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CUSTOMIZED MOBILE ADVERTISING WITHOUT PRIVACY CONCERNS BASED ON SIMILARITY ATTRACTION

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ABSTRACT

This study explores the possibility of applying the sociopsychological phenomenon known as similarity attraction to the creation of more customized and persuasive mobile advertising, and for this purpose, we develop two applications, SensPlus and PerAds. While the SensPlus app accumulates the smartphone usage profiles of participants and constructs a regression model to predict their personality, the PerAds app presents user-created content according to the user's personality. Using these two apps, we first design an advertising scheme providing a customized and persuasive advertising method without privacy concerns and then conduct an experiment to investigate the effectiveness of the smartphone ad scheme. The participants' response to a smartphone ad is measured in terms of invitation acceptance of the cherry blossom festival and classical music concert. We analyze the rate of invitation acceptance using the χ^2 method. Our statistical analysis shows that participants respond differentially to the various types of smartphone ads according to the similarity between the personalities of the user and ad types. Our results indicate that the sociopsychological phenomenon can be introduced into practical application by replacing the personality trait factors with the smartphone usage pattern.

Keywords: *Similarity attraction, Extroversion traits, Smartphone usage profile, Customized advertising, Non-privacy invasive*

1. INTRODUCTION

The propagation landscape is undergoing rapid changes due to the decline in non-individualistic mass communication and rise in customized and personalized communication. Smartphones (and mobile phones in general) are at the core of this change owing to their widespread use. Such devices are simultaneously personal and social by nature [1], [2] – personal because they belong to individual users, contain personal information, and are rarely shared by others, and social because they connect users to social networks, allowing them to communicate with others anytime and anywhere. Such characteristics indicate the need for a more customized and persuasive means to deliver information to users.

Mass marketing is the advertising or promotion of a product or service to a wide variety of audiences while ignoring niche demographic differences. Typically, broadcasting mediums such as TV, radio and newspaper are associated with this marketing strategy [3]. In contrast, digital marketing, often called 'online marketing' or 'internet marketing', employs digital and social media platform and identifies a target market or discovers a marketing segment's needs. In particular, one-to-one marketing delivers personalized ads to the recipient. The level of precision is now extremely high, particularly in online media, in particular, social network service [4]. Over the last two decades, the roles of mass media were disrupted by the information technologies including smartphones.

Several studies have proposed various strategies to customize mobile ads as a means of persuading users to buy advertised products. For example, a system may collect a user's geolocation information and provide a location-specific ad when the user is in the range of the targeted location [5], [6]. Ads related to the user's current activity can be delivered during internet searches [7]. Other user profiles such as interests, daily habits, and purchase history can be utilized to stimulate the user's desire

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for a particular product [8], [9], [10]. Also, some mobile ads rely on specific types of apps [11]

A boom in mobile ads that can target individual smartphone or mobile device users is raising deep concerns over the protection of privacy-sensitive data. For mobile operators, their interest in smartphones is to have the context-dependent information delivering ad services to the specific targeted people in the right place and time contexts. In addition, such customized persuasive strategies have been studied to a limited extent in the context of network technologies and data mining and little attention has been paid to their sociopsychological aspects.

In this study, we investigate the possibility of a customized advertising strategy based on the interaction between smartphone usage profiles and ad types. This interaction is known as the "similarity-attraction effect", or the tendency of people to be attracted by those similar to themselves [12], [13], [14]. The "similarity" factor has been studied with regard to various dimensions such as personality [15], attitude [16], social and cultural background [17], and physical appearance [18]. For example, people tend to select friends with similar personality dimensions such as agreeableness, extroversion, and openness. A higher positive correlation can be found between friends' personalities than between non-friends' personalities [19]. In addition, it has been shown that the attraction to similarity in others is not limited to humans, but can be extended to robots [20], avatars [21], and even commercial advertisement [22].

