attitudes due to their intrusiveness (Le and Vo 2017; Lee and Ahn 2012). For example, Courbet et al. (2014) and Kariyawasam and Wigley (2017) reported that Internet users rated pop-up advertising as the most interfering type of advertising during web browsing, as

compared to all other advertising formats, and that these users were less likely to visit sites associated with pop-up advertising again. Further, among all of the different online Internet advertising formats (e.g. banner; pop-up ads; skyscraper ads; Wallpaper ads; floating ads; interstitial ads), pop-up advertising are associated with the greatest sense of anger and annoyance (Harms, Bijmolt, and Hoekstra 2019; Kariyawasam and Wigley 2017). An additional study found that consumers held the most negative attitudes toward pop-up advertising among the six different online Internet advertising formats (Burns and Lutz 2006; Liu, Liang, and Liu 2019). Although the invention of pop-up advertising was aimed at increasing consumers' awareness of Internet advertising, the expected advertising effects have not materialised, which is also the motivation in this study.

When Internet users are exposed to Internet advertising, they tend to avoid looking at or noticing them, while others close the window in order not to expose themselves to the advertising. These behaviours are called advertising avoidance (Duff and Faber 2011). There are two kinds of advertising avoidance. The first is cognitive advertising avoidance, which refers to browsers'

subconscious efforts to avoid fixating their eyes on the visual range of advertising. The second is physical advertising avoidance, which refers to browsers consciously using an action or mechanical device to avoid advertising exposure (Chatterjee 2008; Söllner and Dost 2019). The current study focuses on pop-up advertising, which are designed to eliminate cognitive advertising avoidance in order to increase consumers' attention and click-through rates. The appearance of pop-up advertising blocks the web content originally seen by web browsers so that they cannot subconsciously avoid fixing their eyes on the advertising. However, due to the fact that pop-up advertising interrupt consumer browsing activities, pop-up advertising often generate negative user attitudes (Chatterjee 2008), which induce physical advertising avoidance to close the pop-up advertising window in order to resume the original web browsing activity (McCoy et al. 2007).

Perceived intrusiveness, defined by Li, Edwards, and Lee (2002) as the 'perception or psychological consequence that occurs when an audience's cognitive processes are interrupted', is one of the most important reasons for advertising avoidance behaviour. As such, consumer perceptions of perceived intrusiveness depend on subjective judgment, rather than the attributes of the advertising itself (Ha and McCann 2008; Jankowski 2017). Another reason for advertising avoidance is advertising irritation. An irritating advertising appears to be 'provoking, causing displeasure and momentary impatience' (Aaker and Bruzzone 1985). The greater the degree of irritation a consumer feels, the more easily they will act to avoid advertising (Li, Edwards, and Lee 2002). In the Internet environment, pop-up advertising interrupt consumers' browsing activity or the flow of reading information, which results in advertising irritation (Chatterjee 2008; Gao, Koufaris, and Ducoffe 2004) and thereby increases advertising avoidance.

Research on television media advertising by Abernethy (1991) has shown that the first advertisement shown among a series of advertising has the highest advertising avoidance behaviour, and that the point in time that an advertising appears is one of the main factors affecting advertising avoidance. Moe (2006) suggested that the timing of pop-up advertising also plays a role in whether the advertising is perceived as an interruption or as additional information. As such, the main purpose of this study was to examine the timing of pop-up advertising appearances and its effect on perceived intrusiveness and advertising attitudes.

Previous studies on pop-up advertising assumed that the advertising appeared after the Internet page opened. However, in reality, pop-up advertising appearances can be controlled by the system, so that advertisers can

choose when they appear. Therefore, Internet advertising practitioners will sometimes see another kind of advertising format called pop-under ad, which is found in real Internet advertising practice (McCoy et al. 2007). In this study, we proposed that when the timing of pop-up ads is delayed – that is, the user is finished or close to finished with the browsing target – the degree of perceived intrusiveness should be lower. In turn, advertising avoidance is proposed to be lower as well.

