Measuring Consumers' Willingness-to-Pay to Avoid Disruptive Advertising in Smartphone Applications

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Abstract

This research examines how advertisement attributes are received by consumers. Six advertisement attributes in the smartphone applications market are studied using a survey of university students. Respondents answer a series of choice experiments. Parameters of a random utility model are estimated by conditional logit to determine a consumer's willingness-to-pay to avoid disruptive advertisement attributes within a smartphone application. The results show that a consumer is willing to pay $4.06 to avoid targeted ads, $0.28 to decrease the frequency of the ads when graphics are static, $2.71 to decrease the frequency of ads when graphics are animated, $1.30 to avoid ads with animated graphics, and $3.73 to avoid animated graphics when paired with the mean ad frequency level of 2.5, or 45 seconds. The results of this study are useful for app developers seeking to monetize their product without alienating users and for companies who aim to create and use an advertisement that does not decrease a consumer's willingness-to-pay for their product.

Executive Summary

How do consumers react to advertising within the smartphone application (app) setting? Do the attributes of the advertisements (ads) employed yield different results for willingness to pay for the app? Furthermore, is the consumer more willing to pay to avoid certain types of ads and not others? In today's profit driven economy, advertising is a tool widely used by companies to increase brand awareness and sales. Consequently, consumers are exposed to a growing amount of advertisements every day, which is leading to an increasingly desensitized audience. As desensitization makes it harder for companies to create advertisements that capture the attention of the consumer, many are resorting to the use of disruptive ads to achieve their goal.

This is especially the case in the smartphone applications market, where the majority of apps are free, and thus app developers must find a different way to generate revenue for their product.

Advertisements that app developers utilize come in varying forms with varying attributes, and, logically, consumers will have differing responses to each. It is important to quantify consumers' reactions to each individual attribute of the advertisements so that companies may be better able to determine the success of particular ads. This is especially important if some attributes cause a consumer's willingness-to-pay for a product to decrease. Consumer reaction to ads is also relevant to app developers, who may be able to place a more accurate value on their ad space based on the level of disruptiveness as well as the success of the advertisement. More disruptive ads should potentially come at a higher cost, as they may be more successful in terms of click-through-rate, but may also decrease user experience. It is important to know how consumer valuation varies with the attributes of an ad so that advertisement avoidance can be mitigated without negative effects.

Similar studies have been conducted to determine the success of different types of advertisements online, but there is a void in the area of smartphone applications. To address this issue, I present a theoretical model, which is an application and development of the labor-leisure choice model. This model serves as the basis of the study. I create and administer a discrete choice survey that uses the stated-preference method to infer a consumer's preferences. I evaluate the data collected using a conditional logit model, with which I estimate a consumer's willingness-to-pay to avoid disruptive ad attributes within smartphone applications. The results show that a consumer is willing to pay $4.06 to avoid targeted ads, $0.28 to decrease the frequency of the ads when graphics are static, $2.71 to decrease the frequency of ads when

graphics are animated, $1.30 to avoid ads with animated graphics, and $3.73 to avoid animated graphics when paired with the mean ad frequency level of 2.5, or 45 seconds.

Contents

1 Introduction

Advertising is a tool employed by many companies to increase product awareness and sales. As a result, consumers in today's profit driven economy are inundated with thousands of advertisements for products and services daily. The volume of these advertisements continues increasing, leading to an increasingly desensitized audience. It is becoming more difficult for companies to create advertisements that capture the attention of the consumer, which is causing some companies to use disruptive ads to achieve their goal.

In conjunction with the growth of advertising, there is a growing smartphone applications market, and in this market the majority of the applications are free. To generate revenue, app developers often utilize different types of ads for varying products and services. Within this background several questions arise. Do the attribute levels of the advertisements used within the application yield different results for willingness-to-pay for the application? Furthermore, is the consumer more willing to pay to avoid certain ad attributes and not others? My study explores consumers' reactions to different ad attributes within the smartphone setting. I postulate that a consumer is more willing-to-pay to avoid disruptive or unproductive ads within an app than ads with less goal impeding attributes.

This research is relevant to app developers in the current economy, as they choose the attributes and forms of advertisements their product uses. This study may allow app developers to place a more accurate value on ad space within their product. For instance, more disruptive ads should come at a higher cost, as they may be more successful in terms of click-through-rate but may also decrease user experience. In other words, more disruptive ads may hurt the performance of the app, as consumers experience goal impediment, but may also enhance the performance of the advertised product because of increased clicks. Moreover, my study applies

to companies who create and buy ad space within smartphone applications, as using ads with certain attributes may alienate customers and decrease a consumer's willingness-to-pay for the advertised product.

Much research has been conducted on the effectiveness of different advertisements and on why consumers avoid advertising. However, these studies have mainly focused on Internet advertising and specific forms of ads. My contribution to this field is my use of the stated-preference method to estimate a consumer's willingness-to-pay to avoid disruptive advertising in the smartphone applications market, which has not been studied closely.

In the following, I describe the relevant literature on this subject. I go on to explain the theoretical model behind a consumer's choice to purchase an app with certain levels of advertising. I explain my methods of data collection, which include an original survey. I discuss the data and empirical model used to evaluate said data. I conclude with a discussion on the results of the study and potential future extensions.