Most of the similarity-attraction studies based on personality employ personality questionnaire, which require manually to be answered. The users' attitudes are then evaluated after they are presented with an ad. However, this experimental procedure lacks practicality for real-world application because we cannot ask users to complete a personality questionnaire. More practical personality indices are required to replace such questionnaire procedures [23]. For example, the individual and social characteristics of smartphones can provide us with sufficient information to extract or infer the users' psychological states or personality traits.

Recent research efforts have tried to illustrate the relationship between user personality and smartphone (mobile) usage [24], [25]. Such research investigated how individual users with diverse personality traits exhibited differing attitudes toward various types of mobile phone applications, text message usage, ring tones, wallpaper, etc.

Although studies on similarity attraction and the relationship between personality and phone usage have been carried out independently, the ubiquity of smartphones provides a technological opportunity to bring them together and customize advertising services for individual users. This study aims to develop a smartphone advertising scheme that employs the similarity attraction effect and protect user's personal data. In this study, we test the opportunity by designing a smartphone ads system in which (1) the smartphone user's personality is based on smartphone usage pattern and not a questionnaire response; (2) the presentation of smartphone ads is customized to suit the smartphone user's personality; and (3) the smartphone user's personality information should not be collected, implying that the privacy-concern should be reduced. For this purpose, we design an experimental scheme to test the practicality of the proposed scheme and its persuasiveness effect.

In the following section, we present a general personality-based smartphone ads scheme, incorporating data collection, regression modeling, and customized advertising. We develop the app, SensPlus, used to collect the smartphone usage profile of users, and construct a personality regression model. The smartphone usage profile includes voice call time, voice call frequency, number of short message services (SMSs), etc. A regression model is used to map the smartphone usage to extroversion trait profile of users and to determine whether the user is an extrovert or introvert. Smartphone ads can be selectively provided to the smartphone user, considering the user's estimated personality. Thus, similarity-attraction effects can be induced by matching the personality of the ad to the estimated personality of the user.

However, note that smartphone users are not required to provide their personality information, which is privacy-sensitive in our proposed scheme. Since the regression modeling process of mapping the smartphone usage patterns to the user's personality can be independently done with a small sample group of different participants, the actual user's personality can be estimated by applying the regression model obtained from the sample group. By separating the regression modeling process from personality estimation, the psychological resistance of the actual smartphone user can be avoided. For personality-dependent ads, we need to simply set the regression parameters on the user's phone. In

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this way, the user's valuable information and privacy can be protected.

2. PERSONALITY-BASED SMARTPHONE ADS SYSTEM

2.1 An Overview of the Personality-based Smartphone Ads System

The general scheme of the personality-based smartphone ads system is presented in Figure 1. The scheme consists of two parts, regression modeling and customized advertisement. For regression modeling of the smartphone user's personality, we collected the smartphone usage profiles of 200 Android smartphone users using the SensPlus app. The smartphone usage profile includes voice call time, voice call frequency, number of SMSs, etc. A regression analysis is carried out to map a user's smartphone usage profile to his/her extroversion personality. For customized advertisement, we use the outputs obtained from the regression modeling stage to determine whether the new smartphone user is an extrovert or introvert. This can be done by applying the regression model to the user's smartphone profile accumulated for a certain period, say two weeks. Then, the smartphone ad is differentially presented – an extroverted ad for the extrovert user and an introverted ad for the introvert user. The smartphone ad is presented using an app called "PerAds." Thus, the similarity-attraction effects can be induced by matching the personality of the ad to the estimated personality of the user. Furthermore, it is not necessary that the ad service provider should know the user's personality in order to present a corresponding ad type for a real application situation. Smartphone advertising can be customized by setting the regression and decision parameters on the user's phone.

[Figure 1 should be here]

2.2 SensPlus App

The SensPlus app collects smartphone usage profiles of an android phone user [26, 27]. The usage profiles include the call and SMSs information such as number and time of incoming and out-going calls and number of SMSs. The SensPlus App stores these smartphone usage profiles into local memory in the form of a database. The application then reads the database stored in the local memory of an individual user's phone and transfers it to the support vector regression function, then maps it into estimated personality (extrovert or introvert).