To test whether there is an effect of late pop-up advertising (after consumer has finished their browsing activity) having lower advertising avoidance than immediate pop-up ones, an experiment was designed to build a virtual Internet environment (including the main content on the webpage and a pop-up ad) and to manipulate the timing of the pop-up ads appearance. Participants were invited to participate in the experiment, and then assigned to a specific target browsing task; their advertising browsing activities during the task were measured. In order to measure their cognitive advertising avoidance, an eye-tracking device was utilised to gain objective and accurate psychological information, in contrast with previous studies that relied on traditional advertising memory (recognition and recall) or the self-description method (Chiu and Chang 2020; Djamasbi 2014; Wästlund et al. 2014). Moreover, the eye-tracking device can be used to conduct eye movement analysis and record the frequency and amount of time of consumers' eye fixation on the pop-up advertisements. Furthermore, to understand the effect of perceived intrusiveness in the two pop-up appearing conditions on advertising avoidance behaviour (browsing behaviour) and advertising attitude, we conducted study two to measure the advertising intrusiveness and advertising attitude.

Compared to prior research, this study has several unique contributions. First, most previous studies have indicated that consumers have a high degree of advertising avoidance toward pop-up advertising because consumers associate pop-up advertising with a higher degree of perceived intrusiveness and advertising irritation. However, according to literature review in current study, perceived intrusiveness depends on personal subjective judgment rather than the attributes of the advertising itself. As noted above, the timing of pop-up advertising appearances can be controlled; therefore, this study focuses on consumer reactions to pop-up advertising that appear at different times, which was seldom discussed before. Second, this study found that browsers have more advertising intrusiveness and negative attitudes on pop-up advertising appeared immediately condition than on pop-up advertising appeared after 20 s condition. When advertising appearance is

delayed, browsers view them more frequently and for longer periods of time, which is the new finding in this study. Third, previous studies have rarely used an eye-tracking device to collect data about consumers' reactions to advertising (Hervet et al. 2011). In this study, we attempt to gain more objective and accurate psychological data by using an eye-tracking device to collect information about eye movements associated with the appearance of pop-up advertising to better analyse consumer behaviours towards them. This can serve as a resource for future research in this area.

2. Literature Review

2.1. Advertising avoidance

On average, every person will be exposed to thousands of advertising messages every day both outside and inside via their televisions, newspapers, magazines, cell phones and the Internet. Advertising are often perceived negatively because they interrupt people while they are busy with other tasks (Hervet et al. 2011) or they disturb people who are processing certain information (Duff and Faber 2011). People may pretend not to look, close the advertising or turn to other pages to resist or avoid contact with advertising messages. Any action to decrease self-exposure to advertising is called advertising avoidance (Walsh 2010).

There are two different formats of advertising avoidance under different media environments: cognitive and physical (Rojas-Mendez, Davies, and Madran 2009). Cognitive advertising avoidance refers to situations where consumers subconsciously avoid fixating their eyes on the visual range of advertising. Cognitive advertising avoidance is an automatic process and involves visual screening out of advertising stimuli embedded within content, and does not require any conscious decision or behavioural action by the consumer (Jankowski 2017). Prior research in preattentive processing has indicated that cognitive advertising avoidance is incidentally processed: it is retained in memory, although without perception, i.e. there is the presence of implicit memory but the absence of explicit memory (Chatterjee 2008; Northup and Mulligan 2013). Even though no explicit memory exists, browsers still express more favourable and positive attitudes toward the target message, which induce consideration and choosing behaviour without any memory of the advertising exposure (Hussain, Ferdous, and Mort 2018; Janiszewski 1988). Physical advertising avoidance occurs when consumers consciously use mechanical devices to avoid advertising, such as changing TV channels to avoid TV advertising, closing pop-up advertising on the web or

throwing away print advertising supplements (Walsh 2010). Physical advertising avoidance is a result of a conscious decision by the consumer to avoid advertising, and leads to various degrees of psychological reactance (Brehm and Brehm 1981).

When consumers are exposed to advertising, they tend to adopt cognitive advertising avoidance because it is a subconscious process and does not require that they deviate from their original goals. However, consumers will engage in physical advertising avoidance when cognitive advertising avoidance is not possible or when they are actively trying to avoid advertising (Chatterjee 2008). Among all web advertising, pop-up advertising are intended to prevent cognitive advertising avoidance in order to increase consumers' attention and click-through rate. However, pop-up advertising interrupt consumers' browsing behaviour on the target pages while showing up; it will also induce negative attitude easily (Lee and Ahn 2012). To remove annoying pop-up advertising, consumers are unable to conduct cognitive behaviour; the only way is through physical advertising avoidance, such as closing pop-up advertising directly (Le and Vo 2017; McCoy et al. 2007).

