



# Transit commuting market investigation using the latent segmentation approach



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## ABSTRACT

This study employs a latent segmentation approach to investigate the commuting market, with focus on the usage of public transit. The factor–cluster analysis technique is used to systematically deal with multi-dimensional psychological statements, and then segment the whole sample into homogenous groups. A six-cluster solution is arrived, each with distinct combinations of latent factors, including attitude, perception, habit, and intention to use public transit. On account of the unique psychological profile of each segment, related measures and strategies are proposed to promote the choice of public transit for each sub-segment. The results demonstrate that individuals within different segments must be treated in different ways since their behavior are motivated by different factors.

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## 1. Introduction

In recent years, there is a rapid growth of motorization in most second- and third-tier cities of China, which is accompanied by severe traffic congestion, extreme environmental pollution, and increasing waste of public resources. In order to relieve or even solve these problems, one of the most effective ways is to lead populations' mobility behavior to be more sustainable, which greatly relies on the understanding of their behavioral reasons. Instead of analyzing the general mobility, this study focuses on the daily commuting mode choice behavior (one of the most important trips that has been widely analyzed), especially choice of public transit since it is regarded as one environmentally-beneficial mode. As emphasized by Hunecke et al. (2010) and McKenzie-Mohr (2000), it is necessary to recognize targeted groups in order to efficiently implement social marketing approach to promote public transit since different groups exhibit heterogeneous motivations and requirements. Thus, this study attempts to find out the reasons why some populations use or do not use public transit (Beirão and Cabral, 2008). It is suggested that the identification of these segments provides starting points for policies (see Jensen, 1999). Hence, transport policies and measures could be customized for specific behavioral reason to increase the attractiveness of this sustainable mode.

The usefulness of segmentation in travel market, i.e., identifying distinct segments with similar characteristics, has long been demonstrated (see, for example, Pas and Huber, 1992). Traditionally, socio-demographical and behavioral characteristics, such as gender, income, and car-use frequency, have been adopted to divide the whole population into different groups. However, it is now widely acknowledged that these objective variables are far from sufficient to understand travel mode choice. In order to promote the usage of public transit, it is of critical importance to understand individuals' psychological feelings since they play an important role in travel behavior (see, for example, Golob, 2003; Kuppam et al., 1999; Parkany et al., 2004). Despite that there have been several studies on travel market segmentation, this study focuses on the integration of perceptions, habits, and intentions toward public transit to segment the whole commuting market into groups with heterogeneous psychologically behavioral reasons, and further analyze their transit usage behavior.

The main objective of this study is to employ a latent segmentation approach to target specific population who are most likely to maintain their current transit commuting behavior or change their mode choice to be more sustainable. More specifically, it is designed to use factor analysis to recognize the inter-relationships among the multiple psychological statements on public transit, and then utilize the cluster analysis to identify distinctive segments based on the extracted latent factors. The identification of segments with distinctive latent factors including attitudes, habits, and intentions toward public transit is expected to identify

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differentiated starting points to increase the usage of sustainable public transit. Hence, effective measures and strategies to promote the transit commuting behavior specific to each segment could be proposed, which is the ultimate goal of this study. As pointed out by [Wedel and Kamakura \(1998\)](#) and [Pronello and Camusso \(2011\)](#), (1) the appropriate segmentation, corresponding to group populations with homogeneous needs and motivations, and (2) personal feelings, perceptions and attitudes, combine to assist in explaining and predicting travel behavior; which, to a great extent, support the objective of this study.

The rest of this study is organized as follows. Section 2 provides a comprehensive review of previous studies on segmentation, while Section 3 outlines the sample data, as well as results of factor analysis. In Section 4, segmentation results and related policy implications are presented and illuminated in detail. Finally, primary conclusions and directions for future research are summarized.

## 2. Literature review

There has always been a focus on the segmentation for behavior analysis, through which populations with the homogeneous characteristics are defined as one group. Generally, the segmentation approach could be classified as (1) the a-priori, through which groups are selected from a population in advance based on predefined characteristics ([Anable, 2005](#)), and (2) the post hoc, whereby empirical investigation is used to identify segments ([Green and Krieger, 1995](#)), in which populations are segmented based on combinations of variables, including personality, lifestyle, or attitudinal characteristics. More importantly, in the latter approach, the segments are defined by the inherent attributes of the data, rather than objectively determined by researchers. With respect to the travel market, the value of segmentation approach has been widely demonstrated. For example, [Pas and Huber \(1992\)](#) pointed out the complexity of travel market, and further the practical advantages of segmentation on the basis of the benefits that individuals desire from various trip modes.

