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Mode choice of university students commuting to school and the role of active travel

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ABSTRACT

In recent years, interest in the travel behavior of students in institutions of higher education has grown. It has been noted that students tend to use a variety of transportation modes, including active travel, more frequently than other population segments. Investigating the modal choice of university students provides a unique opportunity to understand a population that has a large proportion of active commuters at a major trip-generating location. In turn, this can provide valuable insights into the factors that influence active travel. In this paper, we report the results of a mode choice analysis among university students, using as a case study McMaster University, in Hamilton, Canada. The results from this research indicate that modal choices are influenced by a combination of cost, individual attitudes, and environmental factors such as street and sidewalk density. A key finding is that travel time by car and bicycle positively affect the utilities of these modes, although at a decreasing rate as travel time increases. While the positive utility of time spent traveling by car has been documented in other settings, our analysis provides evidence of the intrinsic value that cyclists place on their trip experience. Examples of transportation policy measures suggested by the analysis are discussed.

1. Introduction

In recent years, the transportation situation of students in institutions of higher education has garnered increasing attention. A number of studies can be found that deal with different aspects of the travel patterns of university or college students. These include, among other topics, the use of GIS to visualize and assess travel behavior (Kamruzzaman et al., 2011), modal choices (Delmelle and Delmelle, 2012; Klockner and Friedrichsmeier, 2011; Zhou, 2012), and activity patterns (Chen, 2012; Eom et al., 2009, 2010). Other investigations have focused on attitudes toward safety and the driving behavior of students (Al-Rukaibi et al., 2006), their enjoyment of different modes of transportation (Páez and Whalen, 2010), and the cultural factors that influence the use of active modes of travel in university settings (Bonham and Koth, 2010), as well as the potential for change towards active travel (Shannon et al., 2006).

Several reasons help to explain this surge of interest. First, Khattak et al. (2011) point out that the travel behavior of university students is neither well understood nor well represented in travel-demand analysis. This lack of understanding can be partially attributed to the difficulty of obtaining information from students who may be segregated from the general population, due to their somewhat transient living arrangement during the school term. In contrast to more general efforts to obtain information on travel behaviors, targeted data collection efforts can yield good response rates from students if conducted during the school term. Furthermore, even though different from the general population, Khattak et al. (2011, p. 137) argue that "exploration of students' behavior can be instructive and reveal valuable information about associations with the built environment and the extent of differences in travel compared with the general population."

Second, a key aspect of studying university populations is that modal choices among university/college students often display a higher share of alternative modes compared to the general population, and thus all modes are well-represented in the analysis. This allows analysts to consider a variety of mobility modalities without sacrificing less reported modes – typically active modes (e.g. Diana, 2008, p. 471). For instance, Rodríguez and Joo (2004) report, for their study of commuters attending the University of North Carolina in Chapel Hill, the following mode shares: car (49.6%), bus (17.8%), park and ride (3.7%), bicycle (11.6%), and pedestrian (17.2%). Jacques et al. (2011) found the following shares for McGill University in Canada: motorized vehicle (16%), transit and shuttles (55%), and walking and cycling (26%). Delmelle and Delmelle (2012) report for the University of Idaho that walking is the most prevalent mode, followed by car and cycling. Likewise, Zhou

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(2012), in his study of commuting in the University of California, Los Angeles, found that the share of car is 41.2%, while transit is 30.9%, and biking and walking is 24.8%. These statistics lend credence to the assertion by Lovejoy and Handy (2011) that campus settings, with their larger alternative commuter populations, permit the study of modes that would otherwise be difficult to capture.

Lastly, universities are major trip attractors that require the infrastructure needed to support large volumes of commuters (Lovejoy and Handy, 2011). Promotion of transit and active travel aligns well with institutional sustainability goals, in addition to having an impact on the broader community. The latter point cannot be overstated. It is well known that policies aimed at addressing transportation-related issues can vary in implementation costs and effectiveness (May et al., 2000; May and Crass, 2007). The cost of providing transportation infrastructure varies widely by mode, with infrastructure to support active travel the least expensive (Metrolinx, 2010; Walkinginfo.org, 2011). Judging from the state of congestion in many North American cities, it seems clear that investment to date in road infrastructure has fallen short of alleviating many of the most pressing problems in transportation. As a counter-example, relatively inexpensive investments in bicycle infrastructure and programs have been shown to generate important gains in cycling shares (Pucher et al., 2010).

Given large disparities in cost and effect, there is a need to target policies that can better achieve broader sustainability goals. Considering the fact that current motorized technologies are highly reliant on fossil fuels, of all forms of personal transportation, active travel is the only one that is truly sustainable. In this sense, it is possible that a better understanding of the travel behavior of students, who tend to use alternative commuting modes more frequently, can generate valuable information about factors that may help to sustain the habit of active transportation.