Most prior research on advertising avoidance measured advertising avoidance behaviour using advertising exposure memory testing (Courbet et al. 2014) or self-reported subjective measures (Cho and Cheon 2004). However, when participants memorise or self-report on advertising exposure, the measured avoidance behaviour must have been noticed consciously. For this reason, some researchers have tried to study browsing behaviour directly by investigating consumer eye movements (Hervet et al. 2011; Lo, Hsieh, and Chiu 2014; Wästlund et al. 2014). In the current study, advertising avoidance is measured by examining both the fixation count and fixation length of actual eye fixation on the advertising.

2.2. Advertising conscious intrusiveness and irritation

Consumers exhibit advertising avoidance due to the perceived intrusiveness. Advertising intrusiveness can be defined as an advertisement interrupting the fluency of an editorial unit, where editorial unit refers to any media environment that an advertising can appear in (Jankowski 2017; Ying, Korneliusson, and Gronhaug 2009). Because the goal of advertising is to grab consumers' attention, advertising attempt to interrupt the editorial unit to spontaneously attract browsers' eyes and effectively limit the amount of attention they pay to the original target. At this point, browsers must decide whether to focus on the ad, or to resist it and focus

instead on the original browsing target. If the advertising makes consumers feel impatient or disturbed, negative resistance occurs (Lee and Ahn 2012). Advertising is regarded as intrusive when it is perceived as an interruption to the browsing target (Edwards, Li, and Lee 2002; Ha and McCann 2008). Thus, it is a perception or a psychological result (Li, Edwards, and Lee 2002). Further, consumers' level of perceived intrusiveness depends on subjective judgment of different criteria, which may not be due to the features of the advertising itself (Cronin and Menelly 1992). For example, when a person is conducting an urgent search for information on the Internet, the degree of perceived intrusiveness will be high if an advertising appears that interrupts this mission (McCoy et al. 2007; Moe 2006).

A similar concept is perceived goal impediment (Cho and Cheon 2004), which also refers to the degree consumers perceive they are being blocked by advertising as they pursue the goal of web browsing. When the perceived goal impediment is higher, consumers' aggravation, negative attitudes and advertising avoidance also increase (Krugman 1983). In sum, the levels of perceived intrusiveness or perceived goal impediment associated with any advertising will differ from person to person due to subjective judgment. Further, browsers may at different points in time rate an identical advertising as having increased or decreased perceived intrusiveness or as being a greater or lesser perceived goal impediment, due to various internal or external factors.

Advertising irritation is another cause of advertising avoidance; irritation is defined as the state of feeling annoyed. Advertising irritation generally occurs due to experiencing slight anger or impatience with an advertisement, so the higher the degree of advertising irritation, the more likely the occurrence of advertising avoidance (Li, Edwards, and Lee 2002). There are three main causes of advertising irritation (Edwards, Li, and Lee 2002; Li, Edwards, and Lee 2002). The first is the advertising content. For example, if the content is perceived as being useless, overstated or offensive to the viewer's intelligence, irritation often occurs. The second is related to advertising execution: poorly executed advertising, such as advertising that are lengthy, oversized or difficult to read the main information often generate irritation. The third centre on advertising intensity: consumers get irritated when the same advertising is shown too often in one single media.

In the Internet environment, pop-up advertising not only interrupt consumers' browsing activity but also block consumers from viewing the main page. For this reason, the format of pop-up advertising causes higher perceived intrusiveness (McCoy et al. 2007), higher advertising irritation (Gao, Koufaris, and Ducoffe

2004) and a higher possibility of advertising avoidance, leading the most negative attitude among the Internet advertising format (Ha and McCann 2008; Le and Vo 2017). However, a previous study (Bell and Buchner 2018) found that positive effects of disruptive advertising on consumer preferences, so this study used the timing of advertising appearance to examine the advertising effectiveness.

2.3. The influence of browsing behaviour on the timing of pop-up advertising appearance

Abernethy (1991) discussed the effects of the timing of advertising appearances on viewers' advertising avoidance in a television media environment, and found that among a series of broadcast advertisements between programmes, viewers' advertising avoidance was the highest for the initial advertising shown during the break. Moe (2006) also suggested that the timing of the interruption (the pop-up message) can have an effect on how the individual responds to the interruption.

