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An Explorative Study of the Effectiveness of Mobile Advertising

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AbstractThis study examines factors related to the effectiveness of mobile advertising. Using a large data set with 115, 899 records of ad tap through from a mobile advertising company, we identify that the influencing factors for ad tap through are application type, mobile operators, scrolling frequency, and the regional income level. We use a logit model to analyze how the probability of ad tap through is related to the identified factors. The results show that application type, mobile operators, scrolling frequency, and the regional income level all have significant effects on the likelihood whether users would tap on certain types of advertising. Based on the findings, we propose strategies for mobile advertisers to engage in effective and targeted mobile advertising.

1.   INTRODUCTION

The rapid development of mobile Internet technology makes it possible for mobile advertisers to use various applications to dynamically push advertisements ontosmartphones and tablets. The traditional advertising formats of short message service (SMS) and Multimedia Message Service (MMS)[14, 16] are gradually being replaced by mobile interactive advertising [12]. More advantageous than the traditional advertising, this new form of mobile advertising possesses properties of real-time, mobility, higher rates of user reachability, andinstantaneous interactions. Because of the unique match between asmartphone and its user identification, mobile advertisers can analyze users' behavior and preferences and achieve more accurate advertising content delivery.The mobile advertising service industry, resulting from the popularity of mobile advertising,sets itsthe core business as pushing advertisements to mobile users. They not only organize a large number of mobile application developers to provide application services to mobile customers, but also promote the development and practice of personalized advertising service market.

Due to the popularity of the Android open platform, a new advertising model of "free Apps + advertising"has in recent years gained market popularity. Taking advantage of this trend, a number of mobile advertising companies emerged. Successful examples include Millennial Media, StrikeAd, and AirPush, in the US, and Cellphone Ads Serving E-Exchange (CASEE), WOOBO, and Youmi in China. In 2012, Millennial Media saw it is IPO price rise more than 90% on the first day listed on the NASDAQ, showing the market confidence and expectation for this emerging industry. Among all forms of advertising, the mobile advertising is expected to grow the fastest.It is the new frontier of advertising. Social media companies such as Google and Facebook race to gain shares of this form of advertising. The results of a study by the U.S. market research firm eMarketer show that the U.S. mobile operators mobile advertising revenues reached $760 million in 2009, and are expected to grow at an annual growth rateof more than 40%, reaching $3.3 billion in 2013 [7].

Tsang [18] summarize the nature of mobile advertising as follows: 1) the rapid growth of mobile Internet has

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made effective one-to-one marketing possible; 2) the user attitudes toward mobile advertising are generally passive unless the content are specially customized; and 3) the user attitudes have a direct impact on their behaviors. Xu and Gutierrez [21] also think that the widespread usage of mobile phones has resulted in the rapid growth of mobile commerce (m-commerce), and mobile advertising is one of most important m-commerce applications, as well as one of the highest potential direct marketing channels.

The mobile advertising business model consists of mobile advertising companies, advertisers and App developers. Mobile advertising companiesare responsible for contacting advertisers, making advertising banners, and pushing advertising content to a variety of apps. They also provide advertising placement Software Development Kit(SDK) to third party developers who have registered with the companies. Developers embed the SDK in their developed Apps and publish them on the web. Mobile phone users can download Apps and install themon their phones.When users open an App, the embedded SDK application will request data from the back-end service for specific advertisement banners to display on mobile terminals. The advertisements will scroll in a specific position on the smartphone. When interested in the content of a scrolling banner, a user can tap on it. Then the specific content of the advertisement is shown in appropriate forms on the phone screen. This completesthe publication cycle of an advertisement. The mobile advertising company records the number of taps and advertisers pay an appropriate fee based on the hits. The mobile advertising company then shares part of the revenue with developers.

Because this advertising model is the combination of ad push by mobile advertising companies and ad tap by mobile users, a great deal of randomness is involved. The resulted low tap-through rates indicate the poor effectiveness of the mobile application advertising. In addition, too many ineffective ad displayscan make mobile users unhappy because of unwanted interferences. Huang [8] argues that mobile media companies should respect usersby highlighting the core advertising value of displaying accurate advertising for targeted customers. How to increase the accuracy of advertising placements and reduce user irritation is a very challenging proposition for mobile advertising companies.

