

# The Effect of Repeated Ad Exposure and Physical Avoidance on Consumers' Mobile Ad Response

*Research-in-Progress*

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## **Abstract**

*Opt-in mobile advertisement platform services are increasingly popular. In this paper, we explore how repeated ad exposure and physical avoidance influence consumers' responses to mobile ads. Using a unique panel-level data of 1,193,131 million users from Cash Slide, a Korean mobile advertising platform, we find that 1) repeated ad exposure and physical avoidance has a negative impact on a consumer's response to mobile ads; 2) information richness in a mobile ad has a negative impact on mobile users' response to ads; 3) the negative effect of a user's repeated exposures to a mobile ad and physical avoidance increases in magnitude when the advertisement involves a context of higher information richness. Our finding bridges the gap in the extant literatures by examining the impact of repeated ad exposure and avoidance on consumers' mobile ad response. Moreover, we provide practical implications to advertisers on the mobile platform.*

**Keywords:** Mobile Advertisement, Repeated Ad Exposure, Physical Ad Avoidance, Mobile Commerce

## **Introduction**

With the explosive growth of mobile devices such as smartphones and tablet computers, it has become critical for marketers to capture users' attention on mobile devices to promote their products effectively. To take advantage of this opportunity enabled by the popularity of mobile devices, several mobile apps have been launched to enable advertisers to publish ads to opt-in consumers in a mobile environment. These innovative consent-based mobile advertisement platform services are becoming prevalent today. Examples include Tabjoy in the U.S. as well as Adlatte, and Cash Slide in Korea. In a nutshell, such mobile advertising apps provide users of the app with some rewards for viewing mobile ad creatives.

However, there exist several unique challenges in designing and implementing mobile-based ad service platforms. First, a mobile environment is considered to be more goal and task oriented (as is the case for the web environment (Eighmey 1997)) than traditional offline media such as TV or radio. Thus, compared to traditional media, consumers or users in a mobile device usage context may not pay sufficient attention to mobile ads. Second, since mobile ads are usually smaller in size due the limited screen size of mobile devices, advertisers may not be able to present sufficient information content. Third, similar to a web environment, mobile ads typically may have a low message involvement and high intrusiveness compared to traditional media advertisements (Mu and Galletta 2007). Consequently, there is inherently a higher propensity of mobile users to skip, avoid or ignore ads in a mobile setting.

Given these challenges, two pertinent questions for mobile ad platforms are 1) whether to show the same ad campaign creative to a user in a repeated manner until the ad creative receives sufficient attention, and 2) to what extent mobile ads should contain information content under a limited screen size. Prior studies in the advertising and marketing fields suggest that consumers' memory is a key factor to understand the relationship between ad exposure and response (Yoo 2008). Although consumers may skip ads, the literature on physical ad avoidance suggests that ad avoidance can contribute to consumers' explicit memory of the ads, which consequently heightens their ad response through ad recall and recognition in the future (Greene 1998; Zufryden et al. 1993). Nevertheless, if users skip a certain ad due to its intrusiveness, their memory of avoidance may have a negative impact on their response to the same ad in the future. A negative influence of ad exposure and physical avoidance is more likely in a mobile ad setting due to the intrinsic low message involvement. Thus, it is not clear how repeated ad exposure and avoidance affects a consumer's subsequent ad response. It is also important to understand how the extent of information content (i.e., information richness) may affect consumers' mobile ad response.

Despite the growing importance of capturing users' attention on mobile advertisements, the related research in this area is still nascent in answering these questions. To the best of our knowledge, this is the first to examine such specific research questions in a mobile setting. Our study presents three important findings. First, repeated ad exposure and physical avoidance have negative impacts on a mobile user's ad response. Second, information richness in a mobile ad has a negative impact on users' mobile ad response. Lastly, the negative effects of repeated exposures to a mobile ad and its physical avoidance increase in magnitude with the information richness of mobile ads.

Theoretically, our study aims to bridge the gap in the extant literatures by examining the impact of repeated ad exposure and avoidance on users' mobile ad response. While prior studies claim that the ad exposure enhances consumers' response rate due to the accumulative effects of memory building, our study in a longitudinal setting shows a contradictory finding. For managers, our findings suggest that marketers should realize that the high message involvement in a mobile-based platform does not draw consumers' attention, but instead increases the propensity to skip or avoid the mobile ads. Therefore, marketers should avoid the undiscerning repetitive exposure of ads in a mobile context.

