CAR APP'S PERSUASIVE DESIGN PRINCIPLES AND BEHAVIOR CHANGE*

Chao Zhang[1*], Lili Wan[1*] and Daihwan Min[2]
[1*]*College of Business, Hankuk University of Foreign Studies*
107 Imun-ro, Dongdaemun-gu, Seoul, 02450, Korea
[2]*Department of Digital Management, Korea University, Seoul, Korea*
145 Anam-ro, Seongbuk-gu, Seoul, 02841, Korea

ABSTRACT

The emphasis of this study lies in behavior change after using car apps that assist users in using their vehicles and establishing a process for examining the interrelationship between car app's persuasive characteristics and behavior change. A categorizing method was developed and 697 car apps were investigated and classified into eight categories. Meanwhile, an evaluation guideline was developed and nine persuasive design characteristics were found to be popular used. A quasi-experiment was conducted and a behavior change evaluation process was developed. 109 participants were recruited and asked to use a car app for two weeks. The results indicate that participants clearly perceived eight persuasive design principles and four types of behavior change were found. The participants in four behavior change groups showed different perception levels for eight persuasive design principles. Our pioneer work has contributed to help designers and automakers to develop more effective and more persuasive car apps.

KEYWORDS

Persuasion, Persuasive technology, Persuasive design principles, Behavior change, Car apps, Car-related mobile apps

1. INTRODUCTION

Car-related mobile applications, which have accompanied the explosive growth of smart cars and smart mobile devices, are broadly used as brand-new medium and paid attention by app designers and automakers. However, it still not causes academia attentions. Based on a lot of researches about mobile application and in-car applications, we give a generalization about a car-related mobile application (hereafter shorted as "car app") as a basically little, self-contained programs used for enhancing existing car using or managing functionality and changing complicated car using behaviors into more user-friendly ones. Until May 6, 2016 over 3,973,284 apps from both Android Platform (Google Play) and iOS platform (Apple Store) are approved. But based on our one-year investigation, less than 1% mobile apps are about car using or car management. Most of the car apps have a few downloads and low review points due to poor function design, poor persuasive design, system errors, and etc. It is hard to bring profits for car developers. Another problem is that user acceptance and user intention about car apps are not clear enough for car app designers. Basically, a profitable car app should at least have the characteristic of "network externality". But based on our investigation, most of them are lack of network effet. The most urgent issue is to find out what kinds of design principles have effect on user intention. In other words, car app designers and automakers want to find out how to design effective and persuasive car apps that may attract user's interest or persuade them to continuous use.

* This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2014R1A1A2059510)
[1*] Corresponding authors.

This paper focuses on five research questions: First, what is the development status of car apps? Second, what is the persuasive design status of car apps? Third, is it possible for car user to perceive the persuasiveness of car apps? Fourth, what kind of behavior change can be found after using a car app? Finally, is it possible for car users with different types of behavior change have different perceptions about car app's persuasive design features? The purpose of this study is to provide insight into the current states of persuasive design in car apps and to confirm the relationship between car app's persuasive design features and behavior change. The results can be useful to automakers and independent app designers (hereafter shorted as "app developers") when designing persuasive apps.

This study is conducted in four research stages as follows. First, after one-year investigation, about seven hundred car apps were found and checked from two different app distribution platforms - Apple App Store and Google Play. The investigation focuses on two aspects. One is about car app's function and utility. A categorizing method was developed to classify these car apps into eight different categories. Another aspect focuses on confirming car app's persuasive design features. Based on persuasive technology theory, an evaluation guideline was made to investigate these car apps' persuasive design characteristics. According to the guideline, about nine characteristics were confirmed among these car apps. Second, empirical study methods are rarely involved in most of the existing studies about persuasive design. Furthermore, most of the existing studies are lack of empirical data and feasibility, especially for car apps. Therefore, based on literature review, only a few measurement items were collected from existing studies, while most of the other measurement items were directly developed. After several rounds of expert screening, all measurement items that related to the nine persuasive characteristics were developed. Third, an experimental study process was designed to confirm whether subject's car using behaviors were changed after using a test app. Based on Fogg's Behavior Change Wizard, an evaluation process was designed to check 109 participant's behavior change after two weeks. Four types of behavior change were found. Finally, in order to confirm the relationship between behavior change and persuasive design characteristics, the data collected from the experimental study were further analyzed. The results show that there were significant differences about persuasive design perceptions among four types of behavior change groups.