2 Literature Review

Previous studies that address advertising approach the topic from differing perspectives. Some examine the effectiveness of different types of ads. The types mentioned here are targeted, banner, disruptive, and native ads. Others explore reasons behind a consumer's advertising avoidance. Along with the studies regarding advertising, literature that treats survey collection and the accompanying empirical model is described below.

There is ample research on the effectiveness of different types of ads. The first type is targeted; where the company uses a consumer's browsing history, search behavior or location to

display advertisements that are more relevant to that particular person. This type of advertising is complex, as consumers generally appreciate the relevancy and are therefore less likely to avoid advertisements that are applicable to them. However, users also consider the use of their browsing history or location to be an invasion of privacy. Farahat and Bailey (2012) use a difference-in-difference approach to evaluate the effectiveness of online targeting while controlling for selection bias. They find that it is not cost effective for advertisers to target particular segments of the population. This is because these ads target the group which they believe is most likely to convert to their product, however these individuals are already most likely to buy this product in the absence of advertising. Their results show that using targeted advertising is not beneficial to the advertiser, and may even be harmful. On the other hand, Johnson (2013) finds that targeted advertising increases profits for all firms, including small or niche firms, which would otherwise be unable to reach their target market. Moreover, Johnson finds that while consumers may benefit by seeing more relevant ads, they also experience the negative effects of increased advertisement.

In terms of targeted advertising, it is also important to mention a study by Nath (2015), who investigates targeted advertising in smartphone applications as compared to those in online advertisements. The results show that targeted advertising is used much less frequently in smartphone applications. They usually do not use location, and are instead based on recreation (i.e. games and ringtones). Esteban and Hernandez (2007) find that targeted advertising is more efficient than mass advertising, increases social welfare, and is more beneficial to consumers than to firms. Finally, Turow et al. (2009) examine consumer attitudes towards targeted advertising. They find that the majority of consumers of all ages reject the use of targeted advertising and the invasions of privacy associated with it. This is especially true after they are

educated in the methods used by advertising companies to obtain their information. The findings of the above studies are clearly conflicting, which makes targeted advertising a contentious ad attribute.

Another prominent method of advertising is the banner ad. This type of advertisement can be text, static image, or animated image, and manifests in the form of a small banner usually located near the edges of the display. In recent years, click-through-rates (CTR), which are a method of measuring the effectiveness of particular ads, have been decreasing for banner advertisements. According to Drèze and Hussherr (2003), CTR is low because consumers avoid looking at banner advertisements. This could mean that consumers are not bothered by this form of advertisement, and would not be willing to pay to avoid them. Overall, banner ads are considered the least effective form of advertisement, having the lowest CTR (typically less than one percent), but they are also the most prevalent form, as they are cheap and easy to create.

Disruptive advertising forces the consumer to view the promoted products or services. Disruptive advertising manifests in several different forms, including pop-up ads, interstitial (full page ads), interactive, list or panel ads, and video advertisements, all of which require a click to exit. Some of these ads allow the consumer to click to exit immediately, while others force the consumer to wait a time period, usually five to ten seconds, until they can exit the ad. The consumer may perceive this form of advertisement as intrusive and as an impediment to the completion of their current actions. These advertisements interrupt the consumer while they are in the process of using an application or while browsing online, which could heighten negative attitudes. Cho and Cheon (2004) support this idea in their study, claiming ads that disrupt a consumer's goal result in undesirable outcomes. However, Zulkifly and Firdaus (2014) find that despite interruptive ads creating negative feelings, they did result in 90 percent of respondents

watching the full ad out of curiosity. Acquisti and Speakermann (2011) further find that a consumer's willingness-to-pay for a product significantly decreases after being exposed to interruptive ads. If these papers are correct in their conclusions, then I should find that consumers have the highest willingness-to-pay to avoid disruptive ads, as they are the most bothersome.

Finally, the newest form of online and smartphone application advertising is native advertising. This method blends promotions into the surrounding site or application format. According to Zulkifly and Firdaus (2014), this form allows consumers to view only the ads which interest them, as they are integrated with the website or application's contents. For example, Facebook successfully uses native ads through their 'Suggested Posts' and 'Sponsored Stories'. However, the authors state that because this method of advertising does not prompt action, the CTR is less than 40 percent.

With these forms of advertising in mind, the reasons for consumer advertising avoidance can be examined in more detail. Baek and Morimoto (2012) state that people avoid ads for several reasons. First, consumers may be skeptical of advertising, meaning that they do not believe the claims of the promotions, which leads to negative responses, such as avoidance. As mentioned previously, consumers may also have perceived privacy concerns related to ads that are personalized. The authors end with the idea that perceived ad irritation leads to avoidance, and can be triggered by various factors, such as high volume of ads, confusing information, or repetition of identical ads. A prior article by Cho and Cheon (2004) finds similar reasons for ad avoidance, such as perceived goal impediment, perceived ad clutter, and prior negative experiences. Moreover, Tucker (2012) postulates that advertising avoidance is related to the consumers' distaste for intrusiveness. Finally, Hussain and Lasage (2014) find that advertising

avoidance can be minimized through high levels of content relevance, content authenticity, and interactivity.

To address the aforementioned question regarding smart phone advertising, I conduct a survey. The survey method that I utilize in my research is the stated-preference method, which is commonly used in environmental economics. The literature explaining how the stated-preference method is used includes Portney (1994), who states that this method uses surveys to produce the willingness of respondents to pay for hypothetical products. Survey formats using this method vary, but typically contain a descriptive section and a choice section. The article by Portney further provides reasons for and against the use of this survey method. Smith et al. (1986) compares the use of direct (stated-preference) methods versus indirect valuation methods using a case on water quality, and finds that estimates are comparable. I base the design of my survey on two studies by Savage and Waldman (2009, 2013) and one by Hiller et al. (2012). In all of these there is a cognitive build up section followed by a series of discrete choices.