In this paper, we investigate the modal choice of students in a university setting. The case study is McMaster University, in Hamilton, Ontario, Canada. This paper complements previous research that focused on the enjoyment of the commute experience, specifically the desire to travel more or less when commuting by different modes (Páez and Whalen, 2010). The study by Páez and Whalen (2010) found that students who were more likely to express a willingness to spend more time commuting were those using an active mode. It is now appropriate to ask why respondents choose one mode of travel over the available alternatives.

In conformity with previous research, our findings indicate that modal choices are influenced by a combination of individual attributes, cost, environmental factors such as street and sidewalk density, and Travel Demand Measures (TDMs). A key finding is that travel times by car and bicycle positively affect the utilities of these modes, although at a decreasing rate with increasing time. While the positive utility of traveling by car has been documented in other settings (see Choo et al., 2005; Mokhtarian and Salomon, 2001; Redmond and Mokhtarian, 2001), our analysis provides evidence of the intrinsic value that cyclists place on their trip experience. Insights derived from this research were instrumental in developing new transportation policies for McMaster University.

2. Background

In order to position our study effectively within the context of the existing literature, it is useful to consider two dimensions of the analysis: the methods used and the variables considered. Along the first dimension, previous papers on modal choices of students have used descriptive statistics and/or multivariate analysis. In terms of the variables for the analysis, Zhou (2012) identifies six classes of variables used in the study of mode choices: (1) individual-specific factors (e.g. socio-economic and demographic); (2) psychological factors (e.g. attitudes); (3) mode-specific factors (e.g., comfort); (4) trip characteristics (specific to a mode, such as cost); (5) built environment and urban form variables (e.g., density, intersections); and (6) presence of TDM measures (e.g., parking cost).

Exploratory data analysis using descriptive statistics is a valuable exercise that helps analysts identify noteworthy characteristics of the data, coding errors, or outliers (Haining et al., 1998). By itself, exploratory data analysis can lead to important insights in developing working hypotheses. For example, Delmelle and Delmelle (2012, p. 4) provide mode-choice proportions for their sample using seven socio-demographic classes (male/female, and five student categories from freshman to graduate/law student). Thus, it is possible to assert that "car" and "walk" are the most prevalent modes, with variations by socio-demographic class. In this way, the proportion of males traveling by car is 0.332 whereas for females it is 0.376. The proportion of graduate or law students traveling by car is 0.272. While this suggests gender differences, it is not possible to assess the probability of walking for a female who is also a graduate student relative to a male who is a freshman. Shannon et al. (2006) also report the modal split characteristics of their sample using two dimensions: status at the university (staff/student) and three zones based on distance to campus. A limitation of the use of descriptive statistics alone is that the statistical significance of the factors thought to influence the choice of mode cannot be determined while controlling for potential confounders. Other studies, in contrast, have used multivariate techniques to analyze mode choices. Klockner and Friedrichsmeier (2011) used a multilevel structural equation model, whereas Zhou (2012) estimated a multinomial logistic model for five different modes. With multivariate models, as Klockner and Friedrichsmeier (2011) show, it is possible to quantify how variables combine to predict variations in mode use, or to calculate marginal effects using the coefficients of a multinomial logit model (q.v. Ben-Akiva and Lerman, 1985) to evaluate how changes in one variable influence the probability of selecting a mode.

In terms of the variables considered, there is first the outcome variable. Klockner and Friedrichsmeier (2011), for instance, collapsed the choice set to a binary situation, namely car/other modes (i.e. cycling, walking, and transit). While they note that this simplifies the analysis (see p. 266), it also makes it impossible to assess the factors that affect each of the alternative modes individually. Zhou (2012), in contrast, estimated a multinomial logistic model for five different modes, including, interestingly, telecommuting.

Individual factors (socio-economic, demographic, and psychological) are known to influence travel behavior. The literature in general shows that there are differences in the travel behavior of men and women. Kim and Ulfarsson (2008) found that females have a higher proportion of short automobile trips than males. Differences are also apparent with respect to active modes of transportation. Gatersleben and Appleton (2007) find that cycling is more common among men than women. This finding is corroborated by Stronegger et al. (2010), who find that men preferred cycling, while women preferred walking, in a study that assessed gender-specific links between local infrastructure and amount of walking and cycling for transportation. Stronegger et al. (2010) also suggest that this is perhaps due to women's feelings of perceived safety and choosing to access amenities at shorter distances from home due to household and family responsibilities. Some of these findings are replicated in studies that focused on students. Delmelle and Delmelle (2012) also report in their study lower walking and cycling proportions for females relative to males. Likewise, Zhou (2012) finds that males are more likely to walk or cycle relative to females, but finds no gender differences for any of the other modes.