## **Related Literature and Hypotheses**

The role of memory in advertising and marketing has been viewed as key to understanding the relationship between the exposure of an advertisement and a consumer's response to it. A substantial amount of effort has been devoted towards measuring consumers' memory when they are exposed to advertisements or products (Yoo 2008). In particular, the literature on the relationship between consumers' memory and advertisement exposure has largely focused on examining the effect of memory on advertisement effectiveness (Chatterjee 2008).

To expect the persistence of consumer's attitude towards ad response, a high level of message involvement is required on the advertisement campaigns (Chatterjee 2008). Nevertheless, a high extent of ad processing actually takes place under low involvement conditions (MacInnis et al. 1991). In particular, compared to the traditional media advertisements such as television and radio, web based advertisements typically have low consumer involvement, leading to a higher chance to skip or avoid such advertisements (Mu and Galletta 2007). Thus, skipping advertisements without giving attention to them can be considered a more natural reaction in an online context than in an offline context. Under such ad avoidance behaviors among online consumers, there are two types of relationships between ad avoidance and memory processing, according to the cognitive information processing theory (Richardson and Bjork 1988; Shapiro 1999) as applied in an advertising context: 1) conscious (physical) and 2) unconscious (cognitive).

In this study, we focused on the conscious (physical) ad avoidance. Physical ad avoidance refers to a consumer's decision to avoid (by skipping) a certain advertisement consciously (Brehm and Brehm 1981). A main conclusion of the physical ad avoidance literature is that physical zapping behavior builds some extent of consumers' explicit memory of the ads, which subsequently aids ad recall and recognition, thus heightening consumers' ad response (Greene 1998; Zufryden et al. 1993).

Prior studies documented that the impression built from ad exposures which eventually becomes as a memory plays an important role to affect consumers' purchase intention. In other word, the impression from a first ad exposure would build consumers' subsequent impression toward the same ads, and consequently set in as consumers' memory. To examine the consumers' purchase intention on repeated ad exposure, it is critical to clarify the sign of consumers' cumulative ad impression (positive vs negative) from the repeated ad exposures. However, only a few studies among the physical ad avoidance literatures explicitly suggested the direction (i.e., positive or negative effect) of the impression accumulated by physical avoidance of ads when advertisements are presented repetitively over time, but the most of literatures implicitly take attitude toward a positive effect of physical ad avoidance in the past (Greene 1998; Zufryden et al. 1993). Nevertheless, if users skip a certain ad due to its intrusiveness, their memory of avoidance may have a negative impact in the future. This effect is more likely to occur in a mobile ad environment due to the low message involvement.

One gap in the literature is how consumers react to their repeated physical avoidance of ads. Prior studies analyzed the relationship between consumers' ad exposure and response in a cross-sectional setting by varying the duration of exposure. However, in reality, the ads are exposed to users repeatedly. Thus, with repeated exposure and avoidance of ads, consumers' memory towards ads would be further strengthened. For instance, if one experiences that the ad is intrusive during the first exposure, the user's subsequent impression toward the ad would turn to a negative such that the associated purchase intention may decline due to the negative impression. This implies that the impression is cumulative as exposures increases. Therefore, a cross-sectional analysis may not be the correct approach to examine the effect of consumers' memory of ads. In sum, consumers who are exposed to ads would build an initial memory of the ads but such memory may turn negative due to the intrusiveness and low message involvement in a mobile context. The negative initial impression will be strengthened by the repeated exposures to ad and its physical avoidance. Taken together, we propose the following hypothesis:

- *Hypothesis 1: A consumer's repeated exposures to an advertisement and her physical avoidance have a negative impact on her subsequent response to a mobile advertisement.*

Consumers' recall and recognition rate of brands and products have long been considered as an indicator to evaluate the effectiveness of advertising in the literature (Kuisma et al. 2010). To increase the awareness for recall and recognition, previous studies have focused on the consumers' attention to advertisements and the amount of mental effort taken for the ad stimulus (Kahneman 1973). The literature on advertising suggests that consumers' attention and memory involve a cognitive process that is closely associated with the ad effectiveness (Kuisma et al. 2010). In addition, all advertising models consider consumers' attention as an important antecedent to actual processing, because there is some amount of attention required for ad to be recognized (Yoo and Kim 2005). Therefore, advertisers usually assume that greater attention to ads would enhance memory performance and increase consumers' response to ads (Tavassoli 2008). One of the widely-used indicators of consumers' attention is the stimulus intensity, i.e., the amount of attentional resources allocated.