Based on these results, the current study proposes that when pop-up advertising appear right after the target page is opened, the consumer's browsing target is blocked and interrupted, such that the perceived intrusiveness and advertising irritation are higher, leading to a higher degree of advertising avoidance. In contrast, when pop-up advertising appear later (e.g. after some or all parts of browsing target have been read), consumers will have more time to process the information on the page, thereby decreasing the likelihood of information overload. Consumers' degree of perceived intrusiveness and irritation will be lower, which will in turn lead to a lower degree of advertising avoidance. Moreover, the frequency and time length (seconds) that consumer spends viewing the pop-up advertising will also be higher and longer. Based on the above, this study proposes the following hypotheses:

H1: The fixation count of pop-up advertising appearances as the web page is being read is higher than for appearances immediately after the webpage is opened.

H2: The fixation length of pop-up advertising appearances as the web page is being read is longer than for appearances immediately after the webpage is opened.

3. Method

3.1. Experimental design

This study adopted an experimental design so as to ensure a controlled environment, limiting the potential for other possible factors to affect browsing behaviours. A laboratory experiment was set up to examine the

effects of using early or late pop-up advertising on browsing behaviour. Voluntary participants were assigned to one of two pop-up experimental situations. They were asked to use the Internet browser as they usually would, and were permitted to use a mouse and keyboard to scroll, close windows and progress to other pages. All browsing activities were restricted to the experimental pages constructed for this study. Before studying their browsing behaviour, participants were tested on a pupil calibration process using an eye-tracking device to precisely record their eye movements, similar to previous study (Eraslan et al. 2019; Lo, Hsieh, and Chiu 2014). Following the pupil calibration process, participants were immediately encouraged to browse through the available pages; information about their eye movements associated with the webpage content (including pop-up advertising information) was collected by the eye-tracking device. After they finished browsing, participants were asked to provide certain demographic information.

3.2. Study one

3.2.1. Experimental materials – main content in the webpage

To design an experimental environment that is similar to consumers' usual browsing environment and experience, a modified Yahoo! News website (www.news.yahoo.com.tw) was used as the main page. Yahoo! News is one of the most popular news websites internationally, which would help to reduce any negative effects or reactions caused by an unfamiliar website (Kerlinger and Lee 2000), and to avoid increased eye movements associated with a lack of knowledge regarding the relative position of each type of content.

This study displayed Internet news stories that are neutral and more leisure-oriented, such as travel items, to avoid personal reactions from participants due to personal attitudes regarding politics, entertainment, or people, which would affect their response to the dependent variable. Prior to the experiment, a pilot test of six randomly selected travel stories was performed, where 50 participants were recruited to measure their attitudes about the words and objects (such as scenic spots) described. Based on the results, the news story with the median attitude score (i.e. the most indifferent attitude score) was adopted for the formal experimental web page.

3.2.2. Experimental materials – advertising content

The congruence between Internet advertising content and webpage main content is an important factor in terms of influencing consumers' perceptions of

advertising, as is advertising memory recall and attitudes towards the advertising (Simola et al. 2013). Since the webpage main content centred on a travel story, the advertising topic also needed to focus on this area to ensure congruence.

Researchers in this study chose 8 products (BBQ oven, beach chairs, travel agency, backpack, sunglasses, mountain bikes, sandals, and straw hat) related to travel and leisure as candidates for the formal experimental materials. A 7-point Likert congruity scale (1 = strongly agree, 7 = strongly disagree) was adapted from Sujan and Bettman (1989) to evaluate the congruence of these 8 products. According to the pilot test results, an advertising introducing a 'travel agency' was determined to be the most congruent, and therefore chosen to be the topic of the pop-up advertising content. To avoid participant preferences and attitudes for a particular brand from influencing the results, a fictitious company name was created to examine the effect of pop-up timing (see Figure 1).

3.2.3. Manipulation of independent variable

The purpose of this study is to examine the effects of the timing of pop-up advertising appearances on eye fixation behaviour. As such, the timing of the appearances was manipulated in this study in one of two ways: (1) the pop-up advertising immediately appeared after the webpage loaded, or (2) the pop-up advertising appeared after the browser had sufficient time to finish browsing that webpage. For both experimental conditions, the pop-up advertising appeared in the middle of the screen, which had the blocking and disturbing effect common to pop-up advertising. To determine the length of time needed to finish reading the main page, a pilot test with 50 recruited participants was conducted. The average time required was 20.13 s ($SD = 2.66$). Thus, for the second experimental condition, the pop-up advertising appeared after 20 s.

