e-Review of Tourism Research (eRTR), Vol. 16, No. 2/3, 2019
http://ertr.tamu.edu

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Comparing Techniques for Tracking: The Case of Tourism Tracer in Tasmania, Australia

Many technological options now exist for tourism authorities and researchers to understand the movement of different cohorts of tourists within destinations. However, while the merits and challenges of these methods have received attention within tourism literature, the data that results from different methods have rarely been compared. This preliminary study fills this gap by examining data that emanated from two techniques for capturing tracking data: an app that could be downloaded and placed on participants' phones, and a study phone distributed to tourists that it was pre-loaded with a tracking app. The results reveal that these subtly different techniques produce widely varying results. The implications of these differences are discussed, along with recommendations for future research.

Keywords: tourist tracking, GPS, survey, technology, app

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Introduction

A variety of techniques now exist for tourism authorities and researchers to understand the movement of different cohorts of tourists within destinations. Options include wearable GPS (Global Positioning Systems) devices, smartphones enabled with GPS technology, integrated app-based technology, mobile phone data, big data, social media geotagging, Wi-Fi and Bluetooth beacons. A rapidly growing body of literature is emerging where the merits of these technologies are being explored. However, perhaps due to the rapid growth and sudden emergence of many of these options, scant literature exists which compares the performance of these methods and the data that emerges from their use. This paper represents a preliminary exploration into the quantity and quality of data that emerges from two techniques: tracking within a discrete region in Australia, via an app tourists can download onto their phones and via an app loaded onto a bespoke GPS-enabled study phone.

Literature Review

Tourism tracking is one of the most rapidly changing areas of research as a result of unprecedented technological advances in the past 15 years. A variety of options now exist beyond the physical tracking that was once required to understand where tourists travelled. Hand held GPS trackers had reduced dramatically in size and the technology is now embedded in smart phones. In addition, smart phones themselves can track movement through telecommunications towers, enabling a new era of big data. And recently, WIFI and Bluetooth functionalities have facilitated tracking via modems and beacons which can log individuals' phones when they are in range. A variety of studies now exist which assess and analyse the functionality and accuracy of all these options. For example, while extremely accurate there has been criticism from some that GPS data places too greater emphasis on movement while ignoring other more subtle aspects of participants' travel behaviour (Gren 2001). It has also been stated that handheld GPS trackers are invasive, lack battery life, and that participants change their behaviour when they become aware they are being tracked (Winters et al. 2008).

App-based tracking has also been critiqued. While unobtrusive and, when designed efficiently, able to function without draining battery life, the use of tracking without consent has raised concerns over privacy (Curry 1997; Shoval, 2007; Versichele et al. 2014). This issue came to the fore in early 2018 with the breaking of the Cambridge Analytica scandal. Similarly, the use of unique Internet Protocol (IP) addresses, which are attached to mobile phones, and can be 'farmed' when they connect to Bluetooth or Wi-Fi, have ben critiqued. While unobtrusive, cost-effective and extremely efficient at determining traffic flows between different locations, the technique is limited because it can only track individual phones as they move between locations with receivers, and the demographics of the owner remain largely unknown (Hardy et al. 2017).

However, while the functionality of the methods has been critiqued, what appears to be lacking is an exploration of data that emerges from these different methods. Exceptions include Shoval and Ahas (3016) and Shoval and Isaacson (2007) who compared different tracking technologies available for tracking tourist mobility and, in doing so, assessed the advantages and limitations of a wide variety of methods including satellite (GPS) tracking, land-based antenna-assisted tracking, and hybrid methods. However, while this research provided important insights into the accuracy of tracking performance, impact on the tourist experience and ethical issues related to the different techniques, it did not assess the implications for data analytics on a larger scale. The need for research that addressed that need provided the impetus for this study.