After conducting a survey using methods put forth by these authors, I estimate a discrete choice model that allows me to infer willingness-to-pay for advertising avoidance, and for this the previous work of Savage and Waldman (2009, 2013), and Hiller et al. (2012) will again be useful. For instance, the paper "The Value of Online Privacy" (2013) by Savage and Waldman utilizes a conditional logit model to estimate willingness-to-pay for privacy. In this paper, Savage and Waldman (2013) put forth the theory that apps provide benefits to the consumer through reductions in essential time, which is a concept I incorporate into my theoretical model. Similarly, Hiller et al. (2012) use a mixed logit model to estimate demand for local news sources, and then use these preferences to determine the willingness-to-pay for non-price characteristics of a news source.

3 Theoretical Model

In order to more thoroughly address the issue of consumer advertising avoidance, I first present a theoretical model, which serves as the basis of this study. It is a development and application of the labor-leisure choice model, which includes the effect of advertising on consumption of apps. As mentioned in the literature review, apps provide a benefit to the consumer through reductions in essential time, or the time that is spent carrying out basic activities such as banking, driving, or shopping. Extending this idea, in-app advertisements affect essential time in two aspects.

Productive, or targeted, advertising within the app creates further reductions in essential time, as the consumer sees ads relevant to their needs or wants, and will lower their time spent searching for such products or services. Unproductive advertisements are those that are random and mass distributed (not targeted) and may also be disruptive. Unproductive ads increase essential time, as consumers see ads that are not relevant to them, and which only impede their progress completing a time reducing function within the app. In this theoretical model, there is one free app in the marketplace with advertising. The consumer has the option to later purchase the premium version of the application in order to avoid advertising altogether. With this in mind, the following is the theoretical model behind consuming apps with advertising.

The consumer maximizes a utility (U) function of consumption of a good (x) and leisure (L), subject to budgetary and time constraints.

$$\begin{gathered} Max\ U\ (x, L\ ) \\ s.t\ \ v + wh = x + C\ (a_p, a_n) \\ T = h + L + \ \bar{T}\ (a_p, a_n) \\ Where\ P_x = 1 \end{gathered} \tag{1}$$

In the budgetary constraint: v is non-wage income, w is the set wage, h is a choice variable of the number of hours to work. This is set equal to x, which is the consumption of all other goods, plus the consumption of an app as a function of productive and unproductive advertising. The time constraint contains the following variables: T for total time, h for hours worked, and $\bar{T}\ (a_p, a_n)$ for essential time as a function of productive (a_p) and unproductive (a_n) advertisements. In this model we further define the price of good x (P_x) to equal one.

This model shows how advertising can affect a person's purchases. If the application has a high level of unproductive advertisements, or $a_n > 0$, this can increase the consumer's time spent on essential activities ($\bar{T}$), thereby reducing the amount of time left for leisure or working. If there is a high level of productive advertisement, $a_p > 0$, then this reduces the consumer's time spent on essential activities, increasing their ability to spend time elsewhere. In operationalizing this model through the survey, it is determined which attributes make an app productive or unproductive, and in principle, respondents should avoid those determined to be unproductive. With this theoretical model in place, I can now explain the survey used for data collection.

4 Experimental Design

A survey with a very specific design is necessary for this study. I use the stated-preference method to conduct a discrete choice experiment, where respondents are questioned about their preferences indirectly through a series of discrete choices. The survey opens with a cognitive build-up section. Here, the consumer is asked about their use of smartphones, including questions about their frequency of use, which functions they use most on their smartphone, the number of apps used, which type of apps they use (i.e. social networks, shopping, news, etc.), and if they have previously paid for apps. This section also includes background information

about in-app smartphone advertising in order to prepare the respondent for the upcoming section. Specifically, this segment explains the price of the app, and several different attributes of advertising chosen because they either increase or decrease the productivity of the ad. The attributes are: targeted or not, frequency, graphic features, sounds, whether a click to exit is available, and sound.

First, "price" is described. The survey explains that the price of the application may vary based on the advertisements utilized. The respondents rate the importance of the price of the app to them.

"Targeted," indicates whether the advertisement is targeted or random. The survey explains that targeted advertisements are those that use browser history or location to provide the consumer with relevant ads. Random ads are described as those that are not based upon the consumer's preferences, and are the same for all app users. A question asking whether they prefer targeted or random advertisements follows this description. This attribute is contentious and may divide consumers on whether they prefer targeted ads because of increased relevance (productivity) or if they prefer randomized because of privacy issues.

"Frequency" is explained as how often the ad is visible (or how often it appears if it is a pop-up). This explanation precedes a question about which frequency the respondent prefers, from a series which runs from the ad appearing every five seconds to the ad appearing every five minutes.

"Graphics" are described as images and text in the ad that are either static (pictures or text with no movement) or animated (i.e. flashing or blinking). A question asking the respondent's preference also follows this description.

"Click to exit ability" is explained as the user's ability to exit or remove the advertisement. They can either exit the ad immediately, or they may be forced to wait ten seconds until it is allowed. This again precedes a question regarding the user's preference for ad removal ability.