3.2.4. Measurement of dependent variable

To avoid the aforementioned issues associated with measuring unconscious advertising browsing behaviours using memory tests or self-description, this study utilised an eye-tracking device to record eye movement data associated with the advertising fixation length and fixation count, similar to other studies in this area (Chiu and Chang 2020; Köster et al. 2015). Fixation length refers to the duration of gaze on a target block, and it was measured in seconds (s). A longer fixation length indicates longer gazes duration.

Fixation count refers to the number of times a gaze falls on a target block. A higher number indicates more gaze instances. Further, the eye-tracking device adopted



Figure 1. Experimental Pop-Up Ad Page (ad one).

had a minimum 60 Hz eyeball scanning frequency, able to measure time units at the millisecond level; also, it did not require a headset or touch-based measurements, thereby limiting potential disturbance to the participants.

3.2.5. Participants

This study recruited volunteers who had experience searching websites to participate in the experiment. Participants were randomly assigned to one of the two groups. After deleting invalid subjects, a total of 93 participants completed the experiment, including 45 males and 48 females. The average age was 21.88 years ($SD = 0.48$). There are 52 participants in the first experimental group with the pop-up advertising appearing

immediately; the other 41 participants are in the second experimental group with the pop-up appearing after a 20-second delay.

3.3. Study two

To verify the reason of lower browsing behaviour toward immediate pop-up advertising than toward late pop-up ones and its influence on advertising attitude. We added study two to measure the advertising intrusiveness and advertising attitude.

The experimental materials (main content in the webpage and advertising content) were similar as study one (see Figure 2).



Figure 2. Experimental Pop-Up Ad Page (ad two).

3.3.1. Measurement of dependent variable

In addition to examine the fixation length and fixation count, we also measure the advertising intrusiveness and advertising attitude in study two.

Intrusiveness was measured using the seven-item scale developed by Li, Edwards, and Lee (2002). The participants responded to the statement ‘I feel this advertising is ... very distracting/disturbing/forced/interfering/intrusive/invasive/obtrusive’, and was employed to measure this construct using a 7-point Likert scale that ranged from strongly disagree to strongly agree (Cronbach’s $\alpha = 0.81$ in this study).

Advertising attitudes were measured using the scale developed by Chang and Thorson (2004). The participants responded to the statement ‘I feel (this advertising) is ...’ by using four 7-point semantic differential items (anchored by very likable/very unlikable, interesting/not interesting, good/bad, appealing/not appealing). An average of scale items was used to form a composite measure of advertising attitudes (Cronbach’s $\alpha = 0.77$ in this study).

3.3.2. Participants

A total of 81 participants completed the experiment, including 33 males and 48 females. The average age was 21.23 years ($SD = 0.94$). There are 46 participants in the first experimental group with the pop-up advertising appearing immediately; the other 35 participants are in the second experimental group with the pop-up advertising appearing after a 20-second delay.

4. Data Analysis

Hypothesis 1 concerned whether the fixation count would be significantly different based on the pop-up advertising appearing at different times. Based on the results of an independent t-test (see Table 1), the fixation count for the second experimental condition (pop-up appeared after 20 s) ($M_{ad\ one} = 6.20$, $SD_{ad\ one} = 6.85$) was significantly higher than the fixation count for the

first experimental condition (pop-up advertising appeared immediately) in study one ($M_{ad\ one} = 3.62$, $SD_{ad\ one} = 2.55$) ($t_{ad\ one} = 5.93$, $p_{ad\ one} < .01$). Therefore, H1 was supported.

Likewise, when the pop-up advertising appeared after 20 s, the fixation length ($M_{ad\ one} = 1.85$, $SD_{ad\ one} = 3.70$) was significantly longer than when the pop-up advertising appeared immediately ($M_{ad\ one} = 0.77$, $SD_{ad\ one} = 0.71$) in study one ($t_{ad\ one} = 2.84$, $p_{ad\ one} < .05$). Thus, H2 was also supported (see Table 1).