2. RELATED WORKS

Several prior studies have examined types of behavior change and persuasive design principles by using experimental methods. The review of the prior studies highlights three issues. First, the theoretical interpretation of behavior change after using mobile apps is not clear. Most previous studies highlight the behavior change after some experiments, for example, about weight lose or gain weight after eating some kinds of food, etc. Most of them did not focus on behavior change in mobile apps. Second, the theoretical interpretation of persuasive design for mobile apps that caused behavior change is not explained. In addition, some studies about car apps rarely involve this topic. Third, extant studies typically restrict their empirical research methodologies to surveys or some controlled laboratory experiments, so that it is unclear whether their findings are robust for actual commercial contexts. Only a few studies provided some effective empirical studies about the persuasive design principles, but they did not look hard enough for its concrete behavior change results. This means these studies cannot prove those persuasive design principles to be a good way to make users change their behavior.

Persuasive technology is defined as any interactive technical system designed for the purpose of changing people's attitudes or behaviors [Fogg, 2003]. Persuasive technology, as a kind of interactive information technology, is a fast-growing research topic, especially for mobile app design. In the past, behavioral psychology researchers and mobile app designers had to make guesses at solutions for changing behavior. However, most of their attempts failed. The Behavior Wizard developed by B.J. Fogg is useful as a guide to supply a solution in order to confirm a user's behavior changing type.

Some scholars and researchers also focus on identifying distinct persuasive software features in order to confirm and evaluate the significance of persuasive systems and behavior change support systems [Oinas-Kukkonen, 2012]. Actually, Fogg has provided a widely utilized framework to help developers to understand the persuasive technology [Fogg, 2003]. However, it cannot be used directly to evaluate the persuasive system design or even as a guide to lead developers to follow some effective principles to design a system with persuasion [Harjumaa and Oinas-Kukkonen, 2009]. To evaluate a system or a mobile app, 28

principles that belong to four main categories should be followed. “Primary Task Support” category contains the principles of reduction, tunneling, tailoring, personalization, self-monitoring, simulation, and rehearsal. “Dialogue Support” category includes the principles of praise, rewards, reminders, suggestion, similarity, liking, and social role. System Credibility Support” category is consisted with the principles of trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsement, and verifiability. “Social Support” category includes social learning, social comparison, normative influence, social facilitation, cooperation, competition, and recognition. However, most persuasive system design principles have not been evaluated by empirical research.

Persuasive technology comes into the domain of an interactive information technology combined with behavioral psychology. It focuses on the interaction between humans and intelligent devices, such as human-computer, human-smartphone, etc. [Fogg, 1998, 2010; Oinas-Kukkonen et al. 2008, 2009]. In a sense, persuasive technology can be considered as some kind of design with the intent to persuade people to change their attitudes or behaviors [Lockton et al. 2008]. Oinas-Kukkonen and Harjumaa (2008, 2009) classified the persuasive technologies from another perceptive, which is about whether the persuasive technologies can change user attitudes or behaviors through direct interaction or as a mediating role. Persuasive technologies nowadays take the form of apps or websites that use new capabilities of devices to change user behavior rather than traditional ways that use information, incentives, and even coercion. Persuasive technology can be found in mobile apps or websites with behavior-oriented designs like Amazon and Facebook, which can persuades users to buy more often or stay logged in. Many mobile apps, such as some health-oriented apps that incentivize weight loss and help to manage addictions and other mental health issues. Developers design their products by analyzing and evaluating the content, using established psychological research theories and methods. Most of these products or services have used persuasive design that focuses on making users feel comfortable in making decisions and helping them act on those decisions. For instance, in the automotive area, an insurance company’s “Snapshot” usage-based program can monitor user driving via data from the car data port. Users try their best to drive safer, and then save money on the insurance fee.

The research for behavior change is an important research topic about what caused behavior change for both researchers and software developers. Fogg developed the “Behavior Wizard” to help designers identify specific types of behavior targets, confirm behavior change types, and match them to relevant solutions. It is described as a matrix of 15 types of behavior change. The horizontal axis segments behaviors into five “Flavors” which use five different colors to represent five different behaviors: do a new behavior that is unfamiliar (Green), do a familiar behavior (Blue), increase behavior intensity or duration (Purple), decrease behavior intensity or duration (Gray), and stop doing a behavior (Black). The vertical axis represents behavior’s durations: one time (Dot), span of time (Span), or ongoing (Path). With the 15 behavior types, it can isolate, identify and clarify the target behavior and distinguish it from others. It can highlight the concepts and solutions related to target behavior, which may help to create a persuasive experience [Fogg & Hreha, 2010].

