JOURNAL OF TRANSPORTATION
SYSTEMS ENGINEERING AND INFORMATION TECHNOLOGY
Volume 13, Issue 6, December 2013
Online English edition of the Chinese language journal

Cite this article as: J Transpn Sys Eng & IT, 2013, 13(6), 86−93.

RESEARCH PAPER

Effects of Friends' Information Interaction on Travel Decisions

LIU Tianliang*, ZHANG Chong, WANG Tiange, WU Guojun

School of Economics and Management, Beihang University, Beijing 100191, China

Abstract: Many existing studies focus on the effects of traffic information from ATIS on travel choices. Research on the effect of friends' travel information on people's travel choice is uncommon, yet needed. In this paper, behavioral experiments are conducted to discuss what the effects of information interaction with friends can bring on individual travel decision behavior. The experimental results concluded that when the rate of friends' information interaction reaches 33.3%, the whole system is at an optimal level. Furthermore, users reach an optimum when the rate of friends' travel information interaction is 75%. The average time and cost per person is increasing when the whole system optimum transfers to the user optimum. Moreover, adjustments of departure time at the system optimum are more dispersed than at the user optimum, while travel choice changes are more concentrated.

Key Words: urban traffic; travel decision; experimental study; information interaction with friends; system optimum

1 Introduction

With the rapid development of information technology, traffic information has had a greater effect on the behavior of travel decision-making. With traffic information, the relation among people, vehicles, roads and systems can become parallel. In some ways it simplifies travel and improves the efficiency of the transportation system [1]. Currently, traffic congestion is more severe than ever, and building additional infrastructures may not suit the growing demand. Therefore, taking advantage of traffic information for the efficiency of transportation systems is a popular research topic often discussed by people in academia, industry, and government.

Daily travel decision-making is a long-term, non-cooperative, and multiplayer progress. Travelers who obtain traffic information constantly update their knowledge about traffic systems. Then, use this knowledge to adjust their departure time and paths. Generally, three different approaches can be taken by travelers to gather information through their own travel experience, formal channels and informal social network. Using the formal channels, travelers can obtain the free public information or the paid guiding information. The traffic information is gathered and provided by the Advanced Traveler Information Systems (AITS). Most of existing studies focus on the first two approaches [2]. In this paper, a discussion is made on the effects of individual travel decision behaviors brought by the informal social network known as the friend circle. This kind of traffic information can be easily and spontaneously formed within the friends' circle, by interacting with its members who shares a social relationship with travelers. Moreover, it is usually targeted and more credible for travelers. Thus, it has an obvious effect on individual travel decision behaviors. Traffic information from a friends' circle can be gathered and spread rapidly in easier and cheaper ways such as social network platforms and mobile applications. Travelers who live and work in neighboring places share traffic information and travel experiences with each other through the so-called "Travel friends' circle". So, the study on friends' traffic information interaction will help travelers make improved travel decisions, even if travelers might be drivers of private cars, taxies or buses.

There are three main literature concepts on travel decision behaviors including, mathematical analysis, simulation and experimental studies[3]. The study of mathematical analysis describes the equilibrium point or asymptotical stability process of daily travel behaviors by mathematical models [4,5]. The studies by simulation show dynamic features of traffic

Received date: Jun 7, 2013; Revised date: Aug 26, 2013; Accepted date: Sep 23, 2013
*Corresponding author. E-mail: liutianliang@buaa.edu.cn

DOI: 10.1016/S1570-6672(13)60130-0

systems by simulating and reproducing the real traffic situation [2, 6]. Besides, behavioral experiments are often conducted to observe the actual decisions of the recruited subjects using controlled experimental scenarios [3]. For instance, Selten conducted a route choice behavior experiment among 18 students in Bonn University [7]. Terry studied the choice of departure time in Y-shaped traffic networks containing multiple bottlenecks using 240 subjects [8].