Moreover, the results in study two also showed that the fixation count for the pop-up appeared after 20 s condition ($M_{ad\ two} = 8.97$, $SD_{ad\ two} = 7.76$) was significantly higher than the fixation count for the pop-up advertising appeared immediately condition ($M_{ad\ two} = 5.45$, $SD_{ad\ two} = 4.55$) ($t_{ad\ two} = 2.39$, $p_{ad\ two} < .02$). Likewise, when the pop-up advertising appeared after 20 s, the fixation length ($M_{ad\ two} = 2.54$, $SD_{ad\ two} = 1.68$) was also significantly longer than when the pop-up advertising appeared immediately ($M_{ad\ two} = 0.99$, $SD_{ad\ two} = 0.79$) ($t_{ad\ two} = 5.52$, $p_{ad\ two} < .01$) (see Table 2).

This research also used study two to examine the advertising intrusiveness and attitudes between pop-up advertising appeared immediately and after 20 s. Based on the results of an independent t-test, the advertising intrusiveness for the pop-up advertising appeared immediately condition ($M_{ad\ two} = 4.96$, $SD_{ad\ two} = .54$) was significantly higher than the pop-up advertising appeared after 20 s condition ($M_{ad\ two} = 3.99$, $SD_{ad\ two} = .65$) ($t_{ad\ two} = 7.19$, $p_{ad\ two} < .01$). On the other hand, when the pop-up advertising appeared after 20 s, the advertising attitudes ($M_{ad\ two} = 4.17$, $SD_{ad\ two} = .43$) was also significantly longer than when the pop-up advertising appeared immediately ($M_{ad\ two} = 3.08$, $SD_{ad\ two} = .38$) ($t_{ad\ two} = 11.98$, $p_{ad\ two} < .01$) (see Table 3).

Furthermore, to understand the link of browsing behaviour and the measurement of subjective perception of intrusiveness toward pop-up advertising, this study conducted a regression analysis and found the negative correlation between perceived intrusiveness and

Table 1. The effect of pop-up timing (ad one) on fixation count and length.

Dependent Variable	Condition	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Fixation Count (number of times)	Pop-up ad appears immediately	52	3.62	2.55	5.93	0.01*
	Pop-up ad appears after 20 s	41	6.20	6.85		
Fixation Length (ms)	Pop-up ad appears immediately	52	0.77	0.71	2.84	0.04*
	Pop-up ad appears after 20 s	41	1.85	3.70		

Note: *n* = number of participants; *M* = mean; *SD* = standard deviation; *p* = *p*-value.

Table 2. The effect of pop-up timing (ad two) on fixation count and length.

Dependent Variable	Condition	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Fixation Count (number of times)	Pop-up ad appears immediately	46	5.45	4.55	2.39	0.02*
	Pop-up ad appears after 20 s	35	8.97	7.76		
Fixation Length (ms)	Pop-up ad appears immediately	46	0.99	0.79	5.52	0.01*
	Pop-up ad appears after 20 s	35	2.54	1.68		

Note: *n* = number of participants; *M* = mean; *SD* = standard deviation; *p* = *p*-value.

Table 3. The effect of pop-up timing on advertising intrusiveness and attitudes.

Dependent Variable	Condition	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Intrusiveness	Pop-up ad appears immediately	46	4.96	.54	7.19	0.01*
	Pop-up ad appears after 20 s	35	3.99	.65		
Advertising attitudes	Pop-up ad appears immediately	46	3.08	.38	11.98	0.01*
	Pop-up ad appears after 20 s	35	4.17	.43		

Note: *n* = number of participants; *M* = mean; *SD* = standard deviation; *p* = *p*-value.

browsing behaviour. The negative correlation suggests that as the higher of perceived intrusiveness, the less of browsing length ($\beta = -847.083$, $p = 0.01$) and count ($\beta = -1.36$, $p = 0.01$) toward the pop-up advertising (Table 4).

5. Discussion

Internet advertisers are constantly seeking new ways of grabbing consumers' attention (Chiu, Lo, and Hsieh 2017; Hussain, Ferdous, and Mort 2018). Technological development has helped to create various kinds of Internet advertising with different formats, execution styles, and degrees of consumer interaction (Leiner and Quiring 2008; Seo et al. 2018). That said, each type has both advantages and disadvantages. One obvious advantage of pop-up ads is that their sudden appearance forces consumers to suspend their browsing activity to view the ads, at least for short time. This feature can also be regarded as a disadvantage because it causes consumers to view pop-ups negatively, leading to advertising avoidance behaviours. This disadvantage does not mean pop-up advertising are completely ineffective. As such, the main purpose of this study was to examine the timing of pop-up advertising appearances and its effect on perceived intrusiveness and advertising attitudes.