Methodology

The data for this research originated from the Tourism Tracer project in Tasmania, Australia. The project sought to understand the movements of free independent holiday tourists in the state, using integrated GPS/GNSS and survey data. A smart phone app was created that included Global Navigation Satellite Systems (GNSS) technology, along with an entry survey that collected information on the visitors' demographic profile, intended length of stay, primary trip purpose, and travel party composition. The app stored the GNSS and survey data and when in mobile phone range, sent it back to a central server where it was cleaned and processed. The app was designed to collect data on tourists' movement every 10 seconds, without draining the study phones' battery. This frequency of data collection was similar to previous research that demonstrated 15-second tracking intervals were adequate for studies related to visitor movement (Beeco and Hallo 2014). The apps location-based tracking functionality was similar to apps such as Trip Advisor and Google Maps. However, it differed in that it was a bespoke research app and the front end contained survey questions. With the exception of one study, the research team was unable to locate other instances where this method had been used. Further details on the methods used in this study are detailed in Hardy et al. (2018).

There were two major phases to this research. In 2017, the app was loaded onto a Samsung Galaxy S3 smart phone (hereafter referred to as the ‘study phone'). As an incentive 3 Gigabytes of mobile data was included on each phone - our participants were able to tether the study phone to their own devices via the hotspot function. The data was provided by the Optus network- Australia's second largest mobile phone provider. Participants were asked to keep their study phones on for the duration of their travels in order for a continuous path of travel to be created. Tourists were recruited by trained field workers while waiting for their bags at the luggage carousels in Hobart and Launceston Airports (the two major airport terminals) or while on board the Spirit of Tasmania passenger ferry that arrives at the Tasmanian port town of Devonport. Over 478 tourists were tracked this way (referred to as ‘study phone users’), resulting in the largest GNSS data set of its type in tourism research, temporally, numerically and spatially.

In late 2017 a new technique was trialed. A standalone app was developed, which was a purely research-focussed app, containing the survey, a daily path function that showed tourists where they had travelled on that and previous days, and GNSS functionality. As an incentive, participants were sent a map detailing their route through the island for the duration of their holiday. The app was made freely available on the Google Play and iTunes stores. The GPS coverage was dependant on the participants' mobile phone provider, thus introducing an element of variability into the accuracy of the GPS data being sent to the research server. Two hundred forty-four tourists were tracked using the stand-alone app methods (hereafter referred to as ‘app users').

Rather than recruiting tourists with field workers, the app was simply advertised on a small advertising board, placed near the luggage carousels in Hobart and Launceston, and on an electronic billboard on board the Spirit of Tasmania. Surprisingly, recruitment of the app during 2018 has been highly successful; on most days up to six tourists downloaded it onto their phones each day.

Comparing techniques

Overall, the average characteristics of both the app and study phone users were fairly similar – study phone users' average age was 45.44 and app users was 47.32 years. This slight difference in the distribution of ages was most probably a result of field workers ensuring a broader selection of respondents were recruited to use the study phones.

We found that the study phone was slightly more popular amongst Australians than the app; 78,84% of study phone users were from Australia, compared with 72.37% of app users. However, app users and study phone users were equally likely to be first-time visitors to Tasmania, rather than repeat visitors (46% and 45% respectively). For both methods, females were more likely to participate - 56% of app users were female, compared with 60% of study phone users.

Regarding engagement with the app, we found that app users tended to be less vigilant in completing the survey. While 86.6% of study phone users completed the entry survey, only 62.3% of app users completed their entry survey. This was most likely due to the fact that phone users were recruited in person and were encouraged by the recruiter to complete the survey before departing the airport arrivals hall.

However, while the app appeared to be less effective in terms of ensuring engagement with the survey, the analysis revealed marked differences in the GNSS data quality. To test the performance, cleaning was performed in R then ArcMap. The R-language environment was used for data cleaning as it allowed an automated script to be designed that could be re-used in future research. The automated processes included merging the data of individual UUIDs, creating datasets at multiple time-interval resolutions, removing points, and calculating new variables. For example, points were removed if they were more than 5 kilometers outside Tasmania, moving too quickly, inaccurate, or if they belonged to a universal unique identifier (uuid) with too few points overall. Following this, the data were then manually checked in ArcMap. This approach maximised the interaction between numeric data and the corresponding graphical visualisation; clusters or gaps that should not have existed were removed during this stage. Further manual checks were then performed in ArcMap to ascertain the spatially explicit accuracy of the mapping exercise.

