9th INTERNATIONAL CONGRESS on
TRANSPORTATION RESEARCH IN GREECE
TRANSPORT 4.0: From Research to Implementation

TRANSPORT MODE ON: How to set a discrete choice survey to predict commuters' mode preferences

Eleni Chalkia, Evangelos Bekiaris and George Yannis

1 Introduction

People mainly travel to participate in activities. The commute trip (to work, education, etc.) is generally the most commonly scheduled and realised trip purpose. Also, commute trips have temporal and geographic regularity. Thus, they stress a lot the transportation network, since they are concentrated in time (pick hours) and space. It is a fact that nowadays people living in and around the EU's biggest cities spend a considerable amount of their lives commuting from home and work. Today in European countries the average trip length by car is about 13-15 km per adult and day, while 20-30% of all these trips are for commuting purposes, according to EEA (2016).

There is a steady research interest on peoples' choices of transport mode, since papers that cope with this issue continue to emerge ((Bamberg & Schmidt, 2003), (Klöckner & Mattheis, 2004), (Collins & Chambers, 2005), (Murtagh & Uzzell, 2012)). The choice of travel mode is an issue that has concerned lots of studies, and that is affected by many factors, from situational and transport-specific ones, to individual-related ones such as a person's attitudes, habits and identity. In our research we study the topic of transportation mode choice from two perspectives. The attitudinal one, that has a strong focus on cognitive determinants of travel mode choice; and the situational one which is very much characterized by a focus on travel mode characteristics and socio-demographic factors. The present paper has one main goal which is to provide a summative framework that can be followed in order to build a discrete choice model survey related to the modal use. This framework includes defining the attitudinal and the situational attributes that should be included in a survey related to the modal use and also defining the levels of the attributes and their range.

2 Literature review

2.1 Travel behaviour

Commuting behaviour and mode choices have been heavily studied for decades using a wide range of methodological approaches. The most used theory for predicting the mode choices is the Utility Theory (UT), which is based on the Rational choice theory assuming that people aim to maximise their utility by minimising the time and cost of travel, partly by acting completely rational. Another theory that has been widely adopted by researchers seeking to explain transport choices is the Prospect Theory which was developed in the 1970s as a behavioural-economic alternative to Utility Theory. Lately, efforts have been made to adopt theories that combine psychology with statistical accuracy. An extensively used example is the Theory of Planned Behaviour (TPB), proposed by Ajzen (1991) that seeks to capture the highly complicated transport choice prediction by connecting phycological attributes like attitudes, social norms, and perceived behavioural control, influenced by spatial and socio-demographic characteristics (Keyes & Crawford-Brown, 2018).

A way to predict users' choices is the discrete choice models, deriving from the field of economics. Discrete choice models aim to describe, explain, and predict choices between two or more discrete alternatives, based on individual choice behaviour theory (Ben-Akiva & Lerman, 1985) using parameterised utility functions. In discrete choice models, users are asked to make a decision, facing a set of alternatives which should be exclusive, and included in choice sets that need to be exhaustive having a finite number of alternatives.

2.2 Commuting

In the last decades, urban areas worldwide have become more automobile-dominated and less sustainable. Urban journeys tend to become longer, since most capital cities, where the vast population has gathered at, have turned into megacities. Mainly, people who work in capital cities often face the most lengthy journey times to work and some of the longest delays due to traffic congestion (Eurostat, 2015). OECD (2017) has calculated that workers in OECD countries spend on average 38 minutes per day commuting. Eurostat in its report about "Urban Europe — Statistics on cities, towns and suburbs" enhances the above statement of OECD. It is stating that people living in and around the EU's biggest cities spend a considerable amount of their lives commuting from home and work.

Today in European countries the average trip length by car is about 13-15 km per adult and day, while 20-30% of all these trips are for commuting purposes, according to EEA. Even though cars are mainly made for higher speeds and longer trips, they are still the predominant means for local transportation (about 80% of all trips made by car are less than 20 km long, and 60% are less than 10 km long). At the same time, the commuting journeys made by private car increased more than the ones made by public transport. According to EEA, while 59% of all trips are made by car, when commuting, this percentage rises to 71% (EEA, 2016).

3 Methodology

3.1 Procedure and participants

In our study we will conduct an online survey with participants from Athens. The online survey will be in Google forms which will be sent to possible participants through email and social networks (Facebook, Instagram). The target is to gather at least 200 answers. The target of the number participants, as well as the number of scenarios as it will be described in the following Section, was determined by the literature. Omre (2010) suggest the pooling of choices to be made by minimum 150 respondents, each of whom is observed to make eight choices, thus producing a total of 1,600 choice observations.

3.2 Survey design

Analysis of how travel decisions, like mode choice decisions, take place can be predicted by specific trip characteristics (situational attributes) or personal characteristics (attitudinal attributes) which require granular and aggregated data on individual travel and personal behaviour, as well as suitable statistical tools. Regarding the trip characteristics, Stated Preferences experiments are used widely today to determine the independent influence of various factors on the decisions made by individuals facing a choice situation, like the modal choice one.

The methods used to design statistically robust Stated Preferences experiments have been developed considerably since such experiments were first introduced to the field of transportation research nearly 20 years ago (Louviere, Hensher, & Swait, 2000). The experimental design of any choice experiment involves the planned manipulation of attribute levels to yield a statistically relevant output.

The methodology used in this paper draws from state-of-the-art practices in commuting and mode choice research and it includes the following three steps:

1. Defining the choice problem
2. Defining important alternatives and attributes
3. Defining the experimental design of SP survey

3.3 Analysis strategy

In our study we will use Multinomial Logit to analyse the results of the survey, but we will also check and juxtapose the MNL outcomes with other analytical methods like mixed logit. Also we will check if there are differences in the results when using user clustering groups instead of taking into account individual data. The categorization of user will be done using cluster analysis based on their personal information.