3. RESEARCH APPROACH

The purpose of this study is to evaluate participants with different types of behavior change have different perceiving level for the persuasive design characteristics of car apps. Therefore, an investigation was used to find out the current status of car apps and to check the persuasive design characteristics of current car apps. A quasi-experiment was developed to estimate user’s behavior change, to find out user’s perception for the persuasive design characteristics of car apps, and to check the perception difference for persuasive effectiveness among different behavior change groups.

3.1 Study One: Categorizing for Car Apps & Persuasive Design Evaluation

Investigations for car apps spanned October 2013 till March 2015 in two rounds. About a thousand mobile apps were collected and analyzed by searching with keywords, such as “car”, “locating”, “driving”, “navigation”, “maintenance”, etc. Based on car app’s functionality, utility, and features, a categorizing method for car apps was developed. This method was tested in two rounds by using the method of inter-rater reliability. The results of round one and round two show that the Cohen’s Kappa are 0.886 and 0.828, which

means Cohen's Kappa basically estimate that an agreement level beyond chance at 88.6% and 82.8%. The categorizing method is proved to be reliable. After repeated siftings, a total of 697 available car apps (not include car game apps, cartoons, etc.) are classified into eight different categories: news and basic information about car (C-1), buying and selling (C-2), driver's communication (C-3), location service (C-4), safe driving service (C-5), A/S and maintenance management (C-6), renting service (C-7), and car expenses monitoring (C-8). Table 1 shows the summarized results. The investigation shows that most of the car app developers focus on designing car apps in four categories: car news and basic information (28%), locating service (23%), safe driving service (12%), car renting service (15%). However, their system design is too homogeneous, especially much similar in main functions or operation interface. Only a few apps are designed to be comprehensive and contain functions from two or more categories.

Furthermore, based on prior research, a "Car App's Persuasive Design Guideline" was developed to investigate 679 car apps' persuasive design characteristics [Zhang et al. 2016]. For example, a car app "Mudu Parking", 12 characteristics were found. In this app, "Coupon can be downloaded and bonus points can be used as money" can be confirmed as the persuasive design characteristics of "Rewards". Furthermore, "Use guide, question emails, or Kakao Talk to help users" can be considered as the characteristics of "Suggestion" [Zhang et al. 2016]. The result of Fleiss' Kappa (k=0.782) proved this evaluation method to be useful and reliable. It was found that nine persuasive design characteristics observed in current car apps are popularly used by app developers. They are: self-monitoring, reduction, personalization, reminder, suggestion, trustworthiness, real-world feel, expertise, and verifiability. [Zhang et al. 2016].

3.2 Study Two: Experimental Research Design

Based on our investigation, not all of the persuasive system design principles are used in the current car app's design process. Actually, no existing empirical study about persuasive design is related to mobile apps, especially for car apps. Smartphone and vehicle are two of the indispensable devices of our daily lives, the trend is that in-car apps and car apps are tightly coupled with each other and mutually complement each other. Therefore, how to design a more persuasive car app that can effectively change a user's traditional car using behaviors or managing behaviors should be a pressing and important research topic for app developers and academic researchers. The purpose of this study is to check whether a car user's perception level of the car app's persuasive features is different among different types of behavior change. The main problem is to find out whether subject's car using or managing behavior will change after using a car app.

An experimental study is designed to confirm whether subject's car using behavior will be changed after using a car app for driving or managing the vehicle. This process is compiled to measure subjects' behavior change types after a two-week test. The experiment subjects are drivers who also have a smartphone who can use a car freely or own a car. A parking app (Mudu Parking) from the locating service category is selected as an experimental object, hereinafter referred to as app-A. In this paper, the reason for choosing this app is not only its download amount but also the average rating score in both Apple App Store and Google Play are higher than other parking apps in Korea app market. Furthermore, it represents all of the nine common persuasive design features. This experiment will be performed in the Republic of Korea and it contains three stages. In the pre-test, we show a PPT to participants about test app and make sure all participants clearly understand what the app is used for. For those who want to download and make a trial for App-A will be our experiment participants. After a few minutes for trail, we ask participants to answer the pre-test questionnaire-A, which contains the questions about App-A and demographic information. We inform the participants to use the test app freely during the test period and record their usage frequency. Two weeks later, in the post-test, we ask the participants to answer the post-test questionnaire. The post-test questionnaire contains a post-test experiment questionnaire (A) and a survey about user perception (B).