Finally, the survey explains that an ad can either have sound or not, and asks whether they have a preference for the attribute "sound". Table 1 summarizes price, the ad attributes, and their levels, with each being labeled $x_1 - x_6$.

Table 1
App Characteristics and Levels

Feature	Levels
Price (x_1)	\$0 to \$3.99
Targeted (x_2)	Random (Similar advertisements for everyone) Targeted (Personally chosen advertisements to your liking)
Frequency (x_3)	Appears every 5 minutes Appears every 1 minute Appears every 30 seconds Appears every 5 seconds
Graphics (x_4)	Static (Picture or text with no movement) Animated (blinking/movement)
Click to Exit Ability (x_5)	Can exit or remove ad immediately Must wait period of time (such as 10 seconds) to exit or remove ad
Sound (x_6)	No sound Sound

Directly after this section of the survey is a series of choices. These choices were created using choice based conjoint analysis, with different levels in each alternative that allow for the optimal amount of variation in choice. There are nine choices that a respondent makes between two generic smart phone applications with varying attributes. An example of one such choice is displayed in Figure 1. After these choices are made, the survey ends with a series of

demographics questions. These include questions about age, gender, race, education level, employment and marital status. The demographic questions are not the focus of this study, but may be useful in examining heterogeneous preferences for advertising based on individual demographic characteristics. This survey was fielded online through Qualtrics to University of Colorado--Boulder students. A description of the data collected with this survey design is provided in the following section.

Figure 1
Discrete Choice Sample Question

Features	App 1	App 2
Price	$2.99	$0
Ads Targeted or Not	Random	Targeted
Frequency of Ad Visibility	Appears every 30 seconds	Appears every 5 seconds
Graphics	Animated	Static
Click to Exit Ability	Must wait period of time (such as 10 seconds) to exit or remove ad	Can exit or remove ad immediately
Sound	Sound	No sound

5 Data

The data for this study originates from a survey distributed to University of Colorado--Boulder students over a period of two weeks in February of 2016. The main avenue of survey distribution was through Economics courses, meaning that the respondents were mainly those enrolled in Economics courses in the 2016 Spring semester. Consequently, the data collected is not a nationally representative sample. The total number of respondents was 250, with 237 having completed the survey. As shown in Table 2, 91.8 percent of these respondents were

between the age 18 and 34, 62.5 percent were male, 81.2 percent were white, and 88.4 percent had some college education or below. Participant's responses were promised to be completely anonymous.

Table 2
Sample Demographics

	Percent (%)
Age	
Under 18	6.47
19 – 34	91.81
Older than 34	1.72
Gender	
Male	62.5
Female	37.5
Race	
White	81.2
Non-white	18.78
Education	
Some College or below	88.35
Completed Bachelor's degree or higher	11.65

Respondents: 237

Prior to participating in the survey, respondents were asked whether or not they used a smart phone. Since this experiment is based solely upon smart phone usage, those who selected "no" did not participate in the remainder of the survey. Therefore, all of the respondents were smart phone users. Of these respondents, 58.3 percent used their smartphones for three to six hours a day, 77.3 percent had downloaded from six to 30 applications personally, and 70 percent had paid for an app before. Of those that had paid for an app, 80.9 percent paid between $0.99 and $1.99. In the following section, I explain how this data is analyzed using a conditional logit model.

6 Empirical Model

The format of a choice experiment allows the respondent to concentrate on tradeoffs between attributes that are implicit when making a choice (Holmes & Adamowicz, 2003). The responses collected from this experiment are analyzed based on an extension of the random utility maximization model, where the resulting estimates of the model are based on differences in utility across alternatives within choice sets (Holmes & Adamowicz, 2003).

This model makes several simplifying assumptions. The first is that individuals know their utility with certainty, and that they maximize their utility when making a decision (Holmes & Adamowicz, 2003). Moreover, it is assumed that utility is a linear function of the design's attributes (Holmes & Adamowicz, 2003). The third assumption is that errors are independent and identically distributed with type 1 extreme value distribution (Greene, 2002). The difference between two of these distributions results in a logistic distribution, which leads to a conditional logit model (McFadden, 1974). In the conditional logit model, an additional assumption is made that everybody in the population has the same preference structure.

In my model, a consumer faces a choice with two alternatives; each with six varying attributes. The consumer makes nine such choices. The conditional indirect utility for consumer n= 1, .., N from app alternative j = A, B on choice occasion t = 1, .., 9 is:

$$U_{njt} = \boldsymbol{\beta}' \boldsymbol{X}_{njt} + \varepsilon_{njt} \qquad (2)$$

In this model, $\boldsymbol{\beta}$ is a vector of marginal utility coefficients (preferences) common to all individuals, $\boldsymbol{X}_{njt}$ is a vector of observed attributes of the in-app advertisement, and ε is an

unobserved random error that is independent and identically distributed with type I extreme value distribution (Greene, 2002).

The vector **X** is a measure of the costs, either through price or advertising, of the app to the consumer. The first attribute of this vector is "price", which has a value of $0, $0.99, $1.99, $2.99, or $3.99. The second attribute is "frequency," which can have values one to four, with four being the most frequent. The remaining attributes are coded as dichotomous variables. The variable "targeted" equals one when the ad is targeted and zero when it is random. Similarly, "graphics" is equal to one when the graphics are animated and zero when they are static. Likewise, "click to exit ability" equals one when a user must wait ten seconds for the ad to close and zero when it can be closed immediately. Finally, "sound" is equal to one when the ad has sound and zero when it does not.