4 Stated preferences survey experimental design

4.1 Situational - trip characteristics

When setting up a State Preferences survey, first of all the choice problem should be developed and refined. In order to increase the realism of the Stated Choice experiment for the respondent, there was a need to include features of an actual trip. Therefore, a focus group discussion was realised to cope with the problem studied and to assist in addressing the universal but finite list of alternatives to be use and the realistic attributes to be assigned for each alternative.

4.1.1 Focus group outcomes

A focus group discussion was conducted in Athens in December 2018. The objectives were to find aspects of transportation modes and services that could act as attractive or repulsive factors, to identify important attributes characterizing the commute trip that may be used in the Stated Preferences survey, and to identify potential attitudinal aspects that could be included in the Stated Preferences survey also.

The main findings of the focus groups discussion are the following.

- All participants commute to work every day.
- All participants own a car, but not everyone is using it.
- Most of the participants use a car for their commute (as drivers or passengers) while the rest use PT and specifically metro, in combination with bus sometimes.
- The participants who use a car for their daily commute spend 15-60 minutes for their trip.
- The participants who use PT spend more than one hour for their commute.
- Some of the participants who use the car would not change it with any other mean of transport despite the circumstances. Most of them though would change to PT if there was an accessible stop near their home and work and if the service was more comfortable and reliable.
- Finally the most important attributes related to their trip were the travel time and cost, followed by some attitudinal factors such as environmental friendliness, security, reliability, flexibility, and comfort.

4.1.2 Implementation of Discrete Choice methods in the Stated Preferences survey

The data collected from the focus groups were incorporated into the Stated Choice experimental design to create a realistic choice situation for the survey participants. Based on the information selected from the focus groups one hypothetical scenario was presented to the survey: "You leave in a suburban (or urban) area and you have to commute to and from work every day. You have availability to private car, as well as access to public transport and softer means of transport like bike are available to. Considering that all the other attributes are similar, each mode proposed in the following scenarios has different time (in minutes), cost (in euros) and environmental friendliness (high, medium, low) and you are aware of the levels of these attributes before you make the decision which mode you will choose.". Then the users where presented with choice sets with secnarios that included the car, bus, train and bike with different levels of time, const and environmental friendliness and were asked to make one choice in each choice set.

The success of the experiment involves maximising not only its statistical validity, but also from the nature and complexity of the experiment itself. Bech et al. (2011) in their respective experiment studied the way the number of scenarios affects the results of the discrete choice models. They elucidate that respondents who were asked to choose between 17 choice sets had higher response fluctuation compared to those exposed to 5 choice sets; postulating that cognitive burden is increased as the number of choice sets goes beyond a certain threshold. Thus, in our study 16 scenarios have been developed and were divided into two groups.

4.2 Attitudinal - personal characteristics

Another critical part of our survey, apart from the situational characteristics, are the attitudinal characteristics of the user. The scope of this part of the questionnaire is to gather feedback from users based on their personal preferences regarding some attitudinal aspects and correlate them to the situational aspects of their trips, so as to find if there can also be predictors of their travel and mode choice behaviour. The characteristics that have been captured from our survey are the following.

Demographic characteristics	Physio-Characteristics	Ideo and socio characteristic
Nationality	Special disadvantages	Lifestyle
Age	Urbanisation	Personality traits
Gender	Physical environment	Personal ideologies
Education		
Employment		
status		
Income		
Living arrangement		

5 Conclusions

In this paper, we focus on the commute trip and specifically to the mode choice of commuters. After having reviewed most of the theories related to choices, Utility Theory, Prospect Theory and Theory of Planned Behaviour and the ways that are used to extract and predicts the user choices, we have developed a Discrete choice experiment in order to find out which factors are affectiving commuters mode choices.

The Discrete Choice experiment was realised using a Stated Preferences Survey. In order to create a concrete framework for our Stated Preferences Survey, we conducted a focus group in Athens with 10 participants. The data collected from the focus group were incorporated into the stated choice experimental design to create a realistic choice situation for the survey participants.

The list of alternative modes of transportation that could be used for commuting is quite long, and includes at least 15 alternatives. For the SP survey, a universal but finite list of all the existing alternatives had to be compiled. So it was decided to use a set of four alternatives which were extracted from the focus group discussion. This set of transportation mode alternatives includes the car, the bus, and the train which incorporates the light train, the train and the metro and the bicycle. Each of the attributes was described by a number of levels.

The attributes organized by alternative as well as the selected attribute levels have been used to define the experimental design of the choice experiment which was created using Ngene, a software that is distributed by ChoiceMetrics (www.choicemetrics.com). The actual SP survey is consisted by 16 different scenarios, divided into two groups of 8. Using an SP survey, the respondents are expected to choose the alternative that maximizes their net utility and select the mode alternative that provides the highest utility for them. The data that will be retrieved from the SP survey will be analysed using an MNL and a mix logit mode.

6 References

Abou-Zeid, M., & Scott, D. M. (2011). Current issues in mode choice modeling. Transportation, 38, 581–585.
Bamberg, S., & Schmidt, P. (2003). Incentives, morality or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz and Triandis. Environment and Behavior, 264–285
Ben-Akiva, M., & Lerman, S. (1985). Discrete Choice Analysis Theory and Application to Travel Demand. Cambridge: MIT Press.
Orme, B. (2010). Sample Size Issues for Conjoint Analysis Studie. Sequim: Sawtooth Software Technical Paper