3.2.1 Pre-Test Questionnaire Design

In the pre-test questionnaire, after two rounds pilot test, each question is used as a precondition to determine the participant's behavior status before starting the two-week experiment. The question list and the logistic evaluating standard are listed. Based on 15 types of behavior mentioned by Fogg, this study attempts to make behavior change measurable and observable for researchers additionally. (See Table 1).

Table 1. Pre-test Questions

No.	Questions
Q1	Have you ever used app-A or something similar to app-A while you use or manage your car?
Q2	Have you ever used app-A?
Q3	Please write down all you have ever used car apps that similar to app-A.
Q4	Are you using these kinds of car apps for the past week?
Q5	Please write down the name of app you used last week.
Q6	What's the frequency of using your car app while you use or manage your car?
Q7	Do you think the using frequency that you use these car apps in the past week is more than before?
Q8	How often did you use these kinds of car apps before while you used or managed your car?
Q9	Do you still want to continue to use these kinds of car apps while you use or manage your car?

The pre-test process is mainly used to check out participant's behavior "Flavors" and confirm the usage of test app (App-A) before the test. The pre-test process would show "Green Behavior" (do a new behavior), and "Blue Behavior" (do a familiar behavior) from answers of question 1 (Q1) to question 5 (Q5). The answers from question 1 to question 5 also help to confirm the behavior starting status for "Black Behavior". Before this test, some car users may also have some experience with car apps, especially using app-A. Therefore, question 6 to question 8 show the usage frequency of App-A before the test, which will be used to compare with the usage frequency during the test. The comparison results would show "Gray Behavior" and "Purple Behavior". The other questions are used to help researchers know about the car app usage of participants (See Figure 1).

