Chapter 17
Measuring Travel Behavior Changes to Variably Priced Carsharing Using Mobile Applications

Sisinnio Concas
University of South Florida, USA

Sean J. Barbeau
University of South Florida, USA

Philip L. Winters
University of South Florida, USA

Nevine Labib Georggi
University of South Florida, USA

ABSTRACT
Carsharing programs help reduce car use and increase reliance on congestion-reducing modes, including transit, bicycling, and walking. The basic pricing model, a flat hourly rate, creates an opportunity to study variable pricing as a strategy to increase demand for carsharing, while influencing travel behavior modally, spatially, and temporally. This chapter discusses the use of a GPS-enabled mobile phone application to collect travel behavior data while changes to the hourly rental rates were administered to an experimental group of carsharing users. To assess shifts in peak-hour travel in response to variable pricing, nonparametric methods are used to estimate rental start-time probability density functions. Findings show that using pricing to influence when carsharing members take trips can serve to redirect demand to capacity travel times on the road system.

INTRODUCTION
Positioning technologies in commercially available mobile phones have matured significantly during the last five years, offering new opportunities to collect high-resolution spatial travel behavior data for transportation research and operations. The development of location-determination capabilities in the U.S. was largely triggered by the Federal Communication Commission’s E911 mandate, which established accuracy requirements cellular carriers must meet when locating emergency callers. The demands of current commercial services such as real-time navigation and social location have sustained the advancement of positioning technologies, with advanced precision, accuracy,
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and availability in adverse wireless environments, such as urban canyons and indoor locations.

Modern positioning technologies in mobile devices provide new opportunities to transportation researchers and practitioners for studying the movement of people across many different modes of transportation. Data from mobile devices can help inform the design, deployment, and analysis of new types of transportation modes, such as carsharing. Carsharing is an increasingly popular membership-based service that provides 24-hour-a-day access to a fleet of vehicles rented on a short-term basis. The rental cost typically covers gas, maintenance, and insurance. Members reserve a car online or by phone, access and drive the vehicle with an electronic key card, and then return the vehicle to the same location. Carsharing can substitute for car ownership or provide employees an alternative to driving to work by giving them access to vehicles for business use or personal errands during the day.

Past research has found that carsharing customers increase their use of carpooling, bicycling, and walking, though the impact on transit use shows a slight overall decline (Martin & Shaheen, 2011). A study of North American carsharing organizations demonstrates how the impact of carsharing on transit depends upon users’ travel preferences (Martin et al., 2010). As energy price uncertainty increases, carsharing is poised to grow in the near future (Martin & Shaheen, 2011). However, the geographic characteristics of carsharing user travel behavior, both for carsharing and non-carsharing modes, have not been previously studied. As carsharing programs grow, the question of how variable pricing can be applied to influence usage patterns and levels become relevant. Taking trips in the off-peak period reduces congestion, thus reducing delay, saving time, and improving air quality.

This paper discusses the use of a global positioning system (GPS) mobile phone application to collect travel behavior data of carsharing users as part of a variable pricing experiment in a car-centric university setting and a decentralized urban area (Winters et al., 2012; Concas et al., 2013). The objective was to investigate if variable pricing could be applied to the carsharing model to influence when a carsharing trip was taken. A random sample of 30 participants carried a low-cost mobile phone with the application installed, resulting in over 4 million GPS data points that provided precise geographic and spatio-temporal information. These data informed an analysis of the participants’ geographic footprint of carsharing and non-carsharing users. Data-driven nonparametric estimation methods were used to evaluate the impact on area-based geometric measures of spatial dispersion of out-of-home activities in response to changes in carsharing rental hourly rates. Presented in the form of a case study, the paper discusses the advantages and challenges offered by the use of these novel applications.

THE CARSHARING PROGRAM

Carsharing is a membership-based service that provides 24/7 access to a fleet of vehicles rented on a short-term basis. The rental cost typically covers gas, maintenance, and insurance. Members reserve a car online or by phone, access and drive the vehicle with an electronic key card, and then return the vehicle to the same location. Carsharing can substitute for car ownership or provide employees an alternative to driving to work by giving them access to vehicles for business use or personal errands during the day.

Program Implementation

The University of South Florida (USF) in Tampa, Florida, launched its carsharing program on July 23, 2009. The program began with a fleet of four hybrid vehicles available to students, faculty, and staff. Initially, the vehicle mix included three Toyota Prius and one hybrid Ford Escape. During the course of the project, the vehicle mix was