The a-priori approach used in travel behavior analysis has been almost based on some pre-designated socio-demographic or behavioral characteristics, such as income, gender, trip purpose, and spatial factors (see, for example, [Heinen et al., 2011](#); [Lythgoe and Wardman, 2002](#); [Mandel, 1999](#)). Of course, it has been confirmed that socio-demographics have important influences on attitudes and mobility behavior, such as gender ([Beirão and Cabral, 2008](#)) and age ([Bamberg and Schmidt, 2003](#)). However, the methodological weakness of this approach lies in their lack of explanations for behavior, and it cannot provide any information about the underlying processes that determine the behavior ([Hunecke et al., 2010](#)). On the other hand, by distinguishing populations based on some pre-defined features, the averaged responses of which might be highly divergent ([Hensher, 1976](#)) are actually considered. Thus, it is argued that the a-prior segmentation approach is not effective enough to define groups sharing some homogeneous attributes, and the incorrect assumption of homogeneity can result in bias in explanation and prediction of behavioral tendencies ([Anable, 2005](#)). [Redmond \(2000\)](#) also suggested that the failure in distinguishing groups (which are supposed to be distinctive), as well as recognizing heterogeneity may totally miss some important relationships since only the average coefficients across the whole sample are derived.

As for the post hoc segmentation approach, a large number of studies have demonstrated that mobility behavior is greatly influenced by latent psychological factors, such as general attitudes, travel experiences, and emotions ([Handy et al., 2005](#); [Sheller and Urry, 2006](#)). Using an expanded version of the theory of planned behavior (TPB; [Ajzen, 1991](#)), [Anable \(2005\)](#) segmented the travel market based on multiple attitudinal variables to identify travelers'

potential mode switchability. It was also indicated that this latent segmentation approach was superior to the general method based on observed socioeconomic or behavior variables, which might oversimplify the complex structure of travel market. [Beirão and Cabral \(2008\)](#) compared the differences with respect to the socio-demographic and travel behavior profiles of six clusters, derived based on the travel attitudes and preferences. They suggested the importance of attitudes and preferences in the travel behavior decision-making process. [Shiftan et al. \(2008\)](#) used the segmentation approach to identify potential transit markets, in which the general population fell into eight segments based on three attitudinal factors including sensitivity to time, need for fixed schedule, and willingness to use public transit. Focusing on the bicycle commuting market, [Li et al. \(2013\)](#) segmented it into six submarkets, each profiled by distinctive combinations of willingness to use bicycle, need for fixed schedule, desire for comfort, and environment awareness. Specific policies were developed to increase the bicycle usage in each submarket. There are more studies on the analysis of segmentation based on latent psychological factors, such as [Outwater et al. \(2003\)](#), [Redmond \(2000\)](#), and [Jensen \(1999\)](#). They all demonstrate the determining effects of latent factors such as attitudes, values, and personality on mobility. In addition, habit is found to strongly correlate with intention and behavior (see, for example, [Aarts and Dijksterhuis, 2000](#); [Anable, 2005](#)). [Gärling et al. \(1998\)](#) and [Fujii and Gärling \(2003\)](#) discussed the importance of intention in understanding behavioral choice.

On the other hand, [Pronello and Camusso \(2011\)](#) has confirmed that there exists a dissonance between attitude and behavior when habit, which is consolidated in time, intervenes. They also found that sometimes "the right general attitude" is insufficient to change travelers' mode choice due to the unsatisfying public transports service. Likewise, many studies suggest that the positive attitude toward environment (or environmental consciousness) is not enough to prompt the environmentally-beneficial behavior (see, for example, [Anable, 2005](#); [Beirão and Cabral, 2008](#)).

On account of the complex relationship between psychological factors and behavior, corresponding policies have been proposed with aim to effectively change travelers' mobility behavior, of which the most important is to find their behavioral reasons or motives ([Steg and Gifford, 2005](#)). Thus, the most influencing factors can be targeted. [Beirão and Cabral \(2007\)](#) pointed out that non-bus travelers usually have negative evaluations on bus service, probably because of their lack of knowledge about bus. And at the same time, they perceived more barriers to using buses ([Beale and Bonsall, 2007](#); [Ibrahim, 2003](#)). Thus, it is necessary to change their negative beliefs of bus, as well as to overcome their perceived difficulty to use bus service. Besides, it is essential to provide those habitual car users with the information about the advantages of public transit and working ([Horeni et al., 2007](#)) since they might know little about alternative modes. [Beirão and Cabral \(2008\)](#) proposed that advertising campaigns with aim to promote the public transit usage should be targeted at specific groups, which are most likely and willing to use alternative modes.

Strictly speaking, the objective of this research is driven by the above studies, i.e., the segmentation based on latent factors. However, we focus on the investigation of public transit usage, and further provide practical suggestions to policies.

## 3. Data and factor analysis

### 3.1. Survey description

The data used in this study is derived from a Household Travel Survey (paper-based), which was conducted in Shaoxing, China, in October, 2013. Shaoxing lies in the north central of Zhejiang

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