Currently, few papers directly discuss the effects of information interaction with friends on travel decision behaviors. In this paper, a controlled travel-decision behavioral experiment was conducted to answer the following: ① Does more information from the friends' circle lead to a better travel choice? ② For the whole system, is there a certain rate of friends' information interaction to minimize the subjects total cost, or make the system optimal? ③ For individuals, which rate of friends' information interaction is the best to make the subjects with different departure times and paths have closer travel costs, or reach the user optimum? ④ At system optimum and user optimum, what are differences in selecting departure times and paths between subjects?

2 Related concepts

Firstly, definitions of the related concepts in this section are given prior to the experimental study.

2.1 Friends' circle

Friends' circle is a relationship group, in which each member share a special relationship with others. Here, the friends' circle is referred to "Travel friends' circle". Its members live and work in neighboring places. They could have been actual friends or colleagues. They may know each other well before, or just travel friends, who know each other through Weibo, Weixin or other platforms. They share their travel information such as departure times and paths every day to help improve decisions for the next day.

2.2 Rate of friends' information interaction

Rate of friends' information interaction represents the completeness of information interaction through the friends' circle. If the number of travelers who live and work in neighboring places is M, and the number of travelers in a certain traveler A' friends' circle is N, the rate is φ for A ($\varphi=(N-1)/(M-1)$ ($1 \le N \le M$)). When N=1, A has no friends, and then the rate φ is 0. When N=M, all the travelers who live and work in neighboring places with A are A's friends, which means the rate φ is 100%.

3 The experiment

In this section, behavioral experiments are constructed to discuss the effects of information interaction with friends on individual travel decision behavior. The experiments are carried out in the laboratory of the School of Economics and Management at Beihang University in April, 2013. A LAN-based controllable experimental platform (independently developed by the authors) is used to observe actual travel decisions of recruited subjects. The rewards the subjects recieve are dependent on their travel decision results of various test times, i.e., the scores obtained in the experiments.

3.1 Design of the experiment

3.1.1 Subjects and relevant requirements

25 subjects are recruited through the local internet network platform, many of which who have never participated in a similar experiment and have not known each other prior. The ID number of each subject is randomly assigned according to their arrival order, and no interaction with others is allowed throughout the experiments. The subjects are required to make travel decisions for 113 periods (trials 1–5 are used for practice only) and each test period represents one day. The specific decisions include the choice of departure time and paths.

3.1.2 Experimental scenario and traffic network

3.1.2.1 Experimental scenario

The experimental scenario begins when the subjects depart from a fixed origin and reach a fixed destination every day (such as commuting to work from home). The departure time is limited between 7 o'clock and 9 o'clock (using 5 min as an interval). The subjects are required to make decisions of the departure time and paths to ensure that they can quickly reach the destination at 9 o'clock.

3.1.2.2 Traffic network

In order to avoid introducing too many complicated and uncontrollable factors, the traffic network used for the experimental study is designed to have a simple structure of two parallel paths (shown in Fig. 1). In Fig. 1, path A is the highway containing high travel uncertainty, where the travel time depends on the congestion situation ranging from 30 min to 120 min. Path B is the subway containing low travel uncertainty, where the travel time is fixed at 60 min.

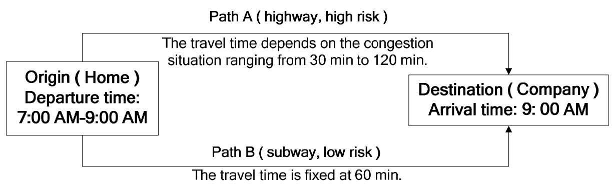

Fig.1 Design of the traffic network

(1) Traveling module of path A

The traveling module of path A is realized by a cellular automata model (NS model). In the NS model, a path is divided into a number of cells, whose length is L (L is generally taken as 7.5 m). Each cell is empty or occupied by a vehicle. The speed of the vehicle has an integer value such as 0, 1, 2,⋯, $v_{\max}$. Here, $v_{\max}$ is the maximum speed. The