Moreover, consumers' intention to pay attention on ads is highly related to their sensorial and cognitive capacity of processing information (Lutz and Hui 2003; McInnis and Jaworski 1989). The attention to ads depends on various factors such as ad contents and message characteristics (Calder et al. 2009). In our study, to measure the intensity, we use information richness as a proxy which is one of the attentional resources that is widely used in prior studies. To measure the ad effectiveness, high attentional resources are required (i.e., high message involvement in our case) (Chatterjee 2008; Kahneman 1973). However, a high extent of ad processing is under low involvement conditions, especially in the online context compared to traditional media (Mu and Galletta 2007). Therefore, we expect that information richness in a mobile platform has a negative impact on the consumers' ad response.

- *Hypothesis 2: The level of information richness that a mobile ad contains has a negative impact on a consumers' response to a mobile advertisement.*

We expect that the negative effect of a consumer's repeated exposures to an advertisement will intensify under richer information contents included in a mobile ad. Intuitively, if one skips an intrusive ad that was repeatedly exposed with a lot of information, the propensity to skip the mobile ad increases in the next exposure due to her negative impression of the ad. This is because the negative impression built from a low message involvement (H2) in a mobile platform would be accentuated by the repeated ad exposures as well as by continuous ad avoidance behaviors (H1). Thus, we expect that both the negative effects would increase in magnitude, and we propose the following hypothesis accordingly:

- *Hypothesis 3: The negative effect of a consumer's repeated exposures to an advertisement and its physical avoidance will increase in magnitude with the information richness of mobile ads.*

## **Data**

### ***Empirical Setting***

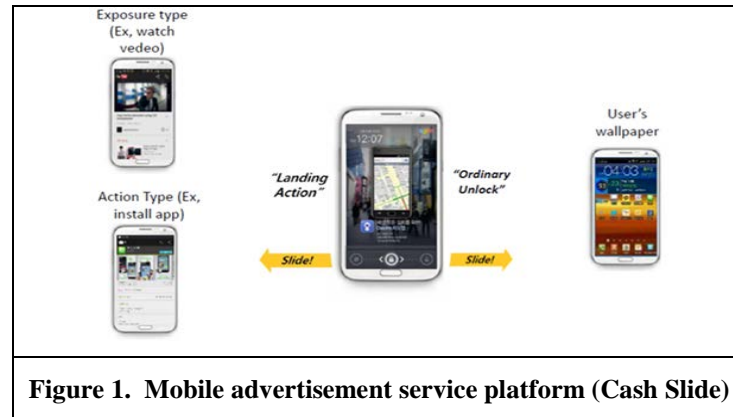
We collected our dataset from Cash Slide, one of the largest reward-based mobile advertisement service platforms for the Android mobile operating system in South Korea. The company was founded in November 2012, and there are about 5.5 million registered members as of April 2013. There are about 1.7 million daily active users, which is almost four times larger than that of other competitors' daily active users. The number of daily views has reached 90 million as of today.

Once a consumer registers for and activates a mobile app from Cash Slide, a graphical image of an advertisement is shown on users' lock screen (See Figure 1). This advertisement app enables advertisers to capture users' initial attention when they turn on their smartphones. After an ad creative or image is shown on a user's lock screen, a user can slide the ad creative to the left or right. By sliding to the left, a user is required to fulfill some conditions that an advertiser has set in order to earn cash rewards in return for being exposed to the ad. By sliding to the right, a user can skip the mobile ad such that it disappears from the screen and the user can proceed to an ordinary unlock page (wall paper) of a smartphone.

Once a user installs the Cash Slide mobile app, upon sliding left in response to an ad, she needs to accomplish an appropriate action or task depending on the type of the advertisement. There are two main types of advertisements, exposure type and action type. For an exposure type ad, a user is exposed to a sequence of advertisements provided by an advertiser without any further action required. A user may be directed to an advertiser's website or a video clip (See Figure 1). On the other hand, an action type ad requires a user to perform a more complex task such as downloading another related app, clicking "Likes" on a Facebook fan page, and signing up as a member of a website to earn full reward credits. Users usually earn more cash reward by completing tasks in the action type ads. The amount of cash reward allocated for the exposure type ads typically ranges between 0 to 200 Korean Won (about 0 to 20 cents in U.S. currency). For the action type ads, the amount of cash reward ranges between 0 and 4500 Korean Won (about 0 to 4.5 dollars in U.S. currency). In addition, a user may also receive a minimum cash reward of less than 10 Korean Won (about less than 1 cent U.S. currency) for sliding the mobile screen to the right if some advertisers allocated a nominal amount of cash reward for such cases.