For regression modeling, we use the support vector regression algorithm. In a previous study [27], we investigated the correlation between extroversion trait and the smartphone usage profile. The participants' extroversion score was measured using a modified Korean version of the Wiggins personality test [28]. The Korean version of the Wiggins test consists of 16 adjectives that describes about a client's interpersonal traits with 5 scale points from 1 to 5. For instance, the Korean adjectives including 'unsociable', 'introvert', 'passive', 'ego-centric', 'social', 'extrovert', 'outgoing', etc are used to rate one's extroversion . The study found that the personality trait "extroversion" was highly correlated with some smartphone usage features such as number of outgoing calls, number of incoming calls, and number of SMSs, but was not correlated with the duration of calls. This indicates that more extroverted persons make and receive more frequently calls, and sends and receives more SMS in comparison with introverted persons.

Using the extroversion score and smartphone usage features, we can establish a regression relation between the input (smartphone usage pattern) and output (extroversion score) by using a machine learning method called support vector machine (SVM) regression.

In SVM regression, the input (smartphone usage pattern) x with m-dimensional feature space is mapped to an output that corresponds to the estimated personality via a non-linear kernel $g(\cdot)$, and a linear model is constructed in this feature space. Thus, the linear model $f(x,w)$ can be given by

$$f(x,w) = \sum_{j=1}^{m} w_j g_j(x) + b$$

, where w is a set of weight parameters and b is the bias term. In a conventional linear regression, a least square estimation is often used to find the best fitted w that minimizes the sum of the squared errors, but this method makes the regression model overfitted to the training data. SVM regression, however, does not consider the training points lying beyond the margin using the ε-insensitive loss function and thus avoids the overfitting problem. For more details, see [27].

2.3 PerAds App

In order to present a personality-based ad on a smartphone, the PerAds app was developed on the Android platform. PerAds selectively presents personality-based ads based on the user's estimated personality using the support vector regression

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output. Two different types of ads are used – one to promote extroversion, and the other to promote introversion. The decision of which type of ad is presented to the user depends on the threshold values set by the experimenter.

For instance, an ad promoting extroversion can be presented on the user's smartphone if the user's estimated extroversion value is bigger than the threshold value. Otherwise, an ad promoting introversion can be presented on the user's smartphone. So, the ad is short and can be interrupted by the user anytime. The detailed procedure of PerAds is given below:

- ✓ Accumulate the user's smartphone usage profiles for N days and average the profiles.
- ✓ Calculate the user's extroversion value by setting the averaged smartphone usage profile in the regression model.
- ✓ Compare the estimated extroversion value with the threshold value provided by the experimenter.
- ✓ If the estimated extroversion value of the user is bigger than the threshold value 1 (T_1), then the user is set as an extrovert. If the estimated extroversion value of a user is less than the threshold value 2 (T_2), the user is set as an introvert. If the user's estimated extroversion value is placed between T_2 and T_1, then the user is set as an ambivert.

Personality can be considered as either a discrete or continuous set of characteristics serving different purposes and is a controversial issue in psychological research. For instance, the trait theory proposes that personality can be placed on a trait continuum, whereas the type theory proposes that a person's personality can be assigned to discrete categories.

In our experimental scheme, the continuous extroversion score obtained from the SVM regression model is discretized by applying thresholds. This is done for a practical research purpose. To induce a similarity-attraction effect between a personality and an ad type, the participant's personality type should be classified as either an extrovert or introvert. Then, one of the two types of smartphone ads should be assigned to the participant.

The simplest way to discretize the continuous extroversion score is to apply a threshold to the middle of the trait continuum. However, in this case, both the extroverts and introverts near to the threshold can be misclassified, thus reducing the similarity effects between the personality and ads. Therefore, in our scheme, the middle portion of the trait continuum is taken out by applying the dual thresholds T_2 and T_1. If a participant's personality score is smaller than T_2, the participant is classified as an introvert. If the participant's personality score is bigger than T_1, the participant is classified as an extrovert. Participants with scores between T_2 and T_1 are taken out and not considered in the statistical analysis.