During cleaning, a much higher number of app users were removed than study phone users- these were participants who downloaded the app but did not record a track of their travels, most likely because they did not enable tracking. Once cleaning was completed, our sample size of tourists who visited the west coast included 96 study phone users and 34 app users.

Table 2: Percentages of Study Phone and App Users Before and After Cleaning

% of total	% Before cleaning	% of each type kept after cleaning	% of each type removed
Study Phone users	66.2	97.9	2.1
App users	33.8	68.9	31.1
Total	100.0	88.1	11.9

The research team selected a region on the west coast of Tasmania. This region is very remote, covering 9,574 km^2 (a similar size to Cyprus) and with only a small population of approximately 4150 (West Coast Council, 2018). Mobile phone coverage is, in places, quite sparse. Yet, the rugged and remote beauty of the region acts as an important drawcard for tourists. These two conditions meant that the region provided a suitable study area where the performance of both the app and study phone could be assessed.

The first step was to access data on the demographics and numbers of tourists using the five roads into the West Coast. Due to the fact that many tourists did not have their phones on and were thus not recording their GNSS route, not all uuids provided information on which roads they took. Assumptions in some cases could have been made based on the town participants were in before entering the West Coast, and the first town they stopped at after, but to avoid inaccurate assumptions, only tourists with points collected on one of the five entry roads were included. In total 102 of the tourists had recorded points for the road including 72 phone users and 30 app users. Six users did record their route in but did not undertake the Tourism Tracer survey so were excluded from the sample, leaving 96 tourists.

When calculating the length of time tourists spent in the West Coast region, the analysis was complicated by a lack of uuids recording a constantly recorded path and consequently missing the precise time of entry and exit from the region. Despite this, the length of stay was found by subtracting the minimum date and time value recorded in the area from the maximum. Following this, each user's individual track was examined to assess the accuracy of its length of stay calculation and the quality of each user's maps. It was found that most of the users with poor quality tracks had used the study phones rather than the app. The study phones seemed to have inconsistent patterns of recording, for reasons which are unknown.

Consequently, the length of stay calculation varied widely between phone and app users. For the app users, the average length of stay in the region was just over two days. When the poor data of the study phone users was included, it lowered the total average time spent in the region by around half a day.

When assessing the number of towns visited by each tourist, our analysis also revealed a difference between the study phone and app users. The study phone users' average number of stops was lower with 51% recorded visiting one or no towns - this was probably due to the lower quality data collection. The results also revealed that 14% of people who visited 3 or 4 towns tended to be older and that Australian tourists were more likely to visit three or four towns than foreign tourists. Tourists that had previously visited Tasmania were also more likely than first-time visitors to stop in three or four towns.

Conversely, amongst app users, only 27% visited one or no towns, while 41% visited three or four. The demographic characteristics of the different travel styles were also reversed from the study phone users: the people who visited three or four towns were younger than the people who visited one or no towns, they were also more likely to be from overseas and to be first-time visitors to Tasmania.

Conclusions

This preliminary study has demonstrated that different methods of tourist tracking have very different outcomes. It has significant implications for tourism researchers as it suggests that different methodological techniques can reduce widely different results. Two methods were used in this study - a standalone app that could be downloaded onto participants' phones and a study phone that had an app placed on it. The results revealed that engagement with the two methods differed widely; study phone users who were recruited by field workers had a far higher engagement in terms of survey completion. Conversely, the standalone app which required self-recruitment produced high numbers of users who downloaded the app but did not activate the tracking function, or complete the survey.

The study also demonstrated that the standalone app produced far more consistent traces of tourists' travel. This could have been due to the age of the study phones or the service provider being sub optimal in the case study region. Most importantly, the two methods produced vastly conflicting results. Given the small sample size and discrete geographical location of the closed study area, further research is now needed to determine the likelihood of divergences in results such as this occurring in the future. Further research is also needed to determine whether the differences in data were due to the type of interaction that users have with a personal phone compared with a phone that was lent to them, or the sample of users.

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