The Cash Slide app presents the ad campaign creative for which a user has not been rewarded by sliding to the left. By sliding to the right repeatedly, a consumer's repeated exposure to the same ad image indicates her prior ad skipping or avoidance behaviors. However, once ad is left-slided, the same ad will

not be exposed to the same user unless the user does not accomplish the required action by quitting in the middle of the complete response process required. When an advertiser specifies a set of ad targeting rules such as target consumer age, group, and gender, a user is exposed to the ad campaign creative only when she satisfies the specific targeting criteria. An ad campaign persists until the budget pre-allocated by an advertiser runs out.



### Data Description and Summary Statistics

We collected detailed user actions during a one-month period between July 01 and July 31, 2013. 1,193,131 individual users were exposed to a total of 907 advertisement campaigns during this period. We also collected the characteristics of ad campaign creatives. For example, we captured whether an advertiser asked Cash Slide to expose the ad to any specific group of users in terms of their age, gender, and smartphone device during a specific time period. Some variables were coded by manually examining each ad campaign creative. For example, we have manually coded 'information richness' by counting the number of information contents (e.g., brand name, discount rate, shop location, etc.) the ads contain. Table 1 describes all the variables used in our study. Table 2 shows their descriptive statistics.

Variable		Description
Dependent Variable	Ad_response	Consumer's ad response decision (i.e., left slide = 1; right slide = 0).
Focal Variables	Exposure	The number of times that the same ad was exposed to the user and physically avoided in the past.
	Info_richness	The number of information contents that each advertisement contains.
Control Variables	Target_gender	1 if an advertiser set the target consumer gender, and 0 otherwise.
	Target_age	1 if an advertiser set the target consumer age, and 0 otherwise.
	Target_time	1 if an advertiser set the target exposure time, and 0 otherwise.
	Target_device	1 if an advertiser set the target smartphone device, and 0 otherwise.
	Message	1 if the ad itself contains some information on products or brands as well as the procedure on how to earn cash, and 0 otherwise.
	Pop-up_message	1 if the ad contains pop-up messages explaining the products or brand, and 0 otherwise.
	Sub_message	1 if the ad contains additional sub-messages explaining the procedure of how to earn cash reward, and 0 otherwise.
Extra_value	1 if the ad offers any type of additional reward value other	

		than the cash reward (e.g., 50% discount), and 0 otherwise.
	Cash_diff	The difference in allocated cash rewards between sliding left and sliding right.
	Ad_communication_type	Advertisement communication strategy to indicate whether the ad is informative or persuasive (1 if the ad is persuasive; 0 if the ad is informative).
	Celebrity_endorsement	1 if the advertisement creative shows a celebrity personality, and 0 otherwise.

Variable	Mean	Std. Dev.	Min	Max
Ad_response	0.030	0.171	0	1
Exposure	8.558	12.454	1	243
Info_richness	4.722	2.168	0	10
Info_exposure	37.728	64.020	0	210
Target_gender	0.983	0.129	0	1
Target_age	0.058	0.233	0	1
Target_time	0.579	0.493	0	1
Target_device	0.003	0.056	0	1
Message	0.924	0.924	0	1
Pop-up_message	0.117	0.322	0	1
Sub_message	0.199	0.399	0	1
Extra_value	0.256	0.436	0	1
Cash_diff	221.038	557.794	0	4500
Ad_communication_type	0.036	0.186	0	1
Celebrity_endorsement	0.079	0.285	0	1

## Model Specification

The main dependent variable of this study is whether a user responds to the mobile ad by sliding to the left on a mobile screen, or if not, skips or avoids the advertisement by sliding to the right. If a user slides to the left, the dependent variable is coded as 1. If she slides to the right, it is coded as 0. We define  $Ad\_response_{ijt} = 1$  if a user  $i$  chooses to respond to a particular advertisement campaign  $j$  at her  $t$ -th exposure to it. Since our dependent variable is a discrete variable, we employ a panel logit model and analyze the probability of responding to an advertisement creative. The model is written as follows.