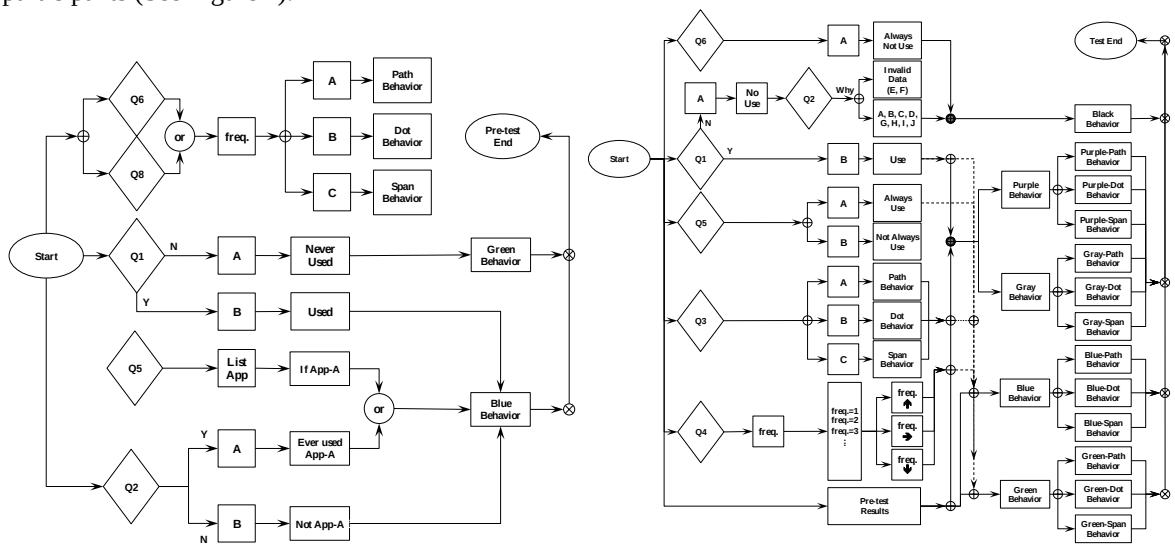

Figure 1. Pre-test & Post-test Evaluation Process

3.2.2 Post-Test Questionnaire Design

Post-test consists of two questionnaires: Post-test Questionnaire A and Post-test Questionnaire B. Questionnaire A is for confirming car user's behavior change. The comparison results between pre-test and post-test could be used to confirm the participant's behavior change status (See Table 2). Questionnaire B is for checking participant's perception about car app's persuasive design. After several times of pilot test, the post-test questionnaire is developed and the answer format is designed with a 7-point Likert scale. It is comprised questions about the usage of the experiment object and questions about persuasive design principles. After going through several rounds of very rigorous process of selection by experts, a simple scale development was compiled. Several measurement items were taken from existing research, but most of the other measurement items were developed directly.

In the post-test evaluation process, the main work is to check out participant's behavior "Duration" and confirm the usage of app-A after the test. The post-test process would show the "Duration" for "Green Behavior", "Blue Behavior", "Purple Behavior", and "Gray Behavior" from answers of question 1 to question 5. The answers of question 2 and question 5 also help to confirm the "Black Behavior". The other

questions are used to help researchers know about the future user intention. Several times of pilot test for the whole experimental process were also performed. All the experiment process is proved to be available. (See Figure 1).

Table 2. Post-Test Questions

No.	Questions
Q1	In the last two weeks, did you use app-A when its functions were needed while you used or managed your car?
Q2	Please write down the reason that you didn't use app-A during the test.
Q3	How often have you used app-A while you use your car during the previous two weeks?
Q4	Please write down the daily usage frequency over the past two weeks.
Q5	In the last two weeks, did you have a situation where you didn't use app-A when its functions were needed while you drove or managed your car?
Q6	In the last two weeks, what's the frequency that you didn't use app-A when its functions were needed while you drove or managed your car?
Q7	Do you still want to continue using app-A after this test?
Q8	Why you don't want to continue using app-A after this test?

3.2.3 Behavior Change Evaluation Process

Based on this experiment design method, the following evaluation rules were followed to estimate participant's behavior change type. For example, "Q1→B" means test question "1", "→" means "to choose", "B" means the answer. The detail descriptions for 15 types of behavior change have been developed but only one examples of evaluation process will be listed in this paper because of the page limitation (See Table 3).

Table 3. Example for Evaluation Process

Status	Test Question	Flavor / Duration Behavior	Behavior Change Type
Pre-test	Q1→B or {Q2→A or Q5→App-A}	Blue Behavior	Blue-Span Behavior
Post-test	Q1→B {Q3→C; Q4 Freq.=2 or 2↑}	Span Behavior	

4. DATA ANALYSIS AND RESULT

This experiment was started on May 17th, 2015 and four round tests were performed until June 4th, 2015. Total 109 participants took part in this test. They were asked to respond to the questionnaires during the post-test. 95 valid data were collected, excluding 14 invalid data. About 51.3% participants came from a company and it's research center, 11.9% participants came from two universities, and about 36.7% data was collected from a Presbyterian church (30.3% homemakers and 6.4% self-employed persons). Among these participants, 71.56% participants are over age 35 and all of the participants have over undergraduate education. About 84.4% participants have more than three years smartphone using experience and over 91.75% participants have more than two years driving experience. About 61.47% participants use smartphone every day less than one hour and 14.68% use 2-4 hours. 96.33% participants drive about 0.5- 2 hours everyday and over 52.29% participants drive in metropolitan cities.

By comparing the results of pre-test and post-test, four types of behavior change were discovered: "Green-Dot" (22 participants), "Green-Span" (41 participants), "Blue-Span" (19 participants), and "Black Behavior" (13 participants). "Green-Dot" behavior means that using app-A to drive or manage their cars is a new behavior for the participant, and this new behavior is only carried out once in a certain period. "Green-Span" behavior means that using app-A to use or manage their car is a new behavior but performed more than one time, but not always during the test. "Blue-Span" behavior means it is not the first time for a participant to use App-A and the usage frequency is more than one time but not always during the whole test period.