If we let Y_{nt} be a random variable that indicates the choice consumer *n* made on choice occasion t, then the probability that consumer *n* will choose alternative *A* (between either A or B) on choice occasion *t* is conditional on the attributes of each app alternative and can be expressed as:

$$P(Y_{nt} = A \mid \boldsymbol{X}_{nAt}, \boldsymbol{X}_{nBt}) = \frac{\exp(\boldsymbol{\beta}' \boldsymbol{X}_{nAt})}{exp(\boldsymbol{\beta}' \boldsymbol{X}_{nAt}) + \exp(\boldsymbol{\beta}' \boldsymbol{X}_{nBt})} \qquad (3)$$

and likewise for the probability that consumer n will choose alternative B. Accordingly, the likelihood function of each consumer's choice between the two alternatives is the product of each probability calculated in equation (3). In equation (4), 1_A and 1_B are indicator variables,

where 1_A equals one when alternative A is chosen and zero otherwise, and similarly 1_B is one when alternative B is chosen and zero otherwise.

$$L(\beta) = P(A)^{1_A} \cdot P(B)^{1_B} \tag{4}$$

The log likelihood function is the log summation of all of the individual choice occasions and is therefore:

$$LogL(\beta) = \sum_{n=1}^{N} \sum_{t=1}^{T} 1_A Log\big(P(A)\big) + 1_B Log\big(P(B)\big) \tag{5}$$

The parameters are estimated by maximizing this likelihood.

This provides marginal utility estimates of the effect of changes in attributes – or $\boldsymbol{X_{njt}}$. These estimates are quantitative measures of tradeoffs between attributes, and they can be used to estimate how much money respondents would be willing to pay for a change in attribute levels, while remaining as well off after the change as they were before the change (Holmes & Adamowicz, 2003). Say, for instance, we are measuring the willingness-to-pay of avoiding ads with sound. In this case, β_s would be the marginal utility of sound avoidance and β_P would be the marginal utility of price. Willingness-to-pay for avoiding ads with sound would be calculated by dividing β_s byβ_P, or $WTP_S = -\frac{\beta_s}{\beta_P}$ (Holmes & Adamowicz, 2003). This method is used to find the willingness-to-pay to avoid each attribute in the design.

7 Results

A conditional logit model is utilized to estimate a consumer's willingness-to-pay to avoid advertisement attributes. In the survey, the respondent makes nine choices, so the sample size is

2,138 choice occasions, obtained from 250 respondents. Column 2 of Table 3 reports the baseline estimates from the conditional logit model. The marginal utility parameters for "price", "targeted", "frequency", and "graphics" are negative and significant at the one percent level. All else held constant, this means that a consumer has a higher utility if the price of the app is lower, the ads are random, less frequent, and the graphics are static.

Next, the marginal utility on "click to exit ability" is not significantly different from zero. Therefore, I fail to reject the null hypothesis that the coefficient on "click to exit ability" is zero. Interestingly, in this basic model, the marginal utility of "sound" is positive and significant at the one percent level. This suggests that the consumer has a higher utility when an ad has sound.

Interaction variables were created to determine the effects of a combination of more than one ad attribute on consumer utility. In theory, the attributes found to be most bothersome to the consumer from the baseline estimates – targeted, graphics and frequency – should have a negative marginal utility when interacted, as an increase in the level of one attribute lowers the coefficient on the direct effect of the other attribute.

The following interaction variables were created: "targeted-graphics", "targeted-frequency", and "frequency-graphics," and added to the model separately. "Targeted-graphics" is not statistically significant. However, the coefficient on "frequency-graphics" is negative and significant at the one percent level. This signifies that an increase the frequency by one level decreases the marginal utility of the direct effect of graphics, and vice versa. In other words, when animated graphics and higher levels of frequency are combined, this lowers the utility of the app for the consumer. Conversely, "targeted-frequency" is positive and significant at the one percent level. This suggests that increasing the frequency of ads by one level increases the coefficient on the direct effect of targeted ads. This could mean that if consumers must encounter

frequent ads, they prefer them to be targeted towards their own preferences. When each of these variables was added to the model, "click to exit ability" became significant at the one percent level as well. As the coefficient on this variable remained positive, the reason for its significance is unclear, so this result is unexplained.

Both of the interaction variables were included in one model. In the results, "frequency-graphics" remained significant at the one percent value, "targeted-frequency" became insignificant, and the coefficients of the rest of the variables became insignificant. This, along with the fact that the magnitude of its marginal utility coefficient is higher, may suggest that the interaction effect between the attributes "frequency" and "graphics" is the strongest, and that app developers should avoid the pairing of animated graphics and frequent pop-ups, as it is the most irritating to consumers. Due to this interaction effect being the strongest, the model including "frequency-graphics" was tested using a likelihood ratio test against the basic model, to see if it is a better fit. With a result of 81.3, the likelihood ratio test shows that the model with "frequency-graphics" is a better fit. The marginal utility coefficients of this model are displayed in column 3 of Table 3.