$$\Pr(Ad\_Response_{ijt} = 1 | X) = \Lambda \left( \begin{array}{l} \alpha_i + \beta_1 \cdot Exposure_{ijt} + \beta_2 \cdot Info\_richness_j \\ + \beta_3 \cdot Exposure_{ijt} \cdot Info\_richness_{ijt} + \beta_4 \cdot Controls_{ijt} + \varepsilon_{ijt} \end{array} \right) \quad (1)$$

where  $\Lambda(x) = e^x / (1 + e^x)$ . The independent variables of our main interest include a user's prior exposure to and physical avoidance of the campaign ( $Exposure_{ijt}$ ), the level of information richness in the ad campaign creative ( $Info\_richness_{ijt}$ ), and their interaction term ( $Exposure_{ijt} * Info\_richness_{ijt}$ ).  $Exposure_{ijt}$  indicates the number of times that the advertisement campaign  $j$  was exposed to the user  $i$  and physically avoided before its  $t$ -th exposure to her.  $Info\_richness_j$  represents the number of information contents composed in a particular advertisement campaign  $j$ . For instance, if an ad only contains product name, the value of this variable is 1. Likewise, if an ad contains a number of information content such as brand name, product name, and discount rate, the value of this variable is 3.  $\alpha_i$  captures unobserved user-specific effects.  $Controls_{ijt}$  include a set of control variables included in this study, as described in Table 1.

## Preliminary Results

We checked the correlations between variables using both correlation table and VIFs (Variance Inflation Factors). All the independent variables are not highly correlated, and their VIFs are far lower than 10. As a second step, we have run the Hausman test. Since the test result rejected the null hypothesis, we adopted the fixed effects model for our final analyses. We clustered standard errors within each user. Table 3 shows the preliminary results. Model (1) represents the baseline model without our focal independent variables; Model (2) and (3) estimates the main effects to test our hypotheses 1 and 2; Model (4) shows the test results for Hypothesis 3.

Variables	Model (1)	Model (2)	Model (3)	Model (4)
Target_gender	0.754*** (0.053)	0.445*** (0.053)	0.495*** (0.053)	0.503*** (0.053)
Target_age	0.913*** (0.028)	0.781*** (0.028)	0.810*** (0.029)	0.801*** (0.029)
Target_time	-0.912*** (0.016)	-0.858*** (0.016)	-0.845*** (0.016)	-0.845*** (0.016)
Target_device	-0.157 (0.103)	-0.240** (0.102)	-0.277*** (0.102)	-0.328*** (0.102)
Message	-0.005 (0.024)	0.297*** (0.025)	0.276*** (0.025)	0.298*** (0.025)
Pop-up_message	-0.083*** (0.026)	-0.032 (0.026)	0.013 (0.026)	0.034 (0.026)
Sub_message	-0.617*** (0.025)	-0.652*** (0.025)	-0.722*** (0.026)	-0.726*** (0.026)
Cash_diff	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Extra_value	0.133*** (0.023)	0.203*** (0.023)	0.280*** (0.024)	0.290*** (0.024)
Ad_communication_type	-0.190*** (0.026)	-0.259*** (0.026)	-0.127*** (0.027)	-0.085*** (0.027)
Celebrity_endorsement	0.138*** (0.022)	0.052** (0.022)	0.106*** (0.022)	0.100*** (0.022)
Exposure (H1)		-0.068*** (0.001)	-0.069*** (0.001)	-0.029*** (0.002)
Info_richness (H2)			-0.050*** (0.003)	-0.006* (0.003)
Info_richness* Exposure (H3)				-0.010*** (0.001)
Pseudo R <sup>2</sup>	0.023	0.045	0.047	0.048
Significant at 1 % ***, 5 % **, and 10% *. The numbers in parentheses are robust standard errors. Number of Observations = 1,193,131.				

First of all, the pseudo R-square value in Model (3) is doubled by including the two main effects of prior ad exposure and avoidance as well as information richness compared to Model (1). Thus, the prior exposure and ad avoidance indeed has a significant negative impact on consumers' response to mobile ads. To interpret the coefficients in logit regression, we consider the odds ratio as a measure of effect size, which is defined as the ratio of the probability that an event would occur to the probability that an event would fail to occur (i.e.  $\Pr(Ad\_Response=1)/\Pr(Ad\_Response=0)$ ). The coefficient for ad exposure in Model (3) ( $\beta = -0.069$ , p-value < 0.01) indicates that an additional ad exposure and avoidance of the same advertisement decreases the odds of responding to the ad by 6.7%. Thus, our Hypothesis 1 is supported.

Next, Model (3) reveals that the effect of information richness to measure the stimulus intensity is statistically significant and has a negative impact on a consumer's ad response decision ( $\beta = -0.050$ , p-value < 0.01). This implies that mobile ads with high information content will fail to capture consumer's attention, which consequently decreases the odds of responding to the ad by 4.9%. Thus, the results also support Hypothesis 2.

