10th International Conference on Transport Survey Methods

A smart card transaction "travel diary" to assess the accuracy of the Montréal household travel survey

Timothy Spurr[a]*, Alfred Chu[a], Robert Chapleau[b], Daniel Piché[b]

[a]*Agence métropolitaine de transport, 700 de la Gauchetière St W., Montreal H3B 5M2, Canada*
[b]*École Polytechnique de Montréal, PO Box 6079, Station Centre-Ville, Montréal H3C 3A7, Canada*

Abstract

This paper proposes to use a smart-card (SC) based "travel diary" to assess the accuracy of a household travel survey (HTS) in which respondents are not asked to provide their smart card number. Using a single day of travel survey data, a methodology based on spatiotemporal filters applied to declared travel patterns is able to match roughly half of transit-using survey respondents with at least one smart card. In cases where a match is possible, preliminary comparison of travel patterns as measured by SC with those measured by the HTS reveals three singular types of traveller survey response.

1. Introduction

In the introduction to their paper on assessing the accuracy of the Sydney household travel survey using Global Positioning Systems (GPS), Stopher et al. [1] wrote:

> Most household travel surveys rely on some form of self-reporting by respondents about the
> travel that they undertake during the survey period. There have been many changes in the way
> in which household travel surveys are conducted over the past 40 or 50 years, whether surveys
> are conducted as retrospective or prospective, and are undertaken by post, face-to-face

---

* Corresponding author. Tel.: +1-514-287-2464; fax: +1-514-287-2460.
E-mail address: tspurr@amt.qc.ca

interview, telephone interview, or Internet, or some combination of these. Ultimately, however, they all rely on the ability of people to report accurately the number of trips they make, the origin and destination addresses of their trips, the time at which each trip was made, and often the duration of the trip both in time and distance ... Unfortunately, people are notoriously poor at providing accurate reports of any of this information.

Indeed, the accuracy and representativeness of self-reported travel information remains an important issue, particularly when detailed and precise measurements or forecasts are required. The study cited above compared travel behaviour recorded in a travel survey with movements of survey respondents as recorded by GPS and was able to measure the degree to which survey respondents accurately (or inaccurately) reported their travel. Smart card transaction records generated concurrently with the execution of a household travel survey afford an opportunity to perform a similar experiment conditional on the ability to match smart cards with transit-using travel survey respondents. If such matching is possible, then the smart card transaction records can serve as a high-precision travel diary which can be used to assess the accuracy of travel information collected through interviews.

While smart cards provide only partial data on the travel patterns of public transit passengers, they have numerous advantages over mobility-aware and on-line technologies such as the mobile phones and GPS: they require no additional effort on the part of the traveller other than validating the fare; the duration of the survey is not limited by equipment, battery life or respondent fatigue; in many locations, the high penetration rate of electronic fare media among transit users means that the transaction data covers virtually an entire population of travellers; finally the cost per observation is several orders of magnitude lower than that of traditional travel survey methods. In addition, the partial information generated by smart card transactions, when enriched with detailed data on transit supply, can produce a highly detailed and precise database describing the transit-using population.

The validation of travel survey data using passive measurement technologies such as GPS and mobile devices has long been a topic of interest to researchers and practitioners [1-3]. Comparisons of travel survey responses with automatically collected data (usually from GPS) have shown that survey respondents tend to under-report the number of trips they make and cannot recall times and locations precisely. Meanwhile, recent experiments [4-7] have shown how the spatiotemporal precision of smart-card transaction data, enriched with data from other sources, can produce highly detailed descriptions of travel demand. This demonstrated potential of smart card data raises the possibility of direct comparisons with individual trip information contained in a traditional travel survey.

Some work of this type has already been done. Trépanier et al. [6] compared indicators from a typical average day compiled using travel survey data with multi-day smart card data covering the time period of the travel survey. The authors draw attention to the potential for mutual enrichment of the smart card and travel survey datasets. Riegel and Attanucci [8] compared individual London Travel Demand Survey responses with individual travel patterns revealed by smart card (Oyster) transactions. In that case, survey respondents volunteered their smart card number so that they could be easily identified in the SC transaction database. The study found that only around half of reported trip legs corresponded to recorded smart card transactions, which implies that identifying the smart card of a specific survey respondent using only declared travel patterns presents a considerable challenge. A recent project using Montreal data [9] compared aggregate indicators derived from smart-card transactions and a household travel survey. The results of the analysis revealed two distinct types of bias in the travel survey's estimates of subway ridership: an underestimation bias during off-peak periods and an over-estimation bias during peak periods. The underestimation bias was explained by the under-reporting of non-home-based trips. The overestimation bias was partially corrected by reweighting the households of subway users but its underlying cause could not be discerned with certainty using aggregate comparisons. Aggregate comparisons were the only option in that study since the smart card data were collected in 2010 and the travel survey was conducted in 2008. The 2013 Montreal travel survey is the first large-sample survey to be completed since the full implementation smart card fare collection system. Consequently, the 2013 survey data can be directly compared to the smart card transaction data at the level of individual transit users.