In the post-test process, participants were also asked to answer Questionnaire B, which was about user perception for car app's persuasive design. Total 95 available data was analyzed. Exploratory factor analysis and credibility test were used to inspect and deal with the collected data. The result of factor analysis shows that all the items are factored into their desired group, such as reminder (0.779), self-monitoring (0.926), real-world feel (0.936), expertise (0.809), suggestion (0.806), and trustworthiness (0.894), only except for

reduction. The Cronbach's alpha values for all six factors are over 0.7, which means these factors appear to have good reliability. The results of one sample t-test show that participants can perceive the persuasive design characteristics of App-A during the test. Questionnaire B uses 7-point Likert Scale to allow participants to value their persuasiveness perceptions from "Strongly disagree" to "Strongly agree". For the variables of "Reminder", "Self-monitoring", "Real-world feel", "Expertise", "Suggestion", and "Trustworthiness", if their population means are more than "4" (neither agree nor disagree), it means participants can perceive the persuasive design principles of App-A. For the variables of "Verifiability" and "Personalization", each variable have seven questions and participants should check "Yes" or "No" or "I don't know". Therefore, if one question of each variable is checked as "Yes", it can be considered that participant can perceive this persuasive design principle. In other words, for variables of "Verifiability" and "Personalization", the population mean should more than "0".

The results of one sample t-test show that all of the p values are significant. That means participants can perceive the persuasive design characteristics of App-A during the test. The research question four can be confirmed. Analysis of variance (ANOVA) was used to examine whether there are differences of participant's perceptions for persuasiveness among different types of behavior change. Based on Table 4, the mean plot for the eight factors can be distinguished as five different patterns.

Table 4. Exploratory Factor Analysis and Reliability

	G1	G2	G3	G4	Sig.	Group Diff.	Pattern
Reminder	4.11(0.99)	5.70(0.89)	5.96(0.73)	3.74(0.64)	***	2, 3 > 1, 4	P1
Self-monitoring	3.58(0.90)	6.17(0.67)	5.92(0.46)	2.90(0.40)	***	2, 3 > 1 > 4	P2
Real-world feel	3.89(1.24)	5.28(1.52)	5.26(1.22)	2.23(0.95)	***	2, 3 > 1 > 4	P2
Expertise	4.02(0.79)	5.59(0.92)	5.40(1.02)	3.64(0.66)	***	2, 3 > 1, 4	P1
Suggestion	3.18(1.02)	5.76(1.03)	4.95(1.20)	3.04(0.88)	***	2 > 3 > 1, 4	P3
Trustworthiness	4.70(0.66)	5.96(1.14)	5.68(0.63)	2.65(1.05)	***	2, 3 > 1 > 4	P2
Verifiability	1.50(0.96)	2.15(0.36)	3.42(0.84)	1.08(0.28)	***	3 > 2 > 1, 4	P4
Personalization	3.23(0.61)	5.39(0.49)	6.47(0.51)	2.54(0.78)	***	3 > 2 > 1 > 4	P5

For Pattern "P1", which means car app users who belong to behavior change group "Green-Span" (G2) can perceive more persuasive design features – "reminder" and "expertise" – than the "Green-Dot" (G1) group and "Black-Path" (G4) group. The same is true for "Blue-Span" (G3). Pattern "P2" describes design features "self-monitoring", "real-world feel", and "trustworthiness". The common characteristic of this pattern is that participants in "Green-Span" and "Blue-Span" can perceive more persuasion than "Green-Dot". Furthermore, participants in "Green-Dot" can perceive more persuasion than "Black Behavior". Pattern "P3" describes factor "suggestion". Participants in "Green-Span" can perceive more persuasion than "Blue-Span". Participants in "Blue-Span" can perceive more persuasion than "Green-Dot" and "Black Behavior". However, there are no significant differences between participants in "Green-Dot" and "Black Behavior". Pattern "P4" describes factor "verifiability". Participants in "Blue-Span" can perceive more persuasion than "Green-Span". Participants in "Green-Span" can perceive more persuasion than "Green-Dot" and "Black Behavior". However, there are no significant differences between participants in "Green-Dot" and "Black Behavior". Pattern "P5" refers to factor "Personalization". Participants in four groups can perceive significantly different persuasive effectiveness for this factor (See Table 4).