The experimental results are summarised as follows. First, the results showed that when the pop-up advertising appeared after 20 s, the fixation length and fixation count were significantly longer than when the pop-up advertising appeared immediately. Second, when the timing of a pop-up ads is delayed (20 s), after user

Table 4. The effect of advertising intrusiveness on fixation count and length.

Independent Variable	Dependent Variable	β	<i>t</i>	<i>p</i>
Intrusiveness	Fixation Count (number of times)	-1.36	-1.47	0.01*
	Fixation Length (ms)	-847.08	-4.34	0.01*

finished reading the web content – the degree of perceived intrusiveness should be lower, and then gain more positive attitudes. Third, this study also found the negative correlation between perceived intrusiveness and browsing behaviour toward the pop-up ads. That is, pop-up advertising that appear after browsers have had a chance to read the main content page are associated with a lower perceived intrusiveness and a higher browsing frequency; in addition, these advertising also are viewed for longer periods of time. In sum, the timing of advertising appearances can be controlled by web advertisers to increase effectiveness: advertising can appear after a period of time has elapsed to obtain higher browsing opportunity and more positive attitude.

5.1. Theoretical implication

There are several theoretical implications associated with these results. First, previous studies on pop-up advertising have revealed that consumers have a high degree of advertising avoidance toward them due to irritation caused by their perceived intrusiveness (Le and Vo 2017; Moe 2006). The current study notes that in the relevant literature, perceived intrusiveness is defined as more of a personal subjective judgment toward an advertising, rather than a direct reaction to the content of that advertising. This study used experiments to examine the browsing behaviour toward the pop-up advertising, and confirmed the effect on perceived intrusiveness.

Second, past studies on pop-up advertising all included the hypothetical condition where the advertising appeared immediately after the webpage opened (Courbet et al. 2014; Deshwal 2016). However, in a realistic webpage operating environment, the timing of pop-up advertising appearances can be controlled by the programmer according to the advertisers' preference. On this basis, the current study examines the effects of immediate and delayed advertising appearances on consumers' browsing behaviours, which was seldom discussed in previous studies. Therefore, this viewpoint complements the understanding of scholars in the field of advertising browsing behaviour in the online environment and provides scholars undertaking future related studies more extensive application scope for online behaviour.

Third, the use of an eye-tracking device to measure advertising avoidance is rare in these types of studies. Using an eye-tracking device allows for more objective data on physiological reactions associated with Internet advertising viewing behaviours (Guitart, Hervet, and Hildebrand 2019; Köster et al. 2015; Wojdyski and Bang 2016). Future studies may also consider using this method to study advertising-related variables.

5.2. Practical implication

There are several practitioner implications associated with the results of this study. First, we provide a different perspective on pop-up advertising. Most people who compare banner and pop-up advertising view the latter as inferior: their nature often makes consumers feel disturbed and irritated, which in the end lead to advertising avoidance. However, the results showed when pop-up advertising appearance is delayed, browsers view them more frequently and for longer periods of time. Advertisers should keep this in mind as they design pop-up advertising and decide on when they should appear to increase their effectiveness.

Second, the advertising platform can provide different pop-up advertising services associated with various pop-up timing and pricing strategies. They can also design their systems to measure the approximate amount of time needed to finish viewing the webpage based on the number of words it contains or the complexity of the content, in order to calculate the optimal timing strategy.

Third, by using an eye-tracking device, this study revealed that users form positive responses to repeated or one-time exposure to information, even in situations in which they do not consciously pay attention to the information. The advertising information to which they have been exposed still contributes to the development of positive brand images.

5.3. Limitations and directions for future studies

This study has a number of limitations. First, this study used single banner advertising in one webpage situation to reduce the influence of other variables on browsing behaviour. Multiple advertising environments might influence the results of this study. Second, it should be noted that the methodology used in this study controlled for a number of factors that can affect consumers' advertising viewing behaviours in a real Internet environment. In the real world, Internet advertising features such as different fonts, font sizes and levels of richness of advertising content can influence consumers' feelings and reactions, which in turn affect their advertising viewing behaviours. These factors should be further investigated in future studies. Third, when users have different task (or no task) may differ in their browsing behaviour, so future studies should ask participants to complete a specific task to examine the results of this study. Moreover, how pop-up ads impact on the usability of the web page when users enter the process of attention stage could be another interesting topic after this study.

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