We attempt in this research to answer this challenge of personalized marketing of "at the right time, sent to the right person"[4]. We build an empirical model based on 115, 899records from a local mobile advertising company to discern the relationships between a tap-through of an advertisement by a user and type of Apps, mobile carriers, and the number of scrolls. Based on the results, we draw policy implications for more precise advertisementdeliveries.

2.   RESEARCH BACKGROUND

Mobile advertising is an emerging research field and many researchers attempt to identify its success or adoption factors ([13, 14, 19].Identified factors include time, location, information and personalization [2] and social norms, user's motives, mode, and personal characteristics [1]. Studies also propose that perceived information, entertainment, and social utility [2] and entertainment, irritation, informativeness, credibility and personalization [21]. Similarly, Cheng et al.[5] analyze four strategies of digital advertising placements on mobile devices and discover that three elements - informativeness, entertainment, irritation – have impact on the effectiveness on mobile advertising. Jun and Lee [10] find that convenience and multimedia service are statistically related to users' acceptance of mobile advertising.

Castro [3] introduces customer location information and user interest in mobile advertising push research. He uses decision keywords to filter the neighborhood list to find the similarity between user locations and interests, and makes recommendation for advertisements. The experiment showed good results with almost 100% of the users expressed a certain level of interest in the received advertisement recommended by the system.Kim [11]designs a system that not only provides recommendations based on user's interest, but also

improves the efficiency of advertising by mining user preferences based on user's text messages. The simulation of the system achieved good experimentalresults. A qualitative study by Peters et al. [15] finds that users' adoption of wireless advertising depends on process motives, social needs and content needs.

From the marketing perspective, some mobile advertising research focuses on how to provide users with valuable information and with accurate marketing services based on market segmentations and user preferences. Tsang et al. [18]propose that entertainment, credibility, irritation, and informativenessare important influencing factors for users' acceptance of mobile advertising. In a study of the young African consumers, Waldt[20]finds generally negative attitude for mobile ads, with entertainment, credibility, and irritation being the relevant factors. Chowdhury [6]discovers that among credibility, irritation, entertainment and information, only credibility is a significant factor influencing users' attitude toward mobile advertising.

In a comparative study, Cheng [5] offers some interesting insights about the old and new advertising push methods. Traditional forms of mobile advertising generally use SMS and telephone calls to push advertising content. However, the type of advertising is often treated as spam messages or phone calls. In the 3G era, the widespread use of smartphones have made new advertising push mode more appealing because users have the freedom to view or not view the advertising content. This leads to the decreased psychological resistance for mobile advertising.

Although current research on mobile advertising enhances our understandings of this new form of advertising and its effectiveness, two gaps between theory and practice still exist. First, theoretical frameworks proposed in the extant literature are mostly abstract in nature. This makes their applications to reality difficult. Second, the focus of most of research is on the sender (seller) side of advertising instead of on the recipient (user) side. This leads to the need to examine advertising effectiveness from the user's perspective [9]. The rapid growth of mobile phone users has attracted a large number of mobile advertisers to enter the market. To minimize irritations with mobile user experience, it is crucial for advertisers to find an innovative and non-invasive method of advertising placements. However, the precise advertising and targeting proves to be still challenging because of the increasingly large demand for mobile advertising and the uncertainty of user behavior [17].