I used the marginal utility coefficients of the model with "frequency-graphics" to estimate willingness-to-pay to avoid each attribute. I find that a consumer is willing to pay $4.06 to avoid targeted ads, $0.28 to decrease the frequency of the ads by one level when ads are static, $2.71 to decrease the frequency of ads by one level when ads are animated, $1.30 to avoid ads with animated graphics, and $3.73 to avoid ads with animated graphics and a frequency of 2.5 (the mean of the four frequency levels – where an ad appears every 45 seconds). These values are listed in column 4 of Table 3.

The dollar value of willingness-to-pay signifies how much more an app without disruptive attributes would have to be priced for the consumer to be indifferent between this app and one with these attributes, or, in other words, how much the respondent is willing to pay for a change in attribute level. To illustrate, consider two apps with identical functionality, but one has targeted advertising while the other has random advertising. The consumer would prefer the app with random advertising, and this app would have to be priced $4.06 for the consumer to be just indifferent between the two apps. In terms of the interaction effects, these show, for example, that an app with static graphics and a lower level of frequency would have to be priced $2.71 more than an app with animated graphics and a higher level of frequency for the consumer to be just indifferent between the two apps. This means that the effect of a higher level of frequency is more irritating to the consumer when graphics are animated.

The high dollar value on willingness-to-pay to avoid targeted ads suggests that this attribute is the most bothersome to consumers. It suggests that app developers should be wary of using ads that target the consumer, as this may deter them even from using the application or buying the product advertised. The high willingness-to-pay to avoid targeted advertising conflicts with my theoretical model. I predicted that consumers would prefer these productive ads because they reduce time spent on essential activities. The results show the opposite, that consumers avoid targeted ads. This could mean that the privacy issues related to targeted ads outweigh their benefits.

Because the majority of the respondents were young, white, college students, there is a lack of socioeconomic variation in the sample. Consequently, the heterogeneous effects of age, education, or income could not be successfully tested. The data was tested for gender effects, but

the differences between male and female marginal utility coefficients were found to be statistically insignificant.

Table 3

Attribute	Basic Model	Interaction Effects Model	WTP	
Price (x_1)	-0.551 ***	-0.480***	---	
	(0.034)	(0.034)		
Targeted (x_2)	-1.676***	-1.950***	$4.06	
	(0.165)	(0.168)		
Frequency (x_3)	-0.311***	-0.133***	$0.28	$x_4 = 0$
	(0.33)	(0.038)	$2.71	$x_4 = 1$
Graphics (x_4)	-2.882***	-0.624**	$1.30	$x_3 = 0$
	(0.228)	(0.343)	$3.73	$\overline{x_3} = 2.5$
Exit Ability (x_5)	0.079	0.773***	---	
	(0.116)	(0.140)		
Sound (x_6)	0.729***	0.313**	$0.65	
	(0.123)	(0.136)		
Frequency-Graphics	---	-1.168***		
		(0.133)		
Log Likelihood	-2201.5	-2160.9		
Likelihood Ratio Test	81.3			
Respondents	250			
Observations	2,138			

Note: WTP is Willingness to pay. *** denotes significant at the one percent level ** denotes significant at the five percent level

8 Discussion

There are limitations in my study that suggest caution when interpreting the results. The experiment was conducted through an online survey, where respondents made a choice between two generic apps (instead of personalized) and were not given the option to choose none. Generally, this heightens the potential for hypothetical bias in the results, however, this applies less to my study because I did not test whether or not respondents would purchase an app with certain characteristics, but rather, which attributes a respondent would avoid if they must purchase or download the app.

To extend this study, a survey environment with personal interviews and interaction would improve the results. If the survey was distributed in person, the surveyor could decrease the potential for hypothetical bias by presenting personalized apps to the respondents, and informing them that they would purchase the app at a later time. For instance, a respondent would be asked what type of apps they use (i.e. social, music, games, etc.) and given a set of specific app choices based on their preference. This would also allow for the attributes to be explained in more detail, with images or animations of the ads shown to the consumers, and for the respondents to ask questions.

Another extension is to include a third option in each choice occasion to choose neither of the two apps. This experiment would provide insight into whether consumers are so bothered by disruptive ad attributes that they would rather not purchase the app at all. Additionally, a new experiment could have one app alternative with worse overall functionality but no disruptive ads, and another app with better overall functionality but with disruptive ads. This would allow for observation of the tradeoff between functionality and disruptive ads within a smart phone app.

This study was also limited in terms of data collection – resulting in a small homogeneous sample and selection bias in the survey's distribution methods. The data in this study represented young college students enrolled in Economics courses. Using cluster sampling across the nation to collect a larger, nationally representative sample would allow for the measurement of heterogeneous effects across socioeconomic factors.

The results of this study provide valuable insight into consumer attitudes toward advertising within smart phone applications. All else held constant, the results show that a consumer is more satisfied when apps have a lower price, have less frequent ads, and have ads without animated graphics. Additionally, although I predicted that consumers would prefer targeted ads due to increased relevance, the findings show the opposite, that consumers are actually better off when ads are random. This may suggest that the privacy concerns related to targeted ads outweigh the benefits of seeing relevant ads. Finally, a consumer is more satisfied when higher frequency ads are not combined with animated graphics.

For app developers, these findings suggest that if they choose to charge a price for their app, it should be lower, perhaps between $0.99 and $1.99, as this is the price most consumers paid for apps. Furthermore, developers should be careful in employing ads that pop-up frequently, have animated graphics, or that have both of these attributes. Due to the privacy concerns related to targeted ads, developers should use caution when considering their utilization.