3. EXPERIMENT

We design an experiment to test the scheme of the personality-based smartphone ads system. Generally, the similarity-attraction effect is examined by a 2 x 2 factorial designed experiment. This allows for the experimenter to investigate the main effect of each factor (e.g., user's personality and ad personality) as well as the interaction effect between the factors on the dependent variable (e.g., the acceptance of invitation). In this case, however, the experimenter needs to know which participant belongs to which condition (e.g., extrovert or introvert), meaning that the advertiser needs to access a user's personal information to evaluate the effect of a smartphone ad. That is, the factorial design is privacy-intrusive.

In this experiment, we measure the invitation acceptance response to a differentially given smartphone ad on the basis of the participant's estimated extroversion trait. This response is compared to the invitation acceptance response to a text-only ad, which might be considered a neutral stimulus. The text-only ad does not contain any personality cues that might be attributed to extrovert or introvert traits. In this case, the difference between the effects of the personality-based ad and neutral ad can be measured, but the interaction effect between the user's estimated personality and the ad type cannot be measured. In contrast, the experiment design is less privacy-intrusive since the experimenter simply calculates the number of invitation acceptances (or rejections) of a given ad.

So, it is assumed that participants are more likely to accept the invitation presented by the extrovert or introvert ads than that presented by the text-only ad. The invitation acceptance of extrovert or introvert ads should be larger than the baseline acceptance of the text-only ad.

3.1 Participants

The experiment participants consisted of a total of 176 undergraduate and graduate students enrolled at a university in Suwon, South Korea.

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They were recruited through university web ads and paid 10,000 Korean won (approximately USD 9) upon completion of the experiment. All participants owned an Android smartphone and were aged from 20 to 35 years, with an average age of 28.7 (SD = 6.7 years). They signed a consent form and were informed of the experiment procedure.

3.2 Stimulus

Two animation video clips (Figure 2) were used for the experiment, one to advertise a cherry blossom festival for extroverted participants and the other to advertise a classical music concert for introvert participants. In the video clip for extroverted participants, an animated avatar introduces the cherry blossom festival and invites a smartphone user. The stimulus was created using a video clip editor.

In order to create the extrovert and introvert ads, visual cues of the avatars were manipulated. Three different types of visual cues, that is, clothe types, movement, and invitation phrases, were differently expressed for the extrovert and introvert avatars. The extrovert avatar wore a casual suit, actively moved her body, and used informal language, whereas the introvert avatar wore a formal suit, rarely moved her body, and used formal language. Each video clip had a 320 x 240 pixel resolution and lasted five seconds.

We tested whether the participants perceived the active ad (invitation ad for the cherry festival) as extroverted and the static ad (invitation ad for the classical music concert) as introverted using the *t*-test. We found that the active ad was perceived more extroverted (M = 5.2882, SD = 1.4609) than the static ad (M = 3.3412, SD = 1.4767). The mean difference between them was statistically significant ($t(95) = 9.1359$, $p < 0.001$). This result indicated that the participants perceived the active ad as extroverted and the static ad as introverted.

In addition to the animation video clip, we also used text-only ads that contained information such as "invitation for cherry blossom festival (for extroverts)," "invitation for classical music concert (for introverts)," date, and location. The date and location are the same for both the extrovert and introvert clips.

[Figure 2 should be here]

3.3 Procedure

The participants were randomly assigned to two groups, the text-only group (80 participants) and the animation group (96 participants). Text-only ads were given to the text-only group, and animation ads were given to the animation group.

The participants were asked to install the mobile app PerAds in their own phones, with instruction not to delete the application until 15 days later, that is, until the end of the experiment period. One day after the usage data accumulation period, an invitation ad is presented differentially to each participant's phone according to his/her estimated personality. That is, the invitation ad for the cherry blossom festival is presented to the extroverted participant's smartphone, and the invitation ad for the classical music concert is given to the introvert's smartphone.

After the participants watched shortly the ads, they are asked whether they would accept the invitation or not. If the participants accept the invitation, they simply respond, "accept the cherry blossom festival" (or the classical music festival). If they reject the invitation, they respond, "reject the cherry blossom festival" (or the classical music festival). The responses (accept vs. reject) are collected and sorted by the ad types (cherry festival vs. classical music concert).