This explorative study aims to close the gaps. We propose an empirical and testable model for the likelihood of user would tap through a particular advertisement.Moreover, we introduce four key explanatory variables directly related to users. The four variables are: 1) App type. The focus of this research is on what type of advertising should be pushed to which type of applications. The current delivery method involves in a great level of randomness，which leads to low rate of tap through because the pushed advertisements are not the ones users are interested in. Hence, we choose application type as one of the explanatory variables. 2)Income level of the user location. We believe that the level of regional income is related to the popularity of certain types of advertising. For example, users in a relatively low income region may be more interested in downloading coupons from their cell phones, whereas users in more affluent regions can obtains coupons in variety of ways. Hence, our second explanatory variable is local GDP. This is similar to the user location concept proposed by Castro [3].3)Mobile Operators. Because there are three major mobile operators (China Mobile, China Unicom, China Telecom), their users may exhibit a different level of preference to certain type of advertising. Finally, 4) The number of scrolling advertisements. When users open an application on their phone, a mobile advertising company starts to send advertisements to scroll in the application. This number is cleared to zero when one advertisement is tapped on. This variable represents the irritation factor identified in the literature [18, 20].

3.   RESEARCH DESIGN

We carried out this study in three steps. First,we collected user data from a mobile advertising company in

Guangzhou, China. Second, we sorted and classified the data. Finally, we analyzed the data using logistic regression to calculate the probability of user tap-through based on App types, mobile carriers, the number of scrolling advertisements, and local GDP.

3.1 Data collection

We collected three month worth's data including the number of ad displays, tap through, the number of scrolling, and mobile carriers from a mobile advertising company located in Guangzhou, China. The data was randomly selected from the company's back-end servers. The volume of the data set was 80 gigabytes. Because the collected data were stored in text format, we developed a Java program to segment and extract text to generate a total of 9 million records. To overcome the large amount of data and limited computing capacity, we filter the records for the time period of 17:00-20:00 each day. This reduced the number of records to 60 million. The tap through stood at 115,899, representing a rate of about 1.9‰. This is our working data set for this study.

We use the classifications for advertisements and Apps defined by the company.The advertisements are distinguished based on the specific form of advertising and promotional content. There are four categories for advertisements. The first category is website promotion advertising, mostly for the promotions of e-commerce, portals and other websites.This type of advertising is mainly pushed to smartphones in the form of text. The second category of advertising ispromotional sales of goods and services by merchants in the form of GIF images.The third classof advertising is for group shoppingcards, coupons, as well as application software downloads.And the last category is the direct introduction and showcase of new products using rich media of audio, video, and animation.

For Apps, software application developers in their registration with the company must select the type of applications to be released. For example, the utility software category included communications and journalism; the games category included chess, puzzles, casual fun, strategic games, simulated adventures, shooting and flying, etc.The mobile carriers include China Mobile, China Unicom, China Telecom, and others (Railway Telecom, Great Wall Broadband, Blue Wave Broadband, Guangdong Telecom, and other small operators).

Tables 1a to 1c show the classification of Apps, advertisements, and mobile providers.

Table 1.   Classification of Apps, AD, and Mobile Carriers

App	App Code	Ad	Ad Code	TC	TC Code
Application Software	0	Website Promotions	1	China Mobile	1
Communication Aids	1	Product recommendations	2	China Unicom	2
Casual Games	2	Coupons and Promotions	3	China Telecom	3
Chess Puzzle	3	Rich Media Promotions	4	Other	4
Other	4				
Multimedia Software	5				
Strategy Games	6				
Network Application	7				
System Software	8				
Role-playing	9				
Shooting & flight	10				
Adventure Simulation	11				
Security Software	12				
Sports Competition	13				
Action Fighting	14				

3.2 Correlation analysis and research model

We report the descriptive statistics and correlation analysis Tables2 and 3.

Table 2.   Descriptive Statistics

AppType	ad1	ad2	ad3	ad4	Total	%
App0	3375	2232	9021	30	14658	12.647
App1	10	0	335	0	345	0.298
App2	4657	2212	39446	1676	47991	41.408
App3	472	290	6736	1	7499	6.470
App4	10279	9001	8941	805	29026	25.044
App5	264	800	2912	90	4066	3.508
App6	57	18	625	4	704	0.607
App7	124	6	1072	0	1202	1.037
App8	29	0	1120	2	1151	0.993
App9	94	1	1854	4	1953	1.685
App10	310	0	3754	0	4064	3.507
App11	9	2	716	12	739	0.638
App12	10	0	94	0	104	0.090
App13	32	5	1144	0	1181	1.019
App14	34	189	992	1	1216	1.049
Total	19756	14756	78762	2625	115899	
%	17.046	12.732	67.957	2.265		