5. DISCUSSION & CONCLUSION

After a long-term research, this paper finds an approach for the research topic and identifies the results. The first is to classify car apps into eight categories. After over 17 months of investigation in the current car app market, 697 car apps were classified into eight categories by using our categorizing method, which is developed by considering car app's functions, utilities, and features. The eight categories are: car news and basic information, buying and selling, car users communication, locating service, safe driving service, A/S and maintenance management, renting service, and car expense monitoring. This categorizing method will help researchers and app developers better understand the developments of the car app market. Second, by using our persuasive design guideline, this paper summarized car app's persuasive design features. Nine features are observed: self-monitoring, reduction, personalization, reminder, suggestion, trustworthiness,

real-world feel, expertise, and verifiability. The detailed information has been discussed in prior research papers. Third, this paper observed four types of behavior change after two-weeks test: “Green-Dot”, “Green-Span”, “Blue-Span”, and “Black” behavior change. Although the experiment design process has been logically and objectively designed, the other eleven types of behavior change were not observed. However, it seems to confirm that this experiment process shows validity. The analytical and clinical view of the experimental procedure was proved to be strong and can be used as a reference to further empirical study in this field. Finally, participants can perceive the App-A’s persuasive design characteristics, which included Self-monitoring, Personalization, Reminder, Suggestion, Trustworthiness, Real-world feel, Expertise, and Verifiability. Furthermore, participants in different behavior change group perceived different level of car app’s persuasive design features. It can be distinguished as five different patterns. The exploratory factor analysis checked seven variables and distributed six sets of factors, excluding reduction. They are: reminder, self-monitoring, real-world feel, expertise, suggestion, and trustworthiness. The reliability analysis shows that these factors appear to have good reliability. Furthermore, a one-way ANOVA was performed and the result showed that there were significant differences between each group.

This study attempts to make several contributions to research and practice in the field of persuasive technology and behavior change. Especially, this research is designed to make a systematic approach to integrate persuasive technology with behavior change research. First, this paper is of great significance in discovering the interrelationship between mobile app’s persuasive characteristics, behavior change, no behavior change. The result of this research not only sheds light on the academic field, but also provides guidelines and suggestions to car designers and automakers. The conclusion of this paper can help them follow appropriate persuasive design principles to design more effective and more persuasive apps for car users. It also may increase car-using efficiency and give some useful suggestions for the development of built-in applications. Second, finding a way to distinguish different types of target behaviors adopted from Fogg’s Behavior Wizard and match them with solutions is a much better way to achieve our target behaviors. In order to distinguish car app user target behaviors, this study developed a questionnaire process to discover, distinguish, and confirm different types of behavior change. Most of the correlative papers about Behavior Wizard are not linked to an integrated process that can discover and distinguish all these different types of behavior changes. Most related research only focused on dealing with a certain type of change, but not all of them. This paper puts all of the behavior change types together into one experimental process and tries to find out an integrated way. Therefore, a two steps experiment process that contains a pre-test and post-test were designed and proved to be useful.

REFERENCES

Fogg, B., and Nass, C. 1997. "Silicon sycophants: the effects of computers that flatter", *International Journal of Human-Computer Studies* (46:5), pp. 551-561

Fogg, B. 2003. *Persuasive technology*, Amsterdam: Morgan Kaufmann Publishers.

Fogg, B. 1998. "Persuasive Computers: Perspectives and Research Directions", in *Human Factors in Computing Systems*, Los Angeles: Addison-Wesley Publishing Co., pp. 225-232.

Fogg, B., and Hreha, J. 2010. "Behavior Wizard: A Method for Matching Target Behaviors with Solutions", in *PERSUASIVE 2010*, Copenhagen: Springer, pp. 117-131.

Lockton, D., Harrison, D., and Stanton, N. 2008. "Design with Intent: Persuasive Technology in a Wider Context", in *PERSUASIVE 2008*, Oulu, Finland: Springer, pp. 274-278.

Oinas-Kukkonen, H. 2012. "A foundation for the study of behavior change support systems", *Pers Ubiquit Comput* (17:6), pp. 1223-1235(doi: 10.1007/s00779-012-0591-5).

Oinas-Kukkonen, H., and Harjumaa, M. 2009. "Persuasive Systems Design: Key Issues, Process Model, and System Features", *Communications of the Association for Information Systems* (24:1), pp. 486-500.

Oinas-Kukkonen, H., and Harjumaa, M. 2008. "Towards Deeper Understanding of Persuasion in Software and Information Systems", in *Advances in Computer-Human Interaction*, Sainte Luce: IEEE, pp. 200-205.

Zhang, C., Wan, L., and Min, D. 2016. "Persuasive Design Principles of Car Apps", in *19th International Conference on Business Information Systems*, Leipzig, Germany, pp. 397-410.