One way for app developers to address the higher costs that come with the employment of these ads in their product is to charge a higher price for ad space that uses animated graphics, targets consumers, or pops up too frequently. However, companies who buy ad space within these apps should also consider the costs that come with employing these attributes, because

although using them may increase the clicks on the ad, they may also alienate many consumers. Furthermore, there is a question of whether disruptive ads cause the consumer not to use an app. If so, then the disruptive ads hurt both the app developer and company buying ad space, as no one uses the app, and therefore no one sees the ads. Instead, app developers should employ ads that have high click through rates but do not alienate users through irritation.

9 Conclusion

In this study, six disruptive advertisement attributes in the smartphone applications market were studied using a survey of university students. A discrete choice survey was conducted on a sample of university students. Respondents answered a series of choice experiments. Parameters of a random utility model were estimated by conditional logit to determine a consumer's willingness-to-pay to avoid disruptive advertisement attributes within a smartphone application. The results show that a consumer is willing to pay $4.06 to avoid targeted ads, $0.28 to decrease the frequency of the ads when graphics are static, $2.71 to decrease the frequency of ads when graphics are animated, $1.30 to avoid ads with animated graphics, and $3.73 to avoid animated graphics when paired with the mean ad frequency level of 2.5, or 45 seconds. The results of this study have useful implications for app developers and companies who buy ad space within apps. The results suggest that these parties should avoid employing ads that target the consumer, have animated graphics, a higher level of frequency, or that combine animated graphics and higher levels of frequency.

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Cognitive Build-Up

The following survey is being conducted for academic research purposes to investigate how University of Colorado Boulder students feel about smart phone advertising.

The results of the survey will be used to complete an undergraduate honors thesis, so if you choose to participate, it would be highly appreciated if you complete all the questions, without any skips. However, you can leave the research at any time, and it will not be held against you.

By checking the field below you consent to participate in this study.

If you have questions, concerns, or complaints, or think the research has hurt you, email the principal investigator at Kristina.avery@colorado.edu.

Yes, I choose to participate. This selection documents your permission to take part in this research.

☐

Note: Feel free to move back and forth on pages in this survey, however, please use the arrows located at the bottom of each page. Do not use the back button in your browser, as it will delete your responses.

Do you use a smart phone?

- Yes
- No

How many hours of the day do you spend using your smart phone (on average)?

- 0-2
- 3-6
- more than 6

Please specify the importance of the following uses of your smart phone.

	Not important	Somewhat important	Very important
Phone Calls			
SMS/MMS messaging			
Social Networking Apps			
Shopping Apps			
Games			
Lifestyle Apps (fitness, recipes, diet)			
Money/Banking Apps			
Music Apps			
Directions and Transportation			
News App			
Email			
Web browsing			
Photos			

How many applications have you downloaded on your smart phone?

(Only count those which you personally downloaded. Do not include the apps already available on your smart phone when it was purchased.)

- 0-5
- 6-15
- 16-30
- Greater than 30

The majority of apps in the app marketplace are free or relatively inexpensive. For this reason, developers must include advertisements in order to make money from their app. The level of advertising can vary for different applications.

Have you ever paid to download a smart phone application?

- Yes
- No

On average, how much have you paid for individual smart phone applications in the past?

- Less than $0.99
- $0.99
- $1.00 - $1.99
- $2.00 - $2.99
- $3.00 - $3.99
- Greater than $3.99

Apps may vary by price depending on the characteristics of their advertisements. ($0 -$3.99)

How important is the price of an app to you?

- Not at all Important
- Unimportant
- Neither Important nor Unimportant
- Important
- Very Important

Apps may have advertisements which are either **targeted** or **random**.
Targeted ads are based on the user's browser history or location. These are specialized to match your preferences.
Random ads are not user specific and appear the same for everyone.

If apps must have ads, do you have a preference for the type of ad?

- Targeted
- Random
- No preference

In-app advertisements may have different attributes. For instance:

The frequency that the ad is visible (or appears if pop-up) varies. It can vary from:

- **appearing every 5 seconds**
- **appearing every 30 seconds**
- **appearing every 1 minute**
- **appearing every 5 minutes**

If apps must have ads, do you have a preference for how frequently they appear?

- ○ Yes
- ○ No
- ○ No opinion

Advertisements may also have different types of graphics. The text or image can be either:

Static: no movement
or
Animated: movement, such as blinking or flashing

How do you feel about graphics in ads (select all that apply)?

- ☐ I'm fine with static ads, but I dislike animated ads.
- ☐ I don't care about ads, I just ignore them.
- ☐ I like well-done animated ads
- ☐ I *hate* blinking and flashing ads

Another attribute of in-app advertising is restriction of the user's ability to click to exit or remove the ad. The user may either:

exit or remove the ad immediately
or
must wait period of time (such as 10 seconds) to exit or remove the ad

Do you have a preference for how quickly you can remove the ad?

- ○ Able to exit or remove ad immediately

- Wait 10 seconds to remove
- No preference

Additionally, advertisements in apps can have sound. This sound may occur when opening the app or when moving to a new page within the app.

Do you have a preference for whether or not the ads have sound?