Table 2 offers a few insights about the relationships between Apps and Ads. First, the tap through on three Apps, Application Software (App0), Casual Games (App2) and Other (App4), account for 67.96% of all tap through, with Casual Games accounting for more than 41%. Second, four Apps, Security Software (App12), Communication Aids (App1), Strategy Games (App6), and Adventure Simulation (App11), account for only 1.03% of the total tap through. Third, ad type Coupons and Promotionsis the most popular, accounting for 67.96% of the total tap through. Fourth, Rich Media Promotion ads are taped through the least for only 2.27%, of which 63.84% are opened in Casual Games Apps.

We use logistic regression model to estimate the factors affecting the probability of users tapthrough an advertisement. The dependent variable is defined as: y = 1 if an ad was taped,0 otherwise

The independent variables are App type, mobile operators, GDP and the number of scrolls of an advertisement. Specifically, the logitmodel is as follows:

WhereP is the prob(y=1); app is the App type，fori = 1,2,3,4；GDP is the local income level of the area where the users resided；RC is the number of scrolls after the App was turned on;and tc is the mobile operator, defined as: tc1=1 for China Mobile, tc2 =1 for China Unicom, and tc3=1 for China Telecom.

4.   RESULTS

We ran the logit model separately for the four different Ad types. The estimation results using SPSS are reported in Table 4. Overall, the probability of a tap through of a certain type of ad is related to App type, mobile operators, the income level of the area where a user resided, and the number of scrolling advertisements.

Among the four types of advertisements, the first type is text based website promotion advertising, mostly for the promotions of e-commerce, portals and other websites. The probability of tap through of this type of ads is correlated with the types of Apps. The likelihood of tap through is largest in the Apps in the App4 category, while is smallest in the Adventure Simulation category (App11). This suggests that adventure simulation gamers most likely do not want to be interfered by this type of Ad in the form of text. The second category of advertising is GIF images based promotional sales of goods and services by merchants. They are more likely to be opened in App4 and App5 (Multimedia Software). The third category of advertising is for group shopping cards, coupons and application software downloads. They are most likely to be taped through in App8 (System Software), while least likely in App4. For the fourth ad category of the rich media based direct introduction and

showcase of new products, it is most likely to be opened in App2 (Casual Games), App4 (Other), App11 (Adventure Simulation) and App5 (Multimedia Software). Because this category of Ad relies on audio, video and animation for deliveries, users who open multimedia related Apps should be more interested in this type of advertisements.

Table 4. Logit Estimation

	Ad1	Ad2	Ad3	Ad4
app0	2.067***	-.092	-.770***	.963
App1	.133	-19.457	2.007***	-14.137
App2	1.314***	-1.336***	.074	3.809***
App3	.835***	-1.551***	.777***	-1.596
App4	2.622***	.818***	-2.112***	3.525***
App5	.631***	.244***	-.405***	3.351***
App6	.957***	-1.986***	.784***	1.889*
App7	1.342***	-4.016***	.746***	-14.046
App8	-.324	-19.513	2.346***	.634
App9	.673***	-5.847***	1.419***	.871
App10	1.070***	-19.501	1.069***	-13.968
App11	-.941**	-4.217***	2.093***	3.361***
App12	1.457***	-19.499	.714**	-14.191
App13	-.123	-3.763***	2.086***	-14.044
tc1	-2.303***	-.433***	2.363***	.972***
tc2	-1.199***	-.121***	1.557***	.568***
tc3	-.689***	-.206***	1.105***	.790***
GDP	.276***	.136***	-.325***	.015
RC	.030***	.071***	-.076***	-4.594***
ρ	-2.104***	-1.393***	-.300***	-8.431***

***significant at the 0.01 level. **significant at the 0.05 level.

The probability of tap through is also correlated with mobile carriers. On one hand, our results show users on the big three networks (China Mobile, China Unicom, and China Telecom) were more likely to tapon ad3 and ad4 than those on the other smaller operators. On the other hand, users on the smaller operators were more likely to open ad1 and ad2than those on the big three network.

