Transportation Research Part F 58 (2018) 881–892

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

Modeling the effects of real time traffic information on travel behavior: A case study of Istanbul Technical University

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ARTICLE INFO

Article history:
Received 18 October 2017
Received in revised form 4 July 2018
Accepted 17 July 2018

Keywords:
Multinomial logit model
Travel behavior
Real-time traffic information
Traffic applications

ABSTRACT

This article adds to the literature on the investigation of choice behavior of travelers under the real-time traffic information acquired through some traffic applications such as GPS navigation devices for car, mobile traffic applications and radio traffic reports on traveler behavior on highways. Self-deviced survey of travelers was conducted for the civil engineering undergraduate – graduate students, academicians and supporting staff at Istanbul Technical University, Turkey in 2016. Multinomial logit mode choice model of the decision making for travel and commuter responses to traffic information were estimated separately in two different commute modes, including private cars and public transit. The attributes that influence travelers' decision-making patterns were broadly categorized into three groups, which were socioeconomics, travel and technological characteristics. The analysis of the results indicated that travelers who obtained traffic information from some traffic applications were more likely to switch their route with respect to their different characteristics. Moreover, the travel pattern of the commuters regarding whether to change their choice of route or not varied with respect to their aforementioned characteristics as well as their selection of commute modes. The results of this research could also help to develop vehicular communication systems such as vehicle-to-infrastructure V2I communications.

1. Introduction and motivation

Real-time traffic information has a significant impact on the travel patterns of the commuters before and during their trips. Acquiring an update on the traffic can update travelers' perceptions of travel alternatives and affect their choice behavior, either by increasing their awareness about other modes, or changing their view on the characteristics of them (Chorus, Molin, & van Wee, 2006). This may result in the change of the trip generation; thus, the mitigation of traffic congestion (Bonsall, 2001; Golledge, 2002; Kanninen, 1996; Koppelman & Pas, 1980; Wang, Khattak, & Fang, 2009). Many studies emphasize the importance of understanding and modeling the impact of travel information on travelers' decision processes (Arentze, Hofman, & Timmermans, 2004; Sun, Arentze, & Timmermans, 2005). A modeling framework consisting of goal formation, information acquisition, driver information, processing capacity and computational ability, decision rules, reviewing, and actual decision was proposed in order to replicate the behavior of the travelers accurately (Ben-Akiva, de Palma, & Kaysi, 1996). There are also studies in which the impact of various types of information on route switching behavior of travelers are

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https://doi.org/10.1016/j.trf.2018.07.013
1369-8478/

inspected (Khattak, Kanafani, & Le Colletter, 1994). Furthermore, the source and timing of the received information is crucial for the traveler and their decision making process.

The biggest impact of traffic information is reflected in route changes and rescheduling of activities (Tsirimpa & Polydoropoulou, 2011). Information received from radio stations, television or telephone can often influence the traveler to change their departure time (Khattak, Yim, & Stalker, 1999). According to Yim and Miller (2000), there is even a bigger ratio of drivers who make the same decision for their departure time as they spend considerable amount of time online. The ratio of drivers who make the same decision increase even further if they are dealing with websites or computers (Yim & Miller, 2000). The travelers who have access to the traffic information before their trip, has the advantage of changing their departure time instead of their route (Shah et al., 2001). For the drivers en route, variable-message signs may cause them to divert from a non-freeway to a freeway rather than vice versa (Hato et al., 1995). This decision making process is affected by their behavioral inertia in response to the advanced traveler information system (ATIS) (Srinivasan & Mahmassani, 2000). While the drivers are making multiple travel plans, the previous experiences of the driver also play a role (Chen et al., 2008). As the technology and the infrastructure is improved, there are more ways to obtain and share the real-time traffic information with the travelers, especially for the ones en route.

With the advancement of data collection techniques, GPS, transit smart cards, mobile phones, and various types of travel trajectory data are increasingly complementing or replacing conventional travel diaries and revealed preference data (Yue et al., 2014). There is also information to support travel decisions which are acquired actively (reading, asking, listening, etc.) or passively (i.e., through experience) which will aid in the long term (auto purchase, etc.) and short term (departure time and route choice, etc.). The fact that the most recent information, essentially the previous trip's travel time, being the most important factor for affecting current decisions, increases the importance of obtaining the most recent information (Chang & Mahmassani, 1988; Lida, Akiyama, & Uchida, 1992). With the introduction of smart phones, a new way of traffic information dissemination is created. This new way of provision has significant advantages over conventional tools, for its ability to be more flexible for travelers in obtaining traffic information. The biggest importance of the introduction of smart phones; however, is the increased availability of real time traffic information. Real time traffic information is much more available with the smart phones, as they become more common and improved in their capabilities. With real time information, people would be able to avoid unexpected severe traffic congestion (Tseng, Knockaert, & Verhoef, 2013). Moreover, with the ATIS, it is possible to reduce travel times, delay, fuel consumption and emission (Adler & Blue, 1998). Yet, for this system to work flawlessly the information needs to be accurate and reliable, otherwise there would be a large economic and environmental loss, especially in the rush hours (Arnott, de Palma, & Lindseyrnott, 1991). Due to the difficulty of applications' providing accurate data, the travelers do not always trust the information they receive. The trust is equally significant as the accuracy and the reliability of the information, in examining the response of travelers whether they actually follow the systems' advice.

A driver's compliance with the provided information depends on the driver's knowledge of the network and the accuracy of information the driver gets (Bonsall, 1992). Accuracy of the ATIS tools have a great influence on people's choice (Khoo & Ong, 2011). The applications for smart phones also provide very important and current information to the drivers. These travel apps can be divided into two categories, the informative apps that provide traffic information to users without route guidance advices and deliver information in the form of traffic images or maps, and the guidance type of traffic applications providing route guidance and advice for avoiding traffic congestion. Top factors that encourage people to use these applications are their ability to deliver real time traffic information in the form of detailed rerouting advice, and/or report on incident and delay estimation. Gokasar and Bakioglu (2016) gathered Google Play Store and App Store reviews under three main titles: accurate/ reliable or not, user friendly or not, and detailed or not. The star rating was taken as a dependent variable. In terms of independent variables, the gender of the reviewer, type of the application (whether it is for public transit or for a private vehicle) and the comment itself were considered. In the section of the article where the data were statistically analyzed, Yandex.Maps was found to be an accurate and a reliable application, due to the positive reviews it received. Moreover, the majority of those reviewers were males. In Gokasar and Bakioglu (2018), some of the traffic applications used in Turkey and around the world are compared. The results showed that Moovit, which is a very commonly used traffic app in Turkey, received many reviews, which mostly centered on its being accurate and reliable. Moreover, the reviews that GPS tracking applications of the cars received reveal that the apps do not give detailed results. Those applications are classified and referred as "Car GPS Tracking" throughout the article.

This research contributes to the literature by focusing on the travelers' response after they receive the information and estimating the relationship between the characteristics of the travelers and their responses through multinomial logit. It aims to analyze the impact of real-time traffic information attained through some traffic applications such as GPS devices, mobile traffic applications, and radio traffic reports on traveler behavior. While achieving the mentioned goal, a multinomial logit model is estimated:

- To analyze the effects of the provision of various types of real-time traffic information acquired by some traffic applications on travelers' behavior,
- To analyze traveler route choice with respect to some different characteristics, namely socioeconomics, travel and technological characteristics.