In addition, Model (4) shows that the negative effect of repeated ad exposure and avoidance becomes stronger under a higher level of information richness ( $\beta = -0.010$ , p-value < 0.01). For example, under the minimal level of information richness in our sample, which is 0, an additional exposure to the same advertisement decreases the odds of responding to the ad by 2.9% only. However, under the maximum level of information richness in our sample, which is 10, an additional exposure to the same advertisement decreases the odds of responding to the ad by 12.1%. Thus, Hypothesis 3 is supported.

## **Discussion and Conclusion**

In this study, we investigated the effect of repeated ad exposure and physical ad avoidance on consumers' mobile ad response. Prior studies suggested that repeated ad exposures enhances consumers' brand awareness and response to ads even when the ads were physically avoided by consumers in the past (Tavassoli 2008). However, our study shows that a user's repeated exposures to a mobile ad and her physical avoidance have a strong negative impact on her subsequent response to the ad. However, our results in the specific context of mobile advertisements can be explained as follows. Since mobile ads are more likely to have low message involvement (low information richness in our case) due to a limited screen size as well as high intrusiveness, consumers build negative impression from their ad exposures even when the ad is avoided. This finding highlights that it is more effective to present mobile ads to a fresh set of consumers with no prior exposures rather than showing ad campaign creatives to the same set of users repeatedly.

We also found an important role of information richness. A mobile environment is characterized by its limitation in providing rich information content due to a limited screen size. A high level of information richness in a mobile advertising creative not only decreases a user's response to an ad, but also intensifies the negative effect of repeated ad exposure and physical avoidance. In other word, consumers' response to an ad is negatively influenced by repeated ad exposure and information richness intensifies its magnitude. Thus, advertisers have to be cautious in designing their ad creatives by reducing the information content in the ad creatives.

In sum, we observe that our empirical results are not consistent with the prior literatures. A potential explanation lies in the unique nature of mobile context. First, mobile platforms are more goal and task oriented device than those traditional media such as TV and radio (Eighmey 1997). Second, the screen sizes of mobile devices are limited. Consequently, small screens discourage users to pay sufficient attention to ads which in turn, brings about lower ad effectiveness (Chatterjee 2008). In addition, if ad creatives are interrupting mobile users' originally intended activities or goals, users would immediately respond to the ads by physically avoiding them. Given the situation, similar to a web environment, mobile ads typically may have a low message involvement due to the small screen and high intrusiveness caused by goal and task oriented device characteristics (Mu and Galletta 2007). Consequently, there is inherently a higher propensity of mobile users to skip, avoid or ignore ads in a mobile setting. The literature on physical ad avoidance suggests that ad avoidance contributes to consumers' explicit memory of the ads (Greene 1998; Zufryden et al. 1993). Nevertheless, if users skip a certain undesirable ad due to its intrusiveness, their memory of avoidance may have a negative impact on their response to the same ad in the future. Thus, consumers' repeated ad exposure to the same ads would lead them to build a negative impression toward these ads over time. A negative influence of repeated ad exposure and physical avoidance is more likely in a mobile ad setting due to the combinations of intrinsic low message involvement as well as a high propensity of intrusiveness.

To the best of our knowledge, this is one of the first attempts to examine a user's response to a mobile ad campaign creative in a longitudinal setting. This research sheds light on the need for improved campaign implementations of mobile ad campaigns conducted by advertisers and mobile advertisement service platforms.

Our future work can extend to examining a user's unconscious exposure to mobile ads and refining the research model based on the cognitive processing theory. Future extensions can also address possible endogeneity issues by using a structural modeling approach. Consumers' dynamic choice behaviors of mobile ad response can be modeled at every exposure to the advertisements. Moreover, due to the uniqueness of our data context, there are two current limitations. First, 'repeated ad exposure' is measured based on users' 'physical ad avoidance'. However, to explore more extensive generalizations for other advertisers, our future work may need to separate them into two different constructs. Second, users' ad consumption behaviors in our sample may be different from those users who see ads in the traditional media due to the consent and reward aspects of Cash Slide's business setting. Thus, we are planning to control for the reward aspect to examine the sole effect of repeated exposures in our future work. Additionally, we believe that users may build different impressions over the different kinds of ad categories or individuals' particulars. Thus, we also plan to more rigorously account for other forms of observed and unobserved individual user heterogeneity in our future work.



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