Increasing Smartphone-based Travel Survey Participants

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Abstract
This study discusses two smartphone-based travel surveys in Kumamoto, Japan, and investigates methods to increase the number of participants in smartphone-based surveys. The first was a visitors’ behavior survey conducted in downtown Kumamoto, which collected 1,086 samples. The second was a truck floating car survey. We offered an incentive and several recruitment methods to increase the sample size. The objectives of this study are to demonstrate the difference between reward effects and effective recruitment methods among different participants. Analysis of the visitors’ survey reveals that young people prefer rewards, while some aged people think that rewards do not matter.

1. Introduction

Smartphone-based travel survey methods attract significant attention as promising alternatives to classical paper-based or web-based survey methods. The smartphone-based method distributes the survey application by web store. Then, participants download the app and install it on their own smartphone. Thus, this method can reduce the survey cost of renting and shipping instruments such as GPS devices, and we can then further improve the GPS-based probe person survey system (e.g., Asakura and Hato 2004, Hato 2010). Despite these advantages, we must consider the challenges of smartphone-based surveys using participants’ smartphones. Several papers discuss issues regarding the implementation of such surveys (e.g., Nitsche et al. 2012, Cottrill et al. 2013, TRB Travel Survey

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Methods Committee 2013), which pose common challenges such as the battery lives of smartphones and privacy issues of participants.

In this paper, we focus on the reward and advertisement strategy to increase the sample size of smartphone-based surveys. People may consider the smartphone-based survey to be more complicated than traditional surveys. Then, recruitment methods and rewards for the participants would play significant roles in increasing the sample and producing a successful outcome.

Research questions of this paper are as follows: How much reward is effective to increase the number of participants? Are these effects different among participant attributes? Does reward give some bias of sample distribution? Is providing rewards cost-effective? Are there any methods outside of rewards to increase the number of participants? What kinds of recruitment methods are effective to increase the number of participants? These questions are investigated among traditional surveys and classical topics. This paper is original in that it examines these issues in smartphone-based surveys based on our experience in Kumamoto, Japan.

As described in our previous paper (Nohara et al. 2013, Maruyama et al. 2014, Asakura et al. 2014), we developed smartphone-based travel survey apps for both Android and iPhone platforms. Using these apps, we conducted a smartphone-based survey trial as a supplement to a large-scale household travel survey conducted in the Kumamoto Metropolitan Area of Japan in autumn 2012. We asked 13,279 households to participate in the smartphone-based survey. Because of some governmental constraints, we were unable to offer incentives to participants during this smartphone-based survey. Fortunately, we recruited 97 participants without offering incentives. Sample distributions of the survey are discussed in Maruyama et al. (2014). One of the challenges of the autumn 2012 survey was a low response rate. To overcome the challenge and gain additional travel information, we conducted additional smartphone-based surveys in November and December 2013. The first survey, the visitors’ behavior survey in downtown Kumamoto, asked the pedestrians and shoppers in that area to participate in a smartphone-based survey on holidays. We provided some incentives (including a coupon worth JPY500 or around US$ 5) to increase the number of samples. We prepared several strategies including posters, a leaflet, broadcasting, and a social networking service, and we successfully collected 1,086 samples. The second survey was the truck floating car survey. We asked seven logistic companies to participate in the smartphone-based floating car survey and accumulated 21 samples of five days’ trucking behavior.

The objectives of this research are to examine the following issues based on our survey experience in Kumamoto, Japan.

1. To demonstrate the reward effect of a smartphone survey especially focusing on its attribute difference.
2. To examine the sampling bias of a smartphone survey given according to the reward policy.
3. To investigate the effect difference by recruitment method and to reveal an effective recruitment strategy.

The paper is structured as follows: Section 2 describes our smartphone survey system and survey details. Section 3 reveals the results of analysis such as attribute distribution of participants, effect of advertisement, and reward. Finally, section 4 summarizes the findings of this study.

2. Methods

2.1. Smartphone-based Survey System

Figure 1 illustrates the smartphone-based travel survey system that we developed. 1) First, users have to register personal information on the website. Users must input their age, gender, address (city/ward/town/village where they are living), and condition of employment (worker/housewife/student/other conditions). The data server retains this information under the severe privacy control. After registration, they receive a unique ID and password that is necessary for the app. 2) Users download the app on the app market for each platform (Android OS/iOS) and install the app to their own devices. 3) In the app, users first input ID and password. The server verifies the ID and their device, and the app starts working. 4) Users begin the survey by tapping the “Departure” button. Then, GPS and acceleration data information is collected and sent to the data server by using the 3G/4G cellular network or Wi-Fi network.
2.2. Visitors’ Behavior Survey in Downtown Kumamoto

Kumamoto Prefecture, Kumamoto City, and Kumamoto University jointly planned to conduct a smartphone-based survey in downtown Kumamoto, which we called the “visitors’ behavior survey.” This survey was conducted on weekends in November and December 2013. We aimed to collect 1,000 samples in 6 days, and we successfully collected 1,086 samples.