The income level of locations of users has different effects on the ad tap-through probability.The higher GDP was correlated with the likelihood of ad1 and ad2 being taped on. That is, ad1 and ad2 were more acceptable to users in areas with high income. On the contrary, ad3 was more acceptable for users in regions with a lower income level. This phenomenon can be attributed to the fact that coupons and group shopping cards are relatively more valuable to users in the lower income areas and phones may be one of few ways of getting them. However, users in more affluent and developed areas, such as big urban centers, can obtain coupons and group shopping cards through a variety of ways because discount delivery terminalsare relatively common. This resulted in the weakened use of mobile phones to download coupons or group shopping cards.

Our results on the scrolling frequency are mixed. On one hand, the number of scrolling has a negative effect on the tap through for advertising types 3 (Coupons and Promotions) and 4 (Rich Media based Promotions). That is, the increased number of scrolling reduces the likelihood of tap through for these types of advertising. This is consistent with previous studies that have found that the scrolling irritates users for their normal use of Apps and would reduce the probability of tap through [5,21]. On the other hand, the number of scrolling has a positive impact on the probability of tap through of advertising types 1 and 2 (Website promotion and Product recommendation). That is, the number of scrolling of such advertising and their tapthrough probability are positively correlated.

5.   DISCUSSION

Our results provide helpful guideline for the mobile advertising company to determine the best possible strategy for ad placement based on user characteristics. By knowing the probability of tap through of a particular ad given App type, mobile carrier, scrolling frequency, and the income level of the region, the company can push the ads to users who are most likely to tap through.

Table 5 list the Apps by the advertising type in a descending order based on the probabilities of Ad tap through calculated using our model. It omits the insignificant coefficients in Table 4. Based on the probabilities, the mobile advertising company can select the advertising type with the highest probabilities to push to users based on the opened apps. For example, for users who open App type 4 (Other) and are in high-income areas, the company should give a high priority to push advertising types 1 and 2 (Website promotion and Product recommendation). Similarly, for users who open App8 (System Software) andApp2(Causal Games) and live in moderate income regions, the company may select first ad3 (Coupons and Promotions) to push to App8 and ad4 (Rich Media based Promotions) to push to App2. If a user opens App5, the company should push Ad2 first.

Table 5.   Order of Ad Pushing by App

Order from highest to lowest	Ad1	Ad2	Ad3	Ad4
1	App4	App4	App8	App2
2	app0	App5	App11	App4
3	App12	App14	App13	App11
4	App7	App2	App1	App5
5	App2	App3	App9	App6
6	App10	App6	App10	App14
7	App6	App13	App6	
8	App3	App7	App3	
9	App9	App11	App7	
10	App5	App9	App12	
11	App14	App1	App5	
12	App11		App0	
13			App4	
14			App14	

6.   CONCLUSION

In this explorative study we model the probability of tap through on a particular type of ad based on App type, mobile operators, and scrolling frequency and the regional income level. Through analysis of a large data set of 115, 899 records, we find that the variables have significant relationships with the likelihoods of ad tap through. Our findings provide a theoretical basis for mobile advertising companies to switch from random ad placements to more personalized ad deliveries based on users' individual characteristics. This consequently can increase the probability for mobile phone users to tap through advertisements, resulting in enhanced efficiency of mobile advertising.

This explorative study offers many avenues for future research. First, more sophisticated modeling techniques can be used. For example, one can build a Bayesian Network to reveal the conditional probability for taping through a mobile Ad after a particular Ad is tapped. Second, individual personal characteristics, such as age, gender, education, etc., of mobile phone users could be directly related to their preference to certain types of advertising. Future research can consider collecting this type of data by surveying mobile users through a questionnaire. Analysis of both data collected by mobile advertising company and from the survey can provide moreinsights for the effectiveness of personalized mobile advertising.

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