- Yes
- No
- No opinion

For your convenience, the table below summarizes the levels of the five features

Feature	Levels
Price of application	$0 to $3.99
Ads Targeted or Not	Targeted (Personally chosen advertisements to your liking) Random (Similar advertisements for everyone)
Frequency of Ad visibility	Appears every 5 seconds Appears every 30 seconds Appears every 1 minute Appears every 5 minutes
Graphics of Ads	Static (Picture or text with no movement) Animated (blinking/movement)

Click to Exit Ability	Can exit or remove ad immediately Must wait period of time (such as 10 seconds) to exit or remove ad
Sound	Sound No sound

For the next set of questions assume you are planning to purchase an app which you will use on a regular basis, say for longer than 10 minutes per day every day.

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$2.99	$0
Ads Targeted or Not	Random	Targeted
Frequency of Ad Visibility	Appears every 30 seconds	Appears every 5 seconds

Graphics	Animated	Static
Click to Exit Ability	Must wait period of time (such as 10 seconds) to exit or remove ad	Can exit or remove ad immediately
Sound	Sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$0.99	$1.99
Ads Targeted or		

Not	Targeted	Targeted
Frequency of Ad Visibility	Appears every 1 minute	Appears every 5 minutes
Graphics	Static	Static
Click to Exit Ability	Can exit or remove ad immediately	Can exit or remove ad immediately
Sound	No sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Assume you are planning to purchase an app which you will use on a regular basis, say for longer than 10 minutes per day every day.

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

Features	App 1	App 2
Price	$1.99	$0.99
Ads Targeted or Not	Targeted	Random

Frequency of Ad Visibility	Appears every 5 seconds	Appears every 5 minutes
Graphics	Static	Static
Click to Exit Ability	Can exit or remove ad immediately	Can exit or remove ad immediately
Sound	No sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$0.99	$0
Ads Targeted or Not	Targeted	Targeted

Frequency of Ad Visibility	Appears every 1 minute	Appears every 5 seconds
Graphics	Animated	Static
Click to Exit Ability	Must wait period of time (such as 10 seconds) to exit or remove ad	Can exit or remove ad immediately
Sound	Sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Assume you are planning to purchase an app which you will use on a regular basis, say for longer than 10 minutes per day every day.

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

Features	App 1	App 2
Price	$1.99	$1.99
Ads Targeted or		

Not	Targeted	Random
Frequency of Ad Visibility	Appears every 30 seconds	Appears every 5 minutes
Graphics	Static	Animated
Click to Exit Ability	Can exit or remove ad immediately	Can exit or remove ad immediately
Sound	No sound	Sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$2.99	$2.99

Ads Targeted or Not	Targeted	Targeted
Frequency of Ad Visibility	Appears every 5 seconds	Appears every 1 minute
Graphics	Static	Static
Click to Exit Ability	Can exit or remove ad immediately	Must wait period of time (such as 10 seconds) to exit or remove ad
Sound	No sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Assume you are planning to purchase an app which you will use on a regular basis, say for longer than 10 minutes per day every day.
Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$0.99	$0
Ads Targeted or Not	Targeted	Targeted
Frequency of Ad Visibility	Appears every 30 seconds	Appears every 5 seconds
Graphics	Static	Static
Click to Exit Ability	Can exit or remove ad immediately	Can exit or remove ad immediately
Sound	No sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

Features	App 1	App 2
Price	$0	$1.99
Ads Targeted or Not	Targeted	Random
Frequency of Ad Visibility	Appears every 5 seconds	Appears every 30 seconds
Graphics	Static	Animated
Click to Exit Ability	Can exit or remove ad immediately	Must wait period of time (such as 10 seconds) to exit or remove ad
Sound	No sound	No sound

- App 1
- App 2

Would you have actually purchased the app you chose above?

- Yes
- No

Assume you are planning to purchase an app which you will use on a regular basis, say for longer than 10 minutes per day every day.

Suppose you are choosing between two apps that have the same function (for instance, navigation apps),
but with differences in the characteristics listed in the table below.

(Even if you do not view either of the options as ideal, tell us which you would most prefer)

Features	App 1	App 2
Price	$2.99	$3.99
Ads Targeted or Not	Targeted	Targeted
Frequency of Ad Visibility	Appears every 5 seconds	Appears every 5 minutes
Graphics	Static	Static
Click to Exit Ability	Can exit or remove ad immediately	Can exit or remove ad immediately
Sound	Sound	No sound

- ○ App 1
- ○ App 2

Would you have actually purchased the app you chose above?

- [ ] Yes
- [ ] No

Demographics

Gender

- [ ] Male
- [ ] Female
- [ ] Prefer not to respond

Ethnicity Origin

- [ ] Caucasian
- [ ] Hispanic or Latino
- [ ] African American
- [ ] Native American
- [ ] Asian or Pacific Islander
- [ ] Other
- [ ] Prefer not to respond

Age

- [ ] Under 18
- [ ] 19 - 34
- [ ] 35 - 60
- [ ] Over 60
- [ ] Prefer not to respond

Highest level of Education completed

- ○ Below High school
- ○ High School Diploma or Equivalent
- ○ 2 year degree/ Associate
- ○ Some College
- ○ 4 year degree/Bachelor
- ○ Beyond Bachelor's degree
- ○ Prefer not to respond

Employment Status

- ○ Employed for Wages
- ○ Self-employed
- ○ Student
- ○ Retired
- ○ Unable to Work
- ○ Unemployed
- ○ Prefer not to respond

Marital Status

- ○ Single
- ○ In a Relationship
- ○ Married
- ○ Divorced
- ○ Separated
- ○ Widowed
- ○ Prefer not to respond

Please contact support@qualtrics.com if you have any questions regarding this survey.