Over 30 Kumamoto University students and over 20 local government staff kindly supported this survey. In addition, KUMAMON supported us in handing out flyers (Figure 2). He is a very popular mascot in the local area, so the street immediately became crowded. His demonstration and support may have been a reason for the successful collection of samples. We asked the smartphone owners to use their own smartphones, but we prepared tablet devices (Nexus 7) for those who are elderly who may not have smartphones. In addition, we prepared a mobile battery to support participants with battery shortages. At the end of the survey, we conducted a questionnaire survey to question participants on the purpose of their visit to the downtown area, their travel mode, the name of entry point (parking, bus stop, tram station, bicycle parking), accompanying members, and attitudes on rewards.

We utilized two registration methods. The first was based on pre-registration, and the second on on-site registration. Participants of the former method were registered via web by PC or smartphone through the flyer and leaflet information distributed in the downtown area, buses, and trams. The participants of the latter method were asked by surveyors in parking, bicycle parking, bus stop, and tram station areas to participate in the survey.

Figure 1 Smartphone-based travel survey system
2.3. Truck Floating Car Survey

A household travel survey will not be enough to capture the behavior of trucks in the city. Thus, we conducted a truck floating car survey in December 2013 as a supplement to the Kumamoto Metropolitan Area person trip survey. We conducted this truck floating car survey utilizing the drivers’ smartphones, and prepared gift vouchers worth JPY 1,000 (around US$ 10) as a reward for participants. Following, we describe the survey methods of recruitment, as well as methods used to contact the truck drivers.

First, we conducted the truck owner survey based on street counting on main intersections in the Kumamoto area. More specifically, surveyors recorded the company names of trucks driving in six intersections from 9:00 am to 12:00 pm on Thursday, November 7, 2013. We then summarized the results and listed the top 30 companies with a large number of observations. The Kumamoto local government conducted a traditional paper-based questionnaire survey administered to these 30 companies prompting on the routes and problems of the roads in the area. Our study team consulted the Kumamoto truck association and picked up seven companies that would participate in the new smartphone-based survey as well.

We found interesting findings through this recruiting process. We prepared the official request letter by Kumamoto Prefecture and the Kumamoto truck association, and made initial contacts with the seven companies by telephone asking them to participate in the smartphone-based survey. However, none of the seven companies were willing to participate in the survey at this stage. We were quite concerned about the success of the survey and visited each company to explain the survey method, aim, and use of the results. After we did this, all seven companies agreed to participate in the survey. We have found it is important to tell the respondents and their company how the survey method will work and how transport policy-makers will use the survey results to increase the number of participants.

3. Results

3.1. Distribution of Participants in Visitors’ Behavior Survey

We successfully collected 1,086 samples in six weekend days. In order to ensure that the collected sample was not biased, we conducted a counting survey of pedestrians in downtown from 1:00 pm to 3:30 pm on December 8, 2013. In this counting survey, surveyors observed and counted the number of pedestrians walking in the downtown area, noting their gender and apparent age. Figure 3 demonstrates the comparison between this counting survey and smartphone-based survey participants. The gender and age distribution are similar, so we concluded that we successfully collected unbiased samples.
3.2 Effect of Advertisement

We prepared several advertisements to increase the number of participants for this smartphone-based survey. Here we investigate their effect by utilizing the questionnaire survey we administered upon the completion of survey participation. Figure 4 shows the distribution of answers to the question: “How did you know about this survey?” Most of the participants said that they were asked by surveyors to participate when they arrived downtown. We refer to this as “catching” the participants. We prepared many posters and flyers advertising the survey. However, they were only effective when it came to the limited age range of 40-59, approximately. Thus, we can see that the effect of advertisement differs among age groups. Careful advertisement preparation should be made considering these results.

Figure 3 Comparison between counting survey and smartphone-based survey participant
3.3. Effect of Reward

We asked the participants of the visitors’ behavior survey two questions to investigate the reward effect. The first question was, “Which of these do you want to participate in for the next survey: a smartphone-based survey with the same reward (JPY 500, or around US$ 5) or a paper-based survey with no reward?” The second question was, “If no reward is provided, which do you choose: a smartphone-based survey, paper-based survey, or not to participate?”

The answers to these questions are summarized by age and gender in Figure 5(a) and Figure 5(b). For the first question (Figure 5(a)), most of the participants responded that they would choose the smartphone-based survey with the reward. This reveals the advantages of a smartphone-based survey over a paper-based survey. Especially, aged people over 60 tend to prefer paper surveys more than do younger people. Although the difference is rather small, such a difference is natural because some aged people may find it difficult to use a smartphone-based application.

Figure 5(b) reveals the most important findings of this study. The participation rate will decline greatly if no reward is provided, especially for young people. We conducted a statistical test to confirm whether the participation rate is different between people under 29 and people over 30. The difference is statistically significant ($p = 1.3 \times 10^{-6} < 0.01$) and we can conclude that reward effect is quite different among different age groups. However, we did not find a statistically significant difference among gender. Interestingly, some adult participants reported that they were quite happy to participate in the survey with no reward if the survey results would be useful for downtown planning and revitalization. We can conjecture from this that an effective method to increase the response rate may be different among different age groups. Younger people prefer rewards, while some aged people think rewards do not matter. We can also infer from Figure 5 that although the reward is effective to increase the sample size, it may result in a biased sample distribution.

Figure 6 also compares the results to the same two questions on reward effect between visitors’ survey and truck floating survey participants. Please note that the truck floating car survey participants may have been ordered or forced to participate in the survey by their company, but the visitors’ survey participants are voluntary participants. Therefore, the results of the visitors’ survey can prove to be naturally favorable in this new method, and the results of the truck floating car survey can be assumed to be more unbiased. Figure 6(a) shows that participants of the truck survey tended to choose the paper-based survey, even if the smartphone survey is rewarded more than that of the visitors’ survey. The difference is statistically significant ($p=8.9 \times 10^{-7} < 0.01$). Figure 6(b) demonstrates that the percentage of participants that answer that they will not participate in the condition of no reward decreased in the truck survey compared to the visitors’ survey. Although the difference is not statistically significant ($p=0.129$), this could partly be due to a small sample size of truck survey participants. Figure 6(b) also demonstrates that the percentage of participants that answered that they would choose a paper survey in the condition of no reward...
increased in the truck survey compared to the visitors’ survey. The difference is statistically significant ($p=0.029<0.05$). The truck survey participants may have been ordered or forced to participate, so they would hesitate to answer that they would not participate. This could be a reason for the increased percentage of those who chose the paper-based survey in the truck survey.

(a) Choice of smartphone with reward vs paper

(b) In no reward, choice of smartphone, paper, and no participation

Figure 5 Age and gender difference in effects of reward on survey participation

(a) Choice of smartphone with reward vs paper

(b) In no reward, choice of smartphone, paper, and no participation

Figure 6 Effects difference of reward on two surveys
4. Conclusion

This study demonstrates two smartphone-based travel surveys in Kumamoto, Japan, and investigates ways in which to increase the number of participants in smartphone-based surveys. The first survey observed was the visitors’ behavior survey in downtown Kumamoto, which collected 1,086 samples. The second survey was the truck floating car survey. We asked seven logistic companies to participate in the smartphone-based floating car survey, and utilized 21 samples of five days’ trucking behavior.

The following findings were obtained from the visitors’ behavior survey in downtown Kumamoto:

1. We obtained a large sample size using courteous requests and rewards.
2. Participants’ reward attitudes differed according to their attributes. Effective reward style also differed by participants’ attributes. Young people preferred rewards, while some aged people thought that rewards did not matter.
3. The posters and flyers of the survey were effective when it came to the range of around 40-59 years old.

Researchers and practitioners expect that smartphone-app-based travel surveys will prove to be a cost-effective tool. However, in our implementation, there was a great cost needed to collect a large sample. The cost included advertisements, rewards, and recruiting labor costs. Simply distributing the app in the application store would not have proved effective in collecting a large and random sample. We therefore asked streetwalkers in the downtown area to participate in the survey. This was effective, but it required a great labor cost.

We obtained the following results in from the truck floating car survey:

1. It is important to tell the respondents and their company how survey methods will work, and how transport policy-makers will utilize the survey results. The survey request by local government and local trucking association was effective.
2. Compared to the visitors’ behavior survey in downtown, rewards may not have been necessary for participants of the truck floating car survey.

These finding will be useful for similar future smartphone-based survey projects.

Our study used coupon as reward but special reward for smartphone users such as giving free airtime could be an effective tool. In other research, we attempt to estimate a discrete choice model of smartphone-based survey participation using survey data (Maruyama 2014). The model is explained by personal attributes (gender, age, occupation, household size) along with household locations, company type, and other factors. This model will prove useful for the development of sampling strategies, and for the removal of sample selection bias in future smartphone-based travel surveys.

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References