4. RESULTS AND ANALYSIS

Using the participants' responses and the ad types, we conducted a non-parametric statistical analysis (chi-square test). As noted earlier, the participants who did not indicate either extroverted or introverted traits were not included in the statistical analysis. This was to reduce the misclassification error and maximize the similarity-attraction effects due to the participants' smartphone usage profiles.

For our statistical analysis, we used the number of participants who responded "accept" or "reject" to the invitation of events and carried out chi-square analysis for each group. The results are summarized in Tables 1, 2, and 3. For the text-only group, which included 37 extroverted and 30 introverted participants, we did not expect any difference between the accept and reject responses to the invitations. Thus, we set the expected number of accept (or reject) responses to 18.5 for the festival condition and to 15 for the concert condition, respectively. The result is given in Table 1. For the festival condition, the chi-square (χ^2) statistic is 1.324 and the p-value is 0.2498. This result is not statistically significant. Similarly, for the concert condition, the chi-square (χ^2) is 0.533 and the *p*-value is 0.4652.

Table 1. Chi-square results for the participants' responses to the cherry festival invitation (top) and the

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classical music concert invitation (bottom) of text-only stimulus

Festival	Observed	Expected #	Expected
Accept	22	18.5	50%
Reject	15	18.5	50%
Column Totals	37	37	100%
Concert	Observed	Expected #	Expected
Accept	17	15	50%
Reject	13	15	50%
Column Totals	30	30	100

For the animation group, which included 45 extroverted and 35 introverted participants, we again assumed no difference between the accept and reject responses to the invitations. Thus, we set the expected number of accept (or reject) to half the number of each personality trait, and then carried out the chi-square analysis. The result is given in Table 2. For the festival condition, the chi-square statistic is 6.422 and the p-value is 0.0113. This result is statistically significant at $p < .05$. However, for the concert condition, the chi-square (χ^2) is 3.457 and the p-value is 0.0630.

Table 2. Chi-square results for the participants' responses to the cherry festival invitation (top) and the classical music concert invitation (bottom) of animated stimulus

Festival	Observed	Expected #	Expected
Accept	31	22.5	50%
Reject	14	22.5	50%
Column Totals	45	45	100%
Concert	Observed	Expected #	Expected
Accept	23	17.5	50%
Reject	12	17.5	50%
Column Totals	35	35	100

The assumption of no difference between the accept and reject responses to the invitations can be problematic. For the text-only condition, for which the ad stimulus is relatively neutral, the participants are more likely to accept the invitation, but the tendency is not statistically significant. This reflects the participants' attitude or response tendency to the events and can be considered the baseline for the effect of animated advertising. Thus, we re-calculate the expected numbers by multiplying the total number of participants in each condition with the proportion of each response in the text-only group. The expected number of accept responses to the festival invitation is 26.775 (45x 22/37) and the expected number of reject responses is 18.225 (45x15/37). Furthermore, the expected number of accept responses to the concert invitation is 19.845 (35x17/30) and the expected number of reject responses to the festival invitation is 15.155 (35x13/30). Using these expected numbers, we re-calculate the chi-square (χ^2) statistics. The result is given in Table 3. For the festival condition, the chi-square statistic is 1.646 and the p-value is 0.1995. These results are not statistically significant at $p < .05$. Similarly, for the concert condition, the chi-square χ^2 is 1.158 and the p-value is 0.2818. These are also not statistically significant at $p < .05$.

Table 3. Recalculated chi-square (χ^2)results for the participants' responses to the cherry festival invitation (top) and the classical music concert invitation (bottom)

Festival	Observed	Expected #	Expected
Accept	31	26.775	59.5%
Reject	14	18.225	40.5%
Column Totals	45	45	100%
Concert	Observed	Expected #	Expected
Accept	23	19.845	56.7%
Reject	12	15.155	43.3%
Column Totals	35	35	100

5. DISCUSSION

This paper proposes the scheme of personality-based ads that use smartphone usage profiles to estimate the user's personality. As noted earlier, the scheme does not require the smartphone user's actual personal information to estimate his/her personality. Furthermore, we suggest the non-privacy invasive evaluation procedure to test the effect of the scheme. The similarity-attraction effect is usually measured using the factorial design that allows for investigating the interaction between independent factors, but the factorial design needs to know the properties of individual participants that are privacy-sensitive. Thus, the factorial design is impractical for a real world application. In contrast, our experiment design does not require the privacy-sensitive information of participants and can thus be applied more freely to smartphone application.

As regards smartphone advertising, we can characterize it in terms of personalized ads that utilize personalized information. Personalized information is either provided by a user or obtained from the user's smartphone activity. For instance, a

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smartphone ad can be based on a user's profile (e.g., user's name, sex, age, and personal interests), current activity-related information (e.g., Googling), or location-based information (searching a local restaurant near a current location). The personalization of ads is based on the understanding of the user's profile and activity that directly influence the effectiveness of advertising. This may be differentiated from the traditional type of advertising in which a product ad is massively distributed without considering user preferences or activity. A few studies have examined the effect of personalized advertising [29], [30], [31], [32], [33]. In Xu et al.'s work [9], for instance, where personalized advertising is compared to random advertising, users are more satisfied with personalized ads. Banner ads experienced a reduction in effectiveness by over 65 percent in terms of stated purchase intent when personalized information was restricted by privacy laws [34]. Personalization in computing services aims to provide highly relevant content to users and therefore allows for service providers to avoid massive advertising campaigns aimed at anonymous individuals [35]. That is, it gives "the right product information to the right person." Our work focuses on how product information is presented to a specific user.

Our approach customizes the presentation mode of ads based on personalized information rather than the advertised product. The rationale of our approach is based on similarity attraction, which is very well documented in both the psychology and communication literature. For example, incidental similarity (e.g., birthday or birthplace), internal similarity (e.g., perception or attitude), and appearance similarity shared between a salesperson and a potential customer can result in a more favorable attitude and a higher intention to purchase [36] The persuasive characteristics of similarity attraction have also been examined in name similarity between participants and product brand [37], and in mere agreement with one's opinion in an interview situation [38]. Also, virtual characters or synthesized voices resembling the personality traits of users can influence user product preferences and purchasing intention [39].

However, our approach does not simply introduce the socio-psychological phenomenon into advertising. Rather, we introduce the computational ground in which the smartphone usage pattern is mapped to the estimated personality. Recent studies have investigated the relationship between mobile/smartphone usage and the "Big Five" personality traits. In particular, extroverted mobile phone users have been reported to spend more time on phone calls, call more frequently, and change ring-tones and wallpaper more often than introverts [25]. A similar tendency has been found among smartphone users [24], [39]. However, all these studies show a correlation relationship between mobile phone (or smartphone) usage pattern and personality, but do not consider this for more practical application. In contrast, we reconsider the relationship in terms of similarity attraction and introduce it into smartphone advertising applications.

Our study indicates that the combination of the SensPlus and PerAds apps is a promising and practical approach to employ the similarity-attraction effect in mobile advertising applications. Methodologically, we collect the smartphone usage of a sample group through the SensPlus system and construct a regression model to predict the actual user's personality. The SensPlus system provides a new approach that investigates the psychological behavior of individuals to develop computing services for smartphones. Although recent research has revealed that the personality, mood, or affective state of a user can be inferred from smartphone usage, there are limitations in the classification of a user's psychological state. However, our study goes one step further by presenting mobile ads via the PerAds. We demonstrate that the presentation of media content can be customized and persuasive when combined with a smartphone usage profile.

The customization of technology is beneficial for mobile phone users as well as service providers: users can escape irrelevant ads and service providers can more effectively persuade users to purchase their products and services. However, note that our approach can be extended to socio- and psycho-adaptive computing technologies for personal devices. Call profiles contain rich personal behavioral data and are more accessible, and thus provide personalized information that can be utilized in developing a user-adaptive computing service in a non-privacy invasive manner. The ability to adapt information to a particular user also means that this information can be presented in a persuasive manner that attracts him or her. The personality information extracted from call profiles can be combined with other personalized information such as location or current activity information. For instance, it can be used in online dating to recommend a potential partner with a similar personality and near to the user. Personality information can also be used to parameterize a robot's personality or behavior.

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However, it should be noted that our study has some limitations in some aspects. First, the smartphone usage patterns were used in order to estimate a smartphone user's personality in our study. This means that the interpersonal personality of a person is characterized in terms of smartphone usage even though it should be considered in a various relation such as peer relation in school or openness to other's opinion. Secondly, in terms of methodology used in this study, it is limited to capture the similarity attraction effect since the stimulus ad had been given differently to the matching participants. So, the effect should be diminished if the stimulus ad is given to the non-matching participants (extrovert participant – introvert ad). This interruption effect was not measured in this work. In addition, for a real world application, privacy issues should be completely solved.

6. CONCLUSION

Although the social scientific findings would be helpful and useful in this smartphone advertising area, numerous socio-psychological studies remain inapplicable and buried within their academic realms. Smartphones, whether as private or social tools, provide a new opportunity for real-world application. This study introduces the socio-psychological phenomenon of similarity attraction to the customized advertisement application domain by establishing the relationship between extroversion and smartphone usage pattern. However, we could not truly demonstrate the customization process of smartphone usage profiles. Future research should create parameters for smartphone usage profiles in order to control for animated agents with rich expressive behaviors.

7. ETHICAL APPROVAL

This study was approved by the Research Board of Department of Herb Science, Dong-Eui Institute of Technology. Data used in this experiment were anonymized by removing personal identifying information such as student's name and id numbers.

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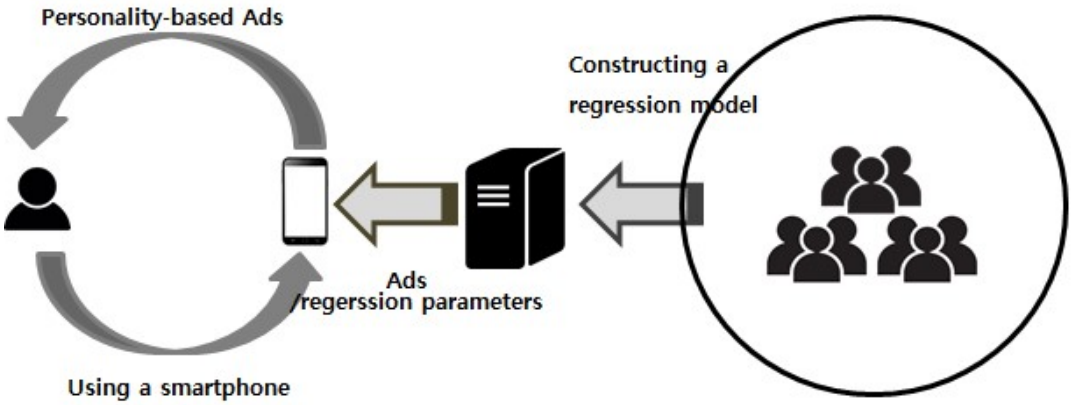

Figure 1. General scheme of the personality-based smartphone ads system. The scheme consists of two separate stages, regression modeling and customized advertisement. The SensPlus app collects smartphone usage profiles including calls, SMSs, and battery, and then transfers them to a server. A regression model can be established by mapping the smartphone usage profile to the extroversion trait. For customized advertisement, the smartphone ad is differentially presented on the basis of the user's estimated personality

(a) Invitation for cherry blossom festival

(b) Invitation for classical music concert

Figure 2. The animation video clips used for advertising stimulus. The extrovert avatar wore a casual suit, actively moved her body, and used informal language, whereas the introvert avatar wore a formal suit, rarely moved her body, and used formal language. In Figure 2 (a), the Korean text 'Please, come and enjoy the cherry blossom festival' is displayed and in Figure 2 (b) the text 'Invite you to our classical music concert' is